School of Psychology

A Transdiagnostic Investigation of Intolerance of Uncertainty on Anxiety Symptomology and Decision-Making

Sarah Shihata

This thesis is presented for the Degree of
Doctor of Philosophy
of
Curtin University

December 2018

Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number # HR34/2015, and # HRE2016-0182.

Signature: ....Sarah Shihata.....

Date: .....20/12/2018.....

Acknowledgements

Thank you to my incredible supervisory team; Professor Peter McEvoy and Associate Professor Barbara Mullan. The unrelenting patience, support, and encouragement you have provided throughout this research project has been invaluable. I am forever grateful for the knowledge that you have shared with me to make this project what it is. I am greatly appreciative for the inspiration, enthusiasm, and motivation you have given me through the course of my candidature as well as the laughter that has been embedded within our supervisory meetings. Trust and kindness; a key message shared by my supervisor that has stayed with me. The essence being to trust in myself and to trust in the process, and through it all, to always be kind to myself. Thank you for highlighting the importance of taking the time to appreciate the little triumphs along the way and to let that drive my ambition. Your guidance has undoubtedly contributed to my professional and personal growth.

Dr Nicholas Carleton also has my gratitude for sharing his immense knowledge and insight and for his valuable contribution to a publication. You have been instrumental in shaping my affinity for this field of research.

To my parents and my brothers, thank you for your support and encouragement throughout this process. Thank you for helping me believe that I can achieve all that I hope to through perseverance, hard work, and faith in myself and God. No words can express my appreciation and gratitude for the unconditional love and support you have given me. Thank you for your unwavering belief in me that held during the most difficult times when that belief in myself was compromised and I struggled to find my own courage.

To my wonderful friends, you have given inspiration and positivity, and have kept me grounded. You have let me share the good and the bad with you. Each of you have made me laugh in abundance, and for that, this precious journey has been made that much fuller and richer.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ACQ: Agoraphobic Cognitions Questionnaire;

APA: American Psychiatric Association;

BAI: Beck Anxiety Inventory;

BDI-II: Beck Depression Inventory-II;

BFNE-S: Brief Fear of Negative Evaluation Scale, Straightforward Items;

CFA: Confirmatory factor analysis;

CFI: Comparative fit index;

CI: Confidence interval;

CPQ: Clinical Perfectionism Questionnaire;

DASS-21: Depression, Anxiety and Stress Scale-21;

DSIU: Disorder-Specific Intolerance of Uncertainty scale;

DSM-IV: Diagnostic and Statistical Manual for Mental Disorders, fourth edition;

DSM-5: Diagnostic and Statistical Manual for Mental Disorders, fifth edition;

ECV: Explained common variance;

EDEQ: Eating Disorder Examination Questionnaire–Version 5;

EFA: Exploratory factor analysis;

GAD-7: Generalised Anxiety Disorder-7;

GLMM: Generalised linear mixed model;

H: Construct replicability;

I-ECV: Item-explained common variance;

IR-ED: Interpersonal Relationships in Eating Disorders;

IU: Intolerance of uncertainty;

IU-ED: Intolerance of uncertainty-eating disorder;

IU-GAD: Intolerance of uncertainty-generalised anxiety disorder;

IU-HA: Intolerance of uncertainty-health anxiety;

IU-MDD: Intolerance of uncertainty-major depressive disorder;

IU-OCD: Intolerance of uncertainty-obsessive-compulsive disorder;

IU-PD: Intolerance of uncertainty-panic disorder;

IU-Phobia: Intolerance of uncertainty-specific phobia;

IU-PTSD: Intolerance of uncertainty-posttraumatic stress disorder;

IU-SAD: Intolerance of uncertainty-social anxiety disorder;

IUI: Intolerance of Uncertainty Inventory;

IUS: Intolerance of Uncertainty Scale;

IUSC: Intolerance of Uncertainty Scale for Children;

IUS-R: Intolerance of Uncertainty Scale-Revised;

IUS-SS: Intolerance of Uncertainty Scale–Situation-Specific;

IUS-12: Intolerance of Uncertainty Scale, Short Form;

M = Mean;

MCAR = Missing completely at random;

MCQ-30: Meta-cognitions Questionnaire-30;

MI: Modification indices;

n: Sample size;

N: Total sample size;

NIMH: National Institute of Mental Health;

OBQ-44: Obsessive-Beliefs Questionnaire-44;

OCI-R: Obsessive Compulsive Inventory-Revised;

PDSS-SR: Panic Disorder Severity Scale-Self-Report;

PSWQ: Penn State Worry Questionnaire;

PUC: Percent uncontaminated correlations;

RMSEA: Root mean square error of approximation;

RSES: Rosenberg Self-Esteem Scale;

SIAS: Social Interaction Anxiety Scale;

SIPS: Social Interaction Phobia Scale;

SD: Standard deviation;

SE: Standard error of measurement;

SEM: Structural equation modelling;

SPSS: Statistical Package for the Social Sciences;

SRMR: Standardised root mean square residual;

STAI: State-Trait Anxiety Inventory for Adults-Form Y;

TLI: Tucker-Lewis index;

TOMS: Tolerance of Mood States Scale;

WLSMV: Weighted least squares mean- and variance-adjusted estimation;

Abstract

Intolerance of uncertainty (IU) is implicated in the development and maintenance of a range of psychological disorders including anxiety disorders and anxiety-related disorders, depressive disorders, and more recently, eating disorders. High IU is associated with comorbidity between emotional disorders, and reductions in IU are associated with symptom relief across different treatments protocols. As such, IU is conceptualised to be a transdiagnostic process and a potential treatment target. While a substantial body of research has examined IU as a dispositional trait, further research is warranted to examine the disorder-specific conceptualisations of IU across symptoms of emotional disorders and decision-making processes. Moreover, a core component of IU theory is that uncertainty is perceived as threatening, but there is a paucity of research examining how IU interacts with perceptions of threat to influence anxiety and behaviour. Thus, the aim of this programme of research was to examine the trait and disorder-specific aspects of IU in a range of emotional disorder and eating disorder symptoms, as well as its association with decision-making and distress across different contexts.

The first study in this thesis presented a narrative review of the literature pertaining to IU across areas including development, assessment, and its relationships to cognitive vulnerability factors and symptoms of emotional disorders. The review highlighted what is known about IU in the literature along with what remains unknown. Further, the review study presented a broad future research agenda to investigate the theoretical and clinical significance of IU. The findings from this review support the four studies included in this programme of research, which aim to investigate the measurement of IU, its association with behaviour and perceptions of threat, as well as the role of trait IU and disorder-specific IU in emotional disorder and eating disorder symptoms.

The second study in this thesis investigated the psychometric properties of the Intolerance of Uncertainty Scale, Short Form (IUS-12) by comparing the fit of competing measurement models in separate undergraduate ($N = 506$) and clinical ($N = 524$) samples. This study built on existing psychometric knowledge about the IUS-12 to inform subsequent studies in the thesis, which investigated the relationships between trait IU, disorder-specific IU and symptoms of emotional disorders. Unidimensional, correlated two-factor, and bifactor models were tested using confirmatory factor analysis. In a bifactor structure, the IUS-12 items load onto a general factor as well an orthogonal set of group factors (i.e., prospective IU and inhibitory IU). The bifactor model was hypothesised to provide a superior fit relative to

the competing models across both samples. The results of both the undergraduate and clinical sample supported a bifactor model consisting of a strong general IU factor. The general IU factor explained the majority of unique variance in the IUS-12, and suggested that a total score is generally appropriate for assessing IU. The general IU factor was most strongly and consistently associated with symptoms of multiple disorders. The inhibitory IU group factor was more weakly associated with most symptom measures in the clinical sample, but only with social anxiety disorder symptoms in the undergraduate sample. The prospective IU group factor was only separable from the general IU factor in the undergraduate sample, and did not explain unique variance in disorder symptoms.

The third study in this thesis examined a hierarchical model to identify the unique contributions of trait IU and disorder-specific IU to multiple anxiety-related disorder symptoms, after controlling for other disorder-specific cognitive vulnerability factors. Undergraduate participants ($N = 506$) completed a battery of online questionnaires. Structural equation modelling was used to evaluate the model fit, as well as the direct and indirect pathways. Trait IU and disorder-specific IU were significantly associated with multiple cognitive vulnerability factors and disorder symptoms. When disorder-specific IU and agoraphobic cognitions were taken into account, trait IU did not have a direct effect on panic disorder. Indirect effects between trait IU and symptoms were observed through disorder-specific IU and cognitive vulnerabilities. Moreover, the relative contribution of trait IU and disorder-specific IU to symptoms varied with trait IU having stronger associations with generalised anxiety disorder and obsessive compulsive disorder and disorder-specific IU having stronger associations with social anxiety and panic disorder.

The fourth study in this thesis examined the effects of trait and disorder-specific IU using experimental methods rather than an individual differences approach. Specifically, relationships between trait and disorder-specific IU, certainty level (uncertain threat; certain threat), and context (social and performance evaluation; contamination and responsibility) on decision-making behaviour and distress were tested. The aim of this study was to enhance the ecological validity of a probabilistic decision-making task (the Beads Task) as an analogue for decision-making in the context of IU. Participants ($N = 136$) were randomised to one of two conditions (uncertain threat versus certain threat) and then completed the Beads Task in both contexts. Contrary to our hypothesis, the results revealed no significant difference in Beads Task outcomes between the uncertain threat versus certain threat conditions. The results indicated that trait IU and inhibitory IU were associated with distress.

The fifth study in this thesis extended investigations of disorder-specific IU in anxiety and depression to eating disorder symptoms. The aim of this study was to develop a measure of IU specific to eating disorder psychopathology, the disorder-specific IU for eating disorders scale (IU-ED). Participants ($N = 172$) were recruited from a university setting and completed a battery of online questionnaires. Exploratory factor analysis was used and yielded a two-factor scale pertaining to uncertainty about core psychopathology and weight control behaviours. The IU-ED was found to exhibit excellent reliability and evidence of construct validity. Scores on the IU-ED scale were elevated amongst participants who reported purging, binge eating, and dietary restraint behaviour. Analyses suggested that the IU-ED scale was associated with unique variance in a global index of eating disorder symptoms and core psychopathology, as well as restraint, purging, and binge eating. The relative contribution of trait IU and disorder-specific IU to eating disorder symptoms was examined. Preliminary support is provided for the reliability and validity of a new measure of disorder-specific IU pertaining to eating disorders. Future research is required to confirm the factor structure and assess the psychometric properties in a clinical eating disorder sample.

The findings from these five studies provide further support for the transdiagnostic conceptualisation of IU, but also highlight the role of disorder-specific IU across different disorder symptoms. For some disorders, disorder-specific IU may represent a more meaningful construct and proximal pathway between trait IU and symptoms. The results highlight that further research is required to examine the underlying structure of IU and the clinical relevance of its prospective (cognitive) and inhibitory (behavioural) dimensions. Based on the findings across this research programme, further studies are warranted to investigate IU within experimental paradigms to better understand its interaction with threat perception and effects on decision-making, behaviour, and related distress. An implication of this transdiagnostic conceptualisation is that cognitive-behavioural theories of emotional and eating disorders could be extended by including IU as a common mechanism across disorders, which can also be targeted in clinical interventions to potentially reduce disorder symptoms and improve treatment outcomes. Further, if disorder-specific IU is consistently found to be a meaningful indirect pathway between trait IU and psychopathology, then the additive impact of cognitive-behavioural and exposure-based interventions that focus on disorder-specific uncertainty could be investigated.

Publications Included as Part of the Hybrid Thesis

The following list of publications are included as part of this thesis and are included in the Appendices.

Study 1 (Chapter 2) of this thesis has been published (see Appendix A);

Shihata, S., McEvoy, P. M., Mullan, B. A., & Carleton, R. N. (2016). Intolerance of uncertainty in emotional disorders: What uncertainties remain? *Journal of Anxiety Disorders, 41*, 115-124. doi:10.1016/j.janxdis.2016.05.001

Study 2 (Chapter 3) of this thesis has been published (see Appendix B);

Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). A bifactor model of intolerance of uncertainty in undergraduate and clinical samples: Do we need to reconsider the two-factor model? *Psychological Assessment, 30*, 893-903. doi:10.1037/pas0000540.

Study 3 (Chapter 4) of this thesis has been published (see Appendix C);

Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). Pathways from uncertainty to anxiety: An evaluation of a hierarchical model of trait and disorder-specific intolerance of uncertainty on anxiety disorder symptoms. *Journal of Anxiety Disorders, 45*, 72-79. doi:10.1016/j.janxdis.2016.12.001

Copyright Statement

Chapter 1: Intolerance of Uncertainty

1.1. A Transdiagnostic Approach to Emotional Disorders

Psychological disorders represent a prevalent and global societal, economic, and individual burden (Whiteford et al., 2013). Within psychological disorders, depression and anxiety disorders are the largest contributors to the non-fatal disease burden, accounting for a third to one half of the global cost of mental illness (Whiteford et al., 2013; World Health Organization, 2013). The burden of psychological disorders is increasing, in part, as a result of continuing epidemiological transition, population growth, and demographic factors (Whiteford, Ferrari, Degenhardt, Feigin, & Vos, 2015). Across the lifespan, psychological disorders contribute to significant health loss and functional impairment (Birnbaum et al., 2010), and are associated with increased risk for the development of chronic medical and physical conditions and related morbidity (Katon, 2011). The global and individual burden associated with psychological disorders highlights the need for further research to enhance our understanding.

Psychological disorders are highly comorbid. Comorbidity rates between anxiety disorders (approximately 55%), and between anxiety disorders and depressive disorders (approximately 76%), are particularly high (Brown, Campbell, Lehman, Grisham, & Mancill, 2001). Indeed, comorbidity is considered to be the norm, with research indicating that the majority of individuals with anxiety disorders are more likely to have a co-occurring anxiety or depressive disorder rather than meet diagnostic criteria for a single diagnosis (Brown et al., 2001; Kessler et al., 2005). Despite advances in evidence-based treatments for emotional and eating disorders, there is substantial room for improvement in terms of treatment outcomes (Byrne et al., 2017; Bystritsky, 2006). Such findings lend support to the conceptualisation of common core pathologies or etiological risk factors that underlie psychological disorders (Norton & Paulus, 2017). Recent research has underscored the potential significance of adopting a transdiagnostic approach to theory and treatment, which suggests that different anxiety disorders and related diagnoses reflect underlying common processes (i.e., temperamental, cognitive, emotional, behavioural, and interpersonal; Harvey, Watkins, Mansell, & Shafrain, 2004). This approach transcends discrete diagnostic classifications, and suggests that differences between disorders reflect differences in the triggering or threatening stimuli and the coping strategies adopted to alleviate distress and increase control (Norton & Paulus, 2017). The transdiagnostic approach does not ignore observable differences (e.g., subtypes of disorders, distinct fears), but rather aims to emphasise the commonalities across

disorders (Norton & Paulus, 2017). Identifying and targeting common underlying processes may be an effective treatment strategy applicable across multiple anxiety and depressive disorders (Barlow, Allen, & Choate, 2004; Norton & Paulus, 2017). Thus, to inform the advancement of treatment, research is required to improve our understanding of the factors that underpin the development and maintenance of anxiety and anxiety-related disorders.

The identification of common underlying mechanisms aligns with the Research Domain Criteria initiative by the United States of America National Institute of Mental Health, which aims to explore behavioural, cognitive, and neurocircuitry dimensions of human functioning along a continuum (Cuthbert, 2015; Kozak & Cuthbert, 2016). The Research Domain Criteria is a framework that focuses on constructs that are associated with behaviour and psychological disorders within the context of environmental factors and developmental trajectories (Kozak & Cuthbert, 2016). The purpose of this framework is to conceptualise mental health in terms of a continuum of dysfunction in general psychological and biological systems, and to better understand how such systems interact to contribute to clinical disorders (Kozak & Cuthbert, 2016). More specifically, the Research Domain Criteria initiative looks to shift from diagnostic categories towards dimensional psychological constructs that can be examined using multiple methodologies and units of analysis (e.g., self-report, behaviour, neural circuits, and physiology; Kozak & Cuthbert, 2016).

Intolerance of uncertainty (IU) is a dispositional trait that reflects an underlying fear of the unknown, which is posited to be "the most basic component of pathological anxiety" (Carleton, 2012; Carleton, Sharpe, & Asmundson, 2007, p. 2314). Research has highlighted that IU is important to the aetiology, development, and maintenance of psychopathology, including a range of anxiety and anxiety-related disorders, depressive disorders, and eating disorders (Brown et al., 2017; Carleton, 2012; Gentes & Ruscio, 2011; Hong & Cheung, 2015). IU is therefore conceptualised as a transdiagnostic process that occurs across psychological disorders, and is implicated as a potentially critical transdiagnostic treatment target (Carleton, 2012; Dugas & Ladouceur, 2000; Dugas & Robichaud, 2007). Consistent with the key aims outlined by the Research Domain Criteria framework, research has provided evidence for IU as a dimensional construct wherein the strength of the relationships between IU and symptoms of psychological disorders are comparable across community, analogue, and clinical populations (Carleton, 2016a; Carleton, Mulvogue, et al., 2012). In addition to the validation of dimensional psychological constructs, the Research Domain Criteria initiative encourages the identification and integration of psychological and biological systems and their associations to clinically defined problems (Kozak & Cuthbert, 2016). IU

has been linked to activity in neuroanatomical structures and physiological responses, as well as distress and psychopathology (Brosschot, Verkuil, & Thayer, 2017; Hong & Cheung, 2015; McEvoy & Mahoney, 2012; Thayer, Åhs, Fredrikson, Sollers, & Wager, 2012; Wever, Smeets, & Sternheim, 2015). Thus, IU appears to be a transdiagnostic construct that can be contextualised within the Research Domain Criteria framework to conceptualise psychological disorders and better understand mental health (McEvoy, Carleton, Correa, Shankman, & Shihata, in press). Despite the increasing relevance of IU to psychopathology, questions remain regarding the measurement structure of IU, its trait and disorder-specific facets across psychological disorders, as well as its associations with threat perception and decision-making behaviour.

1.2. Intolerance of Uncertainty

The human experience is defined by uncertainty. There are situations where uncertainty can be experienced as tolerable or even pleasurable. This can include the uncertainty of whether there will be traffic on the way to our destination, or the unpredictability of a book we are yet to read or the contents of our birthday presents. However, there are other situations where uncertainty can be distressing and feared. Consider the uncertainty about waiting to receive results of an exam or a medical appointment. However, a sense of complete certainty in situations is often unattainable; as such, the ability to tolerate unknowns is vital to cope with everyday life. Nonetheless, the degree to which uncertainty is tolerated, or perceived to be distressing, varies across individuals.

Uncertainty is implicated as central to anxiety and anxiety is posited to be a response to uncertainty about a potential future threat (Carleton, 2012; Grupe & Nitschke, 2013). Researchers assert that the stress response is the default response to uncertainty, and that IU is not acquired during life but is a fundamental aspect inherent in all individuals, which is only alleviated in situations when safety is learned or perceived (Brosschot, Verkuil, & Thayer, 2016). A growing body of research suggests that IU is a robust vulnerability factor implicated in the development and maintenance of psychopathology (Carleton, 2012; Gentes & Ruscio, 2011; Hong & Cheung, 2015). IU is a dispositional trait that reflects a fear of the unknown and negative beliefs about uncertainty (Carleton, 2012; Dugas & Robichaud, 2007). Carleton (2016a, p. 31) defined IU as a broad "dispositional incapacity to endure the aversive response triggered by the perceived absence of salient, key or sufficient information, and sustained by the associated perception of uncertainty". The unknown represents a core component for a number of overlapping constructs (e.g., unpredictability, novelty, uncertainty; Carleton,

2016b). Carleton (2016b) states that dynamic individual differences exist along a continuum, and relatedly, the aversive response accounts for a continuum of emotional responses that range from dislike, to intolerant, to extreme avoidance. In considering IU, it is important to take into account the relevance and sufficiency of information as the perceived absence of information will be influenced based on what is known as well as contextualised cues (Carleton, 2016a, 2016b). The perceived absence of information is contextualised within what is known and unknown, which can indicate whether the absent information is relevant or irrelevant and whether the situation or experience will be associated with a positive or negative valence (Carleton, 2016b). As such, the perceived absence of information, an unknown, may trigger fear and anxiety (Carleton, 2016b).

Individuals who have difficulty tolerating uncertainty may perceive uncertain situations as threatening and negative and may react on a cognitive, emotional, and behavioural level (Buhr & Dugas, 2002; Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994). Higher levels of IU are found to impact decision-making in terms of being linked to a preference for immediately available rewards relative to more valuable and probable but delayed rewards, increased information seeking, and distress during decision-making (Jacoby, Abramowitz, Buck, & Fabricant, 2014; Jacoby, Abramowitz, Reuman, & Blakey, 2016; Ladouceur, Talbot, & Dugas, 1997; Luhmann, Ishida, & Hajcak, 2011). As such, maladaptive responses to uncertainty may be driven by heightened estimates related to the cost and probability of threat and negative outcomes, hypervigilance and increased reactivity to uncertainty, and cognitive and behavioural avoidance (Grupe & Nitschke, 2013). A central component of IU theory is that uncertainty in itself is threatening, and therefore, the literature suggests that an uncertain threat may be more distressing and anxiety-provoking than a certain threat (Carleton, 2012; Dugas, Marchand, & Ladouceur, 2005). Moreover, the IU model suggests that IU facilitates and is exacerbated by worry, cognitive avoidance (e.g., thought replacement, distraction, suppression), and negative problem orientation (e.g., low confidence in problem-solving abilities, tendency to appraise problems as threats; Dugas, Gagnon, Ladouceur, & Freeston, 1998; Dugas & Koerner, 2005). Further, Carleton (2016a, 2016b) asserts that higher levels of IU may be linked to a greater desire for a sense of predictability and control along with lowered self-efficacy, which may contribute to psychopathology. IU has also been differentiated from other related constructs such as intolerance of ambiguity, which also reflects an underlying fear of the unknown (Carleton, 2016b). Although IU and intolerance of ambiguity have been used interchangeably in the literature, they are different constructs. Grenier, Barrette, and Ladouceur (2005) posit that

intolerance of ambiguity is more present-focused and represents a difficulty with a current situation, whereas IU is more future-focused and represents difficulties with the unknown consequences of a current situation and the potential implications. Moreover, research disentangling the relationships between IU, other conceptually similar constructs, and worry found that IU had the strongest relationship with worry and symptoms of generalised anxiety disorder after taking into account other uncertainty-relevant constructs (e.g., indecisiveness, negative risk orientation, and need for predictability; Koerner, Mejia, & Kusec, 2017). Carleton (2012, 2016a) argues that fear of the unknown and IU are fundamental to psychopathology and psychotherapy.

Research suggests that IU consists of two dimensions labelled prospective IU and inhibitory IU. Prospective IU refers to cognitive appraisals of IU and desire for predictability whereas inhibitory IU refers to behavioural inhibition or inaction in the face of uncertainty (Carleton, Norton, & Asmundson, 2007; McEvoy & Mahoney, 2011). The two factors appear to represent independent and meaningful constructs (Boelen & Lenferink, 2018; Hong & Cheung, 2015), and evidence suggests that prospective IU and inhibitory IU are differentially associated with different emotional disorder symptoms (Carleton, Collimore, & Asmundson, 2010; Mahoney & McEvoy, 2012b, 2012c; McEvoy & Mahoney, 2011). In contrast, other studies suggest that these dimensions can be better represented by a single general IU factor (Cornacchio et al., 2018; Hale et al., 2016; Lauriola, Mosca, & Carleton, 2016).

Much of the research to date has focused on investigating trait IU, which reflects more general experiences of uncertainty. More recently, research has distinguished between trait IU and disorder-specific IU, which suggests that experiences of uncertainty may differ across emotional disorders and highlights the importance of individual differences and contextual factors (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013; Mahoney & McEvoy, 2012a, 2012b; Thibodeau et al., 2015). Research indicates a link between increasing levels of trait IU and emotional disorders (Carleton, 2012), but depending on an individual's diagnostic profile, uncertainty experienced in situations that are diagnostically-congruent may differentially heighten IU (Jensen & Heimberg, 2015; Mahoney & McEvoy, 2012a, 2012b). Research exploring the concurrent nature of general trait IU and disorder-specific IU (i.e., manifestations of IU in specific circumstances) is increasing and may be helpful in explaining the development of comorbidity and divergent trajectories as well as the similarities and distinctions between a range of psychological disorders (McEvoy et al., in press; Nolen-Hoeksema & Watkins, 2011). Previous studies demonstrated higher levels of disorder-specific IU compared to trait IU in a clinical sample (Mahoney & McEvoy, 2012b) and an analogue

anxious sample (socially anxious and obsessive-compulsive with contamination concerns; Jensen & Heimberg, 2015). Moreover, the strength of the contributions of disorder-specific IU and trait IU to different emotional disorder symptoms varies (Jensen & Heimberg, 2015; Mahoney & McEvoy, 2012b, 2012c; Thibodeau et al., 2015). Mahoney and McEvoy (2012b) reported significant associations between disorder-specific IU and symptoms of depression and panic disorder, but not worry, obsessive compulsive disorder, or social anxiety disorder. Other research demonstrated that after accounting for trait IU, disorder-specific IU was associated with symptoms of social anxiety and obsessive compulsive disorder (Jensen & Heimberg, 2015). Thibodeau et al. (2015) found that disorder-specific IU was more strongly related to social anxiety and panic disorder symptoms, whereas trait IU was more strongly related to generalised anxiety disorder and obsessive compulsive disorder symptoms. Similar associations where reported between disorder-specific IU and trait IU and symptoms of depression, posttraumatic stress disorder, specific phobia, and health anxiety (Thibodeau et al., 2015). Although evidence for the relative contributions for trait IU and disorder-specific IU to symptoms is mixed, research suggests that disorder-specific IU may be more relevant or proximal to some emotional disorders (Thibodeau et al., 2015).

A growing body of research demonstrates a link between IU and anxiety and worry in child and adolescent samples (Comer et al., 2009; Dugas, Laugesen, & Bukowski, 2012; Fialko, Bolton, & Perrin, 2012; Osmanağaoğlu, Creswell, & Dodd, 2018; Read, Comer, & Kendall, 2013). Sanchez, Kendall, and Comer (2016) suggest that cognitive vulnerabilities, such as IU, may be transmitted from parents to children through socio-contextual factors (e.g., parenting feedback styles, parental modelling). Indeed, prior research has demonstrated that cognitive risk factors associated with the development of depression aggregate in families (e.g., negative cognitive styles, hopelessness; Alloy et al., 2004). Sanchez et al. (2016) reported a significant link between maternal and child IU, and suggested that the association between maternal anxiety and child anxiety may be driven by the link between maternal IU and heightened child IU. Moreover, early caregiver relationships may underscore the association between adult insecure attachment styles (i.e., attachment anxiety and attachment avoidance) and high IU (Wright, Clark, Rock, & Coventry, 2017). A recent study demonstrated that after controlling for neuroticism and maternal anxiety, childhood insecure attachment (ambivalent and disorganised-controlling) and behavioural inhibition were significantly associated with adulthood IU over a 15-year span (Zdebik, Moss, & Bureau, 2018). Behavioural inhibition in early childhood involves heightened responses to uncertainty, which may be a predisposing factor to developing the view that surroundings are threatening

and uncertain (Zdebik et al., 2018). Future research is required to investigate paternal IU, the potential mechanisms through which parents transmit IU to children (e.g., parental modelling of avoidance behaviour when faced with uncertain events), as well as the influence of peers in the relationship between temperament, attachment, and the development of IU (Zdebik et al., 2018). Together, the findings highlight the influential role of early relationships between child and caregiver on the ability to tolerate uncertain events and suggest that IU may aggregate in families (Sanchez et al., 2016; Zdebik et al., 2018).

1.3. Intolerance of Uncertainty and Psychopathology

There is an increasing body of research that shows a relationship between IU and psychopathology in clinical and non-clinical samples, and therefore, IU is posited to be a risk and maintaining factor in several psychopathologies (Carleton, 2016a). IU is considered to be a dimensional construct and is found to have similar associations with disorder symptoms across multiple samples (e.g., community, analogue, clinical; Carleton, 2016a; Carleton, Mulvogue, et al., 2012; Carleton, Weeks, et al., 2012). Research demonstrates that IU is associated with changes in symptom severity across different evidence-based interventions designed to directly or indirectly target IU (McEvoy & Erceg-Hurn, 2016; van der Heiden, Muris, & van der Molen, 2012). As such, IU is conceptualised as a transdiagnostic process associated with multiple emotional disorders (Carleton, 2012; Hong & Cheung, 2015). A transdiagnostic process is a common underlying mechanism that occurs across diagnostic groups and may contribute to the maintenance of psychopathology (Harvey et al., 2004). The association between IU and anxiety disorders has been well-established in the literature, and IU has been consistently linked to generalised anxiety disorder (Buhr & Dugas, 2006; Dugas et al., 1998; Dugas, Schwartz, & Francis, 2004) and social anxiety disorder (Boelen & Reijntjes, 2009; Carleton, Collimore, et al., 2010; McEvoy & Mahoney, 2011; Norr et al., 2013; Whiting et al., 2014). Research documents an association between IU and panic disorder symptoms (Carleton, Fetzner, Hackl, & McEvoy, 2013; Mahoney & McEvoy, 2012c; McEvoy & Mahoney, 2011, 2012). IU has also been found to be related to obsessive compulsive disorder, which has historically been classified as an anxiety disorder, but more recently has been reclassified as separable categories (i.e., obsessive-compulsive and related disorders; Abramowitz & Jacoby, 2014; American Psychiatric Association, 2013 ; Calleo, Hart, Björgvinsson, & Stanley, 2010; Holaway, Heimberg, & Coles, 2006; Tolin, Abramowitz, Brigidi, & Foa, 2003).

Anxiety disorders frequently co-occur with depressive disorders and demonstrate conceptual similarity with overlapping symptoms and symptom reduction in response to similar psychosocial interventions such as cognitive-behavioural treatments (Cuijpers et al., 2013; Norton & Price, 2007; Olatunji, Cisler, & Deacon, 2010). Increasing research indicates an association between IU and depression (Berenbaum, Bredemeier, & Thompson, 2008; de Jong-Meyer, Beck, & Riede, 2009; Gentes & Ruscio, 2011; Paulus, Talkovsky, Heggeness, & Norton, 2015); however, these relationships have not always been found (Boelen & Reijntjes, 2009; Khawaja & McMahon, 2011; Yook, Kim, Suh, & Lee, 2010). Researchers suggest that the relationship between IU and depression may reflect the high comorbidity between disorders, and therefore, may be better accounted for by, and more relevant to, anxiety (Jensen, Cohen, Mennin, Fresco, & Heimberg, 2016; Yook et al., 2010). Jensen et al. (2016) assert that IU may be important to consider in the trajectory from anxiety to depression, and that IU may play a role in disorders that include an element of anxiety. Further, eating disorders represent a potentially relevant clinical group that are highly comorbid with anxiety disorders, and the relationship between IU and eating disorders is of increasing interest in the literature, but remains relatively under-researched (Brown et al., 2017; Kesby, Maguire, Brownlow, & Grisham, 2017). Anxiety disorders typically precede eating disorders and anxiety and fear are core features of eating disorder psychopathology (Keel, Klump, Miller, McGue, & Iacono, 2005; Swinbourne et al., 2012). Evidence supports the relevance of IU to individuals with problematic eating attitudes and eating disorders (Brown et al., 2017; Kesby et al., 2017; Sternheim, Fisher, Harrison, & Watling, 2017). Taken together, these findings support IU as an underlying transdiagnostic vulnerability mechanism for emotional disorders and eating disorder psychopathology (Brown et al., 2017; Carleton, 2012; Hong & Cheung, 2015; Kesby et al., 2017).

1.4. Aims of the Thesis

IU has become an increasingly prominent area of research and is argued to be fundamental to understanding the experience of anxiety and psychopathology (Carleton, 2016b). IU is implicated in the acquisition, maintenance, and treatment of an array of psychological disorders, including anxiety disorders and anxiety-related disorders, depressive disorders, and eating disorders (Carleton, 2012; Gentes & Ruscio, 2011; Hong & Cheung, 2015; Kesby et al., 2017). IU is a potentially important treatment target with evidence indicating changes in disorder symptoms and symptom reduction across different clinical interventions (Dugas & Robichaud, 2007; McEvoy & Erceg-Hurn, 2016). As such, IU is

conceptualised to be transdiagnostic and transtherapeutic in nature (Carleton, 2012; McEvoy & Erceg-Hurn, 2016).

Much of the literature on IU has focused on investigating its trait-like dispositional nature; however, recent findings have highlighted the potential importance of context and disorder-specific manifestations of IU. Disorder-specific IU may be a potential pathway through which individuals with IU experience distress and psychopathology. However, there is limited investigation of the unique and relative associations between trait IU, disorder-specific IU, and emotional disorder symptoms. Further, there is a paucity of experimental research investigating the relationships between IU and behaviour. Improving our understanding of the trait and disorder-specific manifestations of IU and its associations with decision-making behaviour and emotional disorder symptoms over a series of studies is likely to have important implications for transdiagnostic theory and treatment. These studies will add to the literature on the measurement of IU, its behavioural correlates, and links to different disorder symptoms. If IU is an important predisposing and perpetuating factor for a range of psychological disorders (Carleton, 2012), then improving our understanding of the role of IU across disorders, contexts, and in decision-making could inform further theoretical developments and improvements in effective diagnosis-specific and/or transdiagnostic treatments. Disentangling the role of IU beyond other key mechanisms could support the modification of cognitive-behavioural treatments and exposure-based approaches, or the incorporation of an adjunct protocol, to focus on IU. The overarching aim of this thesis is to increase understanding of the transdiagnostic nature of IU by exploring its underlying structure, the contribution of more general and disorder-specific facets, and its impact on symptoms of emotional disorders and eating disorders as well as decision-making behaviour and threat perception using a series of five studies.

1.4.1. Outline of Studies Included in this Thesis

1.4.1.1. Summary, rationale, and aims of Study 1. The first study in this thesis presents a narrative review of the literature as well as a future research agenda for IU. In light of the accumulating interest and promising research on IU, it is timely to emphasise the theoretical and therapeutic significance of IU, as well as to highlight what remains unknown about IU across areas such as development, assessment, behaviour, threat, and risk, and relationships to cognitive vulnerability factors and emotional disorders. The review synthesises what is known and unknown about IU, and, in doing so, proposes broad and novel directions for future research to address the remaining uncertainties in the literature. The

results of this review also provided justification for the next four studies included in this thesis, which sought to understand the measurement of IU and disentangle the role of trait IU and disorder-specific IU to disorder symptoms, threat perception, and behaviour.

1.4.1.2. Summary, rationale, and aims of Study 2. The IUS-12 is a commonly used measure of IU and is often conceptualised as either a unidimensional or two-factor correlated structure. In line with this, there is increasing debate as to whether IU is best represented as a unidimensional or multidimensional construct and recent research has begun to question whether the prospective IU and inhibitory IU subscales are independent meaningful constructs beyond a general IU factor (Hale et al., 2016). Moreover, Hale et al. (2016) suggested that the computation of the IUS-12 subscale scores in prior research was not empirically justified. A bifactor structure of the IUS-12 in undergraduate samples has been supported in recent research (Hale et al., 2016; Lauriola et al., 2016). This research indicated the prospective IU and inhibitory IU subscales can be best conceptualised by a single general factor (Hale et al., 2016; Lauriola et al., 2016). A bifactor approach allows for the identification of the proportion of unique variance attributed to subscale dimensions, and the common variance explained by a general hierarchical construct (Reise, Moore, & Haviland, 2010). As such, a bifactor approach may assist in determining whether prospective IU and inhibitory IU subscales account for unique variance beyond the total scale, or whether the subscales represent the same general IU construct (Reise et al., 2010). While recent studies have supported a bifactor structure of the IUS-12, there is only one study that has used the English version in a student sample and none in a clinical sample. Moreover, research is needed to clarify the relative significance of IU dimensions across disorders. It remains unclear as to whether a bifactor model is supported in clinical populations, and whether the prospective IU and inhibitory IU subscales represent distinct constructs or reflect an underlying general factor as found in undergraduate samples.

The second study in this thesis presented a psychometric evaluation of the IUS-12, which has implications for the computation of total versus subscale scores. This study also examined whether the IU dimensions are independently meaningful or better represented by a single general factor, as well as clarifying the significance of these dimensions across disorder symptoms. Examining the structure of the IUS-12 in undergraduate and clinical samples will inform appropriate methods of scoring (total score and/or subscale scores) and modelling of the scale in structural models. If the IUS-12 is best represented as a bifactor structure and the majority of the variance in prospective IU and inhibitory IU is explained by a general IU construct, this would lend further support to the unidimensional nature of the IU and

computation of the total score. Moreover, investigating the variance accounted for by the lower-order dimensions across emotional disorder symptoms could have potential theoretical and clinical implications, such as incorporating IU into cognitive-behavioural models and as a treatment target in clinical interventions.

1.4.1.3. Summary, rationale, and aims of Study 3. Associations between trait IU and a range of anxiety disorders and depression have been consistently found in the literature. More recently, researchers have distinguished between IU as trait-like and as disorder-specific (i.e., the experience of uncertainty differs across situations and disorders). Some evidence highlights the importance of context in perceiving uncertainty to be threatening (Jensen & Heimberg, 2015). There has been a predominant focus in the literature on trait IU, and given the recent conceptualisation of disorder-specific IU there is a paucity of research investigating its role in emotional disorders. Research supports the concurrent nature of trait IU and disorder-specific IU (Jensen & Heimberg, 2015; Mahoney & McEvoy, 2012b; Thibodeau et al., 2015); however, the relative contributions of trait IU and disorder-specific IU may differ across different emotional disorders. Further research is required to clarify whether disorder-specific IU represents a meaningful construct independent from trait IU and other psychological vulnerability factors (Thibodeau et al., 2015). Improving understanding of the relationships between trait IU, disorder-specific IU, and psychological disorder symptoms may have implications for treatment in terms of psychoeducation and exposure-based approaches.

The third study in this thesis examined a hierarchical model of trait IU and disorder-specific IU, multiple anxiety and anxiety-related disorder symptoms, and additional disorder-specific cognitive vulnerability factors. A structural equation model was used to test model fit and examine the direct and indirect pathways between trait IU, disorder-specific IU, other cognitive vulnerability factors (e.g., negative metacognitions, fear of negative evaluation, inflated responsibility beliefs, and agoraphobic cognitions), and disorder symptoms (e.g., generalised anxiety disorder, social anxiety disorder, obsessive compulsive disorder, and panic disorder). This model determined the relative contribution of trait and disorder-specific IU and the disorder-specific vulnerability factor to disorder symptoms. Such evidence may better understanding of the general and specific importance of IU for a range of cognitive vulnerability factors and corresponding disorder symptoms.

1.4.1.4. Summary, rationale, and aims of Study 4. There is a wealth of research that underscores the relevance of IU to emotional disorders; however, there is a paucity of experimental research that examines the relationships between IU and responses to

uncertainty. IU is said to impact perceptions and responses to uncertainty on a cognitive, behavioural, and emotional level (Dugas, Schwartz, et al., 2004). Researchers assert that IU may contribute to anxiety and disorder symptoms and cognitive and behavioural avoidance strategies through heightened threat perceptions in situations that are uncertain (Carleton, Mulvogue, et al., 2012). In line with this, evidence suggests that individuals with high levels of IU appraise uncertain or ambiguous situations as more threatening relative to individuals with low levels of IU (Koerner & Dugas, 2008; Oglesby, Raines, Short, Capron, & Schmidt, 2016; Oglesby & Schmidt, 2017). Reuman, Jacoby, Fabricant, Herring, and Abramowitz (2015) referred to uncertainty-based reasoning, wherein low-threat situations may be perceived as threatening when uncertainty is explicit, and found that uncertainty-based reasoning is linked to increased anxiety. Further, IU is found to play a role in personally salient situations that are perceived to be devoid of threat (Pepperdine, Lomax, & Freeston, 2018). Moreover, research using a probabilistic inference task as an analogue for decisional uncertainty in anxiety disorders reported links between IU and distress during decision-making (Jacoby et al., 2014; Jacoby et al., 2016; Jacoby, Reuman, Blakey, Hartsock, & Abramowitz, 2017). Although there has been an increase in experimental research, much of the literature has used cross-sectional methods and self-report measures, and therefore research using experimental and behavioural paradigms is needed. Such paradigms would allow for an investigation of the correlates and predictors of IU and related distress as well as a better understanding of the impact on decision-making in the context of IU.

The fourth study in this thesis sought to address some of these gaps in the literature and examined the effects of certainty level (uncertain threat versus certain threat) and context (social and performance evaluation versus contamination and responsibility) on decision-making performance and self-reported distress. The contexts were designed to reflect concerns that typically characterise social anxiety disorder and obsessive compulsive disorder, and to increase perceived task importance and distress relative to prior studies. This study also evaluated the links between trait and disorder-specific IU and threat perception ratings to determine whether IU interacts with perceived threat to influence behaviour and distress. Investigations of IU specific to a given context or set of circumstances may help to elucidate the underlying similarities of psychopathology as well as the differences in manifestations or coping responses used.

1.4.1.5. Summary, rationale, and aims of Study 5. Outside the field of anxiety and anxiety-related disorders, investigations of IU may also improve understanding of important processes implicated in other psychological disorders, particularly eating disorders. Anxiety is

suggested to play a central role in the development and maintenance of eating disorder psychopathology (Swinbourne et al., 2012). Moreover, parallels have been drawn between the cognitive and behavioural symptoms of anxiety disorders and the core features of eating disorders (Steinglass et al., 2011). Kesby et al. (2017) assert that the characteristics that are typical in eating disorders, including strict rules and rituals regarding eating behaviours and predictable routines, may represent maladaptive strategies that function to increase a sense of certainty. Research suggests that IU represents a relevant, yet neglected, construct in eating disorder pathology and future research in this area may lend further support to the transdiagnostic models of eating disorders (Kesby et al., 2017; Renjan, McEvoy, Handley, & Fursland, 2016). A growing body of research indicates a relationship between IU and eating disorder symptoms in non-clinical and clinical samples (Konstantellou & Reynolds, 2010; Renjan et al., 2016; Sternheim, Startup, & Schmidt, 2011; Sternheim et al., 2017). In the anxiety disorder literature, the manifestations of different clinical disorders are thought to be influenced by trait IU, which is suggested to represent general psychopathology, and disorder-specific aspects of IU, which highlight the importance of context in perceiving uncertainty threatening (Jensen & Heimberg, 2015; Thibodeau et al., 2015). As such, the distinction between trait IU and disorder-specific IU may be mirrored in the eating disorder literature (Kesby et al., 2017). There is limited research investigating the links between IU and eating disordered cognitions and behaviour and, therefore, research is needed to disentangle the contributions of trait and disorder-specific IU to eating disorder symptoms.

The fifth study in this thesis consists of the development and preliminary validation of a measure of disorder-specific IU as it relates specifically to eating disorder psychopathology (e.g., concerns about shape, weight, and eating, dietary restraint, purging, bingeing, and body checking). This study also examined the contributions of trait IU and disorder-specific IU to symptoms of eating disorders beyond key constructs outlined in the transdiagnostic model of eating disorders (i.e., clinical perfectionism, low self-esteem, interpersonal difficulties, and mood intolerance). Such research may provide information about the strength of the relationships between trait and disorder-specific IU and whether disorder-specific IU is a useful construct to consider in eating disorders.

In summary, the studies presented in this thesis lend further support to the transdiagnostic conceptualisation of IU and underscore the potential significance of disorder-specific IU as a meaningful construct independent of trait IU. The first aim was to provide a comprehensive review of the literature to highlight what is known and unknown about the relationships between IU and psychopathology. The second aim was to examine the

psychometric structure of a widely used measure of IU and the differential associations between the lower-order dimensions and disorder symptoms. The third aim was to examine the relative strength of the direct and indirect pathways from IU to multiple emotional disorder symptoms. The fourth aim was to investigate the effects of IU on threat perception, decision-making, and distress across different contexts. The fifth aim was to develop a measure of IU specific to eating disorders and evaluate the relative strength of the associations between trait IU and disorder-specific IU and eating disorder symptoms. The discussion section provides an integration of the studies, and describes the strengths and limitations of this thesis and the literature, and potential theoretical and clinical implications.

Note: The following chapter has been published in the Journal of Anxiety Disorders

Shihata, S., McEvoy, P. M., Mullan, B. & Carleton, R. N. (2016). Intolerance of uncertainty in emotional disorders: what uncertainties remain? *Journal of Anxiety Disorders, 41*, 115-124. doi:10.1016/j.janxdis.2016.05.001

Minor edits have been made to the present chapter to ensure consistency with the present thesis (e.g., Australian spelling). Recent literature since the publication of this manuscript has been included in this narrative review. The published article is presented in Appendix A.

Chapter 2 (Study 1): Intolerance of Uncertainty in Emotional Disorders: What Uncertainties Remain?

2.1. Introduction

The current paper briefly reviews what is known about IU before highlighting what remains unknown. Due to rapidly increasing interest and research focus on IU, culminating in the current special issue, a review is both timely and necessary to set a future research agenda. This paper will review IU with respect to conceptual foundations and definitional issues, development, assessment, behavioural consequences, associations to threat and risk, other cognitive vulnerability factors, and emotional disorders, as well as clinical applications. Within each of these domains, what is currently known will first be briefly reviewed followed by what remains unknown. The major contribution of the current paper is the description of future research avenues to address the known unknowns.

2.2. Conceptual Foundations of Intolerance of Uncertainty

2.2.1. What is known?

Models of psychopathology posit that uncertainty is a central feature in anxiety-related experience (Carleton, 2016a) and the incapacity to endure unknowns appears to be a robust vulnerability factor associated with a range of psychological disorders (Grupe & Nitschke, 2013; Hong & Cheung, 2015). IU was originally defined as a broad construct that reflects "cognitive, emotional, and behavioural reactions to uncertainty in everyday life situations" (Freeston et al., 1994, p. 792). Freeston et al. (1994) speculated that people with IU may engage in worry to increase their sense of certainty and control when faced with ambiguity. The definition of IU evolved as research on IU shifted from an initial focus on generalised anxiety disorder to other disorders. A revised and broader definition described IU as a predisposition to negatively perceive and respond to uncertain information and situations irrespective of its probability and outcomes (Ladouceur, Blais, Freeston, & Dugas, 1998; Ladouceur, Gosselin, & Dugas, 2000). IU has also been conceptualised as a cognitive filter and as the excessive tendency to perceive and interpret negative events as unacceptable (Buhr & Dugas, 2002; Dugas, Gosselin, & Ladouceur, 2001). Individuals with high IU have the tendency to appraise ambiguity as threatening and experience heightened physiological arousal (Greco & Roger, 2001, 2003; Hock & Krohne, 2004). Furthermore, difficulties tolerating uncertainty may represent the tendency to believe that uncertainty in itself is distressing, unfair, and should be avoided (Dugas et al., 2005; Dugas, Schwartz, et al., 2004).

Current consensus describes IU as a "dispositional characteristic that reflects a set of negative beliefs about uncertainty and its implications" (Dugas & Robichaud, 2007), and represents an underlying fear of the unknown (Carleton, 2016b). Carleton (2016a, p. 31) recently proposed that IU represents a broad "incapacity to endure the aversive response triggered by the perceived absence of salient, key, or sufficient information".

Recent measurement research sheds light on the conceptual nature of IU, postulating that IU comprises two dimensions; prospective IU (e.g., *"I always want to know what the future has in store for me"*) and inhibitory IU (e.g., *"When its time to act, uncertainty paralyses me"*; Carleton, 2012; Carleton, Sharpe, et al., 2007; Hong & Cheung, 2015; McEvoy & Mahoney, 2011), sometimes referred to as desire for predictability and uncertainty paralysis, respectively (Berenbaum et al., 2008; Birrell, Meares, Wilkinson, & Freeston, 2011). Both prospective and inhibitory IU are conceptualised as responses to uncertainty such that prospective IU represents cognitive appraisals of threat related to future uncertainty while inhibitory IU represents behavioural inhibition related to uncertainty (Carleton, 2012; Carleton, Norton, et al., 2007; Einstein, 2014).

IU has predominantly been conceptualised as a dispositional trait (Mahoney & McEvoy, 2012b); however, recent research suggests distinctions can be made between trait IU and disorder-specific IU (Thibodeau et al., 2015), sometimes referred to as situation-specific IU (Mahoney & McEvoy, 2012b, 2012c). Mahoney and McEvoy (2012b) were the first to conceptualise dimensions of the IU construct as disorder-specific based on early speculations that general experiences of uncertainty may differ across disorders and thus situations (Carleton, Gosselin, & Asmundson, 2010; Tolin et al., 2003). For example, uncertainty about catastrophic consequences of physical symptoms in panic disorder may differ from uncertainty about social evaluative cues in social anxiety disorder. Thus, the nature of uncertainty may differ between emotional disorders and IU may manifest differently based on contextual factors (Boswell et al., 2013; Carleton, 2016a; Mahoney & McEvoy, 2012b). State IU can be considered as any instance of heightened negative affect in response to an uncertain stimulus, which may or may not co-occur with high trait IU or occur within the context of emotional disorders.

Mahoney and McEvoy (2012b) found that clinical participants reported higher disorder-specific IU relative to trait IU. Further, disorder-specific IU displayed a significant, but modest, association with depression and panic disorder symptoms beyond trait IU, but not for social anxiety, worry, or obsessive-compulsive disorder symptoms. Additionally, Mahoney and McEvoy (2012c) reported no significant differences between trait and disorder-specific

IU amongst individuals with generalised anxiety disorder, social anxiety disorder, and panic disorder. Thus, in line with normative descriptive research (e.g., Carleton, Mulvogue, et al., 2012), trait IU appeared comparable across disorders, supporting IU as a transdiagnostic construct.

Jensen and Heimberg (2015) extended this research by comparing diagnostically-congruent and -incongruent situations using a non-anxious control and two anxious groups. The socially anxious and obsessive-compulsive groups reported higher disorder-specific IU relative to trait or disorder-incongruent IU. Further, the socially anxious and control groups reported similar IU levels with regard to contamination concerns, while the obsessive-compulsive and control groups reported similar IU levels with regard to social interactions (Jensen & Heimberg, 2015). Thus, in line with recent theory (Carleton, 2016a), context remains a critical component for considering uncertainty threatening, even for persons reporting high trait IU and anxiety symptoms.

Thibodeau et al. (2015) also found disorder-specific IU was associated with unique variance in concordant symptom measures (e.g., disorder-specific IU in social situations predicted symptoms for social anxiety; disorder-specific IU in bodily sensations predicted symptoms for panic disorder). Relative to disorder-specific IU, trait IU explained more unique variance in generalised anxiety disorder and obsessive-compulsive disorder, but less unique variance in social anxiety and panic disorder symptoms. Disorder-specific and trait IU accounted for similar proportions of unique variance in symptoms of health anxiety, depression, posttraumatic stress disorder, and specific phobia. Taken together, research suggests the generalisability of IU varies, with some disorders appearing more strongly associated with disorder-specific IU than trait IU (Mahoney & McEvoy, 2012c; Thibodeau et al., 2015). Moreover, expressions of disorder-specific and trait IU may be dependent on context, with intolerance increasing during exposure to disorder-congruent situations (Jensen & Heimberg, 2015; Mahoney & McEvoy, 2012c).

2.2.2. What is unknown?

Converging evidence highlights the possibility that IU comprises both prospective IU (desire for predictability) and inhibitory IU (uncertainty paralysis); nevertheless, future research should examine the theoretical nature of prospective and inhibitory IU, and the relationships between these two dimensions and other aspects of psychopathology, including affective, behavioural, cognitive, and interpersonal factors. For example, investigating whether prospective IU is more strongly related to approach behaviours designed to stave off

future uncertainty and whether inhibitory IU is more strongly associated with avoidance behaviours to minimise exposure to uncertainty (Birrell et al., 2011).

The historical focus on trait IU has left the role of disorder-specific IU in emotional disorders less clear. Further research is needed to elucidate the nature of IU across disorders, each of which may involve varying degrees of trait and disorder-specific IU (Thibodeau et al., 2015). There is also a need to clarify the predictive nature of disorder-specific IU in emotional disorders. Disorder-specific and trait IU need to be delineated and integrated into theoretical models to provide a framework for this endeavour. Distinguishing between disorder-specific IU, trait IU, and symptoms may have important treatment implications, such as guiding targets for exposure or psychoeducation. Alternatively, for some or most disorders targeting trait IU may sufficiently generalise to disorder-specific IU, or vice versa, offering several potential avenues for reducing IU-related vulnerability for primary and comorbid emotional problems. Answers to these questions are currently unknown.

2.3. Development of Intolerance of Uncertainty

2.3.1. What is known?

Associations between IU, other cognitive vulnerabilities, and anxiety-related psychopathology underscore the important theoretical and clinical implications of understanding IU development processes (Barlow, Bullis, Comer, & Ametaj, 2013; Osmanağaoğlu et al., 2018). For example, elucidating pathways by which transdiagnostic processes lead to multiple diagnoses (i.e., multifinality) and different disorders (i.e., divergent trajectories) in different people may be critical for advancing theory, treatment, and prevention (Nolen-Hoeksema & Watkins, 2011). Indirect research and theory implicates the developmental importance of IU (Carleton, 2016a); however, direct research into the development of IU is nascent and is reviewed here with a focus on potential processes and developmental origins. We consider IU as a proximal transdiagnostic risk factor akin to Nolen-Hoeksema and Watkins (2011) proposed heuristic for developing transdiagnostic models, which incorporates distal factors, proximal factors, and linking mechanisms for psychopathology.

Distal risk factors may include early family contexts characterised by over-protective and controlling parenting. These parenting styles may decrease children's perceived control and self-efficacy, resulting in maladaptive cognitive strategies, negative perceptions of uncertainty, worry, and anxiety (Aktar, Nikolić, & Bögels, 2017; Buhr & Dugas, 2006; Chorpita & Barlow, 1998; Sanchez et al., 2016). Zlomke and Young (2009) found participants

who reported that their parents displayed adverse behaviours (i.e., anxious rearing and rejection) had significantly higher IU. Importantly, these researchers found that the relationship between anxious parenting and both anxiety and worry symptoms was mediated by IU. Dugas et al. (2012) conducted longitudinal research investigating the temporal relationship between IU and worry during adolescence, providing evidence that changes in IU partially mediate change in worry and vice-versa. Accordingly, Dugas et al. (2012) suggested that worry and IU have a reciprocal relationship over time, with adolescent IU potentiating worry through threatening appraisals of uncertainty and maladaptive behaviours similarly to adults (Bredemeier & Berenbaum, 2008; Gosselin et al., 2008). These researchers observed that transition periods at the start and finish of secondary school were associated with the highest levels of IU, and they suggested that multiple changes during adolescence (e.g., emotional, social, academic; Steinberg, 2005) may have a cumulative effect of increasing IU. Recent longitudinal research demonstrated a link between childhood insecure attachment, behavioural inhibition, and IU in adulthood (Zdebik et al., 2018).

Recent theoretical models (see Grupe & Nitschke, 2013; Wever et al., 2015) implicate several neural structures that may be impacted by, and underlie the expression of, IU. The neurologically-based models are based on functional magnetic resonance imaging evidence that has implicated the insula, amygdala, hypothalamus, anterior cingulate cortex, orbitofrontal cortex, ventromedial prefrontal cortex, dorsolateral prefrontal cortex, and posterior frontomedian cortex as related to IU (Krain et al., 2006; Motzkin, Philippi, Wolf, Baskaya, & Koenigs, 2014; Sarinopoulos et al., 2010; Schienle, Köchel, Ebner, Reishofer, & Schäfer, 2010; Simmons, Matthews, Paulus, & Stein, 2008; Tanovic, Gee, & Joormann, 2018; Thayer et al., 2012). Hyperactivation of these brain regions appears to be associated with maladaptive cognitive and behavioural processes, including hypervigilance for uncertain or threatening stimuli (Wever et al., 2015). Associations between IU and hypervigilance have also been supported by information processing studies indicating a cognitive bias (Fergus, Bardeen, & Wu, 2013; Fergus & Carleton, 2016). Similarly, uncertainty appears related to increases in heart rate variability (Thayer et al., 2012), implicating broad influence throughout the attentional networks and autonomic nervous system.

2.3.2. What is unknown?

There is a paucity of research on IU during childhood and adolescence; such research is critical. Different neurodevelopmental stages contribute to differences in processing uncertainty, which limits generalisability from adult studies to child populations (Krain et al.,

2006; Osmanağaoğlu et al., 2018). Extending research by Wright, Lebell, and Carleton (2016), future research should examine associations between IU and a range of emotional disorders to inform the transdiagnostic nature of IU in child and adolescent populations. Future research using prospective and longitudinal designs are needed. Moderators may shape the effects of trait IU into particular symptoms and disorder-specific IU, helping to explain how this vulnerability results in divergent trajectories or multifinality (Nolen-Hoeksema & Watkins, 2011). Such moderation hypotheses accord with the assertion made by Thibodeau et al. (2015, p. 55) that disorder-specific IU may represent a "theoretically proximal and explicit causal intermediary" between trait IU and disorder symptoms. Trait IU may shape disorder-specific IU through learning, operant conditioning, and modelling, which would shape cognitive and behavioural responses to situational stressors and consequences. A comprehensive review of the interplay between these factors is beyond the scope of this review, but further research examining these relationships is required.

Carleton, Mulvogue, et al. (2012) suggested that rather than investigating discrete causal factors, researchers should explore a range of environmental, genetic, or biological variables that may shape IU. Identifying neural structures related to IU may explain whether IU functions as a shared or specific vulnerability factor (Simmons et al., 2008; Tanovic et al., 2018; Wever et al., 2015). Researchers have yet to explore potential links between IU and congenital biological abnormalities; as such, future researchers and theorists should consider the potential influence of genetically based dispositions that may confer risk for IU. Future researchers should strive to understand the connections between genetic, neural, and cognitive correlates, all of which may facilitate IU and psychopathology (Sanislow et al., 2010). Advancing our understanding of the neurobiological, genetic, and environmental origins of IU is important for advancing our understanding of multifinality and divergent disorder-specific trajectories, as well as preventative and therapeutic interventions (Mahoney & McEvoy, 2012a; Simmons et al., 2008; Wever et al., 2015).

2.4. Assessment of Intolerance of Uncertainty

2.4.1. What is known?

There are several self-report measures designed to assess IU; however, the specific content has often been revisited over the past two decades of IU theory development. The 27-item IU Scale (IUS) was the first measure developed to assess IU and responses to uncertain situations (Freeston et al., 1994). Psychometric evaluations demonstrate excellent internal consistency, test-retest reliability, and construct validity (Freeston et al., 1994); nevertheless,

factor analytic evidence prior to 2007 suggested the IUS had an unstable, complex factor structure with potentially redundant items (Carleton, Norton, et al., 2007). For example, consistent with its original intent, the IUS includes items that specifically relate to generalised anxiety disorder and worry, which may impact transdiagnostic applications (Gentes & Ruscio, 2011). Complications with the IUS factor structure coupled with suggestions that item removal would be unlikely to affect scale reliability (Norton, 2005) led to the development of a 12-item short form (i.e., IU Scale, Short Form; IUS-12; Carleton, Norton, et al., 2007). The IUS-12 comprised two factors, relabelled as prospective IU and inhibitory IU by McEvoy and Mahoney (2011). Prior research represents the IUS-12 as a unidimensional or two-factor correlated model, however recent research provides support for a bifactor model in student samples (Hale et al., 2016; Lauriola et al., 2016). The IUS-12 has strong psychometric properties and is a viable transdiagnostic assessment tool for trait IU (Dekkers, Jansen, Salemink, & Huizenga, 2017; Hale et al., 2016; Khawaja & Yu, 2010; Roma & Hope, 2017).

Subsequent research with the full IUS (Sexton & Dugas, 2009) and a very large sample demonstrated a reliable two factor structure (i.e., uncertainty is unfair and spoils everything; uncertainty has negative behavioural and self-referent implications), with the items for each mapping onto the IUS-12 factors (Carleton, Norton, et al., 2007; McEvoy & Mahoney, 2011). The IUS and IUS-12 overlap such that both are considered defensible and generally comparable tools for assessing IU (Khawaja & Yu, 2010); however, that same conceptual overlap in assessing general reactions to uncertainty or "trait" IU has led some researchers to posit that potential biases might arise when examining IU and emotional disorders, such as an inflated association between IU and generalised anxiety disorder relative to other disorders (Gosselin et al., 2008). In response to such concerns, the 45-item IU Inventory (IUI) was developed (Carleton, Gosselin, et al., 2010; Gosselin et al., 2008). The IUI comprises two distinct parts and, accordingly, distinguishes between trait IU (Part A) and six associated behavioural and cognitive expressions (i.e., avoidance, doubt, overestimation, worry, control, reassurance; Part B). Psychometric evidence indicates the IUI has good reliability, temporal stability, and convergent and incremental validity (Carleton, Gosselin, et al., 2010; Gosselin et al., 2008).

Comer et al. (2009) revised the IUS items to ensure comprehensibility for children, resulting in the first validated measure of IU for children, the Intolerance of Uncertainty Scale for Children (IUSC). Cornacchio et al. (2018) found support for an abbreviated 12-item version in anxious and non-anxious youth, whereby the items draw parallel to the IUS-12. Cornacchio et al. (2018) compared a two-factor correlated and bifactor model and found the

latter provided improved fit and indicated that the items are represented by a general factor. Preliminary psychometric evidence for the IUSC is promising (Comer et al., 2009; Cornacchio et al., 2018). Another measure for use with children is the unpublished 12-item IU Scale-Revised (IUS-R; Walker, Birrell, Rogers, Leekam, & Freeston, 2010) based upon the IUS-12 (Carleton, Norton, et al., 2007). Research exploring IU with children is increasing (Comer et al., 2009; Fialko et al., 2012; Kertz & Woodruff-Borden, 2013; Sanchez et al., 2017); however, the use of different measures limits direct comparisons between studies.

Theoretical distinctions between trait and disorder-specific IU prompted the development of the IU Scale-Situation-Specific Version (IUS-SS; Mahoney & McEvoy, 2012b). The IUS-SS is an adapted version of the IUS-12. Respondents describe a personally distressing, regularly occurring, and specific situation within one of four disorder-specific domains (social evaluative, intrusive thoughts/repetitive behaviours, worry, panic) before completing the IUS-12 items referencing the specific situation. Psychometric evidence demonstrates a unitary factor structure, good reliability, and convergent and discriminant validity. To extend the scope of other measures by focusing IU within discrete symptom categories, the 24-item Disorder-Specific IU Scale (DSIU) was designed (Thibodeau et al., 2015). The DSIU comprises eight subscales assessing IU in the context of various disorder symptoms including generalised anxiety disorder, obsessive-compulsive disorder, social anxiety, health anxiety, panic disorder, specific phobia, posttraumatic stress disorder, and depressive disorder. Psychometric research indicates high reliability, convergent and criterion validity, but research is required to assess the temporal stability and clinical validity of the DSIU (Thibodeau et al., 2015).

2.4.2. What is Unknown?

Psychometric evaluations of the IUI and IUSC are limited and further testing is required within a broader array of adult and child clinical populations, respectively. All measures of IU require further validation across ethnically diverse samples. Different operational definitions underlie the development of each measure (Fergus, 2013). For example, the IUS-12 and the IUI Part A assess responses to uncertainty and the tendency to consider uncertainty intolerable, respectively. Thus, when making decisions about which self-report measures to use researchers need to consider the distinct item content of each measure (Fergus, 2013) and provide an overall theoretical framework to clearly articulate how these aspects of IU relate to each other and to other constructs. Future treatment studies also need to investigate whether existing self-report measures are able to effectively guide case

formulations and treatment plans to improve outcomes for individuals with emotional disorders.

The proliferation of and focus on self-report measures has advanced our understanding of IU; however, exclusive reliance on self-report and often cross-sectional methods are also important limitations of existing research (Jacoby et al., 2014). Self-report data may be vulnerable to subjective response biases and shared method variance, which can inflate associations between variables. Cross-sectional research can provide information about the associations between theoretically related variables, but precludes the ability to draw causal conclusions. Accordingly, broad theoretical and applied progress for understanding IU will require valid and reliable multimodal assessments (Carleton, 2012, 2016a; Einstein, 2014).

2.5. Insights into Intolerance of Uncertainty from Behaviour

2.5.1. What is known?

Current research suggests that IU is characterised by cognitive, affective, and behavioural facets, and may have a broad influence on emotional disorders (Buhr & Dugas, 2002; Carleton, 2016a; Freeston et al., 1994; Thibodeau, Carleton, Gómez-Pérez, & Asmundson, 2013). Researchers have experimentally induced or manipulated uncertainty and examined the correlates of self-report IU and responses to uncertain situations (Faleer, Fergus, Bailey, & Wu, 2017; Jacoby et al., 2016; Jacoby et al., 2017; Oglesby & Schmidt, 2017). The manipulations have included tasks such as overt behavioural assessments, a typing task, bead selection tasks, and a cold pressor task. The results have indicated people with higher IU (1) prefer immediately available rewards, even when they are less probable or less valuable (Luhmann et al., 2011); (2) are less confident about high risk decisions, but also less likely to change their decisions despite receiving new information (Jensen, Kind, Morrison, & Heimberg, 2014); (3) are more likely to seek additional information to increase certainty in non-clinical samples (Jacoby et al., 2014; Jacoby et al., 2016; Ladouceur et al., 1997; Rosen & Knäuper, 2009), though not consistently in clinical samples (Sternheim, Startup, et al., 2011); (4) are more likely to increase certainty by behaving, reacting, or deciding more slowly in clinical (Jacoby et al., 2014) and non-clinical samples (Jacoby et al., 2014; Jacoby et al., 2016; Thibodeau et al., 2013); and (5) are more likely to be distressed by uncertainty in clinical (Jacoby et al., 2014) and non-clinical samples (Jacoby et al., 2016; Jacoby et al., 2017). Taken together, these experimental results suggest that manipulating uncertainty may adversely impact behaviours and decision-making, even with relatively low levels of

perceived threat. In addition, Jacoby et al. (2014) suggest the beads task could be modified to maximise external validity by focusing on specific idiosyncratic concerns of participants.

2.5.2. What is unknown?

There is a relative paucity of research exploring the relationship between self-reported IU on behaviour and decision-making. A multi-modal approach will help researchers and clinicians to better assess the latent IU construct and its consequences. To advance our understanding of the associations between the latent IU construct and a broad range of behaviours, researchers should investigate behaviours characterised by higher-order processes (e.g., probability-based decision-making) as well as common daily behaviours (e.g., public speaking). Researchers should address whether behaviours are driven by uncertainty itself or by the emotional consequences associated with uncertainty (Luhmann et al., 2011), as well as understanding the compounding influence of anticipated reinforcers (e.g., threat, reward). Moreover, a variety of experimental studies should be designed to elucidate whether uncertainty and the latent IU construct are associated with explicit behavioural responses (e.g., impairment), perceptions of distress, cognitive consequences (Jacoby et al., 2016), or all three.

Researchers could manipulate trait IU, disorder-specific IU, probability, and threat across disorder-congruent and -incongruent contexts and explore the interactive effects therein on emotional symptoms and behaviour. For example, uncertainty could be increased in situations pertinent to social anxiety (e.g., fear of being evaluated, performance anxiety), obsessive-compulsive concerns (e.g., contamination concerns, inflated perceptions of responsibility; e.g., Jacoby et al., 2017), a specific phobia, or health concerns (e.g., Rosen & Knäuper, 2009), while investigating emotional and behavioural correlates, including decision-making. Within different disorders, reduced decision-making confidence in varying domains (e.g., social scenarios) may exacerbate disorder-specific concerns contributing to anxiety or depressive symptoms (e.g., fear of negative evaluation for social anxiety disorder; Jensen et al., 2014). Research involving decision-making confidence, behaviour, and IU would also provide insights into the content specificity or disorder-specific aspects of IU. Methodologically varied approaches with diverse samples will enhance our understanding of the trait and state expressions of IU and psychopathology (Jacoby et al., 2014). Future researchers should examine how the prospective and inhibitory IU dimensions are differentially related to behaviour across more general and disorder-specific contexts.

2.6. Intolerance of Uncertainty, Threat, and Risk

2.6.1. What is known?

According to Krohne (1989) coping theory, ambiguous or unpredictable situations may be viewed as threatening and difficulty tolerating uncertainty may result in an excessive tendency to search for threat cues. Vigilance to uncertainty and overestimating the probability and cost of threat appears to be involved in the development and perpetuation of fear and anxiety and engagement in safety behaviours (Mathews & MacLeod, 1994, 2002; Reuman et al., 2015). A link between high IU and the tendency to overestimate the likelihood of negative events has been documented (Dugas, Buhr, & Ladouceur, 2004; Dugas et al., 2005; Koerner & Dugas, 2008; Ladouceur et al., 1997), with uncertainty itself perceived as threatening. Attending to the uncertain aspects of a situation has been conceptualised as uncertainty-based reasoning (Reuman et al., 2015). Relatedly, IU may be sufficiently threatening that it leads to worry (Bredemeier & Berenbaum, 2008; Dugas, Buhr, et al., 2004). Scenarios characterised by explicit uncertainty and high threat, instead of implicit or low threat, produced higher anxiety and urges to engage in safety behaviours; moreover, a low threat situation may be perceived as highly threatening when uncertainty is explicit (Reuman et al., 2015).

2.6.2. What is unknown?

Research examining the interaction between uncertainty and threat in anxiety and emotion is scant and more work is needed to clarify the associations. Researchers should design in vivo manipulations of threat, explicit uncertainty, and implicit uncertainty. Examining threat through vignettes or in vivo situations across a spectrum of symptoms may inform relationships between perceptions of threat and risk in disorder-specific contexts. Such designs may pose ethical challenges for researchers who will benefit most from ecologically valid scenarios; in any case, experimental and longitudinal designs are required to understand causal relationships between IU and estimations of probabilities and costs. In addition, evidence from multiple clinical samples will inform the generalisability across anxiety and depressive disorders.

2.7. Intolerance of Uncertainty as a Cognitive Vulnerability Process

2.7.1. What is known?

Recent research suggests that many vulnerability factors are associated with multiple disorders and are thus transdiagnostic (e.g., Aldao, Nolen-Hoeksema, & Schweizer, 2010; Harvey et al., 2004; Naragon-Gainey, 2010; Starcevic & Berle, 2006). Theory and empirical

evidence has also supported a hierarchical conceptualisation of emotional disorders, such that the influence of higher-order distal traits on disorder symptoms is mediated by intermediate cognitive factors (Norton & Mehta, 2007; Norton, Sexton, Walker, & Norton, 2005; Paulus et al., 2015; Sexton, Norton, Walker, & Norton, 2003; van der Heiden et al., 2010). Researchers have focused on two distal temperament factors, namely neuroticism and extraversion, and evidence for a relationship between neuroticism and psychopathology is strong (Barlow, 2002; Barlow, Sauer-Zavala, Carl, Bullis, & Ellard, 2014; Brown & Naragon-Gainey, 2013; Kotov, Gamez, Schmidt, & Watson, 2010; Watson, 2005). Neuroticism is closely related and largely overlapping with trait anxiety (Clark & Beck, 2010). Neuroticism could be referred to as reflecting a generalised biological vulnerability, although learned experiences are also likely to influence this vulnerability, as highlighted in Barlow's (2000, 2002) triple vulnerability model. IU may reflect a generalised psychological vulnerability that stems from unknowns and perceptions of absent agency over emotions and environment, all of which facilitate neuroticism (Carleton, 2016a, 2016b).

IU appears to be a transdiagnostic cognitive vulnerability factor (Carleton, 2016a) associated with a host of other factors (e.g., anxiety sensitivity; ruminative style). Hong and Cheung (2015) suggested that several cognitive vulnerabilities may share a common core of IU and, therein, fearing the unknown. Indeed, IU mediates the relationship between neuroticism and symptoms of worry, depression, social anxiety, and obsessive-compulsive disorder (Fergus & Wu, 2011; Hong, 2013; McEvoy & Mahoney, 2012; Norton & Mehta, 2007; Norton et al., 2005; Sexton et al., 2003; van der Heiden et al., 2010). Researchers have also evidenced that prospective and inhibitory IU partially mediate the link between neuroticism and emotional disorders (McEvoy & Mahoney, 2011).

2.7.2. What is unknown?

The need remains to disentangle the trait and disorder-specific cognitive vulnerabilities and overlapping transdiagnostic factors in emotional disorders. Carleton (2016a) has offered an overview of processes through which IU may influence psychopathology; however, substantial work remains to be done investigating the specific processes. Inconsistencies in the extant IU literature exploring those specific processes may have resulted from discrepancies in methodological and analytical procedures (Hong, 2013). Future research should continue to evaluate hierarchical models of psychopathology, including IU (Norton & Paulus, 2016; Watson, 2005), considering recent theoretical developments.

Norton and Paulus (2016) assert that hierarchical conceptualisations can aid in identifying transdiagnostic processes with incremental explanatory power beyond higher-order factors like neuroticism or negative affect. Using a meta-analytic approach, Hong and Cheung (2015) examined the overlap among a range of vulnerabilities and found a lack of support for symptom specificity. In line with this and to address limitations of prior studies, future research should include multiple vulnerabilities simultaneously to examine the unique and shared magnitude of associations with different disorder symptoms (Brown & Naragon-Gainey, 2013; Hong & Cheung, 2015; Norton & Mehta, 2007). Furthermore, researchers should investigate how IU relates to, interacts with, and predicts other potential maintaining vulnerabilities such as metacognitive beliefs, perceived control, and behavioural avoidance with longitudinal designs. Such research would increase our understanding of the general and specific importance of IU for cognitive vulnerabilities and corresponding disorder symptoms. The resulting insights will help identify risk factors and advance understanding of the temporal precedence and the relative importance of IU and other constructs (Carleton, 2016a; Mahoney & McEvoy, 2012b; Norton & Paulus, 2016; Treanor, Erisman, Salters-Pedneault, Roemer, & Orsillo, 2011).

2.8. Intolerance of Uncertainty as a Transdiagnostic Process

2.8.1. What is known?

IU was initially developed within the context of worry, a hallmark symptom of generalised anxiety disorder, as outlined in the IU model (Dugas et al., 1998; Freeston et al., 1994). IU was thought to distinguish persons with generalised anxiety disorder from other heterogeneous anxiety disorders (Dugas, Buhr, et al., 2004; Dugas et al., 2001; Dugas, Schwartz, et al., 2004; Ladouceur et al., 1999); however, the assertion of broad specificity for generalised anxiety disorder was challenged by accumulating cross-sectional and meta-analytic evidence highlighting the significance of IU to other symptom constructs and disorders (e.g., Carleton, Mulvogue, et al., 2012; Gentes & Ruscio, 2011; Hong & Cheung, 2015; McEvoy & Mahoney, 2011, 2012; Norton & Mehta, 2007; Starcevic & Berle, 2006). IU has been associated with symptoms of obsessive-compulsive disorder (Holaway et al., 2006; Tolin et al., 2003), social anxiety disorder (Boelen & Reijntjes, 2009; Carleton, Collimore, et al., 2010; Counsell et al., 2017), panic disorder with or without agoraphobia (Carleton et al., 2013; Fetzner, Horswill, Boelen, & Carleton, 2013), health anxiety (Boelen & Carleton, 2012; Fetzner et al., 2013; O'Bryan & McLeish, 2017; Wright et al., 2016), posttraumatic stress symptoms and disorder (Banducci, Bujarski, Bonn-Miller, Patel, & Connolly, 2016; Bardeen,

Fergus, & Wu, 2013; Boelen, Reijntjes, & Smid, 2016; Fetzner et al., 2013; Oglesby, Boffa, Short, Raines, & Schmidt, 2016), and depression (de Jong-Meyer et al., 2009; Gentes & Ruscio, 2011). More recently, evidence suggests IU plays an important role in eating disorders (Konstantellou, Campbell, Eisler, Simic, & Treasure, 2011; Renjan et al., 2016; Sternheim, Startup, et al., 2011), autism spectrum disorders (Boulter, Freeston, South, & Rodgers, 2014; Vasa, Kreiser, Keefer, Singh, & Mostofsky, 2018), prolonged grief (Boelen, 2010; Boelen et al., 2016), hoarding behaviours (Mathes et al., 2017; Oglesby et al., 2013; Wheaton, Abramowitz, Jacoby, Zwerling, & Rodriguez, 2016), adult separation anxiety (Boelen, Reijntjes, & Carleton, 2014), and anger-related emotions (Anderson, Deschênes, & Dugas, 2016; Fracalanza, Koerner, Deschênes, & Dugas, 2014). Not only is IU associated with multiple disorders, but trait and disorder-specific IU are correlated with escalating comorbidity (Dupuy & Ladouceur, 2008; McEvoy & Mahoney, 2012; Yook et al., 2010). Moreover, many clinical features of disorders can be conceptualised as efforts to alleviate or avoid uncertainty (Krohne, 1989). Taken together, the overwhelming evidence supports IU as a transdiagnostic process linked to an array of disorders.

The prospective and inhibitory dimensions of IU have been differentially associated with emotional disorder symptoms (Boelen & Lenferink, 2018; Carleton, Norton, et al., 2007; McEvoy & Mahoney, 2011). McEvoy and Mahoney (2011) found associations between prospective IU and symptoms of generalised anxiety disorder and obsessive-compulsive disorder, while inhibitory IU was associated with symptoms of social anxiety, depression, and panic disorder, agoraphobia in a clinical sample. Their results are consistent with research linking inhibitory IU with social anxiety, depression (Carleton, Collimore, et al., 2010; Mahoney & McEvoy, 2012b), and panic disorder (Boelen et al., 2016), but inconsistent with an association between inhibitory IU and generalised anxiety disorder and obsessive-compulsive disorder (Mahoney & McEvoy, 2012b). Furthermore, inhibitory IU has been associated with posttraumatic stress disorder (Boelen et al., 2016; Fetzner et al., 2013). The results may indicate higher IU produces conflicting cognitive-motivational states. For example, prospective IU may promote approach strategies evident in some disorders, while inhibitory IU may promote avoidance behaviours (e.g., avoidance of situations that may induce panic in panic disorder).The recent conceptualisation of these dimensions means relatively little research is available (e.g., Carleton, Collimore, et al., 2010; Carleton, Norton, et al., 2007; Mahoney & McEvoy, 2012b; McEvoy & Mahoney, 2011), and the available results have not been entirely consistent.

2.8.2. What is unknown?

The original IU model comprehensively outlined the centrality of IU for anxiety symptoms (Dugas et al., 1998), but was designed within the context of generalised anxiety disorder symptoms. Despite the success and longevity of the model, the mechanisms by which IU exerts influence on worry remain less clear (Bredemeier & Berenbaum, 2008). Different cognitive and behavioural constructs may be involved at different stages of worry (Meeten, Dash, Scarlet, & Davey, 2012; Thielsch, Andor, & Ehring, 2015); as such, prospective longitudinal designs appear necessary to understand how IU and other constructs initiate and perpetuate repetitive negative thinking and cyclical interrelationships with disorder symptoms (e.g., Oglesby et al., 2016; Thielsch et al., 2015).

The relative influence of IU across disorders also remains uncertain (Mahoney & McEvoy, 2012b). Anxiety appears inherently dependent upon uncertainty (Carleton, 2016a; Grupe & Nitschke, 2013; Hong & Cheung, 2015); as such, most contemporary research has justifiably focused on anxiety disorders. Despite the current research indicating IU is transdiagnostic and phenomenologically concurrent with anxiety disorders, mood disorders, personality disorders, and normative processes, there is a relative paucity of research exploring the causal, precipitating, maintaining, mediating, and moderating aspects of the relationships. Future research should clarify the relative significance of IU dimensions across disorders.

Accordingly, researchers should explore IU as contextualised within extant cognitive-behavioural models for all such disorders, normative processes, and transdiagnostic models (Carleton, 2012; Einstein, 2014; Mahoney & McEvoy, 2012b). The exploration should explicitly incorporate IU into existing theoretical and treatment models, while also facilitating novel theoretical frameworks and broader integrations with psychology (e.g., Brosschot et al., 2016; Carleton, 2016a). Doing so would inform case formulation, treatment planning, and novel interventions targeting diagnosis-specific and transdiagnostic processes.

2.9. Intolerance of Uncertainty and Clinical Applications

2.9.1. What is known?

Theoretical progression in psychopathology research has been complemented by laudable developments in the treatments of emotional disorders. In line with this, maladaptive thoughts and behavioural processes have been considered valuable targets for intervention (Barlow, 2000). There has also been a shift in perspective from diagnosis-specific conceptualisations and treatment approaches to transdiagnostic models highlighting the

substantial similarities (Barlow et al., 2004; Barlow et al., 2014; Norton & Paulus, 2016). Relatedly, robust relationships between IU and psychopathology implicate IU as a potentially critical transdiagnostic treatment target.

Dugas and colleagues (Dugas et al., 2010; Dugas & Ladouceur, 2000; Dugas et al., 2003; Dugas & Robichaud, 2007) have developed a cognitive-behavioural intervention for generalised anxiety disorder, targeting IU reductions by fostering less negative beliefs about uncertainty. The intervention has been supported by several randomised clinical trials with moderate to large effects (Dugas et al., 2010; Dugas et al., 2003; Gosselin, Ladouceur, Morin, Dugas, & Baillargeon, 2006; Ladouceur, Dugas, et al., 2000; see Robichaud, 2013).

Research has also examined other cognitive-behavioural interventions that do not specifically target IU, but nonetheless have shown a reduction in IU and symptoms of social anxiety (Hewitt, Egan, & Rees, 2009; Mahoney & McEvoy, 2012a), health anxiety (Langlois & Ladouceur, 2004), anxiety and depressive disorders (Bomyea et al., 2015), delivered as individual and group transdiagnostic interventions (Boswell et al., 2013; Talkovsky & Norton, 2016). A randomised control trial for generalised anxiety disorder compared the effectiveness of an IU-therapy, metacognitive therapy, and a delayed treatment control condition (van der Heiden et al., 2012). Results indicated significant symptom reductions and clinically significant change in both therapy conditions; however, metacognitive therapy was superior across the range of outcome measures. Interestingly, metacognitive therapy was also associated with the largest reductions of IU, suggesting interventions from alternative theoretical frameworks may influence IU (McEvoy & Erceg-Hurn, 2016; van der Heiden et al., 2012).

Increasing evidence suggests that changes in IU may be driving changes in symptoms of multiple emotional disorders (i.e., transdiagnostic) and across different treatment protocols (i.e., transtherapy; e.g., McEvoy & Erceg-Hurn, 2016; Roemer & Orsillo, 2007; Treanor et al., 2011). Changes in IU have been uniquely linked to changes in repetitive negative thinking across multiple disorders and treatment programs even after controlling for trait negative affectivity (McEvoy & Erceg-Hurn, 2016). Those changes in IU were also associated with changes in generalised anxiety disorder and social anxiety disorder symptoms, but not depression symptoms. Taken together, the results suggest that IU is a transdiagnostic change factor associated with changes in repetitive negative thinking and symptoms across different disorders and treatment interventions (Boswell et al., 2013; McEvoy & Erceg-Hurn, 2016; Stevens, Rogers, Campbell, Björgvinsson, & Kertz, 2018; Talkovsky & Norton, 2016, 2018).

Abramowitz and Arch (2014) made a compelling argument that exposure-driven cognitive-behavioural treatment for obsessive-compulsive disorder may benefit from strengthening inhibitory learning of nonthreatening associations (e.g., uncertainty is intolerable), such that uncertainty becomes increasingly acceptable as normal across contexts. Abramowitz and Arch (2014) suggest treatment should emphasise tolerating uncertainty through exposure, which may strengthen inhibitory associations. Others have argued that "in many ways, all therapies can be described as attempts to mitigate IU" (Carleton, 2012; p. 942); accordingly, future researchers should examine whether principles of IU exposure can be applied transdiagnostically and across treatment protocols to support broad symptom improvements.

2.9.2. What is unknown?

There are many unknowns associated with IU treatment and emotional disorders. Extant cognitive-behavioural therapies can be readily modified to target fears related to IU and avoidance behaviours; however, research is needed to establish the efficacy of such treatments (Mahoney & McEvoy, 2012c). Currently IU is an implicit component within treatment protocols derived from alternative theoretical frameworks; nevertheless, research suggests that IU could also be more explicitly assessed and targeted. Evidence suggests cognitive-behavioural treatments decrease IU (Mahoney & McEvoy, 2012c), though some researchers have found evidence that directly targeting IU may be no more effective than indirectly targeting IU (van der Heiden et al., 2012). Accordingly, there is a need for more research evaluating and comparing interventions designed to directly target IU with interventions that are non-specific to IU. For a more complete understanding of change processes, Treanor et al. (2011) recommended treatment mechanism research grounded in specific theoretical models. More recently, Einstein (2014) proposed a transdiagnostic IU treatment model with several potential pathways for explicitly targeting different IU dimensions, all of which remains to be explored.

In the interim, the processes by which IU changes in therapy remain relatively unknown. Bomyea et al. (2015) found that over the course of treatment changes in IU significantly mediated changes in worry, which is an important step (Kazdin, 2007), but research is needed to understand the mechanisms of such change across different treatment interventions. Currently there are many different therapies and a thorough understanding of the most critical change mechanisms may contribute to a more parsimonious and efficient therapeutic approach. Specific (e.g., exposure) and non-specific therapeutic factors (e.g.,

therapist features, motivation to engage in treatment) need to be measured when evaluating treatment interventions so we can better understand the relative contributions to changes in IU.

The potential clinical utility of targeting disorder-specific IU should also be investigated. Disorder-specific IU predicts symptoms of a range of disorders (e.g., Thibodeau et al., 2015), suggesting treatment protocols may benefit from tailored modification of disorder-specific IU. For example, tolerating uncertainty about others' evaluations might improve social anxiety symptoms and relapse rates beyond reducing the perceived probability and cost of such evaluations. Thus there are questions remaining about whether clinicians should target trait IU, disorder-specific IU, or a combination of various proportions that may vary by disorder (Thibodeau et al., 2015).

Experimental and clinical research using behavioural methods to corroborate IU before, during, and after treatment would also be beneficial to assess clinical impacts more broadly (Boswell et al., 2013; McEvoy & Erceg-Hurn, 2016). Much of the available treatment literature has been carried out by the same research team and replications are needed. Moreover, there still remains a predominant focus on generalised anxiety disorder and future studies should investigate the impact of these interventions across a broader range of disorders.

2.10. Continuing the Search for Certainties

IU is increasingly considered to be important to the development, perpetuation, and treatment of psychopathology. Basic IU research offers novel and exciting perspectives for understanding psychopathology. The current paper provides a broad IU research agenda with several methodological suggestions for exploring trait, disorder-specific, and transdiagnostic conceptualisations. The review also highlights the need to research normative responses, developmental origins, behaviours, decision-making, and cognitive vulnerabilities related to IU, while understanding relationships with threat and risk. In all cases, explicit integration of IU into theoretical and therapeutic models appears warranted. The increasing focus of research into uncertainty and IU has generated numerous avenues for exploring unknown territory in psychology; as such, future researchers should not fear the unknowns, but rather face them head on as we strive to address the uncertainties that remain.

Note: The following chapter has been published in Psychological Assessment

Shihata, 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 two-factor model? *Psychological Assessment, 30*, 893-903. doi:10.1037/pas0000540.

Minor edits have been made to the present chapter (e.g., Australian spelling) to ensure consistency with the present thesis. Supplementary Material have been presented as part of the results of this chapter. The prepublication article is presented in Appendix B.

Chapter 3 (Study 2): A Bifactor Model of Intolerance of Uncertainty in Undergraduate and Clinical Samples: Do We Need to Reconsider the Two-Factor Model?

3.1. Introduction

IU is a dispositional trait that reflects a fear of the unknown and an "incapacity to endure the aversive response triggered by the perceived absence of salient, key, or sufficient information, and sustained by the associated perception of uncertainty" (Carleton, 2016b, p. 31). IU is posited to be central to psychopathology as difficulty tolerating uncertainty may contribute to maladaptive cognitions (e.g., worry) and behaviours (e.g., avoidance) evident in emotional disorders (Boswell et al., 2013; Carleton, 2016b). These maladaptive cognitive and behavioural processes may reflect attempts to alleviate uncertainty and increase control and, as such, engagement in such strategies perpetuates IU and associated emotional distress and anxiety (Boswell et al., 2013).

A substantial body of research suggests that IU is a robust transdiagnostic risk factor associated with multiple types of psychopathology (e.g., anxiety, mood, and eating disorders; Carleton, 2012; Hong & Cheung, 2015; Mahoney & McEvoy, 2012c; Renjan et al., 2016; Shihata, McEvoy, Mullan, & Carleton, 2016). As such, IU has been conceptualised as a generalised underlying mechanism for anxious pathology and a core feature in anxiety-related experience (Boswell et al., 2013; Carleton, 2016b; Harvey et al., 2004). IU has been implicated as a potentially critical transdiagnostic treatment target. Treatment protocols that directly and indirectly target IU have been supported as efficacious, resulting in symptom reduction and clinically significant change (Dugas & Robichaud, 2007; McEvoy & Erceg-Hurn, 2016; van der Heiden et al., 2012). Moreover, changes in IU may contribute to changes in disorder symptoms across different clinical interventions, suggesting that IU is transdiagnostic and transtherapeutic in nature (McEvoy & Erceg-Hurn, 2016; Treanor et al., 2011).

The role IU is theorised to play in the development, maintenance, and treatment of multiple emotional disorders highlights the importance of valid measures of IU. Over the last two decades there has been an increasing interest in IU, which has been accompanied by the development of a number of self-report measures designed to assess IU. Psychometric research on the first measure of IU, the 27-item IU Scale (IUS), provided initial evidence of construct validity, and internal and test-retest reliability of the total score (Freeston et al., 1994). However, inconsistencies with the factor structure and length of the IUS, as well as

suggestions of potential redundancy amongst items (Carleton, Norton, et al., 2007; McEvoy & Mahoney, 2011; Norton, 2005), led to the development of the revised 12-item IUS, Short Form (IUS-12; Carleton, Norton, et al., 2007). The IUS-12 demonstrated strong psychometric properties and a high correlation with the original IUS (r = .96). Measurement research suggests that the IUS-12 consists of two highly correlated and replicable factors that yield two subscales: a 7-item prospective IU subscale assessing desire for predictability and cognitive appraisals about future uncertainty, and a 5-item inhibitory IU subscale assessing behavioural inhibition or avoidance when faced with uncertainty. The IUS-12 total and subscale scores have showed good construct validity, internal reliability (Cronbach's α of .91 for the total scale and .85 for both subscale scores), and test-retest reliability over a two-week interval (r = .77; Carleton, Norton, et al., 2007; Khawaja & Yu, 2010).

Prior research investigating IU has computed either the IUS-12 total score, the prospective IU and inhibitory IU subscale scores, or both the total and subscale scores (Carleton et al., 2013; Carleton, Mulvogue, et al., 2012; Mahoney & McEvoy, 2012c). Differential associations have been found between prospective and inhibitory IU and symptoms of emotional disorders, such that prospective IU appears to be more strongly related to generalised anxiety disorder and obsessive-compulsive disorder, whereas inhibitory IU appears to be more strongly related to symptoms of social anxiety, panic disorder, depression, and posttraumatic stress disorder (Boelen et al., 2016; Mahoney & McEvoy, 2012b; McEvoy & Mahoney, 2011). Given the relatively recent conceptualisation of these subscales there is limited research and the results are not entirely consistent. Moreover, recent research has begun to question the separability of these subscales (Hale et al., 2016; Lauriola et al., 2016).

The different approaches to using the IUS-12 (i.e., computing subscale versus total scores) are based on the underlying assumptions that the prospective and inhibitory IU subscales reflect theoretically distinct constructs beyond the total scale, and/or that each subscale reflects the same general IU construct (Reise, Bonifay, & Haviland, 2013). Reise et al. (2010) assert that a correlated-traits model and differential relations between subscales and external variables do not provide sufficient evidence for estimating subscale scores. Rodriguez, Reise, and Haviland (2016, p. 234) assert that "differential correlates are the expectation" as any subscales that are not perfectly correlated will have differential predictive utility because each subscale is a combination of the underlying general factor and a separate group factor (Reise et al., 2010). Moreover, the multidimensionality present in the data may impact the interpretability of the total score, and the apparent reliability of the subscales or

narrow dimensional traits may be a reflection of a more general trait IU (Reise et al., 2010). Without empirical justification, interpreting subscale scores as reflecting a meaningful latent construct distinct from a general IU factor may be misguided (Rodriguez et al., 2016). In line with this, Hale et al. (2016) asserted that the computation and interpretation of the prospective IU and inhibitory IU subscale scores in past research was not psychometrically justified. Bifactor modelling is one option for assessing the assumptions that the multidimensional IUS-12 subscales capture unique variance after accounting for the total scale, or alternatively that they reflect a single underlying construct (Reise et al., 2010). Bifactor models, which retain a general factor but also recognise the multidimensionality caused by group factors, are becoming increasingly applied to psychological and clinical constructs (see Reise et al., 2010, for a comprehensive review). Adopting a bifactor approach can inform researchers and clinicians on the psychometric structure of a measure, including the properties of total and subscale scores (and whether total and/or subscale scores should be computed), as well as how a measure should be modelled in structural equation modelling (SEM; Reise, Bonifay, et al., 2013; Reise et al., 2010).

Only two studies to date have tested a bifactor model using the IUS-12. Hale et al. (2016) compared unidimensional, two-factor correlated traits, and bifactor models in an undergraduate sample. Results revealed that the bifactor model yielded the best fit to the data, indicating the presence of a strong general IU factor with substantially higher reliability and that explained a greater proportion of shared variance (80%) than the prospective and inhibitory IU group factors. Similarly, Lauriola et al. (2016) compared unidimensional, two-factor, second-order hierarchical, and bifactor models of the IUS-12 (Italian translation) using an undergraduate sample. Consistent with Hale et al.'s (2016) findings, Lauriola et al. (2016) found the bifactor model exhibited superior fit, and the general IU factor was more reliable and explained a greater amount of common variance (75%) than either group factor. Therefore, despite past studies reporting results using both IUS-12 total and subscale scores (Mahoney & McEvoy, 2012b; McEvoy & Mahoney, 2011), both Hale et al. (2016) and Lauriola et al. (2016) recommended computing only IUS-12 total scores and suggested the IUS-12 has a predominantly unidimensional structure.

While this research appears to support bifactor models of the IUS-12, it is limited to only one study using the English version in an undergraduate sample and none in a clinical population. It is plausible that prospective IU and inhibitory IU are more differentiated at clinical than non-clinical levels of psychopathology. For instance, at clinical levels of anxiety there is evidence that neural structures such as the amygdala are more strongly activated and

therefore play a greater role in identifying and focusing attention on perceived threats in states of uncertainty (general IU), and the insula plays a greater role in prospective IU by guiding predictions about subjective feelings of future events (Wever et al., 2015). In contrast, hyperactivation of the amygdala, in conjunction with *hypo*activation of neural structures that inhibit the freeze response (e.g., ventromedial prefrontal cortex), may contribute to inhibitory IU (Grupe & Nitschke, 2013). Further research investigating bifactor models are therefore required to determine if the initial findings of a predominant common factor in undergraduates is replicated in clinical samples, or rather whether the group factors are more separable and provide unique predictive utility in a clinical sample.

Improving understanding of the structure of the IUS-12 is also important due to its recent inclusion as a key behavioural assessment method of potential threat (Negative Valence System) in the National Institute of Mental Health (NIMH; 2016) Research Domain Criteria initiative. The aim of the Research Domain Criteria initiative is to identify transdiagnostic, dimensional constructs reflecting the core mechanisms of psychopathology across units of analysis (e.g., neural circuitry, physiology, genes, self-report) as an alternative to categorical nomenclature (Berenbaum, 2013; Shankman & Gorka, 2015). Moreover, the transdiagnostic and transtherapeutic relevance of IU to psychopathology underscores the importance of valid measures and research that informs the scoring and interpretation of the IUS-12.

The aim of the present study was to use bifactor modelling to elucidate the extent to which the IUS-12 yields a total score in undergraduate and clinical samples, and thus whether scoring the prospective IU and inhibitory IU subscales is psychometrically justified, and to inform how the IUS-12 should be used in structural models that examine IU (Reise, Bonifay, et al., 2013; Rodriguez et al., 2016). The first hypothesis was that a bifactor model would provide the best fit relative to the unidimensional and two-factor correlated models in an undergraduate sample, and that most variance in the IUS-12 would be explained by the general IU factor, thereby replicating Hale et al. (2016) and Lauriola et al.'s (2016) findings. We extended this previous research to a clinical sample with anxiety and depressive disorders. It was possible that the findings from the undergraduate sample would be replicated. However, it was also plausible that the prospective IU and inhibitory IU group factors would be more separable from the general factor at clinical levels of anxiety, and that these group factors would explain a substantial proportion of reliable variance in the IUS-12. The second hypothesis was that the general IU factor would be a strong predictor of symptoms of multiple emotional disorders in both the undergraduate and clinical samples. If the group factors are

found to be separable in the clinical sample, it would be expected that they will explain unique variance in symptoms beyond the general factor.

3.2. Method

3.2.1. Participants and Procedure

3.2.1.1. Undergraduate sample. Participants (N = 506) were undergraduate psychology students aged between 18 and 55 (M = 21.00; SD = 4.91; 80% female). Participants were recruited via the university's research participant pool through an online experiment database and completed the questionnaire battery online at their convenience. Participants read an information statement and were then directed to an online survey hosted by Qualtrics, where they completed demographic information and the IUS-12 along with a battery of standardised self-report measures used as part of a larger study (Shihata, McEvoy, & Mullan, 2017). Informed consent was obtained from all participants. The IUS-12 was presented first followed by the Disorder-Specific IU Scale (Thibodeau et al., 2015; data not reported here) with the remaining questionnaires randomised. Participants were debriefed and received course credit for their participation. Institutional ethics approval was obtained prior to the commencement of this study (HR34/2015-2; see Appendix F).

3.2.1.2. Clinical sample. Participants (N = 524) were referred by health professionals to a specialist service for the treatment of anxiety and/or depressive disorders. Prior to the initial assessment session participants were posted a standard questionnaire battery that was completed and brought to the initial assessment. At the initial assessment participants were diagnosed via a structured diagnostic interview (Mini International Diagnostic Interview; Sheehan et al., 1998) administered by a masters- or doctorate-level Clinical Psychologist. Inclusion criteria for this study was a principal Diagnostic and Statistical Manual for Mental Disorders (DSM-IV; American Psychiatric Association, 1994) anxiety or depressive disorder (major depressive disorder or dysthymia). Participants were aged between 18 and 69 (M = 33.67; SD = 12.24; 66% female). The proportion of participants meeting criteria for principal anxiety and depressive disorders were as follows; social phobia (also referred to as social anxiety disorder; n =144), generalised anxiety disorder (n = 101), panic disorder with or without agoraphobia (n = 21), specific phobia (n = 7), major depressive disorder (current and in partial remission; n = 222), dysthymic disorder (n =19), anxiety disorder not otherwise specified (n = 8), and depressive disorder not otherwise specified (n = 2). A total of 27% of the sample met criteria for having one diagnosis, 43% had two diagnoses, and 30% had three or more diagnoses. Data on education and marital status were available for 483 participants,

with 51% employed, 32% with a university education qualification, 13% with a technical or trade certificate, and 55% who completed high school or less. Half of the sample were single (55%), with the remaining 34% either married or with a live in partner, and 10% either widowed, separated, or divorced.

3.2.2. Measures

3.2.2.1. Undergraduate sample.

3.2.2.1.1. ***Intolerance of Uncertainty Scale, Short Form (IUS-12; Carleton, Norton, et al., 2007).*** The IUS-12 was developed to measure negative beliefs about and reactions to uncertainty. Participants responded to each item on a five-point scale from *not at all characteristic of me* (1) to *entirely characteristic of me* (5). The IUS-12 total and subscale scores have demonstrated strong psychometric properties including good internal and test-retest reliability and construct validity in diverse populations (Carleton, Norton, et al., 2007; Khawaja & Yu, 2010; McEvoy & Mahoney, 2011).

3.2.2.1.2. Generalised Anxiety Disorder-7 (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006). The GAD-7 was designed to assess the severity of symptoms of generalised anxiety disorder. Participants indicated how often, in the last two weeks, they felt bothered by a range of symptoms along a four-point scale ranging from *not at all* (0) to *nearly every day* (3). Psychometric support indicates evidence of good reliability, construct, discriminant, and factorial validity (Carleton, Mulvogue, et al., 2012; Löwe et al., 2008).

3.2.2.1.3. Social Interaction Phobia Scale (SIPS; Carleton et al., 2009). The 14-item SIPS measures symptoms of social phobia including cognitive, emotional, and behavioural reactions to social interactions (Carleton et al., 2009). Participants responded to each item by indicating the extent to which they were bothered by symptoms along a five-point scale ranging from *not at all characteristic of me* (0) to *extremely characteristic of me* (4). Previous research has supported a three-factor model wherein each subscale assesses a different dimension of social anxiety (social interaction anxiety, fear of overt evaluation, and fear of attracting attention). The SIPS total and subscale scores have demonstrated excellent reliability in both clinical and non-clinical samples and strong factorial, convergent, and discriminant validity (Carleton et al., 2009; Menatti et al., 2015).

3.2.2.1.4. ***Panic Disorder Severity Scale-Self-Report (PDSS-SR; Houck, Spiegel, Shear, & Rucci, 2002).*** The 5-item PDSS-SR assesses the severity of panic disorder symptoms. Participants responded to each item by indicating the frequency, distress, and avoidance behaviours associated with panic attacks along a five-point scale ranging from

none (0) to *extreme* (4). Psychometric evidence indicates acceptable validity and internal reliability (Houck et al., 2002; Wuyek, Antony, & McCabe, 2011).

3.2.2.2. Clinical sample.

3.2.2.2.1. IUS-12 (Carleton, Norton, et al., 2007). As described above.

3.2.2.2.2. Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988). The widely used 21-item BAI was designed to assess subjective, neurophysiologic, autonomic, and panic-related symptoms of anxiety. Participants indicated the extent to which they felt bothered by a range of symptoms during the past week along a four-point scale ranging from *not at all* (0) to *severely – I could barely stand it* (3). Psychometric support indicates evidence of good reliability and validity (Beck et al., 1988).

3.2.2.2.3. Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996). The 21-item BDI-II is a widely used instrument designed to measure the severity of depressive symptoms during the previous two weeks. Participants responded to each item and statement group along a four-point scale from *symptom not present* (0) to *very intense* (3). Although prior studies have reported equivocal factor structures, recent psychometric research suggests computing a total score (Brouwer, Meijer, & Zevalkink, 2013). Psychometric evidence indicates the BDI-II has good construct validity and high internal and test-retest reliability (Beck et al., 1996; Storch, Roberti, & Roth, 2004).

3.2.2.2.4. Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990). The 16-item PSWQ is a widely used measure of pathological worry. Participants responded to each item statement on a five-point scale ranging from *not at all typical of me* (1) to *very typical of me* (5). The PSWQ has demonstrated high internal and test-retest reliability and good construct validity in clinical and non-clinical populations (Brown, Antony, & Barlow, 1992; Meyer et al., 1990).

3.2.2.2.5. Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998). The 20-item SIAS was designed to assess anxiety symptoms including cognitive, behavioural, and affective reactions associated with social interactions. Participants responded to items on a five-point scale ranging from *not at all characteristic or true of me* (0) to *extremely characteristic or true of me* (4). The SIAS total score has demonstrated evidence of good reliability as well as convergent and discriminant validity (Mattick & Clarke, 1998).

3.2.3. Data Analysis

Preliminary data screening of distributions, skewness, and kurtosis were performed in SPSS 22.0.

3.2.3.1. Measurement models and evaluation. Confirmatory factor analysis (CFA) using mean-and variance-adjusted weighted least squares (WLSMV) estimation was conducted in Mplus 7.4 (Muthén & Muthén, 1998-2015) to assess the relative fit of the competing IUS-12 measurement models. The use of WLSMV estimation is appropriate as the item responses of the IUS-12 are ordered-categorical data (Brown, 2006). This approach is consistent with the WLSMV estimation procedure used in previous bifactor studies on the IUS-12 (Hale et al., 2016) and other anxiety-related measures (Ebesutani, McLeish, Luberto, Young, & Maack; Fergus & Bardeen, 2017). The IUS-12 bifactor model was tested against a unidimensional and two-factor correlated model mirroring extant studies (Hale et al., 2016; Lauriola et al., 2016), and to evaluate whether each of these models would demonstrate comparable fits in our samples. The unidimensional model consisted of each of the IUS-12 items loading onto a single latent factor. The two-factor correlated model consisted of seven items with loadings on a prospective IU group factor and five items with loadings on an inhibitory IU group factor, as reported by Carleton, Norton, et al. (2007). The bifactor model consisted of all 12 items loading on a general IU factor as well as on their specific group factor. Consistent with Hale et al. (2016), the covariances of all of the factors were fixed to zero.

A number of fit indices were examined to evaluate the fit of competing models including the chi-square goodness of fit statistic (χ^2), where a non-significant value suggests an acceptable fit. However, the chi-square statistic is influenced by sample size and in large samples often rejects the model (Tabachnick & Fidell, 2013). Additional fit indices included the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA) with 90% confidence intervals (CIs). For the CFI and TLI, values greater than .90 and .95 indicate an acceptable and excellent fit, respectively (Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). For the RMSEA values close to .08 and .06 indicate an acceptable fit (lower values correspond with closer fit) and the upper CI limit should not exceed .10 (Hu & Bentler, 1999; Kline, 2016; Marsh et al., 2004). Model comparisons were evaluated using chi-square difference tests (using the DIFFTEST function in Mplus; Muthén & Muthén, 1998-2015).

3.2.3.2. Bifactor model and evaluation. Consistent with a bifactor model-based approach, a number of other statistical indices were calculated to better inform the psychometric properties of the total and subscale scores and use of the IUS-12 as a latent variable in SEM (see Rodriguez et al., 2016, for review). Coefficient omega (ω) and omega

subscale (ω_S) is a model-based estimate of internal reliability that can be applied to both the general factor and group factors, respectively. The coefficient omega represents the proportion of variance in raw scores for the total scale and each subscale that is explained by all sources of common variance (i.e., both the general factor and each group factor). Omega hierarchical (omegaH or ω_H) represents the proportion of variance in IUS-12 total scores that is explained by the general factor. Omega hierarchical subscale (omegaHS or ω_{HS}) represents the reliability of a subscale score (or the unique variance of each group factor) after controlling for the variance accounted for by the general factor (Reise, Bonifay, et al., 2013). Construct replicability (*H*) represents the quality of an item set or indicators and the reproducibility of a latent variable, and thus, its use in an SEM measurement model (Rodriguez et al., 2016). A high *H* value (greater than .70; Hancock & Mueller, 2001) suggests a well-defined latent variable, which is likely to be stable and replicable, whereas a low *H* value indicates a poorly defined variable, which is likely to change across studies.

Explained common variance (ECV) and percent uncontaminated correlations (PUC) are indices that inform whether a bifactor structure with a strong general factor should be modelled as a unidimensional or multidimensional (bifactor) measurement model in SEM. ECV reflects the proportion of all common variance explained by the general factor relative to the group factors (Rodriguez et al., 2016). A high ECV value (greater than .70 or .80; Rodriguez et al., 2016) lends support for a strong general factor as well as the unidimensionality of a scale's items. In addition, item-explained common variance (I-ECV) represents the proportion of common variance for each IUS-12 item accounted for by the general factor. For the I-ECV, values greater than .80 typically suggest that the IUS-12 items primarily reflect the general factor relative to the group factor and represent a unidimensional item set (Stucky & Edelen, 2015). The ECV is useful to interpret alongside the PUC, which reflects the percent of IUS-12 item covariances influenced by the variance explained by the general factor and group factors (Rodriguez et al., 2016). Thus, the higher the PUC, the more the correlation matrix reflects the general factor (Rodriguez et al., 2016). Parameter bias less than 10% to 15% is considered acceptable, and as such, does not present a serious concern (Muthén, Kaplan, & Hollis, 1987). Moreover, (Reise, Scheines, Widaman, & Haviland, 2013, p. 22) state that when omegaH values for the general factor are greater than .70, ECV values are greater than .60, and PUC values are lower than .80, then the multidimensionality in the data is "not severe enough" to impact modelling and interpretation of the IUS-12 as a largely unidimensional measure.

3.2.3.3. Structural model. SEM consists of testing a measurement model as well as a structural model (Bryne, 2012). CFA was also used to assess the measurement models of each other measure to be used in the structural model. Previous research suggests that prior to testing a structural equation model, each latent variable and its indicators be fit to a measurement model and evaluated using CFA (Kline, 2016; Schreiber, Nora, Stage, Barlow, & King, 2006). Examining the structure of a measurement model for each individual measure provides support for the conceptual reliability of each latent variable included in the structural equation model (Schreiber et al., 2006). Evaluating the fit of a measurement model specifies the relations of the observed indicators to their posited underlying latent constructs, and, therefore, the independent estimation and re-specification of the measurement model prior to the structural model is often recommended (Anderson & Gerbing, 1988). As such, the structure of each measure in both the undergraduate and clinical samples were evaluated using CFA with WLSMV estimation in Mplus 7.4 (Muthén & Muthén, 1998-2015). To evaluate the fit of each measurement model, several fit indices were examined as well as standardised factor loadings and modification indices (MIs).

A structural model was used to assess the incremental validity of the group factor's beyond the general IU factor to symptoms of multiple emotional disorders in the undergraduate (GAD-7, PDSS-SR, SIPS) and clinical sample (BAI, BDI-II, PSWQ, SIAS). Standardised beta estimates were used to examine the strength of the pathways in both samples.

3.3. Results

3.3.1. Preliminary Analyses

Scale total scores for the student and clinical samples were normally distributed as evidenced by acceptable skewness (< 2) and kurtosis (<7) levels (Tabachnick & Fidell, 2013). Using Mahalanobis Distance, no influential multivariate outliers were identified. Multicollinearity was not a problem. Descriptive statistics, internal reliabilities (Cronbach's α), and bivariate correlations for the undergraduate and clinical samples are reported in Table 1.1.

Table 1.1. *Descriptive Statistics, Cronbach's Alpha, and Bivariate Correlations in the Undergraduate and Clinical Samples*

	Mean	*SD*	1	2	3	4	5	6	7	8	9
Undergraduate sample (*N* = 506)											
1. IUS-12	33.25	9.80	.92								
2. GAD-7	7.06	5.38	.62*	.92							
3. SIPS	17.21	13.85	.62*	.62*	.96						
4. PDSS-SR	2.36	2.99	.44*	.63*	.48*	.85					
Clinical sample (*N* = 524)											
5. IUS-12	37.83	10.79					.93				
6. BAI	19.34	19.34					.45*	.93			
7. BDI-II	26.05	26.05					.41*	.58*	.91		
8. PSWQ	61.88	61.88					.56*	.43*	.36*	.91	
9. SIAS	45.42	45.42					.35*	.32*	.32*	.29*	.94

Note. Cronbach's alphas are on the diagonal. *SD* = standard deviation; IUS-12 = Intolerance of Uncertainty Scale-Short Form; GAD-7 = Generalised Anxiety Disorder-7; SIPS = Social Interaction Phobia Scale; PDSS-SR = Panic Disorder Severity Scale, Self-Report; BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory; PSWQ = Penn State Worry Questionnaire; SIAS = Social Interaction Anxiety Scale.

* $p < .001$.

3.3.2. IUS-12 Measurement Models

The goodness-of-fit statistics for the measurement models tested in the undergraduate sample and clinical sample are displayed in Table 1.2. In the student and clinical samples, the unidimensional model and the two-factor correlated model provided a marginal fit. The CFI and TLI values met specified guidelines; however, the RMSEA was elevated. A unidimensional model is nested in a two-factor correlated model (Reise et al., 2010), and, as such, the two-factor correlated model was found to fit the data significantly better than the unidimensional model as indicated by a significant chi-square difference. With the exception of a significant chi-square value, the bifactor model, which consisted of a prospective IU and inhibitory IU group factor, displayed a good fit to the data in the undergraduate sample. Although the RMSEA was slightly high, the upper limit of the RMSEA did not exceed .10. A significant chi-square difference indicated that the bifactor model fit the data significantly better than the correlated two-factor model. Although the bifactor model was characterised by a prospective IU and inhibitory IU group factor, it is important to note that the prospective IU group factor was marked by a single strong loading item (.94) with the other items on this group factor demonstrating relatively low loadings (-.03 to .18).

In the clinical sample, the bifactor model did not produce an admissible solution and it included negative residual variances, and is therefore not presented here. The model indicated that there was a problem involving the prospective IU group factor. The specific problems were explored and minor modifications were made including fixing residual variances to zero for various combinations of problematic items with negative standardised loadings and removing specific indicators based on non-significant loadings. All of these modifications continued to produce inadmissible solutions. Thus, the bifactor model was modified by removing the prospective IU group factor, which yielded an admissible bifactor model consisting of a general factor and the inhibitory IU group factor that provided a good model fit. The bifactor model fit the data significantly better than the competing two-factor correlated model as indicated by a significant chi-square difference. The standardised factor loadings for the one-factor, two-factor correlated, and bifactor models are presented in Tables 1.3 (undergraduate sample) and 1.4 (clinical sample).

Table 1.2 *Goodness-of-Fit Statistics for the Measurement Models*

Model	χ^2 (*df*)	$\Delta\chi^2$ (*df*)	CFI	TLI	RMSEA	RMSEA 90% CI LL	RMSEA 90% CI UL
Undergraduate sample							
Bifactor	207.72 (42)		.981	.970	.088	.077	.100
Correlated two-factor	349.30 (53)	132.33 (11)[b*]	.966	.958	.105	.095	.116
One-factor	443.25 (54)	61.28 (1)[a*]	.955	.946	.119	.109	.130
Clinical sample							
Bifactor	246.08 (49)		.980	.973	.088	.077	.099
Correlated two-factor	490.96 (53)	155.41 (4)[b]*	.955	.944	.126	.116	.136
One-factor	729.64 (54)	100.34 (1)[a]	.931	.916	.155	.145	.165

Note. CFI = comparative fit index; TLI = Tucker-Lewis fit index; RMSEA = root mean square error of approximation; CI = confidence interval; LL = lower limit, UL = upper limit. Models computed using mean-and variance-adjusted weighted least squares (WLSMV) estimation. $\Delta\chi^2$ computed using Mplus 7.4 DIFFTEST function.

[a] $\Delta\chi^2$ comparing unidimensional and correlated two-factor models in both samples. [b] $\Delta\chi^2$ comparing bifactor and correlated two-factor models in both samples.
* $p < .001$.

Table 1.3. *Standardised Factor Loadings for the Measurement Models of the Intolerance of Uncertainty Scale in an Undergraduate Sample*

		One-factor	Two-factor correlated		Bifactor model		
Item			Prospective	Inhibitory	General	Prospective	Inhibitory
1	Unforeseen events upset me greatly	.73	.75		.72	.17	
2	It frustrates me not having all the information I need	.62	.64		.57	.94	
4	One should always look ahead so as to avoid surprises	.69	.71		.70	.07	
5	A small unforeseen event can spoil everything, even with the best of planning	.78	.81		.82	-.03	
8	I always want to know what the future has in store for me	.68	.70		.69	.10	
9	I can't stand being taken by surprise	.78	.80		.81	-.04	
11	I should be able to organize everything in advance	.70	.71		.69	.18	
3	Uncertainty keeps me from living a full life	.79		.82	.79		.15
6	When it's time to act, uncertainty paralyses me	.82		.83	.72		.55
7	When I am uncertain I can't function very well	.82		.84	.74		.44
10	The smallest doubt can stop me from acting	.78		.79	.72		.34
12	I must get away from all uncertain situations	.83		.85	.82		.16
	Coefficient omega				ω = .95	ω_S = .92	ω_S = .92
					ω_H = .90	ω_{HS} = .07	ω_{HS} = .15
	H				.94	.88	.46
	ECV				.80		
	PUC				.53		

Note. N = 506. ω = omega; ω_S = omegaS; ω_H = omegaH; ω_{HS} = omegaHS; H = construct replicability; ECV = explained common variance; PUC = percent uncontaminated correlations. In the two-factor correlated model, the correlation between the factors was .91.

Table 1.4. *Standardised Factor Loadings for the Measurement Models of the Intolerance of Uncertainty Scale in a Clinical Sample*

		One-factor	Two-factor correlated		Bifactor model	
Item			Prospective	Inhibitory	General	Inhibitory
1	Unforeseen events upset me greatly	.75	.78		.78	
2	It frustrates me not having all the information I need	.71	.73		.73	
4	One should always look ahead so as to avoid surprises	.74	.76		.76	
5	A small unforeseen event can spoil everything, even with the best of planning	.75	.77		.77	
8	I always want to know what the future has in store for me	.74	.76		.76	
9	I can't stand being taken by surprise	.78	.81		.80	
11	I should be able to organize everything in advance	.70	.72		.72	
3	Uncertainty keeps me from living a full life	.75		.78	.72	.25
6	When it's time to act, uncertainty paralyses me	.83		.84	.61	.72
7	When I am uncertain I can't function very well	.87		.89	.70	.56
10	The smallest doubt can stop me from acting	.76		.79	.69	.38
12	I must get away from all uncertain situations	.79		.83	.78	.18
	Coefficient omega				ω = .95	ω_S = .92
					ω_H = .90	ω_{HS} = .24
	H				.94	.64
	ECV				.86	
	PUC				.85	

Note. N = 524. ω = omega; ω_S = omegaS; ω_H = omegaH; ω_{HS} = omegaHS; H = construct replicability; ECV = explained common variance; PUC = percent uncontaminated correlations. In the two-factor correlated model, the correlation between the factors was .85.

3.3.3. Evaluation of the IUS-12 through a Bifactor Model Framework

In the undergraduate and clinical samples, most of the IUS-12 items displayed statistically significant and stronger loadings on the general factor than on the group factors. Higher loadings (>.05) on the general factor suggests that the items primarily represent the general IU construct and suggests against computing the subscale scores (Reise et al., 2010).

3.3.3.1. Omega reliability coefficients. In the student and clinical sample, the omega coefficients for the general IU factor and group factors were high. Inspection of omegaH suggested that in both samples 90% of the variance in IUS-12 total scores can be explained by individual differences on the general factor. A comparison between omegaH and omega provides further support that the general IU factor explained a large proportion of variance in total scores (ω_H/ω; .90/.95 = 95%). Moreover, the multidimensionality resulting from the group factors (prospective IU and inhibitory IU in the undergraduate sample; inhibitory IU in the clinical sample) was found to explain only 5% (ω-ω_H; .95-.90) of the variance in IUS-12 total scores. Thus, despite the presence of some multidimensionality, IUS-12 total scores can be practically considered to be a unidimensional representation of trait IU. As can be seen in Table 1.3 and Table 1.4, omegaHS for the group factors were low, particularly when compared to their corresponding coefficient omega values. These results suggest that (a) the general IU factor represents the dominant source of variance in the total IUS-12 score, (b) much of the reliable variance in the subscale scores was explained by the general IU factor, (c) there is only a small proportion of common variance remaining after controlling for the general factor, and therefore, (d) the low reliability of the prospective IU and inhibitory IU group factors provides support against their scoring and interpretation.

3.3.3.2. Construct replicability. In both samples, the low *H* value of the inhibitory IU group factor suggests that it is a poorly defined and unstable latent variable that is likely to be difficult to interpret within an SEM context. In contrast, the high *H* values of the general factor suggests that it is a well-defined, stable, and replicable latent variable. The results also suggest that researchers can have confidence in the predictive utility of the general IU factor when estimating its relationships with external variables in a structural model. In the undergraduate sample, the prospective IU group factor also displayed a high *H* value, however, it is important to note that *H* values are disproportionately influenced by items with high factor loadings (Rodriguez et al., 2016). Most items on the prospective IU group factor displayed low loadings with the exception of Item 2 (.94), which may have caused the high construct replicability estimate (see Table 1.3). Therefore, the construct replicability of the

prospective IU group factor may be misleading and it may not represent a meaningful or empirically identifiable latent construct.

3.3.3.3. ECV and PUC. In the student sample, the general IU factor explained 80% of the common variance, whereas 20% of the common variance was shared amongst the prospective and inhibitory IU group factors. Similarly, in the clinical sample, the general factor explained 86% of the common variance, whereas 14% of the common variance was shared with the inhibitory IU group factor. The high ECV values provided support for a strong general IU factor and the unidimensionality of the IUS-12 items. Of the IUS-12 items, 67% (undergraduate) and 75% (clinical) had I-ECV values greater than .80. The average I-ECV value was .85 (range .27 to 1.00) and .89 (range .42 to 1.00) in the undergraduate and clinical samples, respectively, with only three items with I-ECV values lower than .80 (Item 2, 6, 7 in the undergraduate sample; Items 6, 7, 10 in the clinical sample). Most of the IUS-12 items had high I-ECV values indicating that these items are stronger indicators of general IU and contribute substantially less to the measurement of their respective group factors.

In the undergraduate sample, the PUC value indicated that the general IU factor accounted for approximately half of the item correlations of the IUS-12. In the clinical sample, the PUC value indicated that the general factor accounted for the majority of the IUS-12 item correlations. The average relative parameter bias was acceptable (5% and 8% across IUS-12 items in the undergraduate and clinical samples, respectively) indicating that despite the poorer fit of the unidimensional model, the presence of some multidimensionality in the data will not introduce problematic levels of parameter bias when modelling the IUS-12 as unidimensional in an SEM framework (Muthén et al., 1987; Rodriguez et al., 2016).

3.3.4. Measurement Models

3.3.4.1. Undergraduate sample.

3.3.4.1.1. GAD-7 (Spitzer et al., 2006). The measurement model of the GAD-7 provided a poor model fit, χ^2 (14) = 168.25, $p < .001$, CFI = .985, TLI = .977, and RMSEA = .148 (90% CI [.128 to .168]). The CFI and TLI both met the specified guidelines, however the RMSEA value was elevated and the upper limit of the RMSEA 90% CI exceeded .10. The factor loadings were strong ranging from .75 to .96 and were statistically significant (all *p*s < .001). The latent variable explained between 56% and 91% of the variance in the items. Inspection of the MIs suggested a strong covariance between Item 4 (*"Having trouble relaxing"*) and Item 5 (*"Being so restless that it's hard to sit still"*; MI = 113.76), and between Item 2 (*"Not being able to stop or control worrying"*) and Item 3 (*"Worrying too much about*

different things"; MI = 36.66). These sets of items are conceptually similar as they assess the physical symptoms of hyperarousal and the uncontrollability of worry, respectively. An error covariance between these item sets were added. The modified model provided a good fit, χ^2 (12) = 49.92, $p < .001$, CFI = .996, TLI = .993, and RMSEA = .078 (90% CI [.056 to .102]). The modified model demonstrated a significant improvement in model fit as evidenced by a significant chi-square difference, $\Delta\chi^2$ (2) = 72.90, $p < .001$. The factor loadings were strong ranging from .76 to .93 and were all statistically significant (all *p*s < .001). The latent variable explained between 58% and 86% of the variance in the items.

3.3.4.1.2. SIPS (Carleton et al., 2009). A three-factor correlated model of the SIPS was examined and provided a good model fit, χ^2 (74) = 313.00, $p < .001$, CFI = .991, TLI = .989, and RMSEA = .080 (90% CI [.071 to .089]). The three-factor correlated model demonstrated a significant improvement in model fit relative to the unidimensional model as indicated by a significant chi-square difference, $\Delta\chi^2$ (3) = 237.28, $p < .001$. The standardised factor loadings were all statistically significant (all *p*s < .001) and strong ranging from .91 to .94 for the social interaction anxiety subscale, .87 to .90 for the fear of overt evaluation subscale, and .84 to .92 for the fear of attracting attention subscale. The correlation between the factors were also strong, ranging from .78 to .95. The latent variables explained between 71% and 89% of the variance in the items.

3.3.4.1.3. PDSS-SR (Houck et al., 2002). The measurement model of the PDSS-SR provided a marginal model fit, χ^2 (5) = 108.45, $p < .001$, CFI = .977, TLI = .954, and RMSEA = .202 (90% CI [.170 to .236]). Although the CFI and TLI met specified guidelines, the RMSEA was high. The factor loadings were strong ranging from .76 to .93 and were all statistically significant (all *p*s < .001). The latent variable explained between 58% and 87% of the variance in the items. Inspection of the modification indices indicated a strong covariance between Item 1 (*"How many panic and limited symptom attacks did you have during the past week"*) and Item 2 (*"If you had any panic attacks or limited symptom attacks during the past week, how distressing [uncomfortable, frightening] were they while they were happening? If you had more than one, give an average rating"*; MI = 87.25), and between Item 4 (*"During the past week, were there any places or situations [e.g., public transportation, movie theatres, crowds, bridges, tunnels, shopping malls, being alone] you avoided, or felt afraid of [uncomfortable in, wanted to avoid or leave], because of fear of having a panic attack? Please rate your level of fear and avoidance this past week"*) and Item 5 (*"During the past week, were there any activities [e.g., physical exertion, sexual relations, taking a hot shower*

or bath, drinking coffee, watching an exciting or scary movie] that you avoided, or felt afraid of, because they caused physical sensations like those you feel during panic attacks or that you were afraid might trigger a panic attack? Please rate your level of fear and avoidance of those activities this past week"; MI = 66.01), which could be explained by conceptual similarities. Items 1 and 2 both assess the frequency of acute panic symptoms and distress regarding panic symptoms, whereas Items 4 and 5 both assess avoidance of places, situations, and activities related to panic attacks. An error covariance was added between these sets of items. The modified model provided an excellent model fit, χ^2 (3) = 3.40, p = .334, CFI = 1.000, TLI = 1.000, and RMSEA = .016 (90% CI [.000 to .078]). The modified model demonstrated a significant improvement in model fit as indicated by a significant chi-square difference, $\Delta\chi^2$ (2) = 70.79, p < .001. The factor loadings were strong and ranged from .74 to .86 and were statistically significant (all ps < .001). The latent variable explained between 55% and 74% of the variance in the items.

3.3.4.2. Clinical sample.

3.3.4.2.1. BAI (Beck et al., 1988). A unidimensional measurement model of the BAI was examined and provided a poor model fit, χ^2 (189) = 1866.60, p < .001, CFI = .876, TLI = .862, and RMSEA = .130 (90% CI [.125 to .136]), with no fit indices meeting the specified guidelines. The standardised factor loadings were strong ranging from .48 to .89 and were all statistically significant (all ps < .001). The latent variable explained between 23% and 79% of the variance in the three items. Further inspection of the unidimensional model and associated MIs suggested a strong covariance between Item 12 (*"Hands trembling"*) and Item 13 (*"Shaky/unsteady"*; MI = 574.72), Item 6 (*"Dizzy or lightheaded"*) and Item 19 (*"Faint/lightheaded"*; MI = 152.01), Item 2 (*"Feeling hot"*) and Item 21 (*"Hot/cold sweats"*; MI = 144.47), and between Item 9 (*"Terrified or afraid"*) Item 17 (*"Scared"*; MI = 117.34). The strong covariation between these items could be explained by conceptual overlap and similarities in item phrasing, so they were freed in the model. The modified model provided an adequate model fit, χ^2 (185) = 1023.10, p < .001, CFI = .938, TLI = .930, and RMSEA = .093 (90% CI [.087 to .099]). A significant chi-square difference, $\Delta\chi^2$ (4) = 385.48, p < .001, indicated that the modified model fit the data significantly better relative to the original. Although the RMSEA value remained high, no further modifications were deemed to be theoretically defensible. The standardised factor loadings were strong, ranging from .50 to .82, and were significant (all ps < .001). The latent variable explained between 25% and 66% of the variance in the items.

3.3.4.2.2. BDI-II (Beck et al., 1996). A unidimensional measurement model of the BDI-II was examined and provided a poor fit, χ^2 (189) = 1202.50, $p < .001$, CFI = .887, TLI = .875, and RMSEA = .101 (90% CI [.096 to .107]), with no fit indices meeting the specified guidelines. The standardised factor loadings were strong ranging from .44 to .77 and were statistically significant (all *p*s < .001). The latent variable explained between 19% and 59% of the variance in the items. Further inspection of the unidimensional model and associated MIs indicated a strong covariance between items that were conceptually similar. Item 15 and Item 20 (MI = 148.87) focus on fatigue and energy, Item 11 and Item 17 (MI = 95.10) centre on restlessness and irritability, and Item 4 and Item 12 (MI = 77.60) assess interest and pleasure in activities and people. An error covariance was added between these sets of items and the modified model provided an adequate fit, χ^2 (186) = 905.14, $p < .001$, CFI = .920, TLI = .910, and RMSEA = .086 (90% CI [.080 to .092]). This modified model provided a significant improvement in fit relative to the original unidimensional model as indicated by a significant chi-square difference, $\Delta\chi^2$ (3) = 238.64, $p < .001$. The standardised factor loadings were all statistically significant (all *p*s < .001) and strong ranging from .44 to .75. The latent variable explained between 20% and 56% of the variance in the items.

3.3.4.2.3. PSWQ (Meyer et al., 1990). The measurement model of the PSWQ provided a marginal model fit, χ^2 (104) = 648.50, $p < .001$, CFI = .952, TLI = .945, and RMSEA = .100 (90% CI [.093 to .107]). The standardised factor loadings were strong, ranging from .40 to .92, and were statistically significant (all *p*s < .001). The latent variable explained between 16% and 84% of the variance in the items. Inspection of the MIs suggested a strong covariance between some of the negatively-worded items. As such, a unidimensional model with covariations freed between the five negatively-worded items of the PSWQ (Items 1, 3, 8, 10, 11) was examined. This model provided an acceptable fit to the data, χ^2 (94) = 426.85, $p < .001$, CFI = .971, TLI = .963, and RMSEA = .082 (90% CI [.074 to .090]). The CFI and TLI met specified guidelines and the upper limit of the RMSEA did not exceed .10. The modified model also fit the data significantly better than the original unidimensional model as indicated by a significant chi-square difference, $\Delta\chi^2$ (10) = 178.28, $p < .001$. The standardised loadings were strong ranging from .37 to .92 and were statistically significant (all *p*s < .001). The latent variable explained between 14% and 84% of the variance in the items. The MIs were inspected and no modifications were deemed to be theoretically defensible.

3.3.4.2.4. SIAS (Mattick & Clarke, 1998). The measurement model of the SIAS provided a marginal model fit, χ^2 (170) = 886.96, $p < .001$, CFI = .959, TLI = .954, and RMSEA = .090 (90% CI [.084 to .096]). Although the CFI and TLI met specified guidelines, the RMSEA value was considered high. The standardised factor loadings were strong ranging from .44 to .92 and were all statistically significant (all *p*s < .001). The latent variable accounted for 21% to 85% of the variance in the items.

3.3.5. Structural Regression Model

3.3.5.1. Undergraduate Sample. The final IUS-12 bifactor models were used in all structural models. Standardised beta estimates from the structural regression models are reported in Table 1.5. The structural model provided an excellent fit to the data, χ^2 (624) =1161.473, $p < .001$, CFI = .985, TLI = .983, and RMSEA = .041 (90% CI [.038 to .045]). The general IU factor was significantly associated with generalised anxiety disorder and panic disorder symptoms; however, the prospective IU and inhibitory IU group factors were not (see Table 1.5). The general IU factor and inhibitory IU group factor were also significantly associated with symptoms of social phobia. The model explained 47% (R^2) of the variance in symptoms of generalised anxiety disorder, 52% in fear of attracting attention, 44% in fear of overt evaluation, 39% in social interaction anxiety, and 33% in panic disorder.[1]

3.3.5.2. Clinical Sample. The structural model provided an acceptable fit to the data, χ^2 (3879) = 6643.759, $p < .001$, CFI = .929, TLI = .927, and RMSEA = .037 (90% CI [.035 to .038]). The general IU factor and inhibitory IU group factor were significantly associated with symptoms of anxiety, depression, and social anxiety. As can be seen in Table 1.5, the general IU factor, but not the inhibitory IU group factor, was significantly associated with worry symptoms. The model explained 41% (R^2) of the variance in pathology worry, 26% in anxiety, and 21% in depression and social anxiety symptoms.

1All models using the undergraduate sample were re-run without participants who completed the questionnaires faster (*n*=0 due to a positively skewed distribution) or slower (*n*=21) than two standard deviations from the mean, and again without participants who completed the survey faster than an average of three seconds per item (*n*=16). These models were an attempt to guard against undue influence from careless responses. The pattern of findings from these models was identical, and the excluded subgroups did not significantly differ to the remaining group on total IUS-12 scores (*p*s > .05), so only the analyses with the full sample are reported.

Table 1.5. *Summary of Structural Regression Model for the Undergraduate and Clinical Samples*

	General factor				Inhibitory IU group factor				Prospective IU group factor			
			CI				CI				CI	
	β	SE	LL	UL	β	SE	LL	UL	β	SE	LL	UL
Undergraduate												
GAD-7	.68*	.03	.62	.74	.08	.06	-.04	.19	.05	.06	-.07	.16
PDSS-SR	.56*	.05	.47	.65	.07	.08	-.08	.23	-.10	.08	-.25	.05
SIPS												
SIA	.57*	.04	.50	.64	.25*	.06	.13	.36	-.01	.06	-.13	.10
FOE	.62*	.03	.56	.69	.23*	.06	.12	.34	-.01	.06	-.13	.10
FAA	.68*	.03	.61	.75	.22*	.06	.10	.34	-.09	.06	-.21	.03
Clinical												
BAI	.45*	.04	.38	.53	.24*	.04	.15	.32				
BDI-II	.42*	.04	.34	.49	.19*	.05	.10	.28				
PSWQ	.63*	.03	.58	.69	.08	.04	-.00	.16				
SIAS	.31*	.04	.23	.39	.33*	.04	.25	.42				

Note. IU = intolerance of uncertainty; GAD-7 = Generalised Anxiety Disorder-7; PDSS-SR = Panic Disorder Severity Scale, Self-Report; SIPS = Social Interaction Phobia Scale; SIA = Social Interaction Anxiety Subscale; FOE = Fear of Overt Evaluation Subscale; FAA = Fear of Attracting Attention Subscale; BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory; PSWQ = Penn State Worry Questionnaire; SIAS = Social Interaction Anxiety Scale. CI = 95% confidence interval; LL = lower limit, UL = upper limit.

*$p < .001$.

3.4. Discussion

IU is becoming increasingly recognised as a robust transdiagnostic cognitive vulnerability in the conceptualisation and treatment of psychopathology (NIMH, 2016). The IUS-12 has become a widely used measure with strong psychometric properties and is considered a viable transdiagnostic assessment tool (Carleton, Norton, et al., 2007; Khawaja & Yu, 2010). However, bifactor models have recently been investigated in undergraduate samples as alternatives to the previously established two-factor correlated model, which has important implications for the computation of total versus subscale scores (Hale et al., 2016; Lauriola et al., 2016). The present study replicated and extended this research by examining the structure and predictive validity of the IUS-12 across both undergraduate and treatment-seeking clinical samples.

The correlated two-factor model reported in previous studies was replicated in both the undergraduate and treatment-seeking samples. Also consistent with previous research, the bifactor model provided a superior fit (Hale et al., 2016; Lauriola et al., 2016), although there were important differences across the samples. In the undergraduate sample the IUS-12 bifactor model consisted of a general IU factor and two group factors (prospective IU and inhibitory IU), whereas in the treatment-seeking sample, the bifactor model consisted of a general IU factor and only one group factor (inhibitory IU). Although the prospective IU group factor emerged in the undergraduate sample, it did not appear to be a strong factor as evidenced by its low reliability and that most of the items demonstrated low loadings, with the exception of the very high loading of Item 2. Thus, the results suggest that in both samples, the structure of the IUS-12 was primarily characterised by a general IU factor and an inhibitory IU group factor. The overwhelming majority of the variance in the IUS-12 scores was attributed to the general IU factor in both the undergraduate (80%) and clinical (86%) samples. These results are consistent with the findings of two recently published studies with undergraduate samples that reported that the general IU factor explained approximately 80% (Hale et al., 2016) and 75% (Lauriola et al., 2016) of the shared variance in IUS-12 scores. Further, the majority of the reliable variance in the prospective and inhibitory IU subscale scores was found to be explained by the general IU factor.

In both the undergraduate and clinical samples, the general IU factor was most strongly and consistently associated with emotional disorder symptoms. In the student sample, the prospective IU group factor was not significantly associated with any assessed symptoms of emotional disorder. Moreover, the inhibitory IU group factor was only uniquely, although more weakly, associated with symptoms of social phobia. In the clinical sample, the

inhibitory IU group factor was also most strongly associated with social anxiety symptoms, but also more weakly with anxiety and depression, which is consistent with previous research using treatment-seeking samples (McEvoy & Mahoney, 2011). Overall, the general IU factor demonstrated the most consistent transdiagnostic predictive utility, with inhibitory IU demonstrating weaker transdiagnostic associations but only in the clinical sample. Although the inhibitory IU group factor demonstrated some unique predictive utility, this finding requires replication due to the low reliability and construct reproducibility index of this group factor. The general IU factor shared the strongest association with worry, which is consistent with previous research that has found a strong association with pathological worry and generalised anxiety disorder, and with the initial conceptualisation of IU as a core feature in worry and generalised anxiety disorder (Dugas et al., 2001; Freeston et al., 1994).

The study findings have research and clinical implications. The present results suggest that researchers and clinicians should consider using the total score but not the subscale scores, which is line with recommendations made by other research groups (Hale et al., 2016; Lauriola et al., 2016). The results indicated that the general IU factor is a reliable and well-defined latent variable and that the IUS-12 can be represented as a unidimensional model with little parameter bias. The prospective IU group factor may not be separable or have unique predictive utility in undergraduate and clinical samples. From a theoretical stance, the results may suggest that prospective IU (cognitive appraisals about uncertainty) may not need to be independently interpreted from the general IU factor and rather should be considered a fundamental aspect of general IU. While the inhibitory IU group factor explained only a small proportion of reliable variance in the IUS-12, and therefore need not be considered separate from the general factor, we found that this factor did uniquely and weakly predict social phobia symptoms in undergraduates, and anxiety, social anxiety, and depression in the clinical sample. The greater contribution of inhibitory IU in the clinical sample may be a function of the different measures used across the samples, although it is also possible that inhibitory IU reflects the activation of inhibitory neural pathways at clinical levels of anxiety (Wever et al., 2015). This possibility requires further investigation, and if supported suggests that cognitive-behavioural or exposure-based therapy that aims to build tolerance for uncertainty would benefit from a focus on both the cognitive and behavioural aspects of IU.

The current study is not without limitations, which may inform future research directions. In contrast to the clinical sample who were diagnosed via a structured diagnostic assessment, the undergraduate sample were not subject to diagnostic screening. Thus, we could not rule out that the undergraduate sample did not contain participants with clinical

symptom levels. However, undergraduate samples are commonly used in this research area as they allow for exploration of the dimensional nature of IU through the entire range of symptoms, which is consistent with the National Institute of Mental Health's Research Domain Criteria initiative (Kozak & Cuthbert, 2016). Nonetheless, it would be valuable to examine the bifactor model in community and other clinical samples to increase confidence in modelling the IUS-12 as a single unidimensional latent variable when investigating structural models. Moreover, the present study used only self-report measures and did not include specific items to assess for carelessness in responding. Finally, the IUS-12 assesses self-reported trait IU rather than real time responses to uncertainty. It is also important to note that the bifactor approach examines the structure of a particular measure, in this case the IUS-12, and not the nature of the underlying the construct and its associated neurobiological or psychobiological effect (Bonifay, Lane, & Reise, 2017). It may be that high inhibitory IU and associated neural circuitry play a more important role (e.g., freezing) during exposure to uncertainty in a salient personal domain, but that a trait self-report measure is unable to comprehensively capture this process distinctly from general IU. Future research that assesses multiple units of analysis (e.g., self-report, behavioural, physiological, neurocircuitry) would be useful for identifying how these processes interact to maintain anxiety and intolerance within the context of uncertainty (Bonifay et al., 2017; Kozak & Cuthbert, 2016).

The current study makes an important incremental contribution to recent literature by replicating the structure of the IUS-12 in an undergraduate sample, but also by extending this approach to a clinical sample within the same study to facilitate comparisons. This study also modelled the predictive utility of the general IU factor and group factors, and provided support for the transdiagnostic nature of general IU (undergraduate and clinical samples) and inhibitory IU (clinical sample only). The multidimensionality of the IUS-12 scores does not appear to be substantive, and therefore use of the IUS-12 total score (and not subscale scores) is recommended. The IUS-12 total score displayed strong reliability and predictive validity. Researchers and clinicians should also have increased confidence that scores of the IUS-12 can be regarded as a primarily unidimensional representation of general trait IU.

Note: The following chapter has been published in the Journal of Anxiety Disorders

Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). Pathways from uncertainty to anxiety: an evaluation of a hierarchical model of trait and disorder-specific intolerance of uncertainty on anxiety disorder symptoms. *Journal of Anxiety Disorders, 45*, 72-79. doi:10.1016/j.janxdis.2016.12.001.

Minor edits have been made to the present chapter to ensure consistency with the present thesis (e.g., Australian spelling). Supplementary Material have been presented as part of the results of this chapter. The published article is presented in Appendix C.

Chapter 4 (Study 3): Pathways from Uncertainty to Anxiety: An Evaluation of a Hierarchical Model of Trait and Disorder-Specific Intolerance of Uncertainty to Anxiety Disorder Symptoms

4.1. Introduction

The development and maintenance of anxiety disorders can be attributed to both common and specific vulnerabilities (Barlow, 2000; Brown & Naragon-Gainey, 2013). Models of psychopathology suggest IU is a core feature in anxiety-related experience (Carleton, 2016b), and the past decade has seen IU gain considerable attention as a robust and common vulnerability factor implicated in multiple psychological disorders (Carleton, Mulvogue, et al., 2012; Mahoney & McEvoy, 2012c; Renjan et al., 2016; Shihata et al., 2016). IU is conceptualised as a trait-like disposition that reflects a fundamental fear of the unknown and negative beliefs about uncertainty and its associated implications (Carleton, 2012; Dugas & Robichaud, 2007).

Initial research on IU focused primarily on its relationship with worry and generalised anxiety disorder (Dugas et al., 1998; Freeston et al., 1994); however, it has since been found to be associated with a range of emotional disorder symptoms, suggesting that it is transdiagnostic in nature (Carleton, 2012; Gentes & Ruscio, 2011; Hong & Cheung, 2015; Mahoney & McEvoy, 2012b). Measurement research suggests that IU comprises both prospective (i.e., cognitive appraisals) and inhibitory (i.e., behavioural apprehension) responses to uncertainty (Carleton, Sharpe, et al., 2007; McEvoy & Mahoney, 2011). Moreover, maladaptive cognitions (e.g., worry, obsessional doubt) and behaviours (e.g., avoidance, compulsions) evident in a range of psychological disorders may reflect attempts to gain certainty and control and, therein, may be driven by IU (Boswell et al., 2013; Krohne, 1989). As such, IU may reflect a transdiagnostic or general psychological vulnerability that confers elevated risk to multiple disorders (Carleton, Mulvogue, et al., 2012; Harvey et al., 2004) in line with Barlow's (2000) triple vulnerability model. Barlow (2000) posits that emotional disorders are a function of general biological and psychological mechanisms as well as more disorder-specific vulnerabilities. Whereas the general mechanisms increase vulnerability to multiple emotional disorders, the disorder-specific factors may influence the development and expression of different emotional disorders (Boswell et al., 2013). Although IU has been implicated in a wide range of disorders much less is known about how a general risk factor such as IU may lead to the development of multifinality (i.e., comorbidity) and divergent trajectories (i.e., expressions of different disorders; Nolen-Hoeksema & Watkins,

2011). Thibodeau et al. (2015, p. 55) suggested that disorder-specific IU may reflect "a theoretically proximal and explicit causal intermediary" between trait IU and symptoms of emotional disorders.

Current research highlights a conceptual distinction between dispositional trait IU (i.e., general experiences of uncertainty) and disorder-specific IU (i.e., the specific focus of uncertainty differs between emotional disorders; Boswell et al., 2013; Carleton, 2016b; Carleton, Collimore, et al., 2010; Mahoney & McEvoy, 2012b). For example, the focus of uncertainty prevalent in panic disorder (e.g., uncertainty about when a panic attack may occur) may differ from the focus of uncertainty in obsessive compulsive disorder (e.g., uncertainty about causing harm). Prior research demonstrates that clinical participants report higher disorder-specific IU relative to trait IU (Jensen & Heimberg, 2015; Mahoney & McEvoy, 2012b). Extending this work, Thibodeau et al. (2015) found strong associations between disorder-specific IU and trait IU, and that disorder-specific IU explained unique variance in respective disorder symptoms beyond trait IU. In contrast to previous research suggesting trait IU is comparable across emotional disorders (Carleton, Mulvogue, et al., 2012; Mahoney & McEvoy, 2012c), Thibodeau et al. (2015) found that the generalisability of IU varied; trait IU displayed stronger associations with symptoms of generalised anxiety disorder and obsessive compulsive disorder, while disorder-specific IU was found to be a stronger predictor of social anxiety and panic disorder symptoms. Trait and disorder-specific IU similarly predicted symptoms of depression and specific phobia. Inconsistencies in findings about the generalisability of IU may be due to analytical and methodological differences (e.g., use of different disorder-specific IU measures). Further, the research to date has typically focused on the relationships between trait IU, disorder-specific IU, and emotional disorder symptoms and, as such, the significance and differentiation of disorder-specific IU relative to other vulnerability factors has not been investigated.

Researchers suggest that emotional disorders may be best delineated within a structural framework of general and specific factors (Hong & Cheung, 2015; Taylor, 1998). In line with this, hierarchical conceptualisations of psychopathology that include IU have been supported such that overarching general traits are believed to influence emotional symptoms through intermediate disorder-specific vulnerability factors (Hong, 2013; Norton & Mehta, 2007; Paulus et al., 2015; Sexton et al., 2003; van der Heiden et al., 2010). In their meta-analysis Hong and Cheung (2015) found that several vulnerabilities underlying depression and anxiety may share a common core of IU and, thereby, a fundamental fear of the unknown. Taken together, prior research underscores the importance of IU relative to

other vulnerability processes (Carleton, 2016b), and whilst considerable research has been conducted on trait IU, the role of disorder-specific IU remains less clear. No studies have examined the relationships between trait IU as a higher-order distal factor, and disorder-specific IU and disorder symptomology as intermediate- and lower-order factors, respectively, relative to other specific vulnerabilities.

The aim of the present study was to evaluate a hierarchical model of transdiagnostic and disorder-specific vulnerabilities for symptoms of generalised anxiety disorder, social anxiety disorder, obsessive compulsive disorder,[2] and panic disorder. For each symptom measure an additional key cognitive vulnerability factor articulated in disorder-specific cognitive models was selected and evaluated in this study: negative metacognitions in generalised anxiety disorder (Wells, 2005); fear of negative evaluation in social anxiety disorder (Rapee & Heimberg, 1997); inflated responsibility in obsessive compulsive disorder (Salkovskis, 1985); and agoraphobic cognitions in panic disorder (Goldstein & Chambless, 1978). Further, we aimed to extend previous work (Norton & Mehta, 2007; van der Heiden et al., 2010) by employing structural equation modelling (SEM) techniques to examine the direct and specific indirect effects between the constructs of interest. Our first hypothesis was that trait IU would significantly predict each of the disorder-specific IU subscales, disorder-specific cognitive vulnerabilities, and anxiety disorder symptoms. Our second hypothesis was that disorder-specific IU would account for unique variance in disorder-specific vulnerabilities and concordant disorder symptoms, beyond trait IU. Our third hypothesis was that each of the disorder-specific vulnerabilities would significantly predict their concordant disorder symptoms. Our fourth hypothesis was that each of the disorder-specific IU subscales and other vulnerabilities would carry significant indirect effects between trait IU and disorder-specific symptoms.

4.2. Method

4.2.1. Participants

Participants were 506 undergraduate psychology students (80.20% female) aged between 18 and 55 years (M = 21; SD = 4.91) who were recruited via the university's research participant pool. The majority of the sample identified as Caucasian (68.20%). Eligibility criteria required participants to be over 18 years of age. Based on moderate correlations found

2 Obsessive compulsive disorder was included to assess a broader array of emotional disorder symptoms, although it is acknowledged that it is not considered an anxiety disorder in DSM-5 nosology.

in previous studies investigating relationships between disorder-specific IU and symptom measures (Thibodeau et al., 2015), this sample size was adequate to investigate the final structural model (MacCallum, Browne, & Sugawara, 1996). Taxometric research provides support for the dimensionality of disorder symptoms and associated vulnerability factors, including IU (Carleton, Weeks, et al., 2012; Haslam, Williams, Kyrios, McKay, & Taylor, 2005; Weeks, Norton, & Heimberg, 2009), and therefore we recruited an unselected sample.

4.2.2. Measures

4.2.2.1. Intolerance of Uncertainty Scale, Short Form (IUS-12; Carleton, Norton, et al., 2007). See Chapter 3 (page 40) for a description of the IUS-12.

4.2.2.2. Disorder-Specific Intolerance of Uncertainty Scale (DSIU; Thibodeau et al., 2015). The 24-item DSIU comprises eight three-item subscales that assess disorder-specific IU pertaining to different disorders including generalised anxiety disorder (IU-GAD), social anxiety disorder (IU-SAD), obsessive compulsive disorder (IU-OCD), panic disorder (IU-PD), health anxiety, specific phobia, posttraumatic stress disorder, and depressive disorder. Participants responded to each item on a five-point scale from *not at all* (0) to *extremely* (4). Psychometric evidence indicates convergent and criterion validity. The disorder-specific IU-GAD, IU-SAD, IU-OCD, and IU-PD subscales were used in the present study.

4.2.2.3. Meta-cognitions Questionnaire-30 (MCQ-30; Wells & Cartwright-Hatton, 2004). The short form MCQ-30 was used as a measure of metacognitive beliefs and monitoring (Cartwright-Hatton & Wells, 1997). Participants indicated their level of agreement with each item on a four-point scale from *do not agree* (1) to *agree very much* (4). The MCQ-30 comprises five subscales; positive beliefs about worry, negative metacognitions about the uncontrollability and danger of worry, cognitive confidence, need to control thoughts, and cognitive self-consciousness. Research evidence indicates the MCQ-30 has good temporal stability, and factorial and convergent validity (McEvoy, Moulds, & Mahoney, 2013; Wells & Cartwright-Hatton, 2004). The six-item negative metacognitions subscale was employed in the present study.

4.2.2.4. Brief Fear of Negative Evaluation Scale, Straightforward Items (BFNE-S; Rodebaugh et al., 2004). The adapted 8-item BFNE-S is a widely used measure designed to measure fears pertaining to negative evaluation from others and comprises only the straightforward-worded items (Carleton, Sharpe, et al., 2007; Weeks et al., 2005). Respondents rated items on a five-point scale ranging from *not at all characteristic of me* (1)

to *extremely characteristic of me* (5). The BFNE-S is reported to be a more reliable and valid indicator of fear of negative evaluation than the alternative measure comprising reverse-scored items (Rodebaugh et al., 2004; Weeks et al., 2005). Psychometric research indicates good construct and factorial validity (Carleton, Collimore, & Asmundson, 2007; Rodebaugh et al., 2004).

4.2.2.5. Obsessive-Beliefs Questionnaire-44 (OBQ-44; Obsessive Compulsive Cognitions Working Group [OCCWG], 2005). The OBQ-44, revised from the original lengthier OBQ (OCCWG, 2001), was designed to assess dysfunctional belief domains related to obsessive-compulsive disorder. The OBQ-44 comprises three factors; responsibility/threat estimation (OBQ-RT), importance/control of thoughts, and perfectionism/certainty. Participants rated items on a seven-point scale from *disagree very much* (1) to *agree very much* (7). Psychometric evidence demonstrates temporal stability and construct validity (OCCWG, 2005). This study used only the 16-item OBQ-RT subscale. However, measurement research suggests that the responsibility and overestimation of threat items load on two distinct factors (Myers, Fisher, & Wells, 2008) and that overestimation of threat may be representative of a general anxious pathology (Sookman & Pinard, 2002); as such, we were interested in examining inflated responsibility as a specific vulnerability of obsessive compulsive disorder and thereby analyses were conducted using only the eight responsibility items (Myers et al., 2008).

4.2.2.6. Agoraphobic Cognitions Questionnaire (ACQ; Chambless, Caputo, Bright, & Gallagher, 1984). The 14-item ACQ measures the frequency of catastrophic, negative thoughts about the consequences of anxiety and comprises two subscales pertinent to physical concerns and social/behavioural concerns. Participants indicated how often a thought occurred during an anxiety-provoking experience on a five-point scale ranging from *thought never occurs* (1) to *thought always occurs* (5). Psychometric research indicates temporal stability and construct validity (Chambless et al., 1984).

4.2.2.7. Generalised Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006). See Chapter 3 (page 40) for a description of the GAD-7.

4.2.2.8. Social Interaction Phobia Scale (SIPS; Carleton et al., 2009). See Chapter 3 (page 40) for a description of the SIPS.

4.2.2.9. Obsessive Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). The 18-item short-form OCI-R was adapted from the original OCI (Foa, Kozak, Salkovskis, Coles, & Amir, 1998) and designed to assess obsessive-compulsive symptom severity. Respondents indicated the degree to which they felt distressed or bothered by obsessive-

compulsive symptoms in the last month on a five-point scale from *not at all* (0) to *extremely* (4). The OCI-R comprises six three-item subscales; washing, checking, obsessions, mental neutralising, ordering, and hoarding. Psychometric support indicates evidence of acceptable reliability and validity (Foa et al., 2002).

4.2.2.10. Panic Disorder Severity Scale-Self Report (PDSS-SR; Houck et al., 2002). See Chapter 3 (page 40) for a description of the PDSS-SR.

4.2.3. Procedure

Participants were recruited from the undergraduate psychology research pool through an online experiment database (SONA) to participate in a study of "Uncertainty and Emotion". After reading an information statement and consent form, participants were directed to an online survey hosted by Qualtrics. All participants provided informed consent. Participants completed demographic information and the standardised self-report questionnaires. The IUS-12 and DSIU were presented first; thereafter, the measures were randomised to minimise potential order effects of fatigue and carelessness in responding. Participants were debriefed and granted coursework credit for participation. Prior to the commencement of this study, institutional ethics approval was obtained (HR34/2015; see Appendix E).

4.2.4. Data Analysis

Preliminary analyses were conducted in SPSS 22.0 to screen the data for missing values, outliers, and normality, and to calculate basic descriptive and internal reliability statistics. Assessment of the measurement models for each measure using confirmatory factor analysis (CFA) and the hypothesised model using SEM with maximum likelihood estimation were performed in Mplus 7.4 (Muthén & Muthén, 1998–2015).To determine model fit for the measurement and structural model, fit statistics, factor loadings, and modification indices were examined. Model fit indices included the chi-square goodness of fit statistic, where a non-significant value indicates an acceptable fit; however, the chi-square statistic is sensitive to sample size and often rejects the model in large samples (Tabachnick & Fidell, 2013). For a more comprehensive assessment of model fit, supplementary incremental indices included the comparative fit index (CFI) and the Tucker-Lewis index (TLI), as well as absolute indices such as the root mean square error of approximation (RMSEA) with 90% confidence intervals (CIs), and the standardised root mean square residual (SRMR). For the CFI and TLI, values greater than 0.90 and 0.95 generally indicate an acceptable and excellent fit to the data, respectively (Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). For the RMSEA and SRMR

values close to .08 are indicative of an acceptable fit, and values close to .06 and .05, respectively, are indicative of a close fit (Hu and Bentler, 1999; Marsh et al., 2004). Standardised estimates were used to assess the strength of structural pathways. Further to evaluating direct pathways, the strength of the total and specific indirect effects and their 95% CIs were estimated using bootstrapping with at least 1000 repeated samples. Bootstrapping accounts for non-normality of the sampling distribution and the indirect effects were considered meaningful if the upper and lower limits of the CI did not encompass zero (Hayes, 2009).

4.3. Results

4.3.1. Preliminary Analyses

Participants ($n = 91$) were excluded if more than 5% of their data were missing, they completed the survey more than once (only the earliest response was analysed), and/or they failed to meet eligibility criteria (under 18 years), thereby resulting in a final sample size of 506 participants. Missing values analysis, using Little's MCAR test, indicated that data was missing completely at random, χ^2 (4) = 5.33, $p = .255$. Accordingly, missing data were replaced using the expectation maximisation method (Muthén & Muthén, 1998–2015; Tabachnick & Fidell, 2013). Data screening indicated no problematic distributional properties as evidenced by acceptable levels of skewness (i.e., <2) and kurtosis (i.e., <7) values, and inspection of histograms (Curran, West, & Finch, 1996; Tabachnick & Fidell, 2013). There were no multivariate outliers (i.e., using a $p < .001$ criterion for Mahalanobis D^2) and multicollinearity was not an issue. Descriptive statistics and correlations for all study variables are reported in Table 2.1. Inspection of the bivariate correlations indicated moderate to large significant associations between trait IU, all disorder-specific IU subscales, cognitive vulnerabilities, and disorder symptoms. Cronbach's alphas for all measures were high (Table 2.1).

Table 2.1. *Descriptive Statistics, Cronbach's Alpha, and Bivariate Correlations Between all Study Variables*

	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13
1. IUS-12	33.25	9.80	.92												
2. IU-GAD	5.68	3.31	.78*	.91											
3. IU-SAD	5.31	3.59	.64*	.61*	.92										
4. IU-OCD	5.60	2.96	.55*	.52*	.48*	.85									
5. IU-PD	2.39	3.30	.53*	.47*	.49*	.41*	.96								
6. MCQ-neg	12.44	5.26	.66*	.69*	.56*	.44*	.52*	.93							
7. BFNE-S	15.42	9.45	.62*	.62*	.76*	.42*	.41*	.64*	.97						
8. OBQ-Res	31.01	10.95	.51*	.46*	.43*	.47*	.33*	.43*	.46*	.91					
9. ACQ	24.20	9.69	.55*	.50*	.50*	.38*	.58*	.69*	.58*	.44*	.91				
10. GAD-7	7.06	5.38	.62*	.64*	.53*	.44*	.55*	.77*	.59*	.44*	.68*	.92			
11. SIPS	17.21	13.85	.62*	.56*	.79*	.42*	.47*	.62*	.76*	.46*	.64*	.62*	.96		
12. OCI-R	16.90	13.28	.61*	.56*	.49*	.54*	.51*	.59*	.49*	.48*	.62*	.59*	.58*	.93	
13. PDSS-SR	2.36	2.99	.44*	.47*	.45*	.30*	.62*	.60*	.47*	.35*	.59*	.63*	.48*	.45*	.85

Note: Cronbach's alphas are on the diagonal. *SD* = standard deviation; IUS-12 = Intolerance of Uncertainty Scale, Short Form; IU = intolerance of uncertainty; GAD = generalised anxiety disorder; SAD = social anxiety disorder; OCD = obsessive compulsive disorder; PD = panic disorder; MCQ-neg = negative metacognitions subscale form the Meta-cognitive Beliefs Questionnaire-30; BFNE-S = Brief Fear of Negative Evaluation Scale, Straightforward Items; OBQ-Res = responsibility subscale from the Obsessive-Beliefs Questionnaire-44; ACQ = Agoraphobic Cognitions Questionnaire; GAD-7 = Generalised Anxiety Disorder-7; SIPS = Social Interaction Phobia Scale; OCI-R = Obsessive Compulsive Inventory-Revised; PDSS-SR = Panic Disorder Severity Scale, Self-Report.

*$p < .001$.

4.3.2. Measurement Models

An independent CFA was conducted to evaluate the measurement model of each individual measure used in the final structural model. Prior research asserts that the strength of SEM is captured when each latent variable and its indicators is first evaluated through CFA (Schreiber, Stage, King, Nora, & Barlow, 2006). Testing the measurement model of each individual measure lends support to the conceptual reliability of the underlying factors prior to inclusion in, and assessment of, the final structural model (Schreiber et al., 2006). For models that displayed a poor fit, modification indices were inspected and error covariances were freed if it was deemed theoretically defensible (e.g., items were similarly worded or overlapped in content). The factor loadings of the models were significant and ranged from .47 to .95.

4.3.2.1. IUS-12 (Carleton, Norton, et al., 2007). The measurement model of the IUS-12 was assessed and a unidimensional, single-factor model was compared to the established two-factor structure. Inspection of the fit statistics revealed that the unidimensional, single-factor model displayed a marginal fit to the data, χ^2 (54) = 367.43, p < .001, CFI = .91, TLI = .89, SRMR = .05, and RMSEA = .11 (90% CI [.10 to .12]). The factor loadings were all statistically significant (all ps < .001) and ranged from .54 to .79. The latent variable explained between 29% to 62% of the variance in the items. The established two-factor IUS-12 structure was then assessed and there was a significant improvement in model fit $\Delta\chi^2$ (1) = 69.91, p < .001. An examination of the fit statistics indicated an acceptable fit, χ^2 (53) = 297.52, p < .001, CFI = .93, TLI = .91, SRMR = .04, and RMSEA = .10 (90% CI [.09 to .11]). The factor loadings were all statistically significant (all ps < .001) and strong ranging from .57 to .76 for the prospective IU subscale and .76 to .81 for the inhibitory IU subscale. The latent variable explained between 33% to 65% of the variance in the items. Thus, the two-factor model was preferred and the subscale scores were used as separate indicators of the general trait IU latent variable in the final structural model. This model enabled both group factors to contribute shared and unique variance to a common trait IU factor, which explained the majority of variance in the undergraduate sample in Study 2 (see Chapter 3).The hierarchical model also reduced complexity and parameterisation compared to the bifactor model, thus preserving power for the main aim of the study, which was to identify the differential relationships between general trait IU (rather than the components of IU) and other disorder-specific factors and disorders symptoms.

4.3.2.2. DSIU (Thibodeau et al., 2015). The DSIU measurement model was assessed with four distinct latent factors (i.e., IU-GAD, IU-SAD, IU-OCD, and IU-PD) as we were interested in examining the independent contribution of each disorder-specific IU area.

Covariances between the DSIU latent variables were freed in this model because previous research has found the DSIU scales to be correlated (Thibodeau et al., 2015), which reflects the common origin of the items from the same scale and shared assessment of the general and common IU construct. Correlations among the DSIU factors were all statistically significant (all *p*s < .001) and ranged from .43 to .66. The measurement model of the DSIU subscales displayed an excellent fit to the data, χ^2 (48) = 153.88, *p* < .001, CFI = .98, TLI = .97, SRMR = .04, and RMSEA = .07 (90% CI [.05 to .08]). The standardised factor loadings for all subscales were significant (all *ps* < .001) and ranged from .83 to .90 for the IU-GAD subscale, .87 to .91 for the IU-SAD subscale, .78 to .84 for the IU-OCD subscale, and .93 to .95 for the IU-PD subscale. The latent variable explained between 60% to 90% of the variance in the items.

4.3.2.3. MCQ-30 (Wells & Cartwright-Hatton, 2004). The measurement model of the negative metacognitions subscale of the MCQ-30 demonstrated a marginal fit to the data, χ^2 (9) = 192.61, *p* < .001, CFI = .92, TLI = .87, SRMR = .04, and RMSEA = .20 (90% CI [.18 to .23]). The standardised factor loadings were statistically significant (all *p*s < .001) and ranged from .78 to .89. The latent variable explained between 60% to 79% of the variance in the items. Inspection of the MIs indicated a strong covariance between Items 5 and 6 (MI = 129.65), which could be explained by similar wording and content overlap. Items 5 (*"My worrying could make me go mad"*) and 6 (*"My worrying is dangerous for me"*) both begin with "my worrying" and assess the negative and harmful consequences of worrying. An error covariance between these items were added and model fit significantly improved as indicated by a chi-square difference test, $\Delta\chi^2$ (1) = 131.34, *p* < .001. The revised model displayed a good fit, χ^2 (8) = 61.27, *p* < .001, CFI = .98, TLI = .96, SRMR = .03, and RMSEA = .12 (90% CI [.09 to .14]). Although there was only a modest improvement in the RMSEA, no further modifications were deemed theoretically defensible. The factor loadings were significant and ranged from .73 to .90 (all *p*s < .001). The latent variable explained between 53% and 82% of the variance in the items.

4.3.2.4. BFNE-S (Rodebaugh et al., 2004). The measurement model of the BFNE-S demonstrated a good fit to the data, χ^2 (20) = 137.18, *p* < .001, CFI = .98, TLI = .97, SRMR = .02, and RMSEA = .11 (90% CI [.09 to .13]). The standardised factor loadings were statistically significant and ranged from .88 to .93 (all *p*s < .001). The latent variable accounted for 71% to 86% of the variance in the items. Given the RMSEA was high, the MIs were examined and suggested that Items 3 and 4 (MI = 74.30) had a strong covariance. This

could be explained by item wording and conceptual similarities. Items 3 (*"I am afraid that others will not approve of me"*) and 4 (*"I am afraid that other people will find fault with me"*) both measured fears regarding disapproval from others and begin with "I am afraid". These items were freed to covary and, accordingly, model fit significantly improved $\Delta\chi^2$ (1) = 67.43, $p < .001$. An examination of the fit statistics revealed that the revised model displayed an excellent fit, χ^2 (19) = 69.75, $p < .001$, CFI = .99, TLI = .98, SRMR = .01, and RMSEA = .07 (90% CI [.06 to .09]). The standardised factor loadings were strong, ranging from .85 to .91, and were statistically significant (all *p*s < .001). The latent variable explained 72% to 83% of the variance in the items.

4.3.2.5. OBQ-44 (OCCWG, 2005). The measurement model of the OBQ-RT, comprising only items pertaining to responsibility, displayed a poor fit to the data, χ^2 (20) = 304.81, $p < .001$, CFI = .88, TLI = .83, SRMR = .06, and RMSEA = .17 (90% CI [.15 to .19]). Inspection of the MIs indicated a strong covariance between Items 1 (*"When I see any opportunity to do so, I must act to prevent bad things from happening"*) and 2 (*"Even if harm is very unlikely, I should try to prevent it at any cost"*; MI = 76.00); Items 4 (*"In all kinds of daily situations, failing to prevent harm is just as bad as deliberately causing harm"*) and 5 (*"For me, not preventing harm is as bad as causing harm"*; MI = 89.40); and, Items 5 and 8 (*"To me, failing to prevent a disaster is as bad as causing it"*; MI = 14.35). These sets of items overlapped conceptually in assessing responsibility to prevent harm. The modifications were made and the sets of items were freed to covary and there was a significant improvement in model fit, $\Delta\chi^2$ (3) = 165.77, $p < .001$. However, the fit statistics demonstrated a marginal fit to the data, χ^2 (17) = 139.04, $p < .001$, CFI = .95, TLI = .92, SRMR = .04, and RMSEA = .12 (90% CI [.10 to .14]). Further inspection of the MIs suggested a strong covariance between Items 4 and 8 (MI = 49.64) which could also be explained by an overlap in content. These items were freed to covary and model fit significantly improved, $\Delta\chi^2$ (1) = 46.54, $p < .001$. The fit statistics indicated an acceptable fit to the data, χ^2 (16) = 92.50, $p < .001$, CFI = .97, TLI = .94, SRMR = .03, and RMSEA = .10 (90% CI [.08 to .12]). Although there was only a modest reduction in the RMSEA value, no further modifications were made. The standardised factor loadings were statistically significant (all *p*s < .001) and ranged from .65 to .81. The latent variable explained between 43% to 66% of the variance in the items.

4.3.2.6. ACQ (Chambless et al., 1984). The measurement model of the ACQ was evaluated and a unidimensional, single-factor model was compared to a two-factor model. The unidimensional measurement model demonstrated a poor fit to the data, χ^2 (77) = 820.01,

$p < .001$, CFI = .80, TLI = .76, SRMR = .08, and RMSEA = .14 (90% CI [.13 to .15]). The factor loadings were all statistically significant (all *p*s < .001) and ranged from .52 to .79. The variance in the items explained by the latent variable ranged from 27% to 62%. A two-factor model with subscales (i.e., social concerns and physical concerns) was compared and displayed a marginal fit to the data, χ^2 (76) = 482.88, $p < .001$, CFI = .89, TLI = .87, SRMR = .06, and RMSEA = .10 (90% CI [.09 to .11]). However, a chi-square difference test indicated a significant improvement in model fit $\Delta\chi^2$ (1) = 337.13, $p < .001$. The standardised factor loadings were all statistically significant (all *p*s < .001) and moderate to strong, ranging from .62 to .83 for the social concerns subscale and .47 to .84 for the physical concerns subscale. The latent variable explained between 23% to 71% of the variance in the items. Thus, the two-factor model was preferred and the subscale scores were used as separate indicators of the general agoraphobic cognitions latent variable in the structural model. Due to the complexity of the final structural model, the aim of this study was to examine agoraphobic cognitions as a general latent variable, rather than investigate the differential relations between the components of agoraphobic cognitions.

4.3.2.7. GAD-7 (Spitzer et al., 2006). The measurement model of the GAD-7 demonstrated a marginal fit to the data, χ^2 (14) = 143.40, $p < .001$, CFI = .95, TLI = .92, SRMR = .04, and RMSEA = .14 (90% CI [.12 to .16]). The factor loadings were strong ranging from .70 to .90 and were statistically significant (all *p*s < .001). The latent variable was found to explain between 49% to 81% of the variance in the items. Inspection of the MIs suggested that Items 4 and 5 (MI = 89.72) had a strong covariance. Items 4 (*"Having trouble relaxing"*) and 5 (*"Being so restless that it's hard to sit still"*) both assess the physical symptoms of hyperarousal and therefore are conceptually similar. These items were freed to covary and model fit was significantly improved $\Delta\chi^2$ (1) = 91.69, $p < .001$. The revised model displayed an excellent fit, χ^2 (13) = 51.71, $p < .001$, CFI = .98, TLI = .97, SRMR = .02, and RMSEA = .08 (90% CI [.06 to .10]). The standardised factor loadings were statistically significant (all *p*s < .001) and strong, ranging from .67 to .91. The latent variable explained 45% to 83% of the variance in the items.

4.3.2.8. SIPS (Carleton et al., 2009). The measurement model of the SIPS was assessed and a unidimensional, single-factor model was compared to a unidimensional model with covariations freed between the items based on their relevant subscales. The unidimensional model demonstrated a poor fit to the data, χ^2 (77) = 1365.29, $p < .001$, CFI = .81, TLI = .78, SRMR = .07, and RMSEA = .18 (90% CI [.17 to .19]). The factor loadings

were all statistically significant (all *p*s < .001) and ranged from .72 to .85. The latent variable was found to account for 52% to 73% of the variance in the items. Inspection of the MIs suggested strong covariations between items that load onto the same subscales of the SIPS based on prior research. Thus, a measurement model was run wherein the items were freed to covary based on their established loadings on the three subscales of the SIPS (i.e., social interaction anxiety, fear of overt evaluation, and fear of attracting attention). This model demonstrated a significant improvement in fit, $\Delta\chi^2$ (28) = 1145.62, $p < .001$. An examination of the fit indices revealed an excellent fit χ^2 (49) = 219.67, $p < .001$, CFI = .98, TLI = .95, SRMR = .03, and RMSEA = .08 (90% CI [.07 to .09]). The standardised factor loadings were statistically significant (all *p*s < .001) and strong, ranging from .68 to .89. The latent variable explained between 47% to 79% of the variance in the items.

4.3.2.9. OCI-R (Foa et al., 2002). The measurement model of the OCI-R was evaluated and the six subscale scores were used as separate indicators of general latent obsessive compulsive disorder symptoms. The model displayed a good fit to the data, χ^2 (9) = 52.78, $p < .001$, CFI = .97, TLI = .95, SRMR = .03, and RMSEA = .10 (90% CI [.07 to .12]). Although the RMSEA was considered high, no modifications were deemed theoretically defensible. The standardised factor loadings were statistically significant (all *p*s < .001) and strong, ranging from .66 to .78. The latent variable explained between 44% and 61% of the variance in the items.

4.3.2.10. PDSS-SR (Houck et al., 2002). The measurement model of the PDSS-SR demonstrated a marginal fit to the data, χ^2 (5) = 116.08, $p < .001$, CFI = .91, TLI = .81, SRMR = .06, and RMSEA = .21 (90% CI [.18 to .24]). The standardised factor loadings were significant and ranged from .58 to .87 (all *p*s < .001). The latent variable was found to account for 34% to 75% of the variance in the items. Examination of the MIs indicated a strong covariance between Items 1 and 2 (MI = 105.35) and Items 4 and 5 (MI = 71.96) which could be explained by conceptual similarities. Items 1 (*"How many panic and limited symptom attacks did you have during the past week"*) and 2 (*"If you had any panic attacks or limited symptom attacks during the past week, how distressing [uncomfortable, frightening] were they while they were happening? If you had more than one, give an average rating"*) both assess the frequency of acute panic symptoms and distress regarding panic symptoms. Items 4 (*"During the past week, were there any places or situations [e.g., public transportation, movie theatres, crowds, bridges, tunnels, shopping malls, being alone] you avoided, or felt afraid of [uncomfortable in, wanted to avoid or leave], because of fear of having a panic*

attack? Please rate your level of fear and avoidance this past week") and 5 (*"During the past week, were there any activities [e.g., physical exertion, sexual relations, taking a hot shower or bath, drinking coffee, watching an exciting or scary movie] that you avoided, or felt afraid of, because they caused physical sensations like those you feel during panic attacks or that you were afraid might trigger a panic attack? Please rate your level of fear and avoidance of those activities this past week"*) both measure avoidance of places, situations, and activities related to panic attacks. These sets of items were freed to covary and resulted in a significant improvement in model fit, $\Delta\chi^2$ (2) = 113.67, $p < .001$. The revised model demonstrated an excellent fit, χ^2 (3) = 2.41, $p = .492$, CFI = 1.00, TLI = 1.00, SRMR = .01, and RMSEA = .00 (90% CI [.00 to .07]). The standardised factor loadings were significant (all *p*s < .001) and strong, ranging from .61 to .78. The latent variable explained between 37% to 61% of the variance in the items.

4.3.3. Structural Models

An examination of the fit statistics revealed that the structural model provided an acceptable fit to the data, χ^2 (2278) = 4809.70, $p < .001$, CFI = .92, TLI = .92, SRMR = .06, and RMSEA = .05 (90% CI [.045–.049]). The standardised parameter estimates for the structural pathways are displayed in Figure 1.

4.3.3.1. Generalised anxiety disorder symptoms. The total effect of trait IU on GAD symptoms was significant (β = .78, SE = .02, $p < .001$, 95% CI = .73–.82): the direct effect (β = .33, SE = .10, $p = .001$, 95% CI = .13–.52) and total indirect effect (β = .46, SE = .09, $p < .001$, 95% CI = .28–.62) were both significant. Within the indirect effect, negative metacognitions made a significant contribution (β = .34, SE = .06, $p < .001$, 95% CI = .22–.47), but disorder-specific IU-GAD did not (β = .00, SE = .08, $p = .957$, 95% CI = -.15–.16). There was also a significant indirect path between trait IU and symptoms through IU-GAD and negative metacognitions, respectively (β = .11, SE = .05, $p = .028$, 95% CI = .02–.22).

4.3.3.2. Social anxiety disorder symptoms. The total effect of trait IU on social anxiety disorder symptoms was significant (β = .75, SE = .03, $p < .001$, 95% CI = .70–.80): both the direct effect (β = .20, SE = .06, $p = .001$, 95% CI = .09–.32) and total indirect effect (β = .56, SE = .05, $p < .001$, 95% CI = .46–.64) were significant. Within the indirect effect, disorder-specific IU-SAD (β = .35, SE = .05, $p < .001$, 95% CI = .26–.44) and fear of negative evaluation (β = .09, SE = .03, $p < .001$, 95% CI = .04–.14) made significant contributions. An

additional significant indirect effect was found from trait IU to symptoms through IU-SAD and fear of negative evaluation, respectively (β = .12, SE = .03, $p < .001$, 95% CI = .06–.17).

4.3.3.3. Obsessive compulsive disorder symptoms. An examination of the total effect of trait IU on symptoms of obsessive compulsive disorder was significant (β = .74, SE = .03, $p < .001$, 95% CI = .68–.80): the direct effect (β = .57, SE = .06, $p < .001$, 95% CI = .45–.69) and total indirect effect (β = .18, SE = .04, $p < .001$, 95% CI = .10–.26) were both significant. Within the indirect effect, disorder-specific IU-OCD made a significant contribution (β = .14, SE = .04, $p < .001$, 95% CI = .07–.22), but inflated responsibility did not (β = .02, SE = .02, $p = .285$, 95% CI = −.02–.06).

4.3.3.4. Panic disorder symptoms. The total effect of trait IU on panic disorder symptoms was significant (β = .65, SE = .04, $p < .001$, 95% CI = .57–.72); interestingly, the direct effect was not significant (β = .13, SE = .08, $p = .124$, 95% CI = -.04–.29). The total indirect effect of trait IU on panic disorder symptoms was significant (β = .53, SE = .07, $p < .001$, 95% CI = .39–.66). Within the indirect effect both disorder-specific IU-PD (β = .25, SE = .05, $p < .001$, 95% CI = .16–.34) and agoraphobic cognitions (β = .21, SE = .06, $p = .001$, 95% CI = .09–.34) made significant contributions. An additional significant indirect effect of IU on panic disorder symptoms was found through IU-PD and agoraphobic cognitions, respectively (β = .07, SE = .02, $p = .008$, 95% CI = .02–.12).

The model explained more variance in disorder-specific IU-GAD compared to disorder-specific IU-SAD, IU-OCD, and IU-PD (see Table 2.2). The model explained a greater proportion of variance in fear of negative evaluation, negative metacognitions, and agoraphobic cognitions than inflated responsibility. Further, the model explained a substantial proportion of variance in all symptom measures (59–75%).

Table 2.2. *Proportion of Variance (R^2) in Each Construct Explained by the Final Structural Model*

Disorder	Disorder-specific IU	Cognitive Vulnerability	Symptoms
Generalised anxiety disorder	76%	68% (negative metacognitions)	71%
Social anxiety disorder	57%	70% (fear of negative evaluation)	75%
Obsessive compulsive disorder	40%	42% (inflated responsibility)	59%
Panic disorder	39%	63% (agoraphobic cognitions)	63%

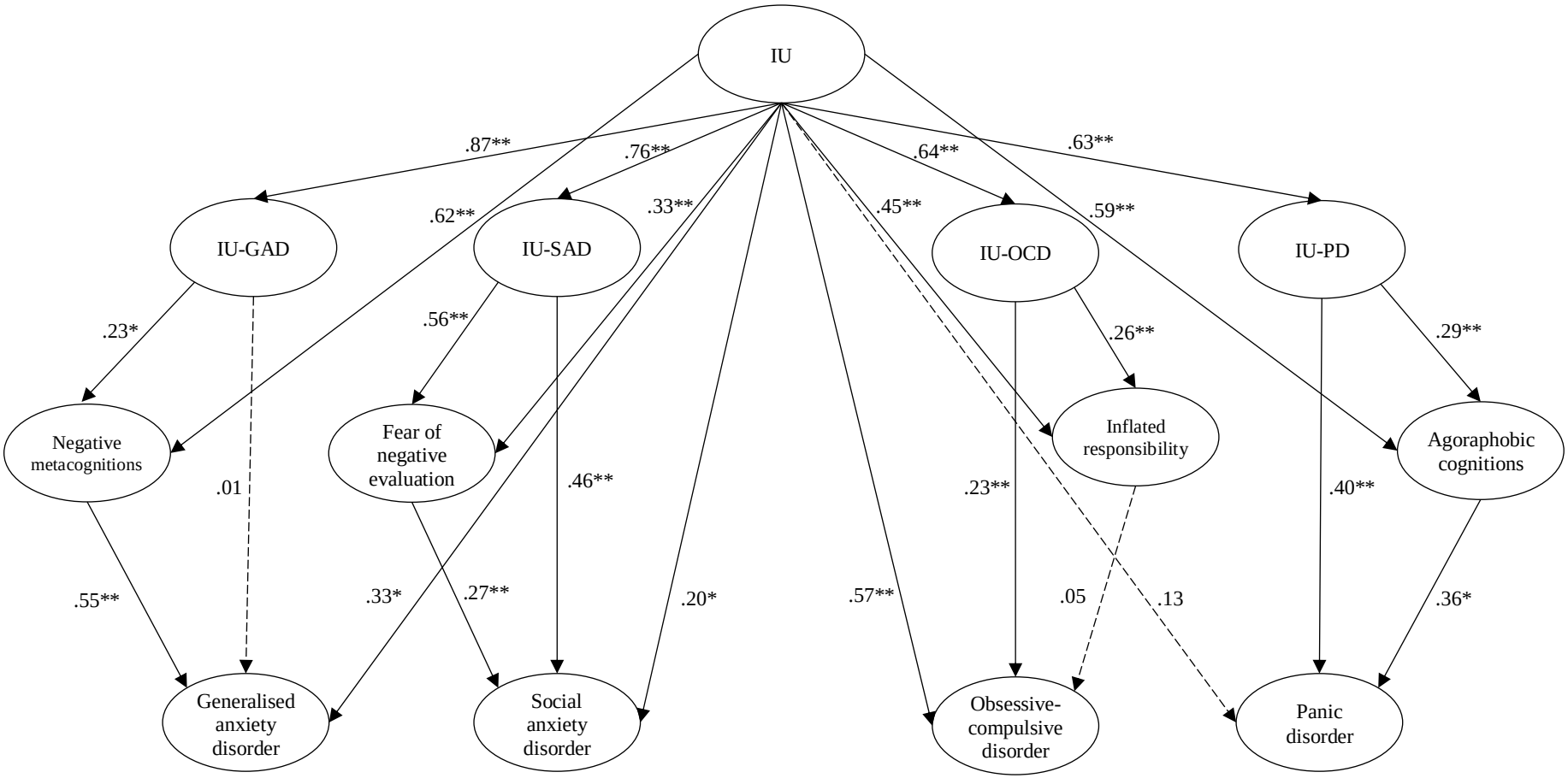


Figure 1. Structural model with direct pathways. Standardised path coefficients are shown. Significant pathways are continuous, whereas non-significant pathways are dashed.

*$p < .05$. **$p < .001$.

4.4. Discussion

Theory and evidence suggest that transdiagnostic and disorder-specific vulnerabilities contribute to the development and maintenance of anxiety-related pathology (Barlow, 2000; Norton & Mehta, 2007). While accumulating literature underscores the transdiagnostic significance of IU, recent findings suggest a distinction between trait and disorder-specific manifestations of IU. The present study evaluated a hierarchical model to identify the unique contributions of trait and disorder-specific IU to symptoms of multiple disorders, after controlling for other established disorder-specific cognitive vulnerabilities.

Trait IU was robustly associated with each of the disorder-specific IU subscales, as well as disorder-specific vulnerabilities (i.e., negative metacognitions, fear of negative evaluation, inflated responsibility, and agoraphobic cognitions), and disorder symptoms (i.e., generalised anxiety disorder, social anxiety, and obsessive compulsive disorder). These results contribute to a sizeable body of research indicating that IU is associated with a host of other vulnerabilities and a broad range of disorder symptomology and, therein, lend support to conceptualisations of IU as transdiagnostic and a general vulnerability for anxiety (Carleton, 2012; Gentes & Ruscio, 2011; Hong & Cheung, 2015; Mahoney & McEvoy, 2012c). Contrary to our hypothesis, when disorder-specific IU-PD and agoraphobic cognitions were taken into account, trait IU did not have a direct effect on panic disorder. This is inconsistent with research demonstrating direct effects and associations between IU and panic symptoms (Boswell et al., 2013; Carleton et al., 2014); however, it is important to note that these studies only assessed trait IU, but not disorder-specific IU, within the context of panic disorder. Our findings align with prior work that examines both trait and disorder-specific IU in panic symptoms and that suggests that trait IU has lesser influence than disorder-specific IU on panic disorder relative to other disorders (Mahoney & McEvoy, 2012b; Thibodeau et al., 2015). Our findings suggest that a core cognitive maintaining factor for panic disorder may be a disorder-specific uncertainty about the potentially catastrophic consequences of one's bodily sensations and physical symptoms, rather than a more generalised trait IU.

Each disorder-specific IU subscale was found to predict its concordant disorder-specific vulnerabilities and disorder symptoms with the exception of IU-GAD. Trait IU but not disorder-specific IU-GAD predicted generalised anxiety disorder symptoms. A possible explanation for this finding is that the measure of disorder-specific IU-GAD assesses broad uncertainty (i.e., uncertainty about everything), and therefore it may not account for unique variance beyond that captured by the IUS-12 which is a measure of general trait IU. Nevertheless, these findings extend prior work suggesting that IU has disorder-specific facets

and that context may be a critical component of perceiving and responding to uncertainty, and perhaps more so for disorders other than generalised anxiety disorder (Jensen & Heimberg, 2015; Mahoney & McEvoy, 2012b; Thibodeau et al., 2015). The results revealed that the relative contributions of trait IU and disorder-specific IU to symptoms varied; trait IU had stronger associations with symptoms of generalised anxiety disorder and obsessive compulsive disorder, whereas disorder-specific IU was found to be a stronger predictor of symptoms of social anxiety and panic disorder. These findings are highly consistent with previous research investigating the generalisability of IU to various emotional disorder symptoms (Mahoney & McEvoy, 2012b; Thibodeau et al., 2015). This study extends our knowledge of the direct and indirect role of trait and disorder-specific IU to disorder symptoms beyond key disorder-specific cognitive vulnerability factors.

Each disorder-specific vulnerability factor significantly predicted concordant emotional disorder symptoms (e.g., fear of negative evaluation predicted social anxiety disorder). These results converge with the original conceptual models of each disorder that underscore the primacy of key disorder-specific variables in predicting symptoms (Goldstein & Chambless, 1978; Rapee & Heimberg, 1997; Salkovskis, 1985; Wells, 2005). In contrast, inflated responsibility did not emerge as a significant predictor of obsessive compulsive symptoms. This finding differs from past work that attests to the central role of responsibility in obsessive compulsive disorder symptoms (Shafran, 1997; Smári & Hólmsteinsson, 2001; Taylor et al., 2010), but it is broadly consistent with studies that have found responsibility does not uniquely contribute to symptoms when taking into account additional belief domains (Gwilliam, Wells, & Cartwright-Hatton, 2004; Myers et al., 2008; Myers & Wells, 2005). Our findings suggest that if individuals are able to tolerate uncertainty in general and with respect to obsessive compulsive concerns, then they may not need to assume responsibility for preventing harm. Thus, IU may have a more primary role in obsessive compulsive disorder symptoms than responsibility. While there are inconsistencies in the literature regarding the role of different belief domains in obsessive compulsive symptoms, other research highlights the primacy of metacognitive beliefs (e.g., importance and control of thoughts; Myers et al., 2008; Myers & Wells, 2005). Thus, the relative independent contribution of IU and other metacognitive beliefs to obsessive compulsive symptoms requires further exploration.

In addition to its direct effect on symptoms, trait IU was also found to have a modest indirect effect on emotional disorder symptoms. As the current study was cross-sectional causal inferences cannot be made, nonetheless the pattern of significant indirect effects provides some initial empirical evidence that trait IU may influence disorder symptoms

through its effect on disorder-specific IU (i.e., IU-SAD, IU-OCD, and IU-PD) and disorder-specific vulnerabilities (i.e., negative metacognitions, fear of negative evaluation, and agoraphobic cognitions). Furthermore, indirect effects also indicated that panic and social anxiety-related disorder-specific IU may also increase the risk of agoraphobic cognitions and fear of negative evaluation, respectively. For example, trait IU may influence or interact with disorder-specific social-evaluative IU (e.g., uncertainty about the thoughts of others in social situations), and reinforce negative beliefs about social catastrophe (e.g., *"I am afraid that others will not approve of me"*, *"I often worry that I will say or do wrong things"*) and, in turn, social anxiety symptoms. Similarly, panic-related IU (e.g., uncertainty about the implications of a physical sensation) may reinforce agoraphobic cognitions (e.g., "*I am going to pass out*", "*I will have a heart attack*") and, in turn, panic symptoms. Together, these findings support the conceptualisation of disorder-specific IU as a proximal and unique pathway between trait IU and particular disorder symptoms (e.g., panic disorder; Thibodeau et al., 2015), and highlight the need to incorporate IU into models of psychopathology.

These findings also have clinical implications. IU is posited to be a potential transdiagnostic treatment target (Boswell et al., 2013; Dugas & Ladouceur, 2000), and more recently, a transtherapy mechanism (McEvoy & Erceg-Hurn, 2016). The robust relationships found in this study highlight the potential value of explicitly incorporating IU into treatment protocols. Cognitive-behavioural or exposure-based interventions with the aim of restructuring beliefs about or building tolerance of uncertainty may be of benefit. Our findings suggest that individuals with generalised anxiety disorder may benefit from challenging thoughts about uncertainty in general, whereas individuals with panic disorder may require a focus on uncertainty about the potential implications of physical sensations. For example, traditional interventions target the threat-appraisal (e.g., "my chest tightness is a definite sign of a heart attack") via methods such as interoceptive exposure (e.g., Andrews et al., 2003). Our findings suggest that it may be important to explicitly and directly target tolerance of the inherent uncertainty about the meaning of physical symptoms for individuals with panic disorder. For instance, clients may be encouraged to acknowledge that a heart attack is only one of many potential outcomes of the physical symptom, consider more benign alternatives, and/or acknowledge that we cannot be completely sure about the correct interpretation. The focus would then shift to strengthening clients' capacity to adopt a more curious stance towards their ability to manage the uncomfortable physical and emotional symptoms associated with this uncertainty. The goal in therapy would shift from immediately seeking certainty about the meaning of a particular symptom to building acceptance and tolerance for

uncertainty. Our results suggest that for individuals with social anxiety disorder and obsessive compulsive disorder, targeting general and disorder-specific IU in therapy may be complementary and additive. Interestingly, the fact that inflated responsibility did not have a direct effect on obsessive compulsive disorder symptoms after controlling for trait and disorder-specific IU invites the intriguing speculation that, if individuals can tolerate uncertainty related to their obsessions, then they do not tend to assume responsibility for preventing their feared outcomes. This finding suggests that targeting IU may be more critical in obsessive compulsive disorder than responsibility. Future intervention studies are required to verify these possibilities.

The current findings should be interpreted with study limitations in mind, which also offer additional avenues for future research. Although SEM incorporates directional hypotheses, the cross-sectional design precludes causal inferences. Future research in this area would benefit from experimental, longitudinal, and treatment studies. It is important to note that the model rejected the null hypothesis for an exact fit and that while the fit indices were good there was room for improvement. An issue in SEM is the possibility of alternative models and while the modification indices suggested improvements could be made we opted to accept our current model. Researchers recommend that modifications be based on statistical and theoretical considerations (Bryne, 2012); as such, the suggested modifications were not deemed theoretically defensible. Further research is warranted to replicate, extend, and explore improvements to the model. Although research supports the dimensional conceptualisation of anxiety constructs and thus we aimed to obtain a comprehensive range of severity scores (Carleton, Weeks, et al., 2012; Sexton et al., 2003), future research needs to examine whether the current results generalise to other community samples as well as clinical populations. Consistent with research in this area, we relied solely on subjective self-report data and future studies should aim to employ multi-method approaches (e.g., clinical interviews; Hong, 2013). A related limitation is that this study did not include specific items to assess for respondent carelessness and/or fatigue. This study extended extant research by investigating a comprehensive set of vulnerabilities as well as disorder-specific factors. The disorder-specific cognitive vulnerabilities were selected on the basis that they are key maintaining factors in contemporary cognitive theories for each disorder. However, it is important to acknowledge that additional factors within each theory were not assessed and were therefore excluded from the model. Future research should investigate the contribution that trait and disorder-specific IU make to the prediction of disorder symptoms beyond other maintaining vulnerability factors included within these models. Incorporating additional

symptom and intermediary variables (e.g., avoidance, anxiety sensitivity) is critical for increasing our understanding of how common and distinct mechanisms interact to influence multifinality and divergent trajectories to emotional disorders.

Notwithstanding these limitations, the current study makes an important contribution to the emotional disorder literature by examining the role of distal transdiagnostic and more proximal disorder-specific vulnerabilities. The results of this study indicate different pathways from uncertainty to anxiety, with trait IU representing a general anxiety vulnerability that influences disorder-specific IU, as well as a range of other disorder-specific vulnerabilities and emotional disorder symptomology. Indirect effects highlight the significance of differentiating between trait and disorder-specific manifestations of IU. Delineating the mechanisms by which IU exerts influence on psychopathology presents an important avenue for theoretical and clinical advancement.

Chapter 5 (Study 4): Intolerance of Uncertainty and Decision-Making: An Experimental Manipulation

5.1. Introduction

Despite the growing body of research that indicates the significant role of IU in psychopathology, there has been a predominant reliance on cross-sectional research and self-report measures to assess IU. Chapters 3 and 4 of this thesis have reported studies using an individual differences approach to investigate the structure of IU as measured by the IUS-12, and relationships between trait IU, disorder-specific IU, and symptoms of multiple emotional disorders. Self-report measures of IU and symptoms are informative for theory development and to increase our understanding of purported relationships between constructs of interest. However, they are limited by potential demand effects and common method variance, which may inflate associations between psychological constructs. Experimental methods are also required to build the case for causal relationships between constructs. To build on knowledge from Studies 2 and 3 reported in previous chapters, this thesis will turn now to an experimental test of the relationships between trait IU, disorder-specific IU, and emotional disorder symptoms.

There has been an increase in experimental studies examining associations between IU, cognitive, emotional, and behavioural reactions, and performance across behavioural tasks or in vivo stressors that involve ambiguity or uncertainty (e.g., responses on a keyboard typing task or gambling task, identifying grammatical errors in checking tasks; Faleer et al., 2017; Luhmann et al., 2011; Rosen et al., 2010; Thibodeau et al., 2013). Oglesby and Schmidt (2017) reported an association between trait IU and increased state anxiety when faced with an uncertain threat (i.e., prospect of giving a speech) and found that inconsistent with core IU theory, for individuals with high IU there was no significant difference in anxiety between a prospective uncertain and certain threat. Estimates of perceived cost or likelihood of threat were not included, and therefore the authors speculated that the prospect of a speech may have been highly threatening, which may heighten anxiety regardless of uncertainty (Oglesby & Schmidt, 2017). Moreover, in low threat situations, uncertainty may increase anxiety and emotional reactions to decision-making tasks as well as the desire to partake in safety behaviours (Jacoby et al., 2014; Reuman et al., 2015). IU and threat are closely related (Grupe & Nitschke, 2013), but the results of a recent study suggest that IU can occur across a range of personally salient situations, even those that are considered to be non-threatening (Pepperdine et al., 2018). Research is needed to examine the interactions between IU and

threat perception ratings and the influence on behaviour and anxiety (Oglesby & Schmidt, 2017; Shihata et al., 2016).

Research has sought to examine the correlates, predictors, and moderators of IU and the decision-making process that occurs in the context of IU to improve understanding of the links between the impact of uncertainty, maladaptive behaviour, and anxiety (Jacoby et al., 2017). Researchers suggest that IU may contribute to heightened worry by elevating threat perceptions, such that higher IU may result in increased estimates of probability (i.e., overestimations of the likelihood of negative outcomes) and cost (i.e., overestimations of the consequences of negative outcomes; Dugas, Buhr, et al., 2004). Moreover, decision-making processes are suggested to be implicated in the experience of anxiety (Maner & Schmidt, 2006) and links between IU and decision-making have been evidenced (Jensen et al., 2014; Luhmann et al., 2011). To investigate the relationships between IU and decision-making behaviour, a number of studies have used a probabilistic decision-making task that involves deciding from which jar a series of different coloured beads are being drawn (Beads Task; Jacoby et al., 2014; Jacoby et al., 2016). IU is thought to be associated with the number of beads needed to be drawn prior to feeling certain enough about making a decision, the time taken to decide, and self-reported distress. However, the associations between IU and performance on the beads task are mixed. Some research indicates a relationship between self-reported IU and draws to reaching a decision across both a non-clinical (Ladouceur et al., 1997) and a clinical anxiety disorder sample (Jacoby et al., 2014). It is important to note that Ladouceur et al. (1997) reported an association between IU scores and draws to decision in an intermediate state of uncertainty or task level, suggesting that moderate uncertainty levels most clearly distinguish between individuals with high and low IU. Moreover, individuals with bulimia nervosa requested more beads prior to making a decision than a healthy control group in an intermediate uncertainty task level (Sternheim, Startup, et al., 2011).

To increase the inherent uncertainty in the task and improve its ecological validity, Jacoby et al. (2016) modified the task by using a 50:50 probabilistic ratio of coloured beads and paired an incorrect decision with an aversive outcome (i.e., a cold pressor task which involves submerging one's hand in a cooler of cold ice water). Accordingly, relative to prior research (Jacoby et al., 2014), the modified procedure resulted in heightened reports of distress, perceived importance of answering correctly, and uncertainty about their decision (Jacoby et al., 2016). Jacoby et al. (2017) further modified the paradigm to examine the impact of obsessive compulsive disorder characteristics including obsessional fears of responsibility for harm to oneself versus to someone else on task performance. Individuals

responsible for incorrect decisions and potential harm befalling someone else reported elevated distress and perceived task importance relative to those who completed the task alone (i.e., without responsibility). There were no group differences in the number of beads requested before making a decision or uncertainty about their decision, suggesting that participants in both conditions reported feeling relatively uncertain about their decision, and that fears of responsibility for harm to oneself versus others does not appear to make a difference in terms of behavioural responses (Jacoby et al., 2017). Further, Jacoby et al. (2017) reported a non-significant association between IU and draws to decision, which is consistent with prior research using a clinical eating disorder sample (Sternheim, Startup, et al., 2011). Taken together, this research indicates a link between IU, uncertainty, and distress in decision-making tasks across different contexts; however, no studies have examined task performance within the context of specific concerns and characteristics related to anxiety disorders other than obsessive compulsive disorder.

Building upon the work by Jacoby and colleagues (Jacoby et al., 2014; Jacoby et al., 2017), the task and behavioural paradigm could be modified to focus on specific idiosyncratic concerns relevant to social anxiety disorder. Researchers have highlighted the value in examining the effects of experimental manipulations on both general beliefs about IU as well as disorder-specific beliefs (Faleer et al., 2017). A key aspect of social anxiety disorder is the fear of negative evaluation and performance evaluation (Rapee & Heimberg, 1997; Stein & Stein, 2008). Prior research using the Beads Task has focused on responsibility for harm in obsessive compulsive disorder (Jacoby et al., 2017), but an additional key aspect of obsessive compulsive disorder includes concerns about being contaminated (Salkovskis & Forrester, 2002; Stein, 2002). As such, the aim of the current study was to investigate the effects of varying threat (uncertain threat versus certain threat) and context (social and performance evaluation versus contamination and responsibility) on Beads Task performance (i.e., draws to decision, time to decide, and distress). Using the Beads Task as an analogue for decisional uncertainty in anxiety disorders, each context was designed to increase perceived task importance and distress. Manipulating the certainty of a threat allows for a test of core IU theory, that is, to examine whether task performance is influenced by the prospect of an uncertain versus certain threat. It was hypothesised that participants in the uncertain threat condition, and participants with higher disorder-specific IU relevant to the context (social anxiety-related IU in a social-evaluative context; obsessive compulsive-related IU in a contamination context), would report more draws to decision, time to decide, and higher distress relative to participants in the certain threat condition and with lower levels of

disorder-specific IU, respectively. It was also hypothesised that these relationships would remain significant after controlling for trait IU and perceived cost of threat.

5.2. Method

5.2.1. Participants

Participants were undergraduate psychology students (n = 130) recruited through the university's research participant pool and individuals from the community (n = 7) recruited through an online experiment database (SONA). Data from one community participant was removed from the analysis as they told the researcher they did not want to be recorded during the task as part of the social and performance evaluation context. Thus, the final sample size consisted of 136 participants aged between 17 and 62 years (M = 22.43; SD = 7.432; 72% female). An a priori power analysis using G*Power 31.92 (Faul, Erdfelder, Lang, & Buchner, 2007) with an alpha level of .05, an auto-correlation of .05, and three measurement occasions revealed that a total of 100 participants were required for an 80% chance of detecting an interaction effect that was low to moderate (f = .10 to .25).

5.2.2. Measures

5.2.2.1. Intolerance of Uncertainty Scale, Short Form (IUS-12; Carleton, Norton, et al., 2007). See Chapter 3 (page 40) for a description of the IUS-12.

5.2.2.2. Disorder-Specific Intolerance of Uncertainty Scale (DSIU; Thibodeau et al., 2015). See Chapter 4 (page 64) for a description of the DSIU. The disorder-specific IU scales for social anxiety disorder (IU-SAD; "I get anxious when I'm not sure how a social interaction will turn out") and obsessive-compulsive disorder (IU-OCD; "When I'm not sure if I did something right, I will do it again until it feels right") were used in this study.

5.2.2.3. State-Trait Anxiety Inventory for Adults-Form Y (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The 40-item STAI is a widely used measure designed to assess trait and state anxiety. The STAI Form Y is a revised version of the original STAI Form X, which has demonstrated improved psychometric properties (Thibodeau et al., 2013). The STAI comprises two 20-item subscales pertaining to state anxiety (STAI-S; feelings at the time of a perceived threat) and trait anxiety (enduring disposition to stress). This study used the STAI-S subscale as a measure of state anxiety. Participants indicated the extent to which each item was consistent with their current feelings on a scale ranging from *not at all* (1) to *very much so* (4). Scores on the state anxiety subscale range from 1 to 80, with higher scores signifying higher levels of state anxiety. An example of an item is "I am tense".

Evidence of good internal consistency for the total scale and subscales, and convergent and discriminant validity of the STAI has been provided (Kogan, Edelstein, & McKee, 2000).

5.2.3. Procedure

Participants were recruited from the SONA online experiment database to participate in a study of "Individual Differences and Decision-Making". The study took approximately 30 minutes to complete and each participant was tested individually. Prior to their arrival at the laboratory, participants were randomised to either the certain or uncertain threat condition via a computerised random-number generator. Participants completed the Beads Task in both contexts (social and performance evaluation context, contamination and responsibility context), which were counterbalanced. Two rooms each with a computer, desk, and chair were set up for each context. In the social and performance evaluation context, a webcam was set up to demonstrate to participants that their image was being recorded while they completed the task. In the contamination and responsibility context, two ostensibly "used" tissues were placed on the desk and a bin of "used" tissues were located to the right next to the participant's chair. Upon arrival to the lab, participants were informed that they would be completing a questionnaire battery and a computer-based decision-making task. Participants were given a unique identification code to de-identify their responses. Once participants entered the room, the researcher conducted the appropriate manipulation depending on context and as per the information outlined below. The experimental manipulation consisted of verbal information designed to manipulate the certainty of the threat. The content of the information was based on concerns or fears that characterise social anxiety disorder (e.g., social and performance evaluation) and obsessive compulsive disorder (e.g., contamination and inflated responsibility beliefs). Two single-item visual analogue scale measures were designed to assess estimates of the perceived probability and cost of threat relevant to each context. Participants responded to each item by dragging their cursor along a scale ranging from *not at all* (0) to *very much* (100).

5.2.3.1. Manipulation for the uncertain threat condition.

5.2.3.1.1. Social and performance evaluation context. In this condition, participants were told "Your performance on the Beads Task may be evaluated by a panel of your peers within psychology tutorials on decision-making. We do not need everyone, so we will be randomly selecting half of our participants for this purpose later, so I cannot tell you whether you will or will not be evaluated. If your performance is chosen, it will be ranked relative to

other participants and feedback will be provided about your ranking. Also, your performance on this part of the task will be recorded."

5.2.3.1.2. Contamination and responsibility context. In this condition, participants were told "The person using the same computer before you had a bad cold. I usually wipe down the computer, but I cannot recall whether or not I did it this time. Anyways, for now complete the Beads Task and you can wash your hands later if you want to be sure. I only have one hand-wipe left that you can use afterwards, but there just will not be any more for the next participant. But it might be okay, because depending on your performance I might not need any more participants today anyway."

5.2.3.2. Manipulation for the certain threat condition.

5.2.3.2.1. Social and performance evaluation context. In this condition, participants were told "Your performance on the Beads Task will be evaluated by a panel of your peers within psychology tutorials on decision-making. Your performance will be ranked relative to other participants and feedback will be provided about your ranking. Also, your performance on this part of the task will be recorded."

5.2.3.2.2. Contamination and responsibility context. In this condition, participants were told "The person using the same computer before you had a bad cold. I usually wipe down the computer, but I did not get a chance to wipe it down. Anyways, for now complete the Beads Task and you can wash your hands later. I only have one hand-wipe left that will be okay for you to use afterwards, but it is important that you focus on your performance. There just will not be any more for the next participant. Anyways for now complete the Beads Task and you can wipe your hands afterwards if you want to."

5.2.3.3. Manipulation-check questions.

5.2.3.3.1. Social and performance evaluation context. The items were: (1) While you were completing the video-recorded Beads Task, how likely did you think it would be that your performance would be chosen to be evaluated by your peers (likelihood)?, and (2) If you knew that your performance was definitely going to be evaluated by your peers, how concerned would you be (cost)?

5.2.3.3.2. Contamination and responsibility context. The items were: (1) While you were completing the Beads Task after the person with the cold, how likely did you think it was that you would catch the previous participant's cold (likelihood)?, and (2) If you knew that you were definitely going to catch the previous participant's cold, how concerned would you be (cost)?

Following the manipulation, the researcher exited the room and participants completed demographic information, the IUS-12, and then the DSIU scale (IU-SAD and IU-OCD). The researcher then re-entered the room and the participant was instructed to begin the Beads Task.

5.2.3.4. The Beads Task (Huq, Garety, & Hemsley, 1988; Jacoby et al., 2014; Phillips & Edwards, 1966). The version of the Beads Task used in this study was the same as that used and described in previous research by Jacoby et al. (2014). The computerised task consists of three difficulty or uncertainty levels, which differ based on proportions of bead colours. The easy or low uncertainty version consists of two jars with an 85:15 blue to red versus 85:15 red to blue ratio. The intermediate uncertainty version consists of two jars with a 60:40 purple to green versus a 60:40 green to purple ratio. The difficult or high uncertainty version consists of three jars with a 44:28:28 orange to yellow to pink versus 44:28:28 yellow to pink to orange versus 44:28:28 pink to orange to yellow ratio. The maximum possible number of beads that could be requested prior to making a decision was 30, which is consistent with the methods of previous studies (Jacoby et al., 2014; Sternheim, Startup, et al., 2011). The sequences of beads in the three uncertainty or difficultly levels (easy, intermediate, and difficult) are presented below. As reported by Jacoby et al. (2014), for the easy and intermediate conditions the first 20 beads presented are modelled after Garety et al. (2005), and the remaining bead sequences were based on the results of a random number generator.

Low uncertainty condition (easy; 85 red [R]: 15 blue [B])
Mostly red – RRRBRRRBRRRBRRBRRRRRRBRRRBRRRR

Intermediate uncertainty condition (intermediate; 60 purple [P]; 40 green [G])
Mostly purple – PGGPPGPPPGPPPPGGPGGPPGGPGGPPPP

High uncertainty condition (difficult; 44 orange [O]; 28 yellow [Y]; 28 pink [P])
Mostly orange – POOYYPOYOYYPOPOOPPOYPOYOOOPYYO

The beads from the previous trials were displayed at the bottom of the computer screen for all participants to view to reduce the influence of memory bias. The researcher recorded the number of beads the participants requested prior to reaching a decision (i.e., draws to decision), the time taken to make the decision, and the accuracy of the decision. A practice version was completed first to ensure participants understood the task and to enable familiarity with the probabilistic rules of the task. The participants then completed the easy,

intermediate, and difficult versions of the task, presented in a randomised counterbalanced order.

Following each difficulty level of the Beads Task, participants completed a series of four visual analogue scale questions that ranged from *not at all* (0) to *very much* (100). The four questions were: (1) How certain are you about your decision?, (2) How distressed do you feel right now?, (3) How confident do you feel about your decision?, and (4) How important is it for you to get the answer right?. The task was completed with the aid and presence of the researcher to increase task reliability (Jacoby et al., 2014).

Upon completion of all three levels of the Beads Task, the researcher exited the room and participants were instructed to complete the STAI-S and the manipulation-check questions (i.e., estimates of perceived probability and cost of threat for the social and performance evaluation context and the contamination and responsibility context). Participants notified the researcher when they had completed the questionnaires. The researcher and participant then moved to the second room that was set up for exposure to the alternative context and the appropriate manipulation was conducted. Participants then completed the Beads Task and the associated visual analogue scale questions a second time. The researcher then exited the room while participants completed the STAI-S and the manipulation-check questions. Following completion of the study, participants received debrief information and course credit for their participation. Community participants received $15 for their participation. Prior to the commencement of this study, approval was obtained by the institution's human research ethics committee (approval number HR34/2015; see Appendix E).

5.2.4. Data Analysis

Analyses and data screening were conducted in SPSS version 24.0. Independent samples *t* tests were conducted to examine group differences on self-report measures of trait IU and disorder-specific IU, and Beads Task outcomes. Given the findings of prior research, performance on the intermediate task level was of focus in this study. Generalised linear mixed models (GLMM) were implemented using the GENLINMIXED procedure. Each context (social and performance evaluation, and contamination and responsibility) was examined independently to investigate the effects of threat condition (certain versus uncertain), cost estimates, trait IU, and disorder-specific IU (i.e., disorder-specific IU-SAD in the social and performance evaluation context; disorder-specific IU-OCD in the contamination and responsibility context). The GLMMs included participants as a nominal

random factor, and the following fixed within-subject factors: cost estimates for the relevant context; and the IU-relevant independent variable (disorder-specific IU-SAD or disorder-specific IU-OCD, IUS-12 total score). A GLMM was conducted for each of the outcome variables associated with the Beads Task (i.e., draws to decision, time taken to decide, and distress). Cost estimates and the IU-relevant variables were entered as continuous variables in each GLMM. The main effects and interaction effects of disorder-specific IU and cost estimates on draws to decision, time to decide, and distress were investigated. The analyses were then re-run controlling for the main effect of trait IU and its interaction with cost estimates. The use of GLMM was preferred over the traditional least squares analysis of variance (ANOVA) approach as it is robust against violations of normality, linearity, and homogeneity of variance (Stroup, 2012). Partial eta-square was used as indices for effect sizes with regards to the main effects and interaction effects. Partial eta-square values of .01, .06, and .14 represent small, medium, and large effect sizes, respectively.

5.3. Results

5.3.1. Preliminary Analyses

Descriptive statistics including means (and standard deviations), ranges, and internal consistency estimates for self-report measures and Beads Task outcomes are reported in Table 3.1. Assumptions of normality were met as evidenced by acceptable skewness and kurtosis values (Tabachnick & Fidell, 2013). There was one univariate outlier on distress (z scores > 3.29), and four univariate outliers on time to decide (z scores > 3.29). GLMMs were run with and without adjusted outliers and the pattern of significance did not change, therefore only results using the total sample are reported. No influential multivariate outliers were identified.

The results of independent samples t tests comparing across certain and uncertain threat conditions indicated that there were no significant group differences on measures of trait IU or disorder-specific (IU-SAD, IU-OCD), or Beads Task outcomes (draws to decision, time to decide, distress, certainty about decision, and perceived task importance). Group mean scores and difference tests on the self-report measures and Beads Task outcomes are presented in Table 3.2.

Table 3.1. *Descriptive Statistics and Cronbach's Alpha (α) for Study Measures (N = 136)*

	Mean (*SD*)	Range	α
IUS-12	30.54 (7.74)	12-47	.87
Prospective IU	19.26 (4.66)	7-29	.79
Inhibitory IU	11.29 (4.06)	5-22	.84
IU-SAD	4.75 (2.99)	0-12	.86
IU-OCD	5.02 (2.55)	0-11	.78
Social and Performance Evaluation Context			
Beads Task Outcomes			-
Draws to Decision	14.24 (7.61)	4-30	-
Time to Decide	18.76 (10.69)	4-71	-
Distress (0-100)	15.54 (18.39)	0-70	-
Importance (0-100)	44.47 (28.15)	0-100	-
Certainty (0-100)	63.62 (19.43)	9-100	
Contamination and Responsibility Context			
Beads Task Outcomes			
Draws to Decision	13.84 (7.57)	3-30	-
Time to Decide	17.37 (9.56)	4-63	-
Distress (0-100)	13.54 (17.68)	0-86	-
Importance (0-100)	43.28 (28.67)	0-100	-
Certainty (0-100)	62.96 (20.66)	8-100	-

Note. SD = standard deviation; IUS-12 = Intolerance of Uncertainty Scale, Short Form; IU = intolerance of uncertainty; SAD = social anxiety disorder; OCD = obsessive compulsive disorder.

Further, there were no significant group differences between the certain and uncertain threat conditions with regards to their probability estimates across the social and performance evaluation context and the contamination and responsibility context (see Table 3.2). These results suggest that although participants in both groups (certain and uncertain threat) reported being relatively uncertain, the manipulation was not successful at generating differential certainty across conditions. Threat condition was therefore not included as an independent variable in further analyses. Pearson bivariate correlations between trait IU, disorder-specific IU, and Beads Task outcomes within each context are presented in Table 3.3. Trait IU and inhibitory IU were significantly correlated with distress across both contexts. IU was correlated with cost estimates across both contexts, while disorder-specific IU-SAD was correlated with cost estimates in the social and performance evaluation context. Disorder-specific IU-OCD was not associated with Beads Task outcomes, or probability and cost estimates.

Table 3.2. *Means (and Standard Deviations) and Differences between Threat Condition for IU, Beads Task Outcomes, and Perceived Probability and Cost of Threat Estimates*

	Threat Condition		
	Certain Threat (n = 68)	Uncertain Threat (n = 68)	Independent $t(df)$
IUS-12	31.22 (7.93)	29.87 (7.55)	
Prospective IU	19.59 (4.54)	18.93 (4.78)	-.83 (134)
Inhibitory IU	11.63 (4.24)	10.94 (3.87)	-.99 (134)
IU-SAD	4.75 (2.97)	4.75 (3.04)	.00 (134)
IU-OCD	4.93 (2.62)	5.12 (2.49)	.44 (134)
Social and Performance Evaluation Context			
Beads Task Outcomes			
Draws to Decision	14.09 (7.41)	14.40 (7.86)	.24 (134)
Time to Decide	17.94 (9.58)	19.59 (11.70)	.90 (134)
Distress	17.41 (19.49)	13.68 (17.15)	-1.19 (134)
Importance	44.51 (29.58)	44.43 (26.86)	-.02 (134)
Certainty	62.72 (19.97)	64.51 (18.97)	.54 (134)
Probability	49.13 (26.29)	44.06 (21.26)	-1.24 (134)
Cost	54.46 (31.52)	43.81 (30.11)	-2.01 (134)*
Contamination and Responsibility Context			
Draws to Decision	13.25 (6.62)	14.43 (8.43)	.91 (126.83)
Time to Decide	16.85 (8.51)	17.88 (10.55)	.63 (134)
Distress	13.91 (17.61)	13.16 (17.88)	-.25 (134)
Importance	43.50 (29.35)	43.06 (28.19)	-.09 (134)
Certainty	62.97 (20.43)	62.96 (21.05)	-.00 (134)
Probability	30.78 (25.41)	37.35 (25.47)	1.51 (134)
Cost	59.97 (30.40)	59.94 (29.28)	-.01 (134)

Note. IUS-12 = Intolerance of Uncertainty Scale, Short Form; IU = intolerance of uncertainty; SAD = social anxiety disorder; OCD = obsessive compulsive disorder.
*p < .05.

Table 3.3. *Correlations Between Trait and Disorder-Specific IU and Decision-Making Behaviour and Distress*

Beads Task Outcomes	IU	Prospective IU	Inhibitory IU	IU-SAD	IU-OCD
Social and Performance Evaluation Context					
Draws to Decision	.08	.07	.07	.10	-.04
Time to Decide	.08	.05	.10	.12	.11
Distress	.20*	.15	.21*	.11	.08
Importance	.13	.14	.08	.01	.13
Certainty	.03	.06	-.01	-.13	.12
Probability	-.10	-.07	-.10	-.09	-.09
Cost	.31***	.25**	.30***	.32***	< .01
Contamination and Responsibility Context					
Draws to Decision	.10	.08	.11	.05	< -.01
Time to Decide	.09	.04	.12	.04	-.01
Distress	.20*	.11	.24**	.10	.08
Importance	.09	.14	.02	-.06	.11
Certainty	.06	.09	.02	-.01	.14
Probability	.13	.12	.10	.02	< .01
Cost	.17*	.21*	.08	.02	.06

Note. IU = intolerance of uncertainty; SAD = social anxiety disorder; OCD = obsessive compulsive disorder.
*p < .05. **p < .01. ***p < .001.

5.3.2. Generalised Linear Mixed Models

5.3.2.1. Social and performance evaluation context.

5.3.2.1.1. Draws to decision. There was a significant small to medium main effect of disorder-specific IU-SAD, $F(1, 132) = 6.85$, $p = .010$, $\eta^2 = .05$, and cost estimates, $F(1, 132) = 13.23$, $p < .001$, $\eta^2 = .09$. The analysis revealed a significant medium two-way interaction of disorder-specific IU-SAD and cost estimates, $F(1, 132) = 9.07$, $p = .003$, $\eta^2 = .06$. For follow-up comparisons and further examination of significant interaction effects, cost estimates for each context were dichotomised via a median split (high versus low). Follow-up analyses revealed a significant large main effect of disorder-specific IU-SAD, $F(1, 66) = 11.95$, $p < .001$, $\eta^2 = .15$, on draws to decision when cost estimates were categorised as low. The small main effect of disorder-specific IU-SAD was non-significant when cost estimates were categorised as high, $F(1, 66) = 3.00$, $p = .088$, $\eta^2 = .04$,. This interaction reflected that higher levels of disorder-specific IU-SAD were associated with higher draws to decision when cost estimates were low ($r = .40$, $p = .001$). Disorder-specific IU-SAD was not significantly associated with draws to decision when cost estimates were high ($r = -.19$, $p = .115$). This suggests that when the perceived cost of social evaluation was high, draws to decision was

similar for individuals who were high and low on disorder-specific IU-SAD. However, when perceived cost of social evaluation was low, individuals high on disorder-specific IU-SAD required more beads before making a decision than those low on disorder-specific IU-SAD. The pattern of significant effects remained the same after controlling for disorder-specific IU-OCD (all *p*s > .05) as well as after controlling for context order (i.e., whether participants were exposed to the social and performance evaluation context first or the contamination and responsibility context first; all *p*s > .05).

However, after controlling for trait IU, $F(1, 130) = 1.96$, $p = .164$, $\eta^2 = .02$, the main effect of disorder-specific IU-SAD was non-significant and small, $F(1, 130) = 2.49$, $p = .117$, $\eta^2 = .02$. There was a significant medium main effect of cost estimates, $F(1, 130) = 8.28$, $p = .005$, $\eta^2 = .06$. The two-way interactions between disorder-specific IU-SAD and cost estimates, $F(1, 130) = 2.74$, $p = .100$, $\eta^2 = .02$, and trait IU and cost estimates, $F(1, 130) = 2.82$, $p = .096$, $\eta^2 = .02$, were non-significant and small. After taking into account trait IU, disorder-specific IU-SAD no longer differentially influenced draws to decision at high and low levels of perceived cost.

5.3.2.1.2. Time to decide. There was a significant small main effect of disorder-specific IU-SAD, $F(1, 132) = 7.00$, $p = .009$, $\eta^2 = .05$, and cost estimates, $F(1, 132) = 5.47$, $p = .021$, $\eta^2 = .04$. The analysis revealed a significant small two-way interaction of disorder-specific IU-SAD and cost estimates, $F(1, 132) = 7.72$, $p = .006$, $\eta^2 = .06$. Follow-up analyses revealed a significant medium main effect of disorder-specific IU-SAD on time to decide when cost estimates were categorised as low, $F(1, 66) = 7.23$, $p = .009$, $\eta^2 = .10$. The small main effect of disorder-specific IU-SAD was non-significant when cost estimates were categorised as high, $F(1, 66) = 0.96$, $p = .330$, $\eta^2 = .01$. This interaction reflected that higher levels of disorder-specific IU-SAD were associated with increased time to decide when cost estimates were low ($r = .35$, $p = .004$). Disorder-specific IU-SAD was not significantly associated with time to decide when cost estimates were high ($r = -.11$, $p = .372$). This suggests that when the perceived cost of social evaluation was high, time to decide was similar for individuals who were high and low on disorder-specific IU-SAD. However, when perceived cost of social evaluation was low, individuals high on disorder-specific IU-SAD required more time to decide than those low on disorder-specific IU-SAD. The pattern of significant effects remained the same after controlling for disorder-specific IU- OCD (all *p*s > .05) as well as after controlling for context order (all *p*s > .05).

After controlling for trait IU, $F(1, 130) = 0.20$, $p = .658$, $\eta^2 < .01$, the small main effect of disorder-specific IU-SAD remained significant, $F(1, 130) = 4.44$, $p = .037$, $\eta^2 = .03$.

The small main effect of cost estimates was non-significant, $F(1, 130) = 0.12$, $p = .735$, $\eta^2 < .001$. The two-way interaction of trait IU and cost estimates was non-significant and small, $F(1, 130) = 0.37$, $p = .546$, $\eta^2 < .01$. The two-way interaction of disorder-specific IU-SAD and cost estimates was significant and small, $F(1, 130) = 5.34$, $p = .022$, $\eta^2 = .04$.

5.3.2.1.3. Distress. The small main effect of disorder-specific IU-SAD on distress was non-significant, $F(1, 132) = 0.01$, $p = .945$, $\eta^2 < .001$. There was a significant medium main effect of cost estimates, $F(1, 132) = 10.09$, $p = .002$, $\eta^2 = .07$. The two-way interaction of disorder-specific IU-SAD and cost estimates was non-significant and small, $F(1, 132) = 0.06$, $p = .805$, $\eta^2 < .001$. The pattern of significant effects remained the same after controlling for disorder-specific IU- OCD (all *p*s < .05). After controlling for context order, there was a significant small three-way interaction of context disorder, disorder-specific IU-SAD, and cost estimates $F(1, 128) = 4.48$, $p = .036$, $\eta^2 = .03$. Follow-up analyses revealed a significant medium main effect of cost estimates when participants were exposed to the contamination and responsibility context first, followed by the social and performance evaluation context, $F(1, 63) = 8.17$, $p = .006$, $\eta^2 = .12$. When participants were exposed to the social and performance evaluation context first, followed by the contamination and responsibility context, the main effect of cost estimates was non-significant and small, $F(1, 65) = 2.53$, $p = .117$, $\eta^2 = .04$.

After controlling for trait IU, $F(1, 130) = 0.02$, $p = .893$, $\eta^2 < .001$, the small main effect of disorder-specific IU-SAD was non-significant, $F(1, 130) < .01$, $p = .963$, $\eta^2 < .001$. The small main effect of cost estimates was non-significant, $F(1, 130) = 0.58$, $p = .449$, $\eta^2 < .01$. The two-way interaction of disorder-specific IU-SAD and cost estimates, $F(1, 130) = 0.12$, $p = .732$, $\eta^2 < .001$, and trait IU and cost estimates, $F(1, 130) = 0.27$, $p = .606$, $\eta^2 < .01$, was non-significant and small.

5.3.2.2. Contamination and responsibility context.

5.3.2.2.1. Draws to decision. There was a non-significant main effect of disorder-specific IU-OCD, $F(1, 132) = 0.31$, $p = .576$, $\eta^2 < .01$, and cost estimates, $F(1, 132) = 0.30$, $p = .588$, $\eta^2 < .01$. The analysis revealed a non-significant two-way interaction of disorder-specific IU-OCD and cost estimates, $F(1, 132) = 0.51$, $p = .476$, $\eta^2 < .01$. The pattern of significant effects remained the same after controlling for disorder-specific IU- SAD (all *p*s > .05) as well as after controlling for context order (all *p*s > .05).

After controlling for trait IU, $F(1, 130) = 0.36$, $p = .551$, $\eta^2 < .01$, the small main effect of disorder-specific IU-OCD was non-significant, $F(1, 130) = 0.06$, $p = .802$, $\eta^2 < .001$. There was a non-significant small main effect of cost estimates, $F(1, 130) = 1.89$, $p = .172$, η^2

= .01. The two-way interaction of disorder-specific IU-OCD and cost estimates, $F(1, 130) = 0.01$, $p = .929$, $\eta^2 < .001$, and trait IU and cost estimates, $F(1, 130) = 1.96$, $p = .163$, $\eta^2 = .01$, was non-significant and small.

5.3.2.2.2. Time to decide. There was a small non-significant main effect of disorder-specific IU-OCD, $F(1, 132) = 0.58$, $p = .448$, $\eta^2 < .01$, and cost estimates, $F(1, 132) = 0.29$, $p = .590$, $\eta^2 < .01$. The analysis revealed a small non-significant two-way interaction of disorder-specific IU-OCD and cost estimates, $F(1, 132) = 0.82$, $p = .366$, $\eta^2 = .01$. The pattern of significant effects remained the same after controlling for disorder-specific IU- SAD (all *p*s > .05) as well as after controlling for context order (all *p*s > .05).

After controlling for trait IU, $F(1, 130) = 0.30$, $p = .583$, $\eta^2 < .01$, the small main effect of disorder-specific IU-OCD was non-significant, $F(1, 130) = 1.39$, $p = .241$, $\eta^2 = .01$. There was a small non-significant main effect of cost estimates, $F(1, 130) = 0.66$, $p = .419$, $\eta^2 = .01$. The two-way interaction of disorder-specific IU-OCD and cost estimates, $F(1, 130) = 2.29$, $p = .133$, $\eta^2 = .02$, and trait IU and cost estimates, $F(1, 130) = 1.70$, $p = .195$, $\eta^2 = .01$, was non-significant and small.

5.3.2.2.3. Distress. There was a non-significant small main effect of disorder-specific IU-OCD, $F(1, 132) = 0.08$, $p = .781$, $\eta^2 < .001$, and cost estimates, $F(1, 132) = 0.04$, $p = .839$, $\eta^2 < .001$. The analysis revealed a non-significant small two-way interaction of disorder-specific IU-OCD and cost estimates, $F(1, 132) = 0.81$, $p = .369$, $\eta^2 = .01$. The pattern of significant effects remained the same after controlling for disorder-specific IU- SAD (all *p*s > .05) as well as after controlling for context order (all *p*s > .05).

After controlling for trait IU, $F(1, 130) = 0.71$, $p = .402$, $\eta^2 = .01$, the small main effect of disorder-specific IU-OCD was non-significant, $F(1, 130) = 0.28$, $p = .601$, $\eta^2 < .01$. There was a non-significant main effect of cost estimates, $F(1, 130) = 0.01$, $p = .908$, $\eta^2 < .001$. The two-way interaction of disorder-specific IU-OCD and cost estimates, $F(1, 130) = 0.45$, $p = .506$, $\eta^2 < .01$, and trait IU and cost estimates, $F(1, 130) < .01$, $p = .973$, $\eta^2 < .001$, was non-significant and small.

5.4. Discussion

A substantial body of research supports the robust association between IU and a range of emotional disorders (Hong & Cheung, 2015; McEvoy & Mahoney, 2011); however, there is a paucity of experimental research examining the links between IU, decision-making, and emotional and behavioural responses to uncertainty. The present study aimed to examine the effects of varying threat and context on decision-making and distress. In line with recent

research, performance on the Beads Task was used as an experimental analogue for decision-making in the context of IU. Consistent with prior research, this study aimed to test a core aspect of IU theory wherein an uncertain event is more threatening or distressing than a certain threat and may reflect difficulties in functioning (Buhr & Dugas, 2002; Krohne, 1989; Oglesby & Schmidt, 2017). There were no significant group differences between participants in the uncertain and certain threat conditions on measures of trait IU and disorder-specific IU. Contrary to the hypothesis, there were no group differences between participants in the uncertain and certain threat conditions on Beads Task performance (i.e., draws to decision, time to decide, and self-reported distress). These findings contrast with Oglesby and Schmidt (2017), who found that trait IU was related to heightened anxiety when in an uncertain threat situation (i.e., the prospective of a speech was based on a coin toss). However, somewhat consistent with the findings from this study, Oglesby and Schmidt (2017) found no significant differences in anxiety among high IU individuals across uncertain and certain threat situations as well as no interaction between IU and uncertain and certain threat situations when predicting anxiety. Moreover, in the current study participants in both groups reported feeling relatively uncertain with regards to their estimates of the probability of threat (i.e., how likely they thought it would be that their performance would be evaluated, and how likely they thought it would be that they would catch a cold). This suggests that the intended manipulation across both contexts was not successful or powerful enough to yield differential effects on task performance or IU. Nonetheless, the findings relating to disorder-specific IU, cost, and Beads Task performance within the social-evaluative context were interesting and potentially informative.

Consistent with prior research using the Beads Task (Jacoby et al., 2014; Jacoby et al., 2016; Jacoby et al., 2017), IU was not significantly correlated with draws to decision or time to decide. However, the results of the mixed models revealed a significant effect of disorder-specific IU-SAD and cost estimates on draws to decision and time to decide in the social and performance evaluation context. The findings revealed that the interaction between disorder-specific IU-SAD and cost estimates was significant at low cost levels. This suggests that higher levels of disorder-specific IU-SAD are associated with more draws to decision and time to decide specifically when the cost of social evaluation is deemed low. Further, when the cost of social evaluation is categorised as high, it appears that participants request more draws to decision and take more time to decide regardless of trait IU and disorder-specific IU-SAD. As such, this may suggest that the role of IU is evident, and perhaps stronger, in situations that are considered to be of low threat. A low threat situation may be linked to

emotional responses and increased safety behaviours (e.g., time to decide, information seeking) through uncertainty-based reasoning (Reuman et al., 2015). Individuals with lower levels of IU and who perceive the cost of the situation to be low may be able to tolerate more uncertainty and make faster decisions. These findings somewhat draw parallel to the results of Reuman et al. (2015) who found that low-threat situations characterised by explicit uncertainty resulted in increased anxiety and urge to engage in safety behaviours. However, these findings should be interpreted with some degree of caution, particularly for draws to decision behaviour. After controlling for trait IU, the main effect of disorder-specific IU-SAD on draws to decision did not remain significant, and this may indicate that disorder-specific IU-SAD does not uniquely influence draws to decision on the Beads Task. Given the substantial proportion of shared variance between trait IU and disorder-specific IU, controlling for trait IU may leave little unique variance in disorder-specific IU with which to predict behaviour.

Consistent with prior research (Jacoby et al., 2014; Jacoby et al., 2016), IU was significantly correlated with distress during the task across both contexts. However, the GLMM results revealed no significant main effect of trait IU or disorder-specific IU on distress. Although there was a range in distress levels, the average ratings of distress endorsed across both contexts were relatively low. With regards to their estimates of the perceived cost of threat (i.e., how concerned they would be if there performance was evaluated, and how concerned they would be if they caught a cold), participants reported the contexts to be moderately threatening. Research suggests that uncertainty may make a situation of moderate threat more anxiety provoking for individuals with high IU (Ladouceur et al., 1997; Oglesby & Schmidt, 2017). Interestingly, there was a significant association between cost estimates and distress in the social and performance evaluation context. A possible interpretation of this finding is that IU may increase vulnerability to interpret situations as more threatening which, in turn, increases vulnerability to experiencing distress. Indeed, research demonstrates that the relationship between IU and worry is partially mediated by perceived threat (Bredemeier & Berenbaum, 2008).

The results revealed no significant main effects or interaction effects of trait IU, disorder-specific IU-OCD, and cost estimates on task performance in the contamination and responsibility context. Previous research examining the associations between IU and obsessive compulsive disorder symptoms found IU was associated with checking compulsions, ordering and arranging behaviours, and obsessional doubts about responsibility for harm (Calleo et al., 2010; Holaway et al., 2006; Jacoby, Fabricant, Leonard, Riemann, &

Abramowitz, 2013; Tolin, Brady, & Hannan, 2008; Tolin et al., 2003). Some studies have found that IU is not strongly related to the contamination symptom dimension, and that beliefs related to IU and perfectionism were not associated with performance on a contamination behavioural approach task (Fitch & Cougle, 2013; Jacoby et al., 2013); however, the findings are inconsistent (Abramowitz & Deacon, 2006; Calleo et al., 2010; Jensen & Heimberg, 2015). Jacoby et al. (2013) suggest that contamination concerns may be more strongly linked to other cognitive constructs such as disgust and overestimation of threat. This may help to explain the lack of associations found in this study between IU and task performance in the contamination and responsibility context.

It is important to note that the current study used a novel methodological paradigm for introducing a contamination-related obsessive-compulsive context. There was no evidence that this method did manipulate the variables it was designed to manipulate, and it is therefore not surprising that no significant effects were observed. The findings provide minimal indication about whether manipulating contamination and responsibility concerns and the certainty of threat (uncertain versus certain) differentially impacts on decision-making and distress for individuals along the trait or disorder-specific IU-OCD dimension. Given that the manipulation of threat in the current study was not successful, and participants reported relatively low levels of probability (i.e., risk level) with regards to the outcome, it is possible that this may have limited the impact of the manipulation and context on Beads Task performance. A series of studies have aimed to improve the ecological validity of the task by pairing it with an aversive stimulus as well as introducing an element of responsibility wherein participants were responsible for decisions that impacted their own wellbeing or that of others (Jacoby et al., 2016; Jacoby et al., 2017). Relative to previous studies (Jacoby et al., 2014), such modifications to the experimental paradigm have been associated with increased levels of distress and perceived task importance (Jacoby et al., 2016; Jacoby et al., 2017). The current study represented a start to this process and modifying the paradigm within the context of contamination-related concerns. As such, and similar to research by Jacoby et al. (2017), future studies are required to consider paradigms that more powerfully manipulate these constructs of interest to provide a stronger test of the effects and interactions between IU, decision-making, and distress. Research examining decision-making within the context of contamination-related fears could be improved by increasing the strength of the contamination stimulus. In an attempt to increase uncertainty without focusing on threat, the contamination stimuli in the current study were removed prior to participants completing the Beads Task, but after there had been some exposure and assumed continued exposure by touching the

keyboard throughout the task (i.e., the experimenter moved the ostensibly used tissues on the desk across the keyboard and into the bin). However, leaving the ostensibly used tissues in situ throughout completion of the Beads Task may have amplified both threat and uncertainty appraisals and therefore resulted in a more powerful effect. Research might also attempt to increase the strength of the contamination stimulus by using a contamination behavioural approach task wherein participants demonstrate increasing approach behaviour towards a range of stimuli prior to completing the Beads Task such as a pile of dirty clothing or a mixture of potting soil, dog hair, and dead crickets (Summers, Sarawgi, Fitch, Dillon, & Cougle, 2016).

The present findings should be interpreted within the context of study challenges and limitations, which also provide directions for future research. The current study involved the use of deception (e.g., participants were told their performance might or will be evaluated and that the previous participant had a cold). It is possible that participants were sceptical about the aims of the study as well as the authenticity of the instructions, particularly undergraduate students enrolled in a psychology course. This represents a challenge of research in this area. To address this challenge, recent research has included a post-hoc debriefing interview to investigate issues related to scepticism (Jacoby et al., 2017). Experimental research examining the links between IU and decision-making is increasing, however, the processes underlying decision-making remain unclear. As noted by Jacoby et al. (2017), future qualitative research is needed to explore the process of how individuals make decisions. For example, some individuals may seek more information to increase certainty about their decision, whereas some individuals may request fewer beads in an attempt to avoid the feelings of uncertainty (Jacoby et al., 2017). As such, future studies examining IU and behavioural correlates should consider the role of negative urgency (i.e., the predisposition to act rashly in response to negative emotional contexts). Pawluk and Koerner (2016) reported an association between IU and negative urgency, and that negative urgency was indirectly related to symptoms of generalised anxiety disorder through increased IU. Thus, other factors aside from IU that may impact behaviour should be examined in future experimental studies. The sample consisted of non-clinical participants and structured diagnostic interviews were not used to screen participants, and as such, this may limit the generalisability of our results to other populations. Future studies should aim to compare participants with higher versus lower levels of trait IU and disorder-specific IU. Further, future research should use clinical samples to investigate whether trait and disorder-specific IU interact with estimates of cost and probability and certainty level to elevate anxiety and influence behaviour. Additionally, the current study was

underpowered to investigate the number of predictors and interaction effects, and further studies with larger samples are required to further disentangle these effects. Moreover, contamination concerns may not be strongly linked to the need for certainty and IU (Jacoby et al., 2013). Thus, outside the context of contamination-related symptoms, future research examining decision-making behaviour and IU across disorder-specific contexts may benefit from designing paradigms centred on other obsessive compulsive symptom dimensions (e.g., ordering and arranging or responsibility for harm to self versus others; Jacoby et al., 2017). In addition, future studies could incorporate psychophysiological measures as an adjunct to in vivo self-report measures (e.g., heart rate, skin conductance reactivity).

Taken together, these findings have research and clinical implications. Research suggests that IU is a potential treatment target and transtherapeutic mechanism (Boswell et al., 2013; McEvoy & Erceg-Hurn, 2016). The relationships found in this study suggest that there is potential value in targeting IU in treatment strategies and interventions. The findings of this study also highlight the significance of disorder-specific IU beliefs. In particular, the results underscore the role of disorder-specific IU to social and performance situations. This builds off the results of correlational studies that reported that relative to trait IU, disorder-specific IU-SAD was more strongly related to social anxiety disorder symptoms (Shihata et al., 2017; Thibodeau et al., 2015). Further, the results provide some insight into the relationship between IU and perceived cost of threat. The findings suggest that targeting IU in treatment may also influence perceived cost of negative outcomes. By focusing on IU in cognitive-behaviour and exposure-based approaches, perceptions of threat may be modified and this may be associated with behavioural change. For example, higher levels of IU may adversely impact decision-making in such situations even in situations perceived to be low cost. Moreover, if these findings were to generalise to clinical samples, disorder-specific IU beliefs may interact with estimates of perceived cost of threat to influence decision-making and engagement in safety behaviours for individuals with symptoms of social anxiety disorder. Given that IU was found to operate in contexts of low cost, exposure-based techniques implemented in situations that are perceived to be less threatening may be effective in impacting IU and increasing clients' willingness to attempt such behavioural experiments (Pepperdine et al., 2018). Thus, targeting IU, and relevant disorder-specific beliefs, may help to strengthen clients' ability to perceive and respond to uncertainty with curiosity rather than discomfort. The focus would be to assist clients to approach situations that are of low threat with more curiosity to be able to engage in more effective decision-making (e.g., less information seeking, faster decisions). Further

research in this area disentangling the relationships between IU, decision-making, and threat perceptions could provide further insight into the treatment of emotional disorders.

Notwithstanding these challenges and limitations, the current study makes an important contribution to the literature by using an experimental in vivo paradigm to examine the emotional and behavioural correlates of trait and disorder-specific IU. This study also investigated the relationships between IU, cost estimates, and decision-making and distress across different disorder-specific contexts. Disorder-specific IU-SAD was associated with requesting more information and taking more time prior to making a decision when the cost of social evaluation was considered to be low. Further, the results indicated no significant association between disorder-specific IU-OCD and task performance in the relevant context. Delineating the relationships between trait and disorder-specific IU, perceived threat, and decision-making behaviour and distress using experimental approaches presents an important avenue for theoretical and clinical progression.

Chapter 6 (Study 5): Disorder-Specific Intolerance of Uncertainty for Eating Disorders (IU-ED): Psychometric Properties of a New Measure and Associations with Eating Disorder Psychopathology

6.1. Introduction

Beyond anxiety and depressive disorders, IU is of increasing relevance to other psychological disorders such as eating disorders. The previous chapters in this thesis have reported cross-sectional and experimental studies examining the associations between trait IU, disorder-specific IU, and emotional disorder symptoms as well as decision-making behaviour. Given the transdiagnostic nature of IU as well as its distinct disorder-specific facets, the relationships between trait IU and disorder-specific IU can be investigated within the context of eating disorder symptoms. The core psychopathology of eating disorders is an overvaluation and control of eating, weight, and shape, along with a disturbance in eating-related behaviour (e.g., dietary restraint, purging, and binge eating;American Psychiatric Association, 2013 ; Fairburn, Cooper, & Shafran, 2003). Onset of eating disorders is typically in early adolescence or young adulthood and represent a complex group of psychological disorders that are associated with poor treatment engagement and outcomes as well as heightened morbidity and mortality (Crow et al., 2009; Steinhausen, 2002; Wittchen et al., 2011). Anxiety is a key feature involved in the development and maintenance of eating disorder psychopathology and, as such, contributes to the complex presentation and treatment of eating disorders (Kesby et al., 2017; Koskina, Campbell, & Schmidt, 2013). There are high rates of comorbidity between anxiety disorders and eating disorders, and many of the cognitive and behavioural processes of anxiety disorders tend to reflect clinical features evident in eating disorders (e.g., safety behaviours, dysfunctional thoughts; Steinglass et al., 2011). Thus, investigating cognitive constructs central to anxiety may enhance our understanding of eating disorder pathology and the associated repertoire of problematic behaviours developed in response to anxiety and fear (Kesby et al., 2017).

The transdiagnostic approach suggests that the specific maladaptive cognitive (e.g., worry, obsessions) and behavioural (e.g., avoidance, compulsions) strategies associated with anxiety and related disorders (e.g., obsessive compulsive disorder) are driven by attempts to mitigate threat, and increase certainty and control (Boswell et al., 2013; Norton & Paulus, 2017). Similarly, it has been suggested that the maladaptive features of eating disorders (e.g., dietary restraint, rigid rules, avoidance of food) may be triggered by a desire to decrease uncertainty (Kesby et al., 2017; Sternheim, Konstantellou, Startup, & Schmidt, 2011). Kesby

et al. (2017, p. 56) suggested that IU presents a "novel theoretical and clinical framework" to understand eating disorder psychopathology. A growing body of research suggests that individuals with subclinical problematic eating attitudes and clinical eating disorders report higher IU compared to control groups (Frank et al., 2012; Konstantellou et al., 2011; Konstantellou & Reynolds, 2010; Sternheim, Startup, et al., 2011; Sternheim, Startup, & Schmidt, 2015). These findings of elevated IU extend to eating disorder patients without a comorbid anxiety or depressive disorder (Frank et al., 2012). Qualitative findings revealed that patients with anorexia nervosa tend to perceive uncertainty as threatening, negative, and something that should be avoided, and felt they were unable to cope with uncertain events (Sternheim, Konstantellou, et al., 2011). Patients reported that uncertainty centred on beliefs about the world being dangerous, and a fear of negative social evaluation and feeling imperfect, and lead to a strict adherence to routines, planning, checking behaviour, and restriction to increase certainty and control (Sternheim, Konstantellou, et al., 2011). Results from an experimental study examining responses to the Beads Task (see page 88) across patients with anorexia nervosa, bulimia nervosa, and healthy controls found that eating disorder patients reported higher IU and distress compared to the control group (Sternheim, Startup, et al., 2011). Sternheim, Startup, et al. (2011) also found that anorexia nervosa patients reported higher IU than bulimia nervosa patients. Research also suggests that individuals with eating disorders report comparable levels of IU to individuals with obsessive compulsive disorder (García-Soriano, Roncero, Perpiñá, & Belloch, 2014). Taken together, these findings suggest that IU may be a transdiagnostic cognitive vulnerability and maintaining factor for eating disorders (Brown et al., 2017).

The core component of the transdiagnostic model of eating disorders proposes that the overvaluation of eating, shape, and weight results in behavioural control (e.g., restraint and purging; Fairburn & Harrison, 2003). In line with this model, eating disorders may be perpetuated through an interaction between this core psychopathology and additional mechanisms, including clinical perfectionism, low self-esteem, interpersonal problems, and mood intolerance (Fairburn et al., 2003). Indeed, in a community sample, research demonstrated an indirect link between maintaining mechanisms and dietary restraint behaviour via the core psychopathology of eating, shape, and weight concerns (Hoiles, Egan, & Kane, 2012). Moreover, broad and enhanced cognitive-behavioural treatments designed to target the additional mechanisms have been found to be effective for eating disorder pathology, emotional disorder symptoms, perfectionism, interpersonal problems, and self-esteem (Byrne et al., 2017; Byrne, Fursland, Allen, & Watson, 2011; Fairburn et al., 2003).

However, treatments for eating disorders have relatively low efficacy, particularly for anorexia nervosa (Byrne et al., 2017; Wilson, Grilo, & Vitousek, 2007). As such, Renjan et al. (2016) argued that theoretical transdiagnostic models of eating disorders should be elaborated to include additional processes, such as IU, that may also be targeted in treatment.

Renjan et al. (2016) found an indirect relationship between IU and eating disorder behaviours (i.e., dietary restraint and purging, but not bingeing) via core psychopathology (i.e., overvaluation of eating, weight, and shape concerns) in a clinical eating disorders sample. IU was also directly associated with dietary restraint. The authors theorised that the significant association between IU and restraint and purging may not extend to bingeing behaviour, as this reflects a loss of control. IU may lead to strict and/or dysfunctional beliefs about eating, and body shape and weight, which may drive restrictive-type behaviours (e.g., dietary restraint, purging) to gain control and certainty, and alleviate distress (Renjan et al., 2016). Further, IU had a direct and indirect association with core eating disorder psychopathology, as well as symptoms of anxiety and depression. Although IU was found to account for unique variance in eating disorder behaviours and emotional disorder symptoms, additional mechanisms posited to maintain eating disorders were not included (e.g., perfectionism, mood intolerance, core low self-esteem, interpersonal problems; Fairburn et al., 2003). No studies have examined the relationships between IU and eating disorder symptoms, relative to the key maintaining features outlined in the transdiagnostic model of eating disorders (Fairburn et al., 2003). Such research may help to delineate the role of IU in eating disorders beyond these other central processes (Kesby et al., 2017; Renjan et al., 2016).

As described throughout this thesis, trait IU refers to general experiences of uncertainty (e.g., "I must get away from all uncertain situations"), whereas disorder-specific IU takes into account the importance of context such that the stimuli triggering IU are expected to differ to some degree across disorders (Thibodeau et al., 2015). Thibodeau et al. (2015) suggested that disorder-specific IU may help to explain how a general risk factor (IU) may result in divergent trajectories (i.e., manifestation of different disorders) and comorbidity. Prior research suggests that clinical participants report higher disorder-specific IU relative to trait IU (Jensen & Heimberg, 2015; Mahoney & McEvoy, 2012b). No previous studies have investigated disorder-specific and trait IU in relation to eating disorder symptoms, and a recent review called for further research to precisely achieve this aim (Kesby et al., 2017).

One important obstacle to research into disorder-specific IU in eating disorders has been the absence of a measure of this construct. The first aim of the current study was therefore to extend prior research on trait IU and disorder-specific IU to eating disorder

symptoms by developing a self-report measure of disorder-specific IU relating to eating disorder psychopathology, the Disorder-Specific IU-ED scale (IU-ED). The second aim was to examine the associations between the newly developed IU-ED scale, trait IU, and eating disorder pathology and associated mechanisms. The third aim was to examine the relative contributions of trait IU and disorder-specific IU-ED to eating disorder symptoms and behaviours, beyond additional key mechanisms articulated in the transdiagnostic model of eating disorders (e.g., clinical perfectionism, core low self-esteem, mood intolerance, and interpersonal difficulties). The first hypothesis was that trait IU would be significantly associated with disorder-specific IU-ED, core eating disorder pathology (i.e., overvaluation of eating, shape, and weight), and dietary restraint. The second hypothesis was that disorder-specific IU-ED would account for unique variance in core eating disorder psychopathology and behaviours, beyond trait IU. The third hypothesis was that each of the additional key mechanisms would be significantly associated with core psychopathology and behaviours.

6.2. Method

6.2.1. Participants

Participants were 172 undergraduate students recruited through the university's research participant pool. Participants were aged between 17 and 59 (M = 22.73; SD = 6.91; 80.23% female). The majority of participants identified as Caucasian (70.3%). Mean body mass index was in the normal range at 23.92 kg/m^2 (SD = 6.29).

6.2.2. Measures

6.2.2.1. Preliminary Disorder-Specific IU for Eating Disorders scale (IU-ED). A preliminary list of 45 items was drafted by a consultation team of four clinicians and researchers with expertise in the area of eating disorders to represent disorder-specific IU for eating disorder pathology. The items were drafted based on theory, clinical experience, symptoms described in the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5; American Psychiatric Association, 2013), and eating disorder-related questionnaires and diagnostic interviews (e.g., Eating Disorder Examination Questionnaire – Version 5, Eating Disorder Examination). Based on these points of reference, different domains pertinent to eating disorders were generated (e.g., eating, shape, and weight concerns, avoidance, binge eating, purging, dietary restriction and rules). Items were drafted to reflect each domain with the aim of emphasising uncertainty and IU about eating disorder-related issues, rather than eating disorder symptoms per se. The items that were retained were agreed upon by the consultation team as reflecting the role of IU in symptoms of eating

disorders. An example item is “I worry if I overeat because I'm unsure of the consequences”. Consistent with the DSIU scales (Thibodeau et al., 2015), participants responded to each item along a four-point scale from *not at all* (0) to *extremely* (4). However, the instructions were modified as follows, “The following statements ask about your experiences of being uncertain about aspects of eating and the potential consequences. Please select the answer that best corresponds to how much you agree with each item”. Internal reliabilities (Cronbach’s alphas) for all measures in the current study are reported in Table 4.1.

6.2.2.2. Intolerance of Uncertainty Scale, Short Form (IUS-12; Carleton, Norton, et al., 2007). See Chapter 3 (page 40) for a description of the IUS-12.

6.2.2.3. Disorder-Specific Intolerance of Uncertainty Scales (DSIU; Thibodeau et al., 2015). See Chapter 4 (page 64) for a description of the DSIU.

6.2.2.4. Eating Disorder Examination Questionnaire – Version 5 (EDEQ; Fairburn & Belgin, 1994). The 33-item EDEQ assesses the severity of eating disorder psychopathology and is a self-report version of the Eating Disorder Examination (a clinician-administered interview designed to assess a range of symptoms related to anorexia nervosa and bulimia nervosa). The EDEQ was developed with a focus on the behavioural facets of eating disorders, and measures the core symptoms of anorexia nervosa, bulimia nervosa, and eating disorders not otherwise specified (Fairburn & Beglin, 1994). The EDEQ assesses concerns relating to eating, shape, and weight, as well as dietary restraint and frequency of purging and bingeing behaviour. The EDEQ comprises four subscales; a 5-item restraint subscale, a 5-item eating concern subscale, an 8-item shape concern subscale, and a 5-item weight concern subscale. Research indicates that the items that form the eating, shape, and weight concern subscales load onto a single factor (Allen, Byrne, Lampard, Watson, & Fursland, 2011), and therefore an average of these subscales was used. The EDEQ has demonstrated good internal reliability and test-retest reliability as well as discriminant validity (Aardoom, Dingemans, Slof Op't Landt, & Furth, 2012; Berg, Peterson, Frazier, & Crow, 2012; Friborg, Reas, Rosenvinge, & Ro, 2013).

6.2.2.5. Clinical Perfectionism Questionnaire (CPQ; Fairburn et al., 2003). The 12-item CPQ was developed to measure clinical perfectionism and the degree to which an individual’s self-worth and self-evaluations are dependent upon their pursuit and achievement of personally demanding performance standards. Participants responded to items describing their ability to strive towards and attain high standards over the past month along a four-point scale from *not at all* (1) to *all of the time* (4). Items 2 and 8 are reverse-scored. Psychometric research supports the internal reliability and construct validity of the CPQ in non-clinical and

clinical eating disorder samples (Chang & Sanna, 2012; Egan et al., 2016; Steele, O'Shea, Murdock, & Wade, 2011).

6.2.2.6. Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965). The 10-item RSES was developed to assess self-esteem and feelings of self-worth and self-acceptance. Participants indicated their agreement with each statement along a four-point scale ranging from *strongly agree* (1) to *strongly disagree* (4). Items 1, 3, 4, 7, and 10 are reverse-scored. Higher scores on the RSES indicate higher self-esteem. The RSES has demonstrated good internal reliability as well as construct and concurrent validity (Hagborg, 1993; Rosenberg, 1965; Schmitt & Allik, 2005).

6.2.2.7. Interpersonal Relationships in Eating Disorders (IR-ED; Jones et al., in press). The 15-item IR-ED was developed to assess interpersonal problems specifically associated with eating disorder pathology. The IR-ED comprises three subscales; a 5-item food-related isolation subscale, a 4-item food-related interpersonal tension subscale, and a 6-item avoidance of body evaluation subscale. However, psychometric analyses indicated that use of the total score is considered to be appropriate (Jones et al., in press). The IR-ED has demonstrated good internal and test-retest reliability in community, student, and clinical samples, and convergent and discriminant validity (Jones et al., in press).

6.2.2.8. Tolerance of Mood States Scale (TOMS; Allen, McLean, & Byrne, 2012). The 11-item TOMS was designed to measure maladaptive behaviour and reactions to intense mood states and emotions. The TOMS consists of two subscales; an 8-item general subscale and a 3-item eating subscale. However, the items can be averaged to compute a total score. Participants responded to each item by indicating the likelihood that they would engage in a particular activity when experiencing intense emotions on a scale from *never* (1) to *always* (5). Item 7 is reverse-scored. Higher scores on the TOMS indicate a more intense response to strong emotions. Preliminary evidence supports the internal reliability and validity of the TOMS (Allen et al., 2012).

6.2.2.9. Depression, Anxiety, and Stress Scale (DASS-21; Lovibond & Lovibond, 1995). The DASS-21, revised from the original DASS-42, was designed to assess physiological distress and comprises three highly correlated 7-item subscales pertaining to symptoms of depression, anxiety, and stress. Participants indicated the extent, over the past week, to which each item applied to them along a four-point scale ranging from *did not apply to me at all* (0) to *applied to me very much, or most of the time* (3). Higher scores suggest higher depression, anxiety, and stress levels. Psychometric support for the DASS-21 has been

provided in clinical and non-clinical samples (Antony, Bieling, Cox, Enns, & Swinson, 1998; Henry & Crawford, 2005; Lovibond & Lovibond, 1995).

6.2.3. Procedure

Participants were undergraduate psychology students recruited from the university's research participant pool via an online experiment database to participate in "A Study of Eating Behaviours and Uncertainty". Participants read an information statement, and were then directed to an online survey administered via Qualtrics, where informed consent was obtained and they completed demographic information and the measures reported above. The IUS-12 (Carleton, Norton, et al., 2007) was presented first followed by the DSIU scales (Thibodeau et al., 2015) and then the newly developed IU-ED scale, and the remaining questionnaires were randomised. The survey included three items that were designed to detect careless responding (e.g., "Respond with "quite a bit" for this item", "I typically eat more than once a week", and "I do not understand a word of English"). Consistent with prior research methods (Meade & Craig, 2012; Thibodeau et al., 2015), 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 any way or influence whether you receive credit points". Participant data was included if they correctly answered these questions and reported that their data was reliable and should be used in this study. Fourteen days later participants were sent a request to a follow-up survey. The follow-up survey consisted of the DSIU scales and the IU-ED scale. Following completion of the second survey, participants were debriefed and received course credit for their participation. Prior to the commencement of this study, institutional ethics approval was obtained (HRE2016-0182; see Appendix G).

6.2.4. Data Analysis

Data screening and preliminary analyses including descriptive statistics, internal consistency estimates, and bivariate correlations were conducted in SPSS 24.0. Exploratory factor analysis (EFA) with a polychoric correlation matrix using weighted least squares mean- and variance-adjusted estimation (WLSMV) in Mplus 7.4 (Muthén & Muthén, 1998-2015) was used to analyse the underlying factor(s) of the 45 items designed to assess IU and eating disorder cognitions and behaviour. The default geomin oblique rotation was used, which allows the factors to correlate and therefore provides a more theoretically accurate solution (Costello & Osborne, 2005). Moreover, Schmitt and Sass (2011, p. 109) suggest that geomin

rotation tends to produce solutions with a "perfect simple structure" comparable to confirmatory factor analysis as it aims to reduce cross-loading between factors and produce significant item factor loadings on the primary factors. In addition to the commonly used scree plot test (Cattell, 1966) and Kaiser criterion (i.e., eigenvalues ≥ 1), parallel analysis (Horn, 1965) was used to guide decisions regarding the number of factors to retain. Parallel analysis is recommended to be the best method to determine factor retention and involves a comparison between actual eigenvalues observed in the data to average eigenvalues resulting from randomly generated data sets (n = 50). A factor was retained if the eigenvalue of that factor was greater than the 95th percentile of the randomly generated eigenvalue (Hayton, Allen, & Scarpello, 2004).

To identify and discard poor performing items, factor analysis was conducted. A total of two factor analyses were conducted with incrementally more strict criteria. Consistent with the approach outlined in previous research (e.g., Thibodeau et al., 2015), the first factor analysis involved removing items that did not have a have a loading of at least .30 on a factor (Peterson, 2000), or items that cross-loaded (i.e., items with loadings larger than .30 on more than one factor; Tabachnick & Fidell, 2013). Following the second factor analysis, items that did not load at least .40 onto their primary factor, or items that cross-loaded (greater than .30 on more than one factor), were removed. This process would result in a long version of the disorder-specific IU-ED scale. To facilitate use in clinical practice and research, a short version of the scale was created by selecting the items from the long version with the highest item-total correlations.

Model fit of the extracted solutions were evaluated using the chi-square statistic (χ^2), comparative fit index (CFI), Tucker-Lewis index (TLI), root-mean-square error of approximation (RMSEA) with 90% confidence intervals (CIs), and the standardised root mean square residual (SRMR). A non-significant chi-square value indicates acceptable fit; however, the chi-square statistic is sensitive to sample size (Tabachnick & Fidell, 2013). For the CFI and TLI, acceptable and excellent fit is indicated by values ≥ .90 and .95, respectively (Hu & Bentler, 1999; Marsh et al., 2004). Acceptable fit is indicated by SRMR values ≤.08, and RMSEA values close to .08 and .06 (lower values correspond with closer fit) and the upper CI limit should not exceed .10 (Hu & Bentler, 1999; Kline, 2016; Marsh et al., 2004).

Pearson correlation coefficients between the study variables were used to examine the construct validity and test-retest reliability of the disorder-specific IU-ED scale. For convergent and divergent validity, correlations between scores on the IU-ED scale and those on the IUS-12, DSIU scales, EDEQ, CPQ, RSES, TOMS, IRED, and DASS were evaluated.

Further, scores on the IU-ED scale were used to compare participants who did and did not self-report binge eating, purging, and dietary restraint behaviour.

Hierarchical linear regression analyses were conducted to examine whether the IU-ED scale explains unique variance in eating disorder symptoms (EDEQ global and subscale scores) beyond IUS-12 scores. Consistent with Thibodeau et al. (2015), the IUS-12 was entered in the first step of the regression, and both the IUS-12 and IU-ED subscales were entered in the second step of the regression analyses. Standardised estimates (β) were used to examine the relative contributions of trait IU and disorder-specific IU-ED to eating disorder symptoms. An additional series of hierarchical linear regressions was conducted to examine whether the IUS-12 and IU-ED scale accounted for unique variance in eating disorder symptoms, when controlling for other key mechanisms (perfectionism, mood intolerance, self-esteem, interpersonal problems). The IUS-12 and/or the IU-ED subscales uniquely associated with eating disorder symptoms in the previous regression analyses were entered in the first step. The additional symptom measures (CPQ, RSES, TOMS, IR-ED) were entered in the second step of the regression.

6.3. Results

6.3.1. Preliminary Analyses

Of the 299 participants who started the survey, participants (n = 127) were excluded if they responded incorrectly to any of the items designed to assess careless responding (n = 37), reported their data should not be used in this study (n = 25), more than 10% of their data were missing (n = 48), and/or they completed the survey more than once (only the response with the least missing data or the earliest response was analysed; n = 17). Thus, the final sample size consisted of 172 participants. Missing values analysis, using Little's MCAR test, indicated that the data was missing completely at random, χ^2 (364) = 326.68, p = .921. The percentage of missing data was negligible (1%) and therefore missing data was imputed using the expectation maximisation method (Muthén & Muthén, 1998-2015; Tabachnick & Fidell, 2013). The descriptive statistics (means and standard deviations), score range, and internal reliability estimates (Cronbach's α) of all measures are reported in Table 4.1. Assumptions of normality were met, no influential multivariate outliers were identified, and multicollinearity was not an issue (Kline, 2016; Tabachnick & Fidell, 2013). There were four univariate outliers on Factor 2 of the IU-ED scale (z scores > 3.29). The pattern of findings was identical with and without these participants, and therefore only findings based on the full dataset are reported.

The EDEQ global score (M = 1.91; SD = 1.40) was greater than the community norms (M = 1.55; SD = 1.21) reported by Fairburn and Belgin (1994) and the recovery cut-off (i.e., score less than one SD above the community mean; 1.74) reported by Fairburn et al. (2009). A proportion of participants (10%) had an EDEQ global score in the "extreme" range (≥ 4), which indicates an extreme level of eating disorder psychopathology (Mond, Hay, Rodgers, & Owen, 2006). Further, 28% of the sample had scores in this range (≥ 4) on the shape concerns subscale, 23% on the weight concerns subscale, 8% on the restraint subscale, and 6% on the eating concerns subscale.

Table 4.1. *Descriptive Statistics and Cronbach's Alpha (α) for all Study Measures*

	Mean (*SD*)	Possible Range	Observed Range	α
IUS-12	31.90 (9.50)	12 – 60	12 – 55	.92
IU-GAD	5.27 (3.44)	0 – 12	0 – 12	.92
IU-SAD	5.36 (3.53)	0 – 12	0 – 12	.91
IU-OCD	5.68 (2.88)	0 – 12	0 – 12	.78
IU-HA	3.15 (3.09)	0 – 12	0 – 12	.89
IU-PTSD	4.17 (3.38)	0 – 12	0 – 12	.90
IU-PD	2.67 (3.47)	0 – 12	0 – 12	.96
IU-Phobia	3.66 (3.47)	0 – 12	0 – 12	.92
IU-MDD	3.51 (3.53)	0 – 12	0 – 12	.92
EDEQ				
Global	1.91 (1.40)	0 – 6	0 – 5.09	.96
Restraint	1.45 (1.41)	0 – 6	0 – 5.20	.82
Eating	1.51 (1.29)	0 – 6	0 – 5	.84
Shape	2.68 (1.77)	0 – 6	0 – 6	.93
Weight	2.37 (1.72)	0 – 6	0 – 6	.87
Purging (n = 81)	10.42 (9.82)	-	1 – 56	-
Bingeing (n = 96)	3.69 (5.86)	-	0 – 28	-
CPQ	25.95 (5.20)	12 – 48	16 – 41	.72
RSES	27.57 (5.86)	10 – 40	12 – 40	.91
TOMS	2.77 (0.65)	1 – 5	1.09 – 4.18	.83
IR-ED	1.70 (0.73)	1 – 5	1 – 3.87	.93
DASS-21	36.04 (26.69)	0 – 126	0 – 116	.96

Note: *SD* = standard deviation; IUS-12 = Intolerance of Uncertainty Scale, Short Form; IU = intolerance of uncertainty; GAD = generalised anxiety disorder; SAD = social anxiety disorder; OCD = obsessive-compulsive disorder; HA = health anxiety; PTSD = posttraumatic stress disorder; PD = panic disorder; Phobia = specific phobia; MDD = major depressive disorder; EDEQ = Eating Disorders Examination Questionnaire; CPQ = Clinical Perfectionism Questionnaire; RSES = Rosenberg Self-Esteem Scale; TOMS = Tolerance of Mood States; IR-ED = Interpersonal Relationships in Eating Disorders Scale; DASS-21 = Depression, Anxiety, and Stress Scale-21.

6.3.2. Factor Structure of the Disorder-Specific IU-ED Scale

Inspection of the Bartlett sphericity test (χ^2 [990] = 7662.85, p < .001) and the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO = .95) indicated that the initial 45 items were suitable for factor analysis (Tabachnick & Fidell, 2013). The initial EFA with 45 items

revealed that a five-factor solution existed based on the Kaiser criterion eigenvalues (29.30, 2.73, 2.05, 1.55, and 1.31). However, a parallel analysis suggested the retention of two factors across the IU-ED items based on the 95th percentile eigenvalues. Item loadings following the first EFA are presented in Table 4.2.

In the series of EFAs conducted, based on our a priori criteria 15 items were removed for cross-loading or not loading .40 onto their respective factor. The EFAs resulted in a long version IU-ED scale consisting of 30 items. The final two factor solution is presented in Table 4.3. The first factor was found to explain 64.83% of the variance. The second factor was found to explain 8.63% of the variance. Fit indices from the EFA provided an excellent fit for the two-factor correlated model, χ^2 (376) = 461.40, $p < .001$, χ^2/df = 1.23, CFI = .99, TLI = .99, RMSEA = .05 [.03 to .07], SRMR = .06. The two factors were strongly correlated (r = .72). The 30-item version (M = 27.52; SD = 24.38; *range* = 0-97) demonstrated excellent internal consistency (α = .97). Item factor loadings along with eigenvalues for the two-factor solution are detailed in Table 4.3.

Factor 1 consists of 19 items relating to uncertainty about eating, and body shape and weight concerns as well as body checking behaviour and distress resulting from uncertainty. Factor 1 also includes items that relate to uncertainty regarding social evaluation of body shape and weight, and eating. Factor 1 (M = 21.54; SD = 17.38; *range* = 0-68) demonstrated excellent internal consistency (α = .96). This factor has been labelled "core and social IU". Factor 2 consists of 11 items relating to bingeing and purging behaviour (e.g., exercise, making yourself sick, use of laxatives or another substance) in response to uncertainty about weight gain or as a strategy to control weight and reduce uncertainty. Factor 2 (M = 5.98; SD = 8.51; *range* = 0-38) demonstrated excellent internal consistency (α = .94). This factor has been labelled "weight and control IU".

Table 4.2. *Item Factor Loadings for the Initial 45-item Disorder-Specific Intolerance of Uncertainty for Eating Disorders Scale (IU-ED)*

Item	Factor 1	Factor 2
1. I need to control my weight, otherwise I can't be certain people will accept me	.81	.07
2. I worry if I overeat because I'm unsure of the consequences	.74	.12
3. Uncertainty about food causes me to have strict dieting rules	.34	.62
4. I avoid weighing myself because I cannot be sure my weight has not increased	.24	.36
5. Eating food with unknown content (e.g., calories, fat, carbohydrates) is more distressing to me than eating food with known content	.40	.43
6. Having strict dietary rules is the only way to be absolutely certain I won't gain weight	.27	.66
7. I weigh myself very often to be certain my weight has not changed	.72	-.01
8. I spend a lot of time body checking (e.g., looking in the mirror, pinching body parts, comparing my body to others) if I am uncertain about whether I have gained weight	.73	.16
9. I probably eat less than I should because I can't be sure I won't gain weight	.49	.35
10. I am more distressed by not knowing my current weight than when I know how much I weigh	.81	-.05
11. Not knowing when I will binge again terrifies me	.13	.76
12. I am afraid of eating because I cannot be sure I'll be able to control myself once I've started	.18	.67
13. It bothers me that I don't know for sure what people think of my body shape and weight	.96	-.12
14. I avoid foods if I am not sure how they will influence my body shape or weight	.30	.60
15. I feel the need to weigh myself when I am uncertain about whether my weight has changed	.89	-.16
16. Certainty about my eating, weight, and/or shape is extremely important to me	.80	.11
17. I require absolute certainty about the quantity and content of the food I eat	.27	.60
18. Purging (e.g., making myself sick, exercising, or using laxatives or another substance) is the only way I can control my weight with certainty	-.02	.94
19. I only eat if I am absolutely certain I won't gain weight	<-.01	.87
20. Feeling unsure about the impact food will have on my body shape or weight makes it difficult for me to concentrate	.23	.69
21. It bothers me that I don't know for sure what people think of me when they see me eat	.68	.14
22. If I'm uncertain about whether I will be able to "purge" food by making myself sick, exercising, or using laxatives or another substance, then I won't eat	-.15	1.04
23. I am more distressed by being unsure about whether my shape has changed than when I know for certain my shape has changed	.81	.09
24. I often skip meals if I am unsure whether I have gained weight	.46	.47
25. Uncertainty about food distresses me	.45	.39
26. I'm unsure what will happen if I don't plan what I eat, and that bothers me	.19	.67

Table 4.2. *Item Factor Loadings for the Initial 45-item Disorder-Specific Intolerance of Uncertainty for Eating Disorders Scale (IU-ED)*

Item	Factor 1	Factor 2
27. I can't be sure if I am "thin" or "fat" and this uncertainty is distressing	.94	-.01
28. I feel "fat" if I am unsure about what I have eaten	.70	.27
29. It is better for me to avoid eating than to eat and be unsure of the consequences	.34	.58
30. I must control my shape and weight because I can't know how people will accept me if I am not thin	.76	.18
31. I am more distressed when I am unsure if I have gained weight than when I know for sure that I have gained weight	.72	.20
32. I avoid food when I'm not certain of the content (e.g., calories, fat, carbohydrates)	.34	.63
33. I would rather strictly control my diet than be uncertain about whether or not I will gain weight	.58	.27
34. I need to plan what I eat because I can't stand being uncertain about whether or not I will gain weight	.34	.60
35. I get distressed if I eat something and I am unsure of the food's content (e.g., calories, fat, carbohydrates)	.48	.49
36. Body checking helps me to be sure of my current weight and shape, because being uncertain is intolerable	.79	.15
37. I purge after eating (e.g., make myself sick, exercise, or use laxatives or another substance) because I like the sense of certainty it gives me that I won't gain weight	.01	.92
38. I prefer to know that my weight has increased than to be unsure about whether it has increased	.61	.04
39. I need to be constantly certain that my weight and shape have not changed	.90	-.07
40. I cannot be sure of what it means to be a "healthy" weight, and that terrifies me	.86	-.10
41. I purge after eating (e.g., make myself sick, exercise, or use laxatives or another substance) even if I have the smallest doubt about whether or not I will gain weight	-.04	1.01
42. I feel the need to follow strict dietary rules if I'm unsure about whether my body weight or shape will change	.38	.61
43. I continue to purge (e.g., make myself sick, exercise, or use laxatives or another substance) because I don't know how stopping would affect my body	-.09	.99
44. Controlling my eating, weight, and/or shape offers a sense of certainty in my life	.51	.41
45. I often do things like make myself sick, exercise, or use laxatives or another substance if I'm uncertain about whether I have gained weight	.02	.88

Table 4.3. *Item Factor Loadings for the 30-item Disorder-Specific Intolerance of Uncertainty for Eating Disorders Scale (IU-ED)*

Item	Factor 1	Factor 2
1. I need to control my weight, otherwise I can't be certain people will accept me	**.80**	.09
2. I worry if I overeat because I'm unsure of the consequences	**.75**	.11
7. I weigh myself very often to be certain my weight has not changed	**.74**	-.02
8. I spend a lot of time body checking (e.g., looking in the mirror, pinching body parts, comparing my body to others) if I am uncertain about whether I have gained weight	**.70**	.20
10. I am more distressed by not knowing my current weight than when I know how much I weigh	**.81**	-.05
11. Not knowing when I will binge again terrifies me	.13	**.78**
12. I am afraid of eating because I cannot be sure I'll be able to control myself once I've started	.19	**.68**
13. It bothers me that I don't know for sure what people think of my body shape and weight	**.97**	-.14
15. I feel the need to weigh myself when I am uncertain about whether my weight has changed	**.93**	-.21
16. Certainty about my eating, weight, and/or shape is extremely important to me	**.89**	-.01
18. Purging (e.g., making myself sick, exercising, or using laxatives or another substance) is the only way I can control my weight with certainty	.02	**.93**
19. I only eat if I am absolutely certain I won't gain weight	-.01	**.85**
20. Feeling unsure about the impact food will have on my body shape or weight makes it difficult for me to concentrate	.23	**.69**
21. It bothers me that I don't know for sure what people think of me when they see me eat	**.62**	.22
22. If I'm uncertain about whether I will be able to "purge" food by making myself sick, exercising, or using laxatives or another substance, then I won't eat	-.12	**1.04**
23. I am more distressed by being unsure about whether my shape has changed than when I know for certain my shape has changed	**.76**	.16
26. I'm unsure what will happen if I don't plan what I eat, and that bothers me	.26	**.56**
27. I can't be sure if I am "thin" or "fat" and this uncertainty is distressing	**.91**	.03
28. I feel "fat" if I am unsure about what I have eaten	**.74**	.21
30. I must control my shape and weight because I can't know how people will accept me if I am not thin	**.79**	.15
31. I am more distressed when I am unsure if I have gained weight than when I know for sure that I have gained weight	**.71**	.21
33. I would rather strictly control my diet than be uncertain about whether or not I will gain weight	**.72**	.04
36. Body checking helps me to be sure of my current weight and shape, because being uncertain is intolerable	**.83**	.09

Table 4.3. *Item Factor Loadings for the 30-item Disorder-Specific Intolerance of Uncertainty for Eating Disorders Scale (IU-ED)*

Item	Factor 1	Factor 2
37. I purge after eating (e.g., make myself sick, exercise, or use laxatives or another substance) because I like the sense of certainty it gives me that I won't gain weight	.05	**.91**
38. I prefer to know that my weight has increased than to be unsure about whether it has increased	**.61**	.04
39. I need to be constantly certain that my weight and shape have not changed	**.91**	-.07
40. I cannot be sure of what it means to be a "healthy" weight, and that terrifies me	**.87**	-.12
41. I purge after eating (e.g., make myself sick, exercise, or use laxatives or another substance) even if I have the smallest doubt about whether or not I will gain weight	<-.01	**.99**
43. I continue to purge (e.g., make myself sick, exercise, or use laxatives or another substance) because I don't know how stopping would affect my body	-.05	**.99**
45. I often do things like make myself sick, exercise, or use laxatives or another substance if I'm uncertain about whether I have gained weight	.03	**.88**
Eigenvalue (final solution)	19.45	2.59

Note. Salient coefficients are bold-faced and retained for that respective factor.

The 30-item version was adapted by selecting the three items with the highest item-total correlations for each factor, resulting in a shortened six-item scale assessing disorder-specific IU for eating disorders. The six items (three items from each factor) with the highest corrected item-total correlations were retained for the final and briefer IU-ED scale and are presented in Table 4.4. The six-item total scale score was found to be highly correlated with the 30-item IU-ED scale ($r = .95$, $p < .001$) and demonstrated excellent internal consistency ($\alpha = .88$). The three-item Factor 1 (core and social IU) and three-item Factor 2 (weight and control IU) were highly correlated with the 30-item IU-ED Factor 1 ($r = .92$, $p < .001$) and Factor 2 ($r = .92$, $p < .001$), respectively. The three-item subscales demonstrated excellent internal consistency; core and social IU ($M = 3.46$; $SD = 3.49$; $\alpha = .88$), and weight and control IU ($M = 1.04$; $SD = 2.29$; $\alpha = .92$). The core and social IU subscale and the weight and control IU subscale were strongly correlated ($r = .56$, $p < .001$). Item-total correlations ranged from .55 to .84 and were deemed to be acceptable (Nunnally & Bernstein, 1994). The pattern of results across the long and short version of the IU-ED scale was similar, and therefore the results reported in this chapter were derived from use of the six-item IU-ED total score and subscale scores.

Table 4.4. *Scale Items for the Short 6-item Version of the Disorder-Specific Intolerance of Uncertainty for Eating Disorders Scale (IU-ED)*

	IU-ED
Factor 1 – Core and social IU	
1	I feel “fat” if I am unsure about what I have eaten
2	I must control my shape and weight because I can’t know how people will accept me if I am not thin
3	Body checking helps me to be sure of my current weight and shape, because being uncertain is intolerable
Factor 2 – Weight and control IU	
4	Purging (e.g., making myself sick, exercising, or using laxatives or another substance) is the only way I can control my weight with certainty
5	If I'm uncertain about whether I will be able to "purge" food by making myself sick, exercising, or using laxatives or another substance, then I won't eat
6	I purge after eating (e.g., make myself sick, exercise, or use laxatives or another substance) even if I have the smallest doubt about whether or not I will gain weight

6.3.3. Test-Retest Reliability of the Disorder-Specific IU-ED Scale

The descriptive statistics for the six-item IU-ED total and subscales for the test-retest samples ($n = 116$) along with the correlation coefficients between Time 1 and Time 2 ($M = 15.87$ days; $SD = 6.74$) are presented in Table 4.5. Paired t tests revealed that there were no significant changes in IU-ED mean scores over the two-week interval (range of ps = .063

to .927). Paired *t* tests indicated that there were no significant changes in DSIU mean scores (range of *p*s = .424 to .852); however, there was a significant difference in the IU-SAD mean scores between time points (*p* = .036). There were significant and strong associations between the IU-ED total score and subscales between Time 1 and Time 2 (all *p*s < .001). There were strong associations between the eight DSIU scales over the two-week interval (all *p*s < .001). These correlations indicate acceptable stability of scores (Nunnally & Bernstein, 1994).

Table 4.5. *Means (and Standard Deviations), and Test-Retest Correlations for the Disorder-Specific Intolerance of Uncertainty for Eating Disorders Scale (IU-ED) and the Disorder-Specific Intolerance of Uncertainty Scales (DSIU)*

	Time 1 *M* (*SD*)	Time 2 *M* (*SD*)	Paired *t*(115)	Test-retest *r*
IU-ED six-item scale				
Total score	4.19 (4.89)	4.44 (5.29)	-.95	.85**
Core and social IU	3.28 (3.43)	3.27 (3.51)	.09	.83**
Weight and control IU	.91 (2.11)	1.17 (2.35)	-1.88	.77**
DSIU scales				
IU-GAD	5.04 (3.42)	5.09 (3.23)	-.24	.75**
IU-SAD	5.01 (3.57)	4.62 (3.33)	2.12*	.84**
IU-OCD	5.35 (2.86)	5.19 (2.69)	.71	.60**
IU-HA	3.00 (3.01)	2.84 (2.97)	.68	.62**
IU-PTSD	4.10 (3.36)	4.21 (3.28)	-.38	.61**
IU-PD	2.42 (3.28)	2.38 (3.26)	.19	.71**
IU-Phobia	3.36 (3.20)	3.48 (3.23)	-.53	.71**
IU-MDD	3.41 (3.49)	3.60 (3.61)	-.80	.74**

Note. IU = intolerance of uncertainty; ED = eating disorder; IU-ED = Disorder-specific IU-ED Scale; DSIU = Disorder-specific IU Scales; GAD = generalised anxiety disorder; SAD = social anxiety disorder; OCD = obsessive-compulsive disorder; HA = health anxiety; PTSD = posttraumatic stress disorder; PD = panic disorder; Phobia = specific phobia; MDD = major depressive disorder.
*p < .05. **p < .001.

6.3.4. Convergent and Divergent Validity of the Disorder-Specific IU-ED Scale

The correlations between study variables are reported in Table 4.6. There were significant small correlations between scores on the IU-ED total score and the core and social IU subscale (Factor 1), trait IU scores (IUS-12), and the DSIU scales. The weight and control IU subscale (Factor 2) of the IU-ED scale, which assesses purging behaviour, was not significantly correlated with IUS-12 scores.

Moreover, there was a non-significant association between scores on the IUS-12 and the EDEQ global score and the restraint, shape concerns, and purging subscales. The total score and subscales of the IU-ED displayed moderate to strong associations with the EDEQ global score and subscales (restraint, eating, shape, and weight concerns). There were

significant correlations between scores on the IU-ED and measures of mood intolerance, perfectionism, interpersonal difficulties, self-esteem, and depression, anxiety, and stress.

6.3.5. Differences in IU across Diagnostic Subgroups of Purging, Binge Eating, and Dietary Restraint

A series of independent samples *t* tests were conducted to compare scores on the IU-ED total score and subscales (core and social IU, and weight and control IU) and the IUS-12 across participants who reported purging and non-purging behaviour, binge eating and non-binge eating, and dietary restraint and non-restraint. The mean scores on the six-item IU-ED scales and the IUS-12 for the different symptom profiles (e.g., binge eating and non-binge eating) are displayed in Table 4.7.

Participants who reported purging over the previous month (n = 81) scored significantly higher on the IU-ED total score, $t(133.75) = 4.93$, $p < .001$, 95% CI [2.22 to 5.20], $d = 0.08$, the core and social IU subscale, $t(151.56) = 5.19$, $p < .001$, 95% CI [1.61 to 3.60], $d = 0.79$, and the weight and control IU subscale, $t(119.59) = 3.13$, $p = .002$, 95% CI [.40 to 1.80], $d = 0.48$, than participants who did not reporting purging (n = 91). There was no significant difference on trait IU (IUS-12) between participants who reported purging and non-purging participants, $t(170) = -.89$, $p = .374$, 95% CI [-4.16 to 1.57], $d = 0.14$.

The results revealed that participants who did report binge eating over the previous month (n = 96) scored significantly higher on the IU-ED total score, $t(163.33) = 5.32$, $p < .001$, 95% CI [2.35 to 5.12], $d = 0.82$, core and social IU subscale, $t(169.96) = 5.21$, $p < .001$, 95% CI [1.58 to 3.51], $d = 0.80$, and weight and control IU subscale, $t(134.77) = 3.80$, $p < .001$, 95% CI [.57 to 1.82], $d = 0.58$, than participants who did not report binge eating (n = 76). There was a significant difference on IUS-12 scores between participants who reported binge eating and participants who did not report binge eating, $t(170) = 3.34$, $p = .001$, 95% CI [1.94 to 7.54], $d = 0.51$.

Participants who reported dietary restraint behaviour (n = 136) scored significantly higher on the IU-ED total score, $t(86.37) = 5.30$, $p < .001$, 95% CI [2.37 to 5.21], $d = 0.99$, core and social IU subscale, $t(90.91) = 6.61$, $p < .001$, 95% CI [2.15 to 4.00], $d = 1.24$, and weight and control IU subscale, $t(88.35) = 2.17$, $p = .033$, 95% CI [.06 to 1.36], $d = 0.41$, than participants who did not report dietary restraint behaviour (n = 36). There was a non-significant difference on IUS-12 scores between participants who reported restraint and participants who did not report restraint behaviour, $t(170) = -.41$, $p = .683$, 95% CI [-4.49 to 3.03], $d = 0.08$.

Table 4.6. *Correlations Between all Study Variables*

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. IU-ED Total																							
2. IU-ED F1	.93**																						
3. IU-ED F2	.83**	.56**																					
4. IUS-12	.17*	.19*	.10																				
5. IU-GAD	.23**	.25**	.13	.76**																			
6. IU-SAD	.35**	.36**	.24**	.61**	.65**																		
7. IU-OCD	.30**	.29**	.23**	.56**	.52**	.53**																	
8. IU-HA	.24**	.20**	.23**	.48**	.49**	.36**	.45**																
9. IU-PTSD	.27**	.26**	.20*	.49**	.59**	.43**	.35**	.49**															
10. IU-PD	.27**	.22**	.28**	.46**	.53**	.53**	.33**	.48**	.54**														
11. IU-Phobia	.27**	.25**	.22**	.66**	.60**	.63**	.49**	.53**	.53**	.65**													
12. IU-MDD	.27**	.26**	.21**	.52**	.63**	.60**	.34**	.41**	.55**	.62**	.62**												
13. EDEQ-Global	.66**	.68**	.44**	.14	.26**	.41**	.18*	.01	.25**	.24**	.20**	.32**											
14. EDEQ-Restraint	.65**	.66**	.46**	.02	.12	.25**	.12	-.04	.09	.12	.06	.19*	.83**										
15. EDEQ-Eating	.63**	.58**	.53**	.18*	.29**	.37**	.18*	<.01	.28**	.31**	.26**	.32**	.88**	.68**									
16. EDEQ-Shape	.57**	.62**	.34**	.14	.26**	.44**	.19*	.03	.26**	.24**	.21**	.32**	.95**	.70**	.78**								
17. EDEQ-Weight	.55**	.60**	.31**	.17*	.27**	.41**	.18*	.02	.25**	.21**	.19*	.32**	.94**	.67**	.76**	.93**							
18. EDEQ-Purging	.49**	.43**	.45**	-.04	.04	.14	.07	-.03	.07	.03	<.01	.07	.46**	.58**	.43**	.38**	.32**						

Table 4.6. *Correlations Between all Study Variables*

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
19. EDEQ-Bingeing	.33**	.32**	.25*	.27**	.30**	.31**	.16*	-.07	.26*	.28**	.33**	.31**	.47**	.26**	.54**	.44**	.47**	.23*					
20. CPQ	.38**	.38**	.27**	.28**	.34**	.30**	.41**	.28*	.37**	.29**	.29**	.32**	.43**	.33**	.42**	.40**	.40**	.24*	.25*				
21. RSES	-.29**	-.32**	-.18*	-.32**	-.44**	-.52**	-.21*	-.24*	-.37**	-.38**	-.38**	-.62**	-.56**	-.32**	-.53**	-.58**	-.57**	-.16*	-.40**	-.34**			
22. TOMS	.38**	.41**	.23*	.51**	.56**	.55**	.38**	.27**	.49**	.47**	.46**	.57**	.58**	.32**	.59**	.56**	.60**	.20*	.47**	.53**	-.62**		
23. IR-ED	.59**	.54**	.50**	.29**	.30**	.43**	.25*	.19*	.27**	.34**	.35**	.42**	.72**	.54**	.73**	.67**	.69**	.36**	.51***	.46**	-.57**	.58**	
24. DASS-21	.30**	.31**	.21*	.53**	.56**	.57**	.36**	.46**	.46**	.52**	.55**	.68**	.43**	.27**	.46**	.42**	.42**	.16*	.40**	.48**	-.67**	.70**	.53**

Note. IU = intolerance of uncertainty; ED = eating disorder; IU-ED = Disorder-Specific Intolerance of Uncertainty for Eating Disorders Scale; IUS-12 = Intolerance of Uncertainty Scale, Short Form; EDEQ = Eating Disorders Examination Questionnaire; CPQ = Clinical Perfectionism Questionnaire; RSES = Rosenberg Self-Esteem Scale; TOMS = Tolerance of Mood States; IR-ED = Interpersonal Relationships in Eating Disorders scale.
*$p < .05$, **$p < .01$. ***$p < .001$.

Table 4.7. *Means (and Standard Deviations) of the Disorder-Specific Intolerance of Uncertainty for Eating Disorders Scale (IU-ED) across Dietary Restraint, Purging, and Binge Eating Status*

	Purging (n = 81)	Non-purging (n = 91)	Binge eating (n = 96)	Non-binge eating (n = 76)	Restraint (n = 136)	Non-restraint (n = 36)
IU-ED						
Total	6.46 (5.79)	2.75 (3.73)***	6.15 (5.59)	2.41 (3.58)***	5.29 (5.25)	1.50 (3.33)***
Core and social IU	4.84 (3.63)	2.23 (2.86)***	4.58 (3.55)	2.04 (2.85)***	4.10 (3.50)	1.03 (2.13)***
Weight and control IU	1.62 (2.83)	0.52 (1.52)**	1.56 (2.78)	0.37 (1.19)***	1.18 (2.44)	0.47 (1.52)*
IUS-12	31.21 (9.47)	32.51 (9.55)	33.99 (8.83)	29.25 (9.72)**	31.74 (9.36)	32.47 (10.15)

Note. IU = intolerance of uncertainty; ED = eating disorder; IU-ED = Disorder-Specific IU-ED Scale; IUS-12 = Intolerance of Uncertainty Scale, Short Form.
*p < .05. **p < .01. ***p < .001.

6.3.6. Trait IU, Disorder-Specific IU, and Eating Disorder Psychopathology

The results of the hierarchical regressions for trait IU (IUS-12) and disorder-specific IU-ED (core and social IU, and weight and control IU) predicting eating disorder symptoms are displayed in Table 4.8. The criterion variables in the five models were eating disorder symptoms (Model 1: EDEQ Global score; Model 2: EDEQ Eating, Shape, and Weight Concerns; Model 3; Dietary Restraint; Model 4: Purging; Model 5: Binge Eating). Trait IU, as measured by the IUS-12, was not significant in Step 2 for any of the models except for binge eating. The IU-ED Factor 1 (core and social IU) subscale explained unique variance in all aspects of eating disorder psychopathology and behaviour, beyond the variance explained by the IUS-12. In contrast, the IU-ED Factor 2 (weight and control IU) subscale accounted for unique variance in purging behaviour, but not in any other symptoms.

The results of the regression analyses for trait IU (IUS-12) and disorder-specific IU-ED (core and social IU, and weight and control IU) predicting eating disorder symptoms, beyond the variance accounted for by other key constructs, are displayed in Table 4.9. Step 1 for each of the models is identical to the previous hierarchical linear regression (see Table 4.8), and thus only the results of Steps 2 and 3 are presented in Table 4.9. When controlling for the additional mechanisms outlined in the transdiagnostic model of eating disorders, the results revealed that the IUS-12 and IU-ED Factor 1 (core and social IU) accounted for unique variance in eating disorder symptoms including the overvaluation of eating, shape, and weight, as well as dietary restraint and purging (but not binge eating). The IU-ED Factor 2 (weight and control IU) remained a significant predictor of purging. Relative to trait IU, the disorder-specific IU-ED subscales were more strongly associated with the EDEQ global and subscale scores. The RSES, TOMS, and IR-ED were found to significantly predict eating disorder core psychopathology (i.e., overvaluation of eating, shape, and weight). However, the CPQ did not explain unique variance in the core psychopathology or in the EDEQ global score. Further, the CPQ and RSES were not significantly associated with dietary restraint, purging, or binge eating. The IR-ED was found to significantly predict restraint and binge-eating, but not purging behaviour. The TOMS was found to be significantly associated with binge eating, but not purging or restraint.

Table 4.8. *Summary of Hierarchical Linear Regressions Analyses*

Criterion: Eating disorder symptoms	Predictors	F	R^2	*B*	SEB	β	*t*	Part *r*
EDEQ Global	Step 1: IUS-12	3.59	.02	.02	.01	.14	1.89	.14
	Step 2:	Δ70.04	Δ.45***					
	IUS-12			<.01	.01	.02	.33	.02
	IU-ED Core and social IU			.25	.03	.63	9.10***	.51
	IU-ED Weight and control IU			.05	.04	.09	1.27	.07
EDEQ Eating, Shape, and Weight Concerns	Step 1: IUS-12	5.22	.03*	.03	.01	.17	2.29*	.17
	Step 2:	Δ55.40	Δ.39***					
	IUS-12			.01	.01	.06	.93	.06
	IU-ED Core and social IU			.26	.03	.59	8.22***	.49
	IU-ED Weight and control IU			.04	.05	.07	.92	.06
EDEQ Restraint	Step 1: IUS-12	.34	<.01	.01	.01	.05	.58	.05
	Step 2:	Δ47.10	Δ.42***					
	IUS-12			-.01	.01	-.07	-1.05	-.07
	IU-ED Core and social IU			.20	.03	.51	6.37***	.42
	IU-ED Weight and control IU			.12	.04	.22	2.74**	.18
EDEQ Purging	Step 1: IUS-12	.01	<.01	.01	.12	.01	.09	.01
	Step 2:	Δ10.85	Δ.22***					
	IUS-12			-.08	.11	-.07	-.69	-.07
	IU-ED Core and social IU			.37	.35	.14	1.06	.11
	IU-ED Weight and control IU			1.3	.44	.38	3.04**	.31
EDEQ Binge Eating	Step 1: IUS-12	5.08	.05*	.17	.07	.23	2.25*	.23
	Step 2:	Δ1.52	Δ.03					
	IUS-12			.16	.08	.21	2.09**	.21
	IU-ED Core and social IU			.23	.22	.13	1.03	.10
	IU-ED Weight and control IU			.17	.28	.07	.59	.06

Note. IU = intolerance of uncertainty; ED = eating disorder; IU-ED = Disorder-Specific Intolerance of Uncertainty for Eating Disorders Scale; IUS-12 = Intolerance of Uncertainty Scale, Short Form; EDEQ = Eating Disorders Examination Questionnaire; CPQ = Clinical Perfectionism Questionnaire; RSES = Rosenberg Self-Esteem Scale; TOMS = Tolerance of Mood States; IR-ED = Interpersonal Relationships in Eating Disorders.

*p < .05. **p < .01. ***p < .001.

Table 4.9. *Summary of Hierarchical Linear Regressions – Controlling for Additional Key Mechanisms*

Criterion: Eating disorder symptoms	Predictors	F	R^2	*B*	SEB	β	*t*	Part *r*
EDEQ Global	Step 1: IU-ED Core and social IU	145.12	.46***	.27	.02	.68	12.05***	.68
	Step 2:	Δ28.03	Δ.22***					
	IU-ED Core and social IU			.16	.02	.39	7.25***	.32
	CPQ			<.01	.01	<.01	.06	.03
	RSES			-.04	.01	-.17	-2.77**	-.12
	TOMS			.25	.14	.12	1.82	.08
	IR-ED			.67	.12	.35	5.52***	.24
EDEQ Eating, Shape, and Weight Concerns	Step 1: IU-ED Core and social IU	117.83	.41***	.28	.03	.64	10.86***	.64
	Step 2:	Δ35.89	Δ.27***					
	IU-ED Core and social IU			.14	.02	.32	6.03***	.26
	CPQ			<-.01	.02	-.01	-.19	-.01
	RSES			-.05	.02	-.19	-3.26**	-.14
	TOMS			.40	.15	.17	2.73**	.12
	IR-ED			.73	.13	.36	5.64***	.25
EDEQ Restraint	Step 1: IU-ED Core and social IU	46.81	.41***	.19	.03	.50	6.28***	.42
	IU-ED Weight and control IU			.12	.04	.22	2.74**	.18
	Step 2:	Δ1.87	Δ.03					
	IU-ED Core and social IU			.17	.03	.44	5.22***	.34
	IU-ED Weight and control IU			.08	.05	.15	1.75	.12
	CPQ			.03	.02	.10	1.29	.09
	RSES			-.01	.02	-.05	-.50	-.03
	TOMS			-.24	.20	-.11	-1.21	-.08
	IR-ED			.32	.18	.17	1.74	.11

Table 4.9. *Summary of Hierarchical Linear Regressions – Controlling for Additional Key Mechanisms*

Criterion: Eating disorder symptoms	Predictors	F	R^2	*B*	SEB	β	*t*	Part *r*
EDEQ Restraint	Step 1: IU-ED Core and social IU	46.81	.41***	.19	.03	.50	6.28***	.42
	IU-ED Weight and control IU			.12	.04	.22	2.74**	.18
	Step 2:	Δ1.87	Δ.03					
	IU-ED Core and social IU			.17	.03	.44	5.22***	.34
	IU-ED Weight and control IU			.08	.05	.15	1.75	.12
	CPQ			.03	.02	.10	1.29	.09
	RSES			-.01	.02	-.05	-.50	-.03
	TOMS			-.24	.20	-.11	-1.21	-.08
	IR-ED			.32	.18	.17	1.74	.11
EDEQ Purging	Step 1: IU-ED Weight and control	20.51	.21***	1.58	.35	.45	4.53***	.45
	Step 2:	Δ.48	Δ.02					
	IU-ED Weight and control			1.51	.42	.44	3.59**	.37
	CPQ			-.14	.23	-.08	-.63	-.06
	RSES			.20	.26	.11	.76	.08
	TOMS			-.67	2.31	-.04	-.29	-.03
	IR-ED			1.76	1.87	.14	.94	.10
EDEQ Binge Eating	Step 1: IUS-12	5.08	.05*	.17	.07	.23	2.25*	.23
	Step 2:	Δ4.85**	Δ.17**					
	IUS-12			.07	.08	.09	.89	.08
	CPQ			-.03	.14	-.02	-.21	-.02
	RSES			-.26	.16	-.21	-1.65	-.15
	TOMS			.88	1.54	.08	.57	.05
	IR-ED			1.92	1.06	.23	1.81	.17

Note. IU = intolerance of uncertainty; ED = eating disorder; IU-ED = Disorder-Specific Intolerance of Uncertainty for Eating Disorders Scale; IUS-12 = Intolerance of Uncertainty Scale, Short Form; EDEQ = Eating Disorders Examination Questionnaire; CPQ = Clinical Perfectionism Questionnaire; RSES = Rosenberg Self-Esteem Scale; TOMS = Tolerance of Mood States; IR-ED = Interpersonal Relationships in Eating Disorders.
*$p < .05$. **$p < .01$. ***$p < .001$.

6.4. Discussion

IU is a transdiagnostic process associated with anxiety disorders and depressive disorders, and there has been a growing interest in its role in eating disorders. The aims of this study were to develop and validate a disorder-specific IU scale specifically related to eating disorders (the IU-ED scale), and to examine the associations between scores on this scale and eating disorder symptoms. The results revealed that a two-factor 30-item version and abbreviated six-item version best represented the IU-ED scale. Core and social IU (Factor 1) centres on uncertainty pertaining to the core psychopathology of eating disorders, and concerns about social evaluation. Weight and control IU (Factor 2) centres on uncertainty as a trigger for weight-controlling behaviours (e.g., binge eating and purging). The shorter six-item IU-ED scale was strongly correlated with the 30-item version of the scale, and both exhibited excellent internal consistency and test-retest reliability. The six-item IU-ED scale demonstrated a similar pattern of findings to the long 30-item version, and therefore the shorter IU-ED scale can be considered useful for research and clinical purposes.

The disorder-specific IU-ED scale showed convergent validity with measures of perfectionism, mood intolerance, self-esteem, interpersonal problems, and symptoms of depression and anxiety. The IU-ED scale showed evidence of divergent validity with measures of disorder-specific IU relating to different emotional disorder symptoms. However, the correlation between trait IU and the IU-ED total score and core and social IU subscale was relatively low, and there was a non-significant correlation between trait IU and weight and control IU. This is in contrast to previous research reporting strong associations between trait IU and disorder-specific IU pertaining to different emotional disorders in undergraduate samples (DSIU scales; Thibodeau et al., 2015). Anxiety and depressive disorders are the most prevalent mental health problems in undergraduate students (Blanco et al., 2008). Thus, the symptom severity of these disorders may be higher in student samples relative to symptoms of eating disorders and may result in a greater range attenuation of scores. The relatively lower symptom severity of eating disorders in student samples may be a possible explanation for the low and non-significant associations in this study. It is important to note that trait IU (IUS-12) did not have significant associations with the EDEQ global score, shape concerns, or dietary restraint. This is contrary to prior research, which found moderate to strong associations between trait IU and eating disorder symptoms and behaviours in clinical samples (Renjan et al., 2016). Trait IU and disorder-specific IU (as it relates to anxiety disorders, depressive disorder, and eating disorders) displayed significant associations with other constructs, including perfectionism, interpersonal problems, and mood intolerance, which lends support

to the transdiagnostic conceptualisation of IU (Carleton, 2012; Hong & Cheung, 2015). Taken together, the findings provide initial support for the reliability and construct validity of the newly developed disorder-specific IU-ED scale in an undergraduate sample. Moreover, this study provided support for the test-retest reliability of the eight DSIU subscales (Thibodeau et al., 2015).

The disorder-specific IU-ED scale was also found to be strongly associated with core eating disorder psychopathology (i.e., the overvaluation of eating, shape, and weight). Moreover, IU-ED scores were elevated amongst participants who self-reported purging, dietary restriction, and binge eating. Consistent with prior research examining anxiety and depressive disorder symptoms (Shihata et al., 2017; Thibodeau et al., 2015), the relative contributions of trait IU and disorder-specific IU to eating disorder symptoms varied. The results indicated that relative to disorder-specific IU, trait IU was a stronger predictor of binge eating. In contrast, disorder-specific IU was a stronger predictor of core psychopathology, dietary restraint, and purging. This pattern remained when controlling for additional transdiagnostic mechanisms associated with eating disorders. The regression analyses also indicated that disorder-specific IU explained unique variance in eating disorder symptoms beyond trait IU and other key mechanisms involved in eating disorders. It is important to note that when the additional mechanisms were included in the regression model, trait IU did not significantly predict binge eating. This is consistent with previous research that reported a non-significant direct effect with binge eating and a non-significant indirect effect between IU and binge eating via overvaluation of eating, shape, and weight (Renjan et al., 2016). In line with the transdiagnostic model of eating disorders, binge eating is not part of the core psychopathology but represents a consequence of breaking dietary rules and restrictions, and therefore Renjan et al. (2016) speculated that IU may have a stronger relationship to restraint and purging (i.e., behaviours characterised by a sense of control) than binge eating (i.e., behaviour characterised by a lack of control). This study adds to the literature by highlighting the potential importance of disorder-specific IU to eating disorder symptoms beyond other key constructs (mood intolerance, interpersonal difficulties).

The unique relationships between disorder-specific IU and eating disorder symptoms suggests that there may be utility in integrating IU into the transdiagnostic model of eating disorders. It is possible that disorder-specific IU represents a proximal pathway between trait IU and eating disorder psychopathology. Research suggests that IU may represent a potential transdiagnostic and transtherapeutic treatment target (Dugas & Ladouceur, 2000; McEvoy & Erceg-Hurn, 2016). As such, interventions based on cognitive-behavioural or exposure

principles that challenge trait and disorder-specific IU regarding eating disorder symptoms (e.g., uncertainty about food, body weight) and that increase tolerance of uncertainty could be of benefit (Kesby et al., 2017; Renjan et al., 2016). A treatment protocol targeting IU, developed by Dugas and Ladouceur (2000), was adapted for use with adolescents with anorexia nervosa in a recent pilot study (Sternheim & Harrison, 2018). There was a significant reduction in IU scores between pre-treatment and post-treatment, which were maintained at three-month follow-up; however, these reductions fell short of the reliable change cut-off. Further research is needed to examine the benefits of this intervention in reducing IU and eating disorder symptoms in larger and more diverse samples (Sternheim & Harrison, 2018). Moreover, eating disordered behaviours such as food avoidance and restriction, compulsive exercise, and body checking that may function to reduce uncertainty about potential weight gain may be targeted via exposure-response prevention, imaginal or in vivo exposure, and behavioural experiments that violate expectancy effects (Reilly, Anderson, Gorrell, Schaumberg, & Anderson, 2017). A recent review by Reilly et al. (2017) detail a range of exposure-based techniques, exercises, and specific examples for translating anxiety-disorder interventions to eating disorders. For example, exposure tasks can include presenting avoided food (e.g., high-calorie foods) to encourage tolerance of anxiety and heightened fear of weight gain, and/or behavioural experiments can include testing the expectancies about the likelihood of immediate/rapid weight gain when high-calorie foods are consumed (Reilly et al., 2017). For effective treatment, the authors highlight the importance of adopting an idiographic approach, and understanding the function of target behaviours for each individual as well as the complexities associated with eating disorders (Reilly et al., 2017).

This study has a number of limitations, which also provide avenues for future research. This study was cross-sectional and thus precludes directional or causal inferences. The role of IU in eating disorders is an emerging topic and future research should aim to use experimental, longitudinal, and treatment studies. The sample size was adequate to investigate correlations and regression analyses, but the study was underpowered to examine direct and indirect pathways using structural equation modelling (SEM). Future research using larger samples would allow for use of SEM or path analysis to examine the relative contributions of, and relationships between, trait IU, disorder-specific IU, eating disorder symptoms, and additional mechanisms outlined in the transdiagnostic model of eating disorders (Fairburn et al., 2003).

Nonetheless, this is an important first step in examining the relative associations between trait IU and disorder-specific IU as it relates to eating disorder symptoms. Extending

prior research, indirect effects of trait IU and disorder-specific IU to eating disorder symptoms could also be examined (Renjan et al., 2016; Shihata et al., 2017). The current study used a student population and although a small proportion of the sample reported purging and binging behaviour, as well as eating, shape, and weight concerns, examination and validation of the IU-ED scale in a clinical eating disorder sample is required. In addition, the IU-ED scale could be compared across distinct diagnostic subgroups (e.g., purging, binge eating) to determine whether disorder-specific IU plays a greater role in driving a particular behaviour. Future research using undergraduate and clinical samples should conduct a confirmatory factor analysis to confirm whether a two-factor model or bifactor structure is appropriate (Reise, 2012) as has been recently demonstrated for trait IU (Shihata, McEvoy, & Mullan, 2018). Finally, the core and social IU subscale assesses uncertainty about core eating disorder psychopathology, and therefore it is likely to be strongly associated with eating disorder symptoms and may leave little variance to be captured by other constructs. However, the core and social IU subscale did not predict purging behaviour, which is not part of the core psychopathology, but the weight and control IU subscale was found to be significantly associated. The development of the IU-ED scale was designed to focus on uncertainty, and as such, it is possible that the strong association between the IU-ED scale and eating disorder symptoms may be explained by conceptual similarities across the items and common method variance (e.g., IU-ED measures uncertainty about symptoms; EDEQ measures symptoms).

Notwithstanding these limitations, the current study contributes to the extant literature by developing a measure of disorder-specific IU related to eating disorders and examining the role of trait IU and disorder-specific IU to eating disorder symptoms beyond other key mechanisms. Preliminary support for the validity and reliability of the IU-ED scale was found. Disorder-specific IU-ED was found to explain unique variance in eating disorder symptoms beyond trait IU, which underscores the potential importance of trait and disorder-specific manifestations of IU. Further research examining the psychometric properties and clinical utility of the IU-ED scale to eating disorder psychopathology in community and clinical samples is required.

Chapter 7: General Discussion

The transdiagnostic approach to emotional disorders underscores the identification of common processes involved in the predisposition and perpetuation of psychopathology (Norton & Paulus, 2016). A growing body of research supports the conceptualisation of IU as a transdiagnostic mechanism implicated in the development and maintenance of a range of psychological disorders. IU reflects a fear of the unknown, is linked to perceptions that uncertainty is threatening and negative, and impacts responses to uncertainty on cognitive, emotional, and behavioural levels (Freeston et al., 1994; Hock & Krohne, 2004). Further, IU is found to be associated with high rates of comorbidity between emotional disorders (McEvoy & Mahoney, 2012). A major foci for research has been investigating the dispositional trait nature of IU in disorder symptoms and its potential to impact therapeutic outcomes and be targeted in treatment, but recent studies have highlighted the relevance of disorder-specific manifestations of IU (Boswell et al., 2013; Thibodeau et al., 2015). There has been limited research investigating the unique and relative contributions of trait IU and disorder-specific IU to symptoms of emotional disorders and eating disorders. The separability of the dimensions of a widely used measure of trait IU (IUS-12) have also been questioned, with researchers suggesting that IU is best represented as a general factor in undergraduate samples (Hale et al., 2016; Lauriola et al., 2016). As such, researchers assert that the IUS-12 total score rather than subscale scores (prospective IU and inhibitory IU) be used (Hale et al., 2016; Lauriola et al., 2016). Moreover, while there has been a substantial amount of research on IU, there is a paucity of experimental studies and research examining the behavioural correlates of IU and how uncertainty interacts with threat across situations. Given that cognitive-behavioural models highlight the role of threat perception and uncertainty in anxiety (Carleton, Weeks, et al., 2012; Grupe & Nitschke, 2013), research investigating how uncertainty and perception of threat impacts behaviour and distress across different certainty levels and contexts would provide empirical insight into these relationships. The aim of this thesis was to improve our understanding of the transdiagnostic nature of IU by evaluating its psychometric structure, trait and disorder-specific manifestations, along with its interactions and associations with threat perceptions and decision-making behaviour across contexts. To address important gaps within the IU literature, cross-sectional and experimental studies were used to examine the measurement and role of IU in emotional disorders, eating disorders, and decision-making.

The results from the thesis indicated that a widely used measure of IU, the IUS-12, is best represented as a bifactor structure across both undergraduate and clinical populations (see Chapter 3). Although there were differences in structure across the samples, the results indicated that the total score and not the subscale scores can validly be used in clinical and research contexts. The results also suggested that the IUS-12 reflects a unidimensional assessment of IU. The findings provided information about commonalities across the dimensions, suggesting that prospective IU (cognitive appraisals about uncertainty) and inhibitory IU (behavioural inhibition in the face of uncertainty) may be considered as core aspects of general IU and need not be interpreted independently. Across both samples, the general IU factor was most strongly related to emotional disorder symptoms and was found to demonstrate the most consistent transdiagnostic predictive utility.

In addition, the findings indicated that the relative strength of unique associations with multiple anxiety and anxiety-related disorder symptoms vary between trait and disorder-specific IU (see Chapter 4). Consistent with prior research, trait IU was more strongly associated with symptoms of generalised anxiety disorder and obsessive compulsive disorder, whereas disorder-specific IU was more strongly associated with symptoms of social anxiety disorder and panic disorder. An important extension to the literature was that this study disentangled the relative contribution of additional key disorder-specific vulnerability factors associated with each disorder. The results suggest that trait IU may increase vulnerability to disorder-specific IU and disorder-specific vulnerability factors and, in turn, increase vulnerability to disorder symptoms. Future research using prospective and experimental designs are needed to clarify these relationships, and if these associations are replicated in such studies this may suggest that IU represents a proximal intermediary between general trait IU and symptoms of emotional disorders.

Much of the research to date on IU has predominantly used self-report and cross-sectional methods, which are important for developing our understanding of the associations between constructs. However, such methods are subject to demand effects, shared method variance, and may result in heightened associations between constructs of interest. Thus, there is a need for experimental research examining IU and its cognitive, emotional, and behavioural correlates. Building on the previous studies that investigated the structure of a measure of IU and the relationships between trait IU, disorder-specific IU, and symptoms of multiple disorders, the findings of the thesis also provided information about the associations between IU and decision-making within an experimental context (see Chapter 5). The previous studies in this thesis highlighted the relevance of disorder-specific IU to multiple

emotional disorder symptoms, and as such, the aim of the experimental study was to extend investigation of trait IU, disorder-specific IU, and behaviour using an in vivo paradigm and probability-based decision-making task. In addition, this study evaluated a core component of IU theory, which suggests that an uncertain situation is more threatening and anxiety provoking than a certain threat. The results indicated no significant group differences between the uncertain and certain threat conditions. Moreover, estimates of perceived probability of the outcome suggested that participants reported feeling relatively uncertain, and therefore the intended manipulation to induce differential uncertainty across groups was not successful. Despite this, the results relating to disorder-specific IU, perceived cost, and decision-making performance within the social evaluation and performance context were potentially informative and warrant discussion. The results revealed higher disorder-specific IU is associated with decision-making behaviour (i.e., increased draws to decision and time taken to make a decision) specifically when the cost of social evaluation is perceived to be low. There was a significant relationship between cost estimates and distress during decision-making, which may suggest that the perceived cost of threat is more proximal to distress. There were no significant associations between disorder-specific IU-OCD, cost estimates, and decision-making and distress in the contamination and responsibility context. Taken together, IU may play a stronger role in situations that are deemed to be of low cost or threat than high cost. The findings suggest that when the cost of social evaluation is deemed to be high, then participants request more draws to decision and take more time to decide regardless of IU.

In the final study, the relationships between trait IU, disorder-specific IU as it relates to eating disorder psychopathology, and eating disorder cognitions and behaviours were investigated (see Chapter 6). Recent research has highlighted the relevance of IU to eating disorders, which are highly comorbid with anxiety and anxiety disorders, and represent a complex group of psychological disorders. As such, the aim of this study was to extend prior research on disorder-specific IU by developing a measure to asses disorder-specific IU relevant to eating disorders (IU-ED scale). Exploratory analyses highlighted the presence of a two-factor structure and an abbreviated six-item version was created to facilitate use in research and clinical contexts. Preliminary psychometric support was evidenced by good internal consistency, test-retest reliability, and convergent and divergent validity. The results indicated that IU-ED scores were heightened amongst individuals who reported eating disorder behaviours (i.e., purging, binge eating, and dietary restraint). Moreover, the IU-ED scale explained unique variance in core eating disorder psychopathology, as well as restraint and purging behaviour, but not binge eating.

In summary, the findings of this thesis provide further support for IU as a transdiagnostic process and its associations with a host of other vulnerability factors and a broad range of disorder symptoms. The findings underscore the potential relevance of disorder-specific IU as a proximal intermediary and pathway between trait IU and psychopathology, and provide new information about the relationships between uncertainty, threat perception, and cognitive, behavioural, and emotional responses.

7.1. Theoretical and Clinical Implications

There are several theoretical implications of the present research. The results of the thesis highlight the relationships between IU and disorder symptoms and provide further support for research that explicitly incorporates IU into cognitive-behavioural models of psychopathology. Consistent with prior research (Hale et al., 2016), the results of the thesis indicated that prospective IU and inhibitory IU may not need to be interpreted independently and may be better represented as core features of a general IU factor. This is in contrast to other research that highlighted that prospective IU and inhibitory IU dimensions are distinct and meaningful (Boelen & Lenferink, 2018; Oglesby, Allan, Short, Raines, & Schmidt, 2017). Oglesby et al. (2017) found that the IU dimensions are distinct at moderate levels of IU, but not at overall high or low levels. Moreover, Boelen and Lenferink (2018) identified distinct subgroups with different IU profiles (i.e., characterised by low IU, predominantly prospective IU, predominantly inhibitory IU, and high IU). The authors reported differential associations between the subgroups and disorder symptoms such that relative to low IU, high IU was more strongly related to cognitive vulnerabilities (e.g., rumination, worry), and symptoms of anxiety disorders and depression (Boelen & Lenferink, 2018). Moreover, some research suggests that relative to prospective IU, inhibitory IU is more strongly related to emotional distress and disorder symptoms, and is therefore, the more debilitating aspect of IU (Boelen & Lenferink, 2018; Hong & Lee, 2015). This somewhat accords with the findings of the thesis that inhibitory IU demonstrated transdiagnostic utility, although more weakly. Future research is required to investigate the structure of IU and the differential discriminant validity of prospective IU and inhibitory IU (Boelen & Lenferink, 2018; Hale et al., 2016; McEvoy & Mahoney, 2011).

The findings from the thesis lend additional support to the transdiagnostic conceptualisation of IU (Carleton, 2012; Hong & Cheung, 2015). The trait and disorder-specific manifestations of IU were found to be associated with a host of other vulnerability factors and a broad range of disorder symptoms in undergraduate and clinical samples. IU was

associated with symptoms of generalised anxiety disorder, obsessive compulsive disorder, social anxiety disorder, panic disorder, depressive disorder, and eating disorders. The indirect pathways suggest that IU may influence emotional disorder symptoms by increasing vulnerability to disorder-specific IU and disorder-specific vulnerability factors. Consistent with previous research, the strength of the pathways between trait IU and disorder-specific IU and disorder symptoms varied (Thibodeau et al., 2015). Extending the literature, this thesis examined the associations between IU and disorder symptoms beyond other key mechanisms outlined in cognitive-behavioural models. Disorder-specific vulnerability factors were associated with concordant emotional disorder symptoms, which supports the original conceptual models that highlight the key role of disorder-specific variables in predicting the development and maintenance of the disorder (Goldstein & Chambless, 1978; Rapee & Heimberg, 1997; Salkovskis, 1985; Wells, 2005). The findings underscore the importance of research investigating unique and shared processes in emotional disorder symptoms. An important first step addressed in this thesis was to develop a measure of disorder-specific IU for eating disorders to identify the potential relevance of disorder-specific aspects of IU to this complex group of illnesses. The results revealed that relative to trait IU, disorder-specific IU was more strongly related to core eating disorder psychopathology and behaviour (i.e., dietary restraint and purging). As such, the findings highlight the theoretical distinction of disorder-specific IU as a meaningful construct independent of trait IU. For some disorders, such as social anxiety disorder and panic disorder, disorder-specific IU may represent a proximal intermediary pathway between general trait IU and symptoms.

The experimental study in the thesis presents an important step towards better understanding causal models of IU. Despite the transdiagnostic associations between IU and emotional disorders, much of this research is correlational in nature and, as such, there is a paucity of experimental studies investigating IU. Carleton, Mulvogue, et al. (2012) highlight the need for research investigating IU as a causal risk factor associated with anxiety and anxiety-related behaviours. The experimental study in this thesis contributes to the literature that aims to elucidate the nature of IU within a disorder-specific context (Faleer et al., 2017). Moreover, the current research extends the literature by examining the relationships between IU and threat perception (Pepperdine et al., 2018). The results of the thesis indicated that disorder-specific IU and estimates of the perceived cost of the negative outcome were related to decision-making behaviour. More specifically, the relationships between disorder-specific IU as it pertains to social anxiety disorder and decision-making behaviour was evident when the cost of social evaluation was deemed low. This suggests that IU may play a stronger role

in situations that are considered to be of low cost or threat than in situations considered to be of high threat. In addition to decision-making behaviour, cost estimates were implicated in self-reported distress. Such findings may suggest that the role of cost estimates and threat perceptions are more proximal and closely related to distress than IU and future research is required to investigate this further. Probability estimates of the outcome occurring were used as a manipulation check, and based on this and the non-significant group differences between the uncertain and certain threat conditions, the manipulation appeared to be unsuccessful. However, threat perceptions, which involve inflated estimates of the probability of an outcome, may contribute to elevated worry (Buhr & Dugas, 2002). Indeed, Einstein (2014) asserts that heightened threat expectancy drives emotional responses to uncertainty. Thus, it is important for future research to consider the role of threat perceptions (estimates of probability and cost) in predicting behavioural responses to uncertainty and anxiety. If future research finds that the link between IU and behaviour and emotional responses is moderated by threat perceptions, then this would provide further support to cognitive-behavioural models of anxiety disorders which suggest that anxiety is maintained by attention to threat and overestimations of threat probability and cost (Grupe & Nitschke, 2013). The current research provides a foundation for future experimental studies that seek to manipulate the certainty of a threat, and investigate the relationships between IU, threat perception, and behaviour.

Research evaluating the relationships between trait and disorder-specific IU, emotional disorder symptoms, and decision-making behaviour could inform theory as well as treatment. With regards to the clinical implications of the thesis, research suggests that maladaptive cognitive and behavioural processes represent valuable treatment targets (Barlow, 2000). With the shift in nosology from diagnosis-specific symptom clusters to transdiagnostic and dimensional approaches (Kozak & Cuthbert, 2016; McEvoy et al., in press), well-documented associations between IU and psychopathology indicate that IU may be a transdiagnostic target for intervention. Research suggests that changes in IU are linked with symptom improvement and positive treatment outcomes across a range of emotional disorders including generalised anxiety disorder, social anxiety disorder, obsessive compulsive disorder, and depression (Dugas & Ladouceur, 2000; Dugas & Robichaud, 2007; Hewitt et al., 2009; Mahoney & McEvoy, 2012a; Talkovsky & Norton, 2016; Treanor et al., 2011; van der Heiden et al., 2012). Indeed, a recent study suggested that IU is a transtherapeutic mechanism, which contributes to changes in emotional disorder symptoms across different treatment interventions (McEvoy & Erceg-Hurn, 2016). Therapeutic treatments designed to reduce anxiety-related psychopathology have noted the importance of increasing tolerance for

uncertainty and risk (Clark & Beck, 2010). Moreover, Carleton (2012) noted that all therapies represent attempts to alleviate IU and fear of the unknown. Therapeutic interventions that aim to remove or minimise threats, increase sense of certainty, and foster the ability to cope with threatening outcomes and uncertainty may all contribute to a sense of personal agency, and in turn, symptom reduction (Carleton, 2012). However, Carleton (2012) posits that treatment protocols that work to increase tolerance of uncertainty may bring about the most pervasive clinically significant change, although they may represent a challenge to clinicians and clients. Within treatment protocols derived from different theoretical frameworks, IU is an implicit component (Mahoney & McEvoy, 2012a; van der Heiden et al., 2012). To the extent that the findings of the thesis have clinical implications for anxiety, mood, and eating disorders, they suggest that uncertainty be a focus in treatment.

The role of IU and uncertainty in cognitive-behavioural models could be highlighted in psychoeducation. Information could be given regarding the ubiquity of uncertainty and, while it may elicit feelings of anxiety and worry, it is not dangerous. With regards to cognitive-behavioural therapy techniques, beliefs about uncertainty and maladaptive appraisals could be challenged and modified. Psychoeducation and cognitive restructuring could be used to strengthen beliefs that uncertainty is tolerable and normal as well as highlight the likelihood of being able to tolerate such uncertainty and anxiety (Abramowitz & Arch, 2014). Within cognitive-behavioural therapy, exposure-based techniques that emphasise inhibitory learning are recommended for the treatment of anxiety disorders (Craske, 2012; Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). Adopting an exposure-based and inhibitory learning approach aims to increase the likelihood that nonthreatening associations (e.g., uncertainty about the feared consequences is acceptable) inhibit threatening associations (e.g., uncertainty about the feared consequences is unacceptable; Abramowitz & Arch, 2014). The results of the thesis suggest that some disorders such as generalised anxiety disorder may benefit from a more general focus on tolerating IU across life domains. Cognitive restructuring could include verbal cognitive strategies to assist clients in challenging their need for certainty about a range of situations with an emphasis on thinking differently about uncertainty and learning that uncertainty is acceptable and tolerable. Through discussion and challenging thoughts, clients may become aware and find evidence that they can accept and tolerate uncertainty in other life areas and function effectively (Abramowitz & Arch, 2014). Exposure therapy for individuals with generalised anxiety disorder might have a more general focus on building tolerance for uncertainty across different life domains. Clients could be guided to appraise the experience of uncertainty across multiple contexts, without cognitive or

behavioural attempts to minimise uncertainty (e.g., worry, reassurance-seeking, excessive checking, and procrastination), as consistent with the overarching therapy aim of increasing tolerance of uncertainty and reducing vulnerability to emotional distress. Cognitive strategies or behaviours that *heighten* uncertainty should be encouraged and approached.

The findings of the thesis contribute to literature that highlights the importance of context and disorder-specific IU in psychopathology (Thibodeau et al., 2015). There may be benefit from targeting disorder-specific IU in treatment and future research is needed to investigate this possibility. For example, individuals with social anxiety disorder and panic disorder may benefit from a treatment that focuses more on building tolerance for uncertainty specific to their concerns (e.g., social evaluation and bodily sensations, respectively). Exposure therapy for individuals with social anxiety disorder could emphasise that the goal is to learn to tolerate uncertainty specific to social interactions. Exposure-based tasks could be framed to investigate whether the feared outcomes occurred in social and performance situations (e.g., blushing, excessive perspiration) and to build tolerance of uncertainty about not knowing whether or not they were evaluated in such situations. To generalise learning of nonthreatening associations to many real-life scenarios (e.g., uncertainty about social evaluation), systematic exposure to social and performance situations should be conducted in a range of environments and through a combination of different types of exposure (e.g., situational exposure, imaginal exposure, in vivo exposure, interoceptive exposure). Treatment studies are warranted to determine whether clinicians should target trait or general IU, disorder-specific IU, or a combination of the two that may differ across disorders (Thibodeau et al., 2015). It is important for future research to compare the effects of treatments designed to directly and indirectly target IU.

7.2. Strengths of the Present Research

In this thesis an evaluation of the relationships between trait IU, disorder-specific IU, disorder-specific vulnerability factors, and multiple anxiety and anxiety-related disorder symptoms using structural equation modelling (SEM) was presented. An advantage of SEM relative to other regression approaches that use observed variables (e.g., path analysis) is the ability to use item level data to create latent variables, which allows measurement error to be modelled (Tomarken & Waller, 2005). Further, the measurement model of each measure was examined with an independent confirmatory factor analysis (CFA), which provides support for the support for the conceptual reliability of the underlying factors prior to being included in the final structural model (Schreiber et al., 2006). Unlike previous research, the study was

able to examine the strength of the direct and indirect pathways between IU and disorder symptoms beyond other key vulnerability factors. These models included the common and unique contribution of these processes to a range of symptoms, which represented both a more comprehensive and more conservative test of the unique associations between IU and disorder symptoms. This was an important aspect of the research as it enhanced understanding of the relative contributions between trait IU, disorder-specific IU as it pertains to different disorders, and multiple emotional disorder symptoms beyond other key cognitive vulnerability factors.

An additional strength of the present research is the use of an experimental behavioural paradigm as an analogue to examine decision-making and distress within the context of IU. Although there has been a gradual increase in the number of laboratory studies and in vivo measures of IU, there is a relative paucity of experimental research in this area. There are several novel aspects to the experimental paradigm applied in the current research. This study examined the relationships between both general trait IU and disorder-specific IU beliefs within different disorder-specific contexts. It was the first study to examine the links between IU and decision-making behaviour as measured by the Beads Task within a social evaluative and contamination-related context. Moreover, based on assertions that IU and threat perceptions are closely related and central to anxiety, the current research represents an important step in the literature by accounting for the impact of estimates of the probability and cost of threat. The methodological paradigm designed to introduce a social and performance evaluative threat and contamination threat were novel. Although the contamination-related context did not yield differential results and no significant relationships were observed, it has provided a foundation for future experimental research that seeks to examine the association between IU and obsessive compulsive disorder-relevant symptoms.

7.3. Limitations and Directions for Future Research

Limitations for each study have been discussed throughout this thesis as relevant. There are several general limitations of the present research, which provide avenues for future research. A limitation of this thesis concerns the generalisability of the findings. Apart from the first study in the thesis, data were collected using a non-clinical and undergraduate sample. The participants were unscreened and structured diagnostic interviews were not conducted. Evidence suggests that IU is a dimensional and continuous construct that exists on a continuum of severity (Carleton, Weeks, et al., 2012), and therefore findings derived from non-clinical populations may be relevant to clinical populations. With regards to the studies in

this thesis, the aim was to obtain a comprehensive range of severity scores on measures of IU and other vulnerability factors and symptoms. However, it is unclear whether the relationships between trait and disorder-specific IU, emotional disorder symptoms, and decision-making observed in the present thesis will generalise to community samples and clinical samples with higher levels of trait and disorder-specific IU and psychopathology. Future research is needed to examine the generalisability of the current results to clinical samples. Moreover, the present thesis was not sufficiently powered to examine the direct and indirect pathways between trait and disorder-specific IU and eating disorder symptoms beyond other key constructs implicated in the transdiagnostic model (Fairburn et al., 2009; Fairburn et al., 2003). Thus, future research in this area should examine these pathways in larger community samples and clinical eating disorder samples to assess whether disorder-specific IU has stronger associations to core psychopathology and particular behaviours (e.g., dietary restraint). Such research would provide insight into the distinction between trait IU and disorder-specific IU in this population.

The studies in the thesis extended previous research by investigating the contributions of IU along with a comprehensive set of other vulnerability factors implicated in the cognitive-behavioural models of disorders. However, additional factors and processes related to emotional disorders, eating disorders, and decision-making behaviour were excluded from the studies. In the experimental study, additional constructs that may predict, mediate, or moderate the relationships between IU and decision-making behaviour and distress should be considered (e.g., negative urgency, perceived control). In the cross-sectional studies, additional maintaining factors could be included to assess how IU and shared and unique processes interact to influence the different trajectories to emotional disorders (e.g., anxiety sensitivity in panic disorder; overestimation of threat in obsessive compulsive disorder). However, this was outside of the scope of the research and incorporating several additional key mechanisms identified in cognitive-behavioural models would have reduced the likelihood of obtaining an adequate sample size and maintaining sufficient power. A greater understanding of the different pathways and mechanisms through which IU may contribute to different emotional disorders may help to identify malleable treatment targets across disorders. Moreover, limitations of the methodological design include the cross-sectional nature of some of the studies presented in the thesis, which precludes causal inferences and conclusions about directional effects. Directional hypotheses were tested about the relationships between trait IU, disorder-specific IU, and multiple emotional disorder symptoms using SEM techniques, however, temporal and causal relationships could not be

tested. It is possible that some relationships between the variables included in the models may be bidirectional in nature. Thus, experimental, longitudinal, and prospective research studies are warranted. Experimental studies that examine in vivo behavioural, emotional, cognitive, and physiological responses to uncertainty would be informative to identify causal links between IU and disorder symptoms. Further, these experimental designs could be incorporated into treatment studies to increase clinical utility. Hebert and Dugas (2018) assert that behavioural experiments involve testing relevant uncertainty-related beliefs to determine whether such beliefs are accurate and true, and to identify alternative beliefs. Preliminary evidence demonstrates that directly targeting IU through idiosyncratic behavioural experiments is associated with meaningful change in IU and symptoms of generalised anxiety disorder (Hebert & Dugas, 2018). Moreover, combining experimental designs with treatment studies that examine aspects of exposure therapy can inform clinical practice (e.g., combining multiple fear cues, expectancy violations, variability in exposure; Jacoby & Abramowitz, 2016). In line with traditional exposure therapy, clients progress through an exposure hierarchy in a linear manner beginning with the least distressing exposures to the most distressing exposures. In contrast to progressing in a fixed order, the inhibitory learning approach postulates that exposure may be more effective when clients work through exposure tasks in a random order (Craske et al., 2008; Craske et al., 2014; Knowles & Olatunji, 2018). Increasing variability in exposure by varying the order of exposure tasks and associated distress may in itself represent a method to target IU. The uncertainty associated with varying the presentation of exposure hierarchy tasks provides a treatment context that fosters learning and increased fear tolerance as well as ecological validity (Knowles & Olatunji, 2018). Further, Knowles and Olatunji (2018) suggest that varying exposure across contexts and stimuli may facilitate inhibitory learning, increased tolerance of uncertainty, and approach behaviour in uncertain contexts, which may contribute to improved treatment outcomes. In discussion of the treatment goals, building tolerance of fear and uncertainty and acting despite fear should be highlighted (Knowles & Olatunji, 2018). In addition to a focus on threat perceptions (i.e., estimates of the perceived probability and cost), exposure to situations where the probability of exposure to the feared stimulus is unknown or unpredictable should be incorporated into the rationale for treatment as well as the client self-reflections that occur both in and between sessions. Variability in exposure may also increase expectancy violation and generalisation such that when exposure occurs under conditions that are unpredictable or varied in some way it creates an incongruence between the perceived probability, cost, and uncertainty of the expected and actual outcome, which may reinforce learning (Craske et al.,

2014; Knowles & Olatunji, 2018). Variable exposure may encourage clients to learn to tolerate their fears along with the inherent uncertainty of the feared stimuli they encounter (e.g., when, where, and which type of the feared stimuli will be encountered). Variable exposure may encourage clients to learn a new association between uncertainty and a lack of harm (Knowles & Olatunji, 2018). Given the transdiagnostic nature of IU, research is needed comparing treatment outcomes across interventions designed to target IU directly and indirectly.

Treatment studies that investigate the efficacy of interventions targeting trait IU, disorder-specific IU, or a combination that may vary depending on the disorder, is an important area of future research. This would help to determine whether disorder-specific IU should inform case conceptualisation and treatment planning and whether particular disorders would benefit more from a focus on increasing tolerance for uncertainty in contexts that are more specifically related to their diagnostic profile (Thibodeau et al., 2015). Longitudinal and prospective designs might provide insight into the distal risk factors that link IU to emotional disorders across the lifespan. This research would be informative in improving understanding of the developmental course of IU. Further, longitudinal and prospective research that examines changes in IU over the course of different treatment protocols would lend further support to the predictive ability and transtherapeutic nature of IU.

In addition, a limitation of the present thesis is the difficulty in examining IU from an experimental perspective. The experimental study in this thesis used a novel methodological paradigm for introducing a social evaluation-related social anxiety and contamination-related obsessive-compulsive context. Overall, self-report ratings of distress and perceived task importance were relatively low, and estimates of cost indicated that participants reported the contexts to be moderately threatening. This may help to explain the non-significant associations between IU and distress across both contexts. Recent studies that have paired the decision-making task with an aversive stimulus as well as a heightened sense of responsibility to others have reported elevated levels of distress and perceived task importance, and associations between IU and distress (Jacoby et al., 2016; Jacoby et al., 2017). Future research could aim to improve the ecological validity of the task by designing idiographic contexts associated with higher threat perceptions (i.e., increased estimates of the likelihood and cost of the outcome). It would be informative for future research to consider whether there were any differences in decision-making behaviour and distress levels between individuals with higher and lower levels of trait IU and disorder-specific IU. Such research would provide further insight into whether higher IU is associated with elevated threat perception and

distress and impaired decision-making in an uncertain context. Further, this would provide insight into how individuals with anxiety disorders make decisions when there is a feared outcome (Jacoby et al., 2017). Another challenge to conducting research in this area is the difficulty in elucidating the process of decision-making. Jacoby et al. (2017) assert that there may be differences in the ways in which individuals make decisions (e.g., seeking more information to increase certainty about a decision versus making a hasty decision to avoid feelings of uncertainty). Future studies would also benefit from incorporating qualitative interviews or self-report decision-making measures to provide information about how decisions were made (Jacoby et al., 2017). It would be interesting for further research to induce a sense of uncertainty and examine the behavioural responses and links between IU, threat perception, and different decision-making styles (e.g., vigilant versus avoidant).

Examining responses to uncertainty using in vivo behavioural paradigms and decision-making tasks presents a challenge for researchers as many tasks may measure reactions to risk rather than uncertainty, which may impact ecological validity (Koerner et al., 2017). A distinction has been made between decision-making tasks that reflect "small world problems" (i.e., decision-making within a context of known probabilities and outcomes) versus "large world problems" (i.e., decision-making within a context of unknown or unknowable probabilities and outcomes; Koerner et al., 2017, p. 153; Volz & Gigerenzer, 2012). More specifically, small world problems are suggested to represent risk, whereas large world problems represent uncertainty and are influenced by environmental factors (Koerner et al., 2017; Volz & Gigerenzer, 2012). The experimental study design presented in this thesis may better reflect a small world problem as the decision-making task was implemented within a laboratory paradigm. Decision-making tasks and experimental paradigms that are characterised by small world problems may not necessarily reflect, or generalise to, the decision-making problems that individuals encounter in daily life (Volz & Gigerenzer, 2012). Moreover, the decision-making processes that an individual may engage in response to these problems may differ (e.g., a statistical versus heuristic approach to decision-making), and may be dependent on environmental and contextual factors (Koerner et al., 2017). As such, drawing inferences about real-world decision-making behaviour based on decisions made during laboratory tasks is difficult and should be done with caution (Koerner et al., 2017). The findings from this thesis highlight that disorder-specific IU and perceived cost may be implicated in the decision-making process and influence information-seeking behaviour and time taken to decide. However, the ecological validity of these results and the generalisability of the role of IU and cost estimates to making decisions in daily life should be done with

caution. A challenge to researchers is designing experiments that reflect large world problems such as decisions about short- and long-term future plans (e.g., planning a family outing, marriage, and children). Future research with more ecologically valid scenarios that reflect real world problems and decisions would be informative to elucidate the relationships between IU, threat perception, and decision-making. Further, Koerner et al. (2017) assert the importance of designing in vivo behavioural experiments by drawing on decision-making theories beyond the field of clinical psychology (e.g., medical decision-making, economics; Elstein & Schwarz, 2002; Sanfey, Loewenstein, McClure, & Cohen, 2006).

7.4. Conclusion

IU is conceptualised as a transdiagnostic process that occurs across a range of psychological disorders (Carleton, 2012). The extant literature has historically focused on trait IU and, as such, there has been limited research investigating the contribution of disorder-specific IU to disorder symptoms. While a wealth of research documents the associations between IU and emotional disorder symptoms, there has been a predominant reliance on the use of self-report measures and cross-sectional research methods. Experimental research in the area of IU is scarce and there are a limited number of studies investigating the relationships between uncertainty, threat perception, and cognitive, emotional, and behavioural responses. The overarching aim of this thesis was to better understanding of the transdiagnostic nature of IU by undertaking a narrative review to identify what is known and unknown about the construct, exploring its underlying psychometric structure, its contribution of more general and disorder-specific facets, and its impact on symptoms of emotional disorders and eating disorders as well as decision-making and threat perception. From these series of studies presented in this thesis, the emerging key findings were the transdiagnostic nature of IU, the meaningful distinction between trait IU and disorder-specific IU, and the integral role of threat perception in impacting distress and decision-making.

This research presents an important contribution to the literature and is valuable in relation to improving knowledge of the assessment, measurement, and conceptualisation of IU across behaviour and psychological disorders. This thesis has increased understanding of the trait and disorder-specific manifestations of IU and their relative importance to symptoms of anxiety and anxiety-related disorders as well as eating disorders. These findings provide further insight into the measurement of IU, computation of total and subscale scores, and the relevance of the different subscale dimensions across anxiety and depressive symptoms in undergraduate and clinical populations. In addition, the findings underscore the importance of

considering perceptions of threat in the context of IU and its associations with decision-making behaviour and uncertainty-related distress. Future research should investigate whether these results generalise to community and clinical populations. The findings from the thesis have provided avenues for future research to inform explicitly incorporating IU into a clinical context.

References

Aardoom, J. J., Dingemans, A. E., Slof Op't Landt, M. C. T., & Furth, E. F. V. (2012). Norms and discriminative validity of the Eating Disorder Examination Questionnaire (EDEQ). *Eating Behaviors, 13*, 305-309. doi:10.1016/j.eatbeh.2012.09.002

Abramowitz, J. S., & Arch, J. J. (2014). Strategies for improving long-term outcomes in cognitive behavioral therapy for obsessive-compulsive disorder: Insights from learning theory. *Cognitive and Behavioral Practice, 21*, 20-31. doi:10.1016/j.cbpra.2013.06.004

Abramowitz, J. S., & Deacon, B. J. (2006). Psychometric properties and construct validity of the Obsessive–Compulsive Inventory—Revised: Replication and extension with a clinical sample. *Journal of Anxiety Disorders, 20*, 1016-1035. doi:10.1016/j.janxdis.2006.03.001

Abramowitz, J. S., & Jacoby, R. J. (2014). Obsessive-compulsive disorder in the DSM-5. *Clinical Psychology: Science and Practice, 21*, 221-235. doi:10.1111/cpsp.12076

Aktar, E., Nikolić, M., & Bögels, S. M. (2017). Environmental transmission of generalized anxiety disorder from parents to children: worries, experiential avoidance, and intolerance of uncertainty. *Dialogues in Clinical Neuroscience, 19*, 137-147.

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review, 30*, 217-237. doi:10.1016/j.cpr.2009.11.004

Allen, K. L., Byrne, S. M., Lampard, A., Watson, H., & Fursland, A. (2011). Confirmatory factor analysis of the Eating Disorder Examination-Questionnaire (EDE-Q). *Eating Behaviors, 12*, 143-151. doi:10.1016/j.eatbeh.2011.01.005

Allen, K. L., McLean, N. J., & Byrne, S. M. (2012). Evaluation of a new measure of mood intolerance, the Tolerance of Mood States Scale (TOMS): Psychometric properties and associations with eating disorder symptoms. *Eating Behaviors, 13*, 326-334. doi:10.1016/j.eatbeh.2012.05.005

Alloy, L. B., Abramson, L. Y., Gibb, B. E., Crossfield, A. G., Pieracci, A. M., Spasojevic, J., & Steinberg, J. A. (2004). Developmental antecedents of cognitive vulnerability to depression: Review of findings from the cognitive vulnerability to depression project. *Journal of Cognitive Psychotherapy, 18*, 115-133. doi:10.1891/jcop.18.2.115.65957

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed.). Washington, DC: Author.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin, 103*, 411-423. doi:10.1037/0033-2909.103.3.411

Anderson, K. G., Deschênes, S. S., & Dugas, M. J. (2016). Experimental manipulation of avoidable feelings of uncertainty: Effects on anger and anxiety. *Journal of Anxiety Disorders, 41*, 50-58. doi:10.1016/j.janxdis.2016.03.007

Andrews, G., Creamer, M., Crino, R., Hunt, C., Lampe, L., & Page, A. (2003). *The treatment of anxiety disorders: Clinician guides and patient manuals* (2nd ed.). Cambridge Cambridge University Press.

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-Item and 21-Item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment, 10*, 176-181. doi:10.1037/1040-3590.10.2.176

Banducci, A. N., Bujarski, S. J., Bonn-Miller, M. O., Patel, A., & Connolly, K. M. (2016). The impact of intolerance of emotional distress and uncertainty on veterans with co-occurring PTSD and substance use disorders. *Journal of Anxiety Disorders, 41*, 73-81. doi:10.1016/j.janxdis.2016.03.003

Bardeen, J., Fergus, T., & Wu, K. (2013). The interactive effect of worry and intolerance of uncertainty on posttraumatic stress symptoms. *Cognitive Therapy and Research, 37*, 742-751. doi:10.1007/s10608-012-9512-1

Barlow, D. H. (2000). Unraveling the mysteries of anxiety and its disorders from the perspective of emotion theory. *The American Psychologist, 55*, 1247-1263. doi:10.1037/0003-066X.55.11.1247

Barlow, D. H. (2002). *Anxiety and its disorders: the nature and treatment of anxiety and panic* (2nd ed.). New York, NY Guilford Press

Barlow, D. H., Allen, L. B., & Choate, M. L. (2004). Toward a unified treatment for emotional disorders. *Behaviour Therapy, 35*, 205-230. doi:10.1016/S0005-7894(04)80036-4

Barlow, D. H., Bullis, J. R., Comer, J. S., & Ametaj, A. A. (2013). Evidence-based psychological treatments: an update and a way forward. *Annual Review of Clinical Psychology, 9*, 1-27. doi:10.1146/annurev-clinpsy-050212-185629

Barlow, D. H., Sauer-Zavala, S., Carl, J. R., Bullis, J. R., & Ellard, K. K. (2014). The nature, diagnosis, and treatment of neuroticism. *Clinical Psychological Science, 2*, 344-365. doi:10.1177/2167702613505532

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: psychometric properties. *Journal of Consulting and Clinical Psychology, 56*, 893-897. doi:10.1037/0022-006X.56.6.893

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory-II*. San Antonio, TX: Psychological Corporation.

Berenbaum, H. (2013). Classification and psychopathology research. *Journal of Abnormal Psychology, 122*, 894-901. doi:10.1037/a0033096

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*, 117-125. doi:10.1016/j.janxdis.2007.01.004

Berg, K. C., Peterson, C. B., Frazier, P., & Crow, S. J. (2012). Psychometric evaluation of the eating disorder examination and eating disorder examination‐questionnaire: A systematic review of the literature. *International Journal of Eating Disorders, 45*, 428-438. doi:10.1002/eat.20931

Birnbaum, H. G., Kessler, R. C., Kelley, D., Ben-Hamadi, R., Joish, V. N., & Greenberg, P. E. (2010). Employer burden of mild, moderate, and severe major depressive disorder: mental health services utilization and costs, and work performance. *Depression and Anxiety, 27*, 78-89. doi:10.1002/da.20580

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*, 1198-1208. doi:10.1016/j.cpr.2011.07.009

Blanco, C., Okuda, M., Wright, C., Hasin, D. S., Grant, B. F., Liu, S.-M., & Olfson, M. (2008). Mental health of college students and their non–college-attending peers: results From the national epidemiologic study on alcohol and related conditions. *Archives of General Psychiatry, 65*, 1429-1437. doi:10.1001/archpsyc.65.12.1429

Boelen, P. (2010). Intolerance of uncertainty and emotional distress following the death of a loved one. *Anxiety, Stress, & Coping, 23*, 471-478. doi:10.1080/10615800903494135

Boelen, P. A., & Carleton, R. N. (2012). Intolerance of uncertainty, hypochondriacalconcerns, obsessive–compulsive symptoms, and worry. *The Journal of Nervous and Mental Disease, 200*, 208-213. doi:10.1097/NMD.0b013e318247cb17

Boelen, P. A., & Lenferink, L. I. M. (2018). Latent class analysis of indicators of intolerance of uncertainty. *Scandinavian Journal of Psychology, 59*, 243-251. doi:10.1111/sjop.12440

Boelen, P. A., & Reijntjes, A. (2009). Intolerance of uncertainty and social anxiety. *Journal of Anxiety Disorders, 23*, 130-135. doi:10.1016/j.janxdis.2008.04.007

Boelen, P. A., Reijntjes, A., & Carleton, R. N. (2014). Intolerance of uncertainty and adult separation anxiety. *Cognitive Behaviour Therapy, 43*, 1-12. doi:10.1080/16506073.2014.888755

Boelen, P. A., Reijntjes, A., & Smid, G. E. (2016). Concurrent and prospective associations of intolerance of uncertainty with symptoms of prolonged grief, posttraumatic stress, and depression after bereavement. *Journal of Anxiety Disorders, 41*, 65-72. doi:10.1016/j.janxdis.2016.03.004

Bomyea, J., Ramsawh, H., Ball, T. M., Taylor, C. T., Paulus, M. P., Lang, A. J., & Stein, M. B. (2015). Intolerance of uncertainty as a mediator of reductions in worry in a cognitive behavioral treatment program for generalized anxiety disorder. *Journal of Anxiety Disorders, 33*, 90-94. doi:10.1016/j.janxdis.2015.05.004

Bonifay, W., Lane, S. P., & Reise, S. P. (2017). Three concerns with applying a bifactor model as a structure of psychopathology. *Clinical Psychological Science*, 184-186. doi:10.1177/2167702616657069

Boswell, J. F., Thompson-Hollands, J., Farchione, T. J., & Barlow, D. H. (2013). Intolerance of uncertainty: a common factor in the treatment of emotional disorders. *Journal of Clinical Psychology, 69*, 630-645. doi:10.1002/jclp.21965

Boulter, C., Freeston, M., South, M., & Rodgers, J. (2014). Intolerance of uncertainty as a framework for understanding anxiety in children and adolescents with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 44*, 1391-1402. doi:10.1007/s10803-013-2001-x

Bredemeier, K., & Berenbaum, H. (2008). Intolerance of uncertainty and perceived threat. *Behaviour Research and Therapy, 46*, 28-38. doi:10.1016/j.brat.2007.09.006

Brosschot, J. F., Verkuil, B., & Thayer, J. F. (2016). The default response to uncertainty and the importance of perceived safety in anxiety and stress: An evolution-theoretical

perspective. *Journal of Anxiety Disorders, 41*, 22-34. doi:10.1016/j.janxdis.2016.04.012

Brosschot, J. F., Verkuil, B., & Thayer, J. F. (2017). Exposed to events that never happen: Generalized unsafety, the default stress response, and prolonged autonomic activity. *Neuroscience and Biobehavioral Reviews, 74*(Pt B), 287-296. doi:10.1016/j.neubiorev.2016.07.019

Brouwer, D., Meijer, R. R., & Zevalkink, J. (2013). On the factor structure of the Beck Depression Inventory–II: G is the key. *Psychological Assessment, 25*, 136-145. doi:10.1037/a0029228

Brown, M., Robinson, L., Campione, G. C., Wuensch, K., Hildebrandt, T., & Micali, N. (2017). Intolerance of uncertainty in eating disorders: A systematic review and meta-analysis. *European Eating Disorders Review, 25*, 329-343. doi:10.1002/erv.2523

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York: Guilford Press.

Brown, T. A., Antony, M. M., & Barlow, D. H. (1992). Psychometric properties of the Penn State Worry Questionnaire in a clinical anxiety disorders sample. *Behaviour Research and Therapy, 30*, 33-37. doi:10.1016/0005-7967(92)90093-V

Brown, T. A., Campbell, L. A., Lehman, C. L., Grisham, J. R., & Mancill, R. B. (2001). Current and lifetime comorbidity of the DSM-IV anxiety and mood disorders in a large clinical sample. *Journal of Abnormal Psychology, 110*, 585-599. doi:10.1037/0021-843X.110.4.585

Brown, T. A., & Naragon-Gainey, K. (2013). Evaluation of the unique and specific contributions of dimensions of the triple vulnerability model to the prediction of DSM-IV anxiety and mood disorder constructs. *Behavior therapy, 44*, 277-292. doi:10.1016/j.beth.2012.11.002

Bryne, B. M. (2012). *Structural equation modelling with Mplus: Basic concepts, applications, and programming*. New York, NY: Routledge.

Buhr, K., & Dugas, M. J. (2002). The Intolerance of Uncertainty Scale: psychometric properties of the English version. *Behaviour Research and Therapy, 40*, 931-945.

Buhr, K., & Dugas, M. J. (2006). Investigating the construct validity of intolerance of uncertainty and its unique relationship with worry. *Journal of Anxiety Disorders, 20*, 222-236. doi:10.1016/j.janxdis.2004.12.004

Byrne, S., Wade, T., Hay, P., Touyz, S., Fairburn, C. G., Treasure, J., . . . Crosby, R. D. (2017). A randomised controlled trial of three psychological treatments for anorexia nervosa. *Psychological Medicine, 47*, 2823-2833. doi:10.1017/S0033291717001349

Byrne, S. M., Fursland, A., Allen, K. L., & Watson, H. (2011). The effectiveness of enhanced cognitive behavioural therapy for eating disorders: An open trial. *Behaviour Research and Therapy, 49*, 219-226. doi:10.1016/j.brat.2011.01.006

Bystritsky, A. (2006). Treatment-resistant anxiety disorders. *Molecular Psychiatry, 11*, 805-814. doi:10.1038/sj.mp.4001852

Calleo, J. S., Hart, J., Björgvinsson, T., & Stanley, M. A. (2010). Obsessions and worry beliefs in an inpatient OCD population. *Journal of Anxiety Disorders, 24*, 903-908. doi:10.1016/j.janxdis.2010.06.015

Carleton, R. N. (2012). The intolerance of uncertainty construct in the context of anxiety disorders: theoretical and practical perspectives. *Expert Review of Neurotherapeutics, 12*, 937-947. doi:10.1586/ern.12.82

Carleton, R. N. (2016a). Fear of the unknown: One fear to rule them all? *Journal of Anxiety Disorders, 41*, 5-21. doi:10.1016/j.janxdis.2016.03.011

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

Carleton, R. N., Collimore, K. C., & Asmundson, G. J. G. (2007). Social anxiety and fear of negative evaluation: Construct validity of the BFNE-II. *Journal of Anxiety Disorders, 21*, 131-141. doi:10.1016/j.janxdis.2006.03.010

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*, 189-195. doi:10.1016/j.janxdis.2009.10.007

Carleton, R. N., Collimore, K. C., Asmundson, G. J. G., McCabe, R. E., Rowa, K., & Antony, M. M. (2009). Refining and validating the Social Interaction Anxiety Scale and the Social Phobia Scale. *Depression and Anxiety, 26*, E71-E81. doi:10.1002/da.20480

Carleton, R. N., Duranceau, S., Freeston, M. H., Boelen, P. A., McCabe, R. E., & Antony, M. M. (2014). "But it might be a heart attack": intolerance of uncertainty and panic disorder symptoms. *Journal of Anxiety Disorders, 28*, 463-470. doi:10.1016/j.janxdis.2014.04.006

Carleton, R. N., Fetzner, M. G., Hackl, J. L., & McEvoy, P. (2013). Intolerance of uncertainty as a contributor to fear and avoidance symptoms of panic attacks. *Cognitive Behaviour Therapy, 42*, 328-341. doi:10.1080/16506073.2013.792100

Carleton, R. N., Gosselin, P., & Asmundson, G. J. G. (2010). The Intolerance of Uncertainty Index: Replication and extension with an English sample. *Psychological Assessment, 22*, 396-406. doi:10.1037/a0019230

Carleton, R. N., Mulvogue, M. K., Thibodeau, M. A., McCabe, R. E., Antony, M. M., & Asmundson, G. J. G. (2012). Increasingly certain about uncertainty: Intolerance of uncertainty across anxiety and depression. *Journal of Anxiety Disorders, 26*, 468-479. doi:10.1016/j.janxdis.2012.01.011

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*, 105-117. doi:10.1016/j.janxdis.2006.03.014

Carleton, R. N., Sharpe, D., & Asmundson, G. J. (2007). Anxiety sensitivity and intolerance of uncertainty: requisites of the fundamental fears? *Behaviour Research and Therapy, 45*, 2307-2316. doi:10.1016/j.brat.2007.04.006

Carleton, R. N., Weeks, J. W., Howell, A. N., Asmundson, G. J. G., Antony, M. M., & McCabe, R. E. (2012). Assessing the latent structure of the intolerance of uncertainty construct: an initial taxometric analysis. *Journal of Anxiety Disorders, 26*, 150-157. doi:10.1016/j.janxdis.2011.10.006

Cartwright-Hatton, S., & Wells, A. (1997). Beliefs about worry and intrusions: the Meta-Cognitions Questionnaire and its correlates. *Journal of Anxiety Disorders, 11*, 279-296. doi:10.1016/S0887-6185(97)00011-X

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research, 1*, 245-276. doi:10.1207/s15327906mbr0102_10

Chambless, D. L., Caputo, G. C., Bright, P., & Gallagher, R. (1984). Assessment of fear of fear in agoraphobics: The Body Sensations Questionnaire and the Agoraphobic Cognitions Questionnaire. *Journal of Consulting and Clinical Psychology, 52*, 1090-1097. doi:10.1037/0022-006X.52.6.1090

Chang, E. C., & Sanna, L. J. (2012). Evidence for the validity of the Clinical Perfectionism Questionnaire in a nonclinical population: more than just negative affectivity. *Journal of Personality Assessment, 94*, 102-108. doi:10.1080/00223891.2011.627962

Chorpita, B. F., & Barlow, D. H. (1998). The development of anxiety: the role of control in the early environment. *Psychological Bulletin, 124*, 3-21. doi:10.1037/0033-2909.124.1.3

Clark, D. A., & Beck, A. T. (2010). *Cognitive therapy for anxiety disorders: science and practice.* New York, NY: Guilford Press. .

Comer, J. S., Roy, A. K., 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*, 402-411. doi:10.1037/a0016719

Cornacchio, D., Sanchez, A. L., Coxe, S., Roy, A., Pincus, D. B., Read, K. L., . . . Comer, J. S. (2018). Factor structure of the Intolerance of Uncertainty Scale for children. *Journal of Anxiety Disorders, 53*, 100-107. doi:10.1016/j.janxdis.2017.07.003

Costello, A., B. , & Osborne, J. (2005). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment, 10*, 1-9.

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

Craske, M. G. (2012). Transdiagnostic treatment for anxiety and depression. *Depression and Anxiety, 29*, 749-753. doi:10.1002/da.21992

Craske, M. G., Kircanski, K., Zelikowsky, M., Mystkowski, J., Chowdhury, N., & Baker, A. (2008). Optimizing inhibitory learning during exposure therapy. *Behaviour Research and Therapy, 46*, 5-27. doi:10.1016/j.brat.2007.10.003

Craske, M. G., Treanor, M., Conway, C. C., Zbozinek, T., & Vervliet, B. (2014). Maximizing exposure therapy: An inhibitory learning approach. *Behaviour Research and Therapy, 58*, 10-23. doi:10.1016/j.brat.2014.04.006

Crow, S. J., Peterson, C. B., Swanson, S. A., Raymond, N. C., Specker, S., Eckert, E. D., & Mitchell, J. E. (2009). Increased mortality in bulimia nervosa and other eating disorders. *American Journal of Psychiatry, 166*, 1342-1346. doi:10.1176/appi.ajp.2009.09020247

Cuijpers, P., Berking, M., Andersson, G., Quigley, L., Kleiboer, A., & Dobson, K. S. (2013). A meta-analysis of cognitive-behavioural therapy for adult depression, alone and in comparison with other treatments. *The Canadian Journal of Psychiatry, 58*, 376-385. doi:10.1177/070674371305800702

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods, 1*, 16-29. doi:10.1037/1082-989X.1.1.16

Cuthbert, B. N. (2015). Research Domain Criteria: toward future psychiatric nosologies. *Dialogues in Clinical Neuroscience, 17*, 89-97. doi:10.1016/j.ajp.2013.12.007

de Jong-Meyer, R., Beck, B., & Riede, K. (2009). Relationships between rumination, worry, intolerance of uncertainty and metacognitive beliefs. *Personality and Individual Differences, 46*, 547-551. doi:10.1016/j.paid.2008.12.010

Dekkers, L. M. S., Jansen, B. R. J., Salemink, E., & Huizenga, H. M. (2017). Intolerance of Uncertainty Scale: Measurement invariance among adolescent boys and girls and relationships with anxiety and risk taking. *Journal of Behavior Therapy and Experimental Psychiatry, 55*, 57-65. doi:10.1016/j.jbtep.2016.11.009

Dugas, M. J., Brillon, P., Savard, P., Turcotte, J., Gaudet, A., Ladouceur, R., . . . Gervais, N. J. (2010). A randomized clinical trial of cognitive-behavioral therapy and applied relaxation for adults with generalized anxiety disorder. *Behavior Therapy, 41*, 46-58. doi:10.1016/j.beth.2008.12.004

Dugas, M. J., Buhr, K., & Ladouceur, R. (2004). The role of intolerance of uncertainty in etiology and maintenance. In R. G. Heimberg, C. L. Turk, & D. S. Mennin (Eds.), *Generalized anxiety disorder: advances in research and practice.* New York: Guilford Press.

Dugas, M. J., Gagnon, F., Ladouceur, R., & Freeston, M. H. (1998). Generalized anxiety disorder: a preliminary test of a conceptual model. *Behaviour Research and Therapy, 36*, 215-226. doi:10.1016/S0005-7967(97)00070-3

Dugas, M. J., Gosselin, P., & Ladouceur, R. (2001). Intolerance of uncertainty and worry: Investigating specificity in a nonclinical sample. *Cognitive Therapy and Research, 25*, 551-558. doi:10.1023/A:1005553414688

Dugas, M. J., & Koerner, N. (2005). Cognitive-behavioral treatment for generalized anxiety disorder: current status and future directions. *Journal of Cognitive Psychotherapy, 19*, 61-81. doi:10.1891/jcop.19.1.61.66326

Dugas, M. J., & Ladouceur, R. (2000). Treatment of GAD. Targeting intolerance of uncertainty in two types of worry. *Behaviour Modification, 24*, 635-657. doi:10.1177/0145445500245002

Dugas, M. J., Ladouceur, R., Léger, E., Freeston, M. H., Langlois, F., Provencher, M. D., & Boisvert, J.-M. (2003). Group cognitive-behavioral therapy for generalized anxiety

disorder: treatment outcome and long-term follow-up. *Journal of Consulting and Clinical Psychology, 71*, 821-825. doi:10.1037/0022-006X.71.4.821

Dugas, M. J., Laugesen, N., & Bukowski, W. M. (2012). Intolerance of uncertainty, fear of anxiety, and adolescent worry. *Journal of Abnormal Child Psychology, 40*, 863-870. doi:10.1007/s10802-012-9611-1

Dugas, M. J., Marchand, A., & Ladouceur, R. (2005). Further validation of a cognitive-behavioral model of generalized anxiety disorder: diagnostic and symptom specificity. *Journal of Anxiety Disorders, 19*, 329-343. doi:10.1016/j.janxdis.2004.02.002

Dugas, M. J., & Robichaud, M. (2007). *Cognitive-behavioural treatment for generalised anxiety disorder: From science to practice*. New York, NY: Routledge.

Dugas, M. J., Schwartz, A., & Francis, K. (2004). Brief report: intolerance of uncertainty, worry, and depression. *Cognitive Therapy and Research, 28*, 835-842. doi:10.1007/s10608-004-0669-0

Dupuy, J.-B., & Ladouceur, R. (2008). Cognitive processes of generalized anxiety disorder in comorbid generalized anxiety disorder and major depressive disorder. *Journal of Anxiety Disorders, 22*, 505-514. doi:10.1016/j.janxdis.2007.05.010

Ebesutani, C., McLeish, A., Luberto, C., Young, J., & Maack, D. A bifactor model of anxiety sensitivity: Analysis of the Anxiety Sensitivity Index-3. *Journal of Psychopathology and Behavioral Assessment, 36*, 452-464. doi:10.1007/s10862-013-9400-3

Egan, S. J., Shafran, R., Lee, M., Fairburn, C. G., Cooper, Z., Doll, H. A., . . . Watson, H. J. (2016). The reliability and validity of the Clinical Perfectionism Questionnaire in eating disorder and community samples. *Behavioural and Cognitive Psychotherapy, 44*, 79-91. doi:10.1017/S1352465814000629

Einstein, D. A. (2014). Extension of the transdiagnostic model to focus on intolerance of uncertainty: a review of the literature and implications for treatment. *Clinical Psychology, 21*, 280-300. doi:10.1111/cpsp.12077

Elstein, A. S., & Schwarz, A. (2002). Clinical problem solving and diagnostic decision making: selective review of the cognitive literature. *British Medical Journal, 324*, 729-732. doi:10.1136/bmj.324.7339.729

Fairburn, C. G., & Beglin, S. J. (1994). Assessment of eating disorder psychopathology: interview or self-report questionnaire? *International Journal of Eating Disorders, 16*, 363-370. doi:10.1002/1098-108X(199412)16:4<363::AID-EAT2260160405>3.0.CO;2-%23

Fairburn, C. G., Cooper, Z., Doll, H. A., O'Connor, M. E., Bohn, K., Hawker, D. M., . . . Palmer, R. L. (2009). Transdiagnostic cognitive-behavioral therapy for patients with eating disorders: A two-site trial with 60-week follow-up. *American Journal of Psychiatry, 166*, 311-319. doi:10.1176/appi.ajp.2008.08040608

Fairburn, C. G., Cooper, Z., & Shafran, R. (2003). Cognitive behaviour therapy for eating disorders: a "transdiagnostic" theory and treatment. *Behaviour Research and Therapy, 41*, 509-528. doi:10.1016/S0005-7967(02)00088-8

Fairburn, C. G., & Harrison, P. J. (2003). Eating disorders. *The Lancet, 361*, 407-416. doi:10.1016/S0140-6736(03)12378-1

Faleer, H. E., Fergus, T. A., Bailey, B. E., & Wu, K. D. (2017). Examination of an experimental manipulation of intolerance of uncertainty on obsessive-compulsive outcomes. *Journal of Obsessive-Compulsive and Related Disorders, 15*, 64-73. doi:10.1016/j.jocrd.2017.07.002

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191. doi:10.3758/BF03193146

Fergus, T., Bardeen, J., & Wu, K. (2013). Intolerance of uncertainty and uncertainty-related attentional biases: evidence of facilitated engagement or disengagement difficulty? *Cognitive Therapy and Research, 37*, 735-741. doi:10.1007/s10608-012-9509-9

Fergus, T., & Wu, K. (2011). Searching for specificity between cognitive vulnerabilities and mood and anxiety symptoms. *Journal of Psychopathology and Behavioral Assessment, 33*, 446-458. doi:10.1007/s10862-011-9245-6

Fergus, T. A. (2013). A comparison of three self-report measures of intolerance of uncertainty: An examination of structure and incremental explanatory power in a community sample. *Psychological Assessment, 25*, 1322-1331. doi:10.1037/a0034103

Fergus, T. A., & Bardeen, J. R. (2017). The Metacognitions Questionnaire–30: An examination of a bifactor model and measurement invariance among men and women in a community sample. *Assessment*. doi:10.1177/1073191116685807

Fergus, T. A., & Carleton, R. N. (2016). Intolerance of uncertainty and attentional networks: Unique associations with alerting. *Journal of Anxiety Disorders, 41*, 59-64. doi:10.1016/j.janxdis.2016.03.010

Fetzner, M., Horswill, S., Boelen, P., & Carleton, R. (2013). Intolerance of uncertainty and PTSD symptoms: exploring the construct relationship in a community sample with a

heterogeneous trauma history. *Cognitive Therapy and Research, 37*, 725-734. doi:10.1007/s10608-013-9531-6

Fialko, L., Bolton, D., & Perrin, S. (2012). Applicability of a cognitive model of worry to children and adolescents. *Behaviour Research and Therapy, 50*, 341-349. doi:10.1016/j.brat.2012.02.003

Fitch, K., & Cougle, J. (2013). An evaluation of obsessive beliefs as predictors of performance on in vivo assessments of obsessive–compulsive symptoms. *Cognitive Therapy and Research, 37*, 207-220. doi:10.1007/s10608-012-9457-4

Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., & Salkovskis, P. M. (2002). The Obsessive Compulsive Inventory: development and validation of a short version. *Psychological Assessment, 14*, 485-496. doi:10.1037//1040-3590.14.4.485

Foa, E. B., Kozak, M. J., Salkovskis, P. M., Coles, M. E., & Amir, N. (1998). The validation of a new obsessive compulsive disorder scale: the Obsessive-Compulsive Inventory. *Psychological Assessment, 10*, 206-214. doi:10.1037//1040-3590.10.3.206

Fracalanza, K., Koerner, N., Deschênes, S. S., & Dugas, M. J. (2014). Intolerance of uncertainty mediates the relation between generalized anxiety disorder symptoms and anger. *Cognitive Behaviour Therapy, 43*, 1-11. doi:10.1080/16506073.2014.888754

Frank, G. K. W., Roblek, T., Shott, M. E., Jappe, L. M., Rollin, M. D. H., Hagman, J. O., & Pryor, T. (2012). Heightened fear of uncertainty in anorexia and bulimia nervosa. *International Journal of Eating Disorders, 45*, 227-232. doi:10.1002/eat.20929

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

Friborg, O., Reas, D. L., Rosenvinge, J. H., & Ro, O. (2013). Core pathology of eating disorders as measured by the Eating Disorder Examination Questionnaire (EDE‐Q): the predictive role of a nested general (g) and primary factors. *International Journal of Methods in Psychiatric Research, 22*, 195-203. doi:10.1002/mpr.1389

García-Soriano, G., Roncero, M., Perpiñá, C., & Belloch, A. (2014). Intrusive thoughts in obsessive–compulsive disorder and eating disorder patients: a differential analysis. *European Eating Disorders Review, 22*, 191-199. doi:10.1002/erv.2285

Garety, P. A., Freeman, D., Jolley, S., Dunn, G., Bebbington, P. E., Fowler, D. G., . . . Dudley, R. (2005). Reasoning, emotions, and delusional conviction in psychosis. *Journal of Abnormal Psychology, 114*, 373-384. doi:10.1037/0021-843X.114.3.373

Gentes, E. L., & Ruscio, A. M. (2011). A meta-analysis of the relation of intolerance of uncertainty to symptoms of generalized anxiety disorder, major depressive disorder, and obsessive–compulsive disorder. *Clinical Psychology Review, 31*, 923-933. doi:10.1016/j.cpr.2011.05.001

Goldstein, A. J., & Chambless, D. L. (1978). A reanalysis of agoraphobia. *Behavior Therapy, 9*, 47-59. doi:10.1016/S0005-7894(78)80053-7

Gosselin, P., Ladouceur, R., Evers, A., Laverdière, A., Routhier, S., & Tremblay-Picard, M. (2008). Evaluation of intolerance of uncertainty: Development and validation of a new self-report measure. *Journal of Anxiety Disorders, 22*, 1427-1439. doi:10.1016/j.janxdis.2008.02.005

Gosselin, P., Ladouceur, R., Morin, C. M., Dugas, M. J., & Baillargeon, L. (2006). Benzodiazepine discontinuation among adults with GAD: A randomized trial of cognitive-behavioral therapy. *Journal of Consulting and Clinical Psychology, 74*, 908-919. doi:10.1037/0022-006X.74.5.908

Greco, V., & Roger, D. (2001). Coping with uncertainty: the construction and validation of a new measure. *Personality and Individual Differences, 31*, 519-534. doi:10.1016/S0191-8869(00)00156-2

Greco, V., & Roger, D. (2003). Uncertainty, stress, and health. *Personality and Individual Differences, 34*, 1057-1068. doi:10.1016/S0191-8869(02)00091-0

Grenier, S., Barrette, A.-M., & Ladouceur, R. (2005). Intolerance of uncertainty and intolerance of ambiguity: similarities and differences. *Personality and Individual Differences, 39*, 593-600. doi:10.1016/j.paid.2005.02.014

Grupe, D. W., & Nitschke, J. B. (2013). Uncertainty and anticipation in anxiety: an integrated neurobiological and psychological perspective. *Nature Reviews Neuroscience, 14*, 488-501. doi:10.1038/nrn3524

Gwilliam, P., Wells, A., & Cartwright‐Hatton, S. (2004). Does meta‐cognition or responsibility predict obsessive–compulsive symptoms: a test of the metacognitive model. *Clinical Psychology & Psychotherapy, 11*, 137-144. doi:10.1002/cpp.402

Hagborg, W. J. (1993). The Rosenberg Self-Esteem scale and Harter's Self-Perception profile for adolescents: a concurrent validity study. *Psychology in the Schools, 30*, 132-136. doi:10.1002/1520-6807(199304)30:2<132::AID-PITS2310300205>3.0.CO2-Z

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*, 200-208. doi:10.1080/00223891.2015.1070355

Hancock, G. R., & Mueller, R. O. (2001). Rethinking construct reliability within latent variable systems. In R. Cudeck, S. d. Toit, & D. Sörbom (Eds.), *Structural equation modeling : Present and future-A Festschrift in honor of Karl Jöreskog* (pp. 195-216). Lincolnwood, IL: Scientific Software International.

Harvey, A., Watkins, E., Mansell, W., & Shafrain, R. (2004). *Cognitive behavioural processes across psychological disorders: A transdiagnostic approach to research and treatment*. Oxford, UK: Oxford University Press.

Haslam, N., Williams, B. J., Kyrios, M., McKay, D., & Taylor, S. (2005). Subtyping obsessive-compulsive disorder: A taxometric analysis. *Behavior Therapy, 36*, 381-391. doi:10.1016/S0005-7894(05)80120-0

Hayton, J., Allen, D., & Scarpello, V. (2004). Factor retention decisions in exploratory factor analysis: a tutorial on parallel analysis. *Organizational Research Methods, 7*, 191-205. doi:10.1177/1094428104263675

Hebert, E. A., & Dugas, M. J. (2018). Behavioral experiments for intolerance of uncertainty: challenging the unknown in the treatment of generalized anxiety disorder. *Cognitive and Behavioral Practice*. doi:10.1016/j.cbpra.2018.07.007

Henry, J. D., & Crawford, J. R. (2005). The short‐form version of the Depression Anxiety Stress Scales (DASS‐21): construct validity and normative data in a large non‐clinical sample. *British Journal of Clinical Psychology, 44*, 227-239. doi:10.1348/014466505X29657

Hewitt, S. N., Egan, S., & Rees, C. (2009). Preliminary investigation of intolerance of uncertainty treatment for anxiety disorders. *Clinical Psychologist, 13*, 52-58. doi:10.1080/13284200802702056

Hock, M., & Krohne, H. W. (2004). Coping with threat and memory for ambiguous information: testing the repressive discontinuity hypothesis. *Emotion, 4*, 65-86. doi:10.1037/1528-3542.4.1.65

Hoiles, K. J., Egan, S. J., & Kane, R. T. (2012). The validity of the transdiagnostic cognitive behavioural model of eating disorders in predicting dietary restraint. *Eating Behaviors, 13*, 123-126. doi:10.1016/j.eatbeh.2011.11.007

Holaway, R. M., Heimberg, R. G., & Coles, M. E. (2006). A comparison of intolerance of uncertainty in analogue obsessive-compulsive disorder and generalized anxiety

disorder. *Journal of Anxiety Disorders, 20*, 158-174. doi:10.1016/j.janxdis.2005.01.002

Hong, R. (2013). From dispositional traits to psychopathological symptoms:Social-cognitive vulnerabilities as intervening mechanisms. *Journal of Psychopathology and Behavioral Assessment, 35*, 407-420. doi:10.1007/s10862-013-9350-9

Hong, R. Y., & Cheung, M. W. L. (2015). The structure of cognitive vulnerabilities to depression and anxiety: Evidence for a common core etiologic process based on a meta-analytic review. *Clinical Psychological Science 3*, 892-912. doi:10.1177/2167702614553789

Hong, R. Y., & Lee, S. S. M. (2015). Further clarifying prospective and inhibitory intolerance of uncertainty: factorial and construct validity of test scores from the Intolerance of Uncertainty Scale. *Psychological Assessment, 27*, 605-620. doi:10.1037/pas0000074

Horn, J. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika, 30*, 179-185. doi:10.1007/BF02289447

Houck, P. R., Spiegel, D. A., Shear, M. K., & Rucci, P. (2002). Reliability of the self‐report version of the Panic Disorder Severity Scale. *Depression and Anxiety, 15*, 183-185. doi:10.1002/da.10049

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*, 1-55. doi:10.1080/10705519909540118

Huq, S. F., Garety, P. A., & Hemsley, D. R. (1988). Probabilistic judgements in deluded and non-deluded subjects. *The Quarterly Journal of Experimental Psychology Section A, 40*, 801-812. doi:10.1080/14640748808402300

Jacoby, R. J., Abramowitz, J. S., Buck, B. E., & Fabricant, L. E. (2014). How is the Beads Task related to intolerance of uncertainty in anxiety disorders? *Journal of Anxiety Disorders, 28*, 495-503. doi:10.1016/j.janxdis.2014.05.005

Jacoby, R. J., Abramowitz, J. S., Reuman, L., & Blakey, 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. doi:10.1016/j.janxdis.2016.02.003

Jacoby, R. J., Fabricant, L. E., Leonard, R. C., Riemann, B. C., & Abramowitz, J. S. (2013). Just to be certain: Confirming the factor structure of the Intolerance of Uncertainty Scale in patients with obsessive-compulsive disorder. *Journal of Anxiety Disorders, 27*, 535-542. doi:10.1016/j.janxdis.2013.07.008

Jacoby, R. J., Reuman, L., Blakey, S. M., Hartsock, J., & Abramowitz, J. S. (2017). "What if I make a mistake?": Examining uncertainty-related distress when decisions may harm oneself vs. others. *Journal of Obsessive-Compulsive and Related Disorders*. doi:10.1016/j.jocrd.2017.11.003

Jensen, D., Cohen, J. N., Mennin, D. S., Fresco, D. M., & Heimberg, R. G. (2016). Clarifying the unique associations among intolerance of uncertainty, anxiety, and depression. *Cognitive Behaviour Therapy, 45*, 431-444. doi:10.1080/16506073.2016.1197308

Jensen, D., & Heimberg, R. G. (2015). Domain-specific intolerance of uncertainty in socially anxious and contamination-focused obsessive compulsive individuals. *Cognitive Behaviour Therapy, 44*, 1-9. doi:10.1080/16506073.2014.959039

Jensen, D., Kind, A. J., Morrison, A. S., & Heimberg, R. G. (2014). Intolerance of uncertainty and immediate decision-making in high-risk situations. *Journal of Experimental Psychopathology 5*, 178-190. doi:10.5127/jep.035113

Jones, S., Raykos, B., McEvoy, P. M., Ieraci, J., Fursland, A., Byrne, S., & Waller, G. (in press). The development and validation of a measure of eating disorder-specific interpersonal problems: The Interpersonal Relationships in Eating Disorders (IR-ED) scale. *Psychological Assessment*.

Katon, W. J. (2011). Epidemiology and treatment of depression in patients with chronic medical illness. *Dialogues in Clinical Neuroscience, 13*, 7-23.

Kazdin, A. E. (2007). Mediators and mechanisms of change in psychotherapy research. *Annual Review of Clinical Psychology, 3*, 1-27. doi:10.1146/annurev.clinpsy.3.022806.091432

Keel, P. K., Klump, K. L., Miller, K. B., McGue, M., & Iacono, W. G. (2005). Shared transmission of eating disorders and anxiety disorders. *International Journal of Eating Disorders, 38*, 99-105. doi:10.1002/eat.20168

Kertz, S., & Woodruff-Borden, J. (2013). The role of metacognition, intolerance of uncertainty, and negative problem orientation in children's worry. *Behavioural and cognitive psychotherapy, 41*, 243-248. doi:10.1017/S1352465812000641

Kesby, A., Maguire, S., Brownlow, R., & Grisham, J. R. (2017). Intolerance of Uncertainty in eating disorders: An update on the field. *Clinical Psychology Review, 56*, 94-105. doi:10.1016/j.cpr.2017.07.002

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*, 593-602. doi:10.1001/archpsyc.62.6.593

Khawaja, N. G., & McMahon, J. (2011). The relationship of meta-worry and intolerance of uncertainty with pathological worry, anxiety, and depression. *Behaviour Change, 28*, 165-180. doi:10.1375/bech.28.4.165

Khawaja, N. G., & Yu, L. N. H. (2010). A Comparison of the 27-Item and 12-Item Intolerance of Uncertainty Scales. *Clinical Psychologist, 14*, 97-106. doi:10.1080/13284207.2010.502542

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). New York, NY: Guilford Press.

Knowles, K. A., & Olatunji, B. O. (2018). Enhancing inhibitory learning: the utility of variability in exposure. *Cognitive and Behavioral Practice*. doi:10.1016/j.cbpra.2017.12.001

Koerner, N., & Dugas, M. J. (2008). An investigation of appraisals in individuals vulnerable to excessive worry: the role of intolerance of uncertainty. *Cognitive Therapy and Research, 32*, 619-638. doi:10.1007/s10608-007-9125-2

Koerner, N., Mejia, T., & Kusec, A. (2017). What's in a name? Intolerance of uncertainty, other uncertainty-relevant constructs, and their differential relations to worry and generalized anxiety disorder. *Cognitive Behaviour Therapy, 46*, 141-161. doi:10.1080/16506073.2016.1211172

Kogan, J. N., Edelstein, B. A., & McKee, D. R. (2000). Assessment of anxiety in older adults: current status. *Journal of Anxiety Disorders, 14*, 109-132. doi:10.1016/S0887-6185(99)00044-4

Konstantellou, A., Campbell, M., Eisler, I., Simic, M., & Treasure, J. (2011). Testing a cognitive model of generalized anxiety disorder in the eating disorders. *Journal of Anxiety Disorders, 25*, 864-869. doi:10.1016/j.janxdis.2011.04.005

Konstantellou, A., & Reynolds, M. (2010). Intolerance of uncertainty and metacognitions in a non-clinical sample with problematic and normal eating attitudes. *Eating Behaviors, 11*, 193-196. doi:10.1016/j.eatbeh.2010.01.003

Koskina, A., Campbell, I. C., & Schmidt, U. (2013). Exposure therapy in eating disorders revisited. *Neuroscience and Biobehavioral Reviews, 37*, 193-208. doi:10.1016/j.neubiorev.2012.11.010

Kotov, R., Gamez, W., Schmidt, F., & Watson, D. (2010). Linking "big" personality taits to anxiety, depressive, and substance use disorders: a meta-analysis. *Psychological Bulletin, 136*, 768-821. doi:10.1037/a0020327

Kozak, M. J., & Cuthbert, B. N. (2016). The NIMH Research Domain Criteria initiative: Background, issues, and pragmatics. *Psychophysiology, 53*, 286-297. doi:10.1111/psyp.12518

Krain, A. L., Hefton, S., Pine, D. S., Ernst, M., Xavier Castellanos, F., Klein, R. G., & Milham, M. P. (2006). An fMRI examination of developmental differences in the neural correlates of uncertainty and decision-making. *Journal of Child Psychology and Psychiatry, 47*, 1023-1030. doi:10.1111/j.1469-7610.2006.01677.x

Krohne, H. W. (1989). The concept of coping modes: Relating cognitive person variables to actual coping behavior. *Advances in Behaviour Research and Therapy, 11*, 235-248. doi:10.1016/0146-6402(89)90027-1

Ladouceur, R., Blais, F., Freeston, M. H., & Dugas, M. J. (1998). Problem solving and problem orientation in generalized anxiety disorder. *Journal of Anxiety Disorders, 12*, 139-152. doi:10.1016/S0887-6185(98)00002-4

Ladouceur, R., Dugas, M. J., Freeston, M. H., Léger, E., Gagnon, F., & Thibodeau, N. (2000). Efficacy of a cognitive–behavioral treatment for generalized anxiety disorder: evaluation in a controlled clinical trial. *Journal of Consulting and Clinical Psychology, 68*, 957-964. doi:10.1037/0022-006X.68.6.957

Ladouceur, R., Dugas, M. J., Freeston, M. H., Rhéaume, J., Blais, F., Boisvert, J.-M., . . . Thibodeau, N. (1999). Specificity of generalized anxiety disorder symptoms and processes. *Behavior Therapy, 30*, 191-207. doi:10.1016/S0005-7894(99)80003-3

Ladouceur, R., Gosselin, P., & Dugas, M. J. (2000). Experimental manipulation of intolerance of uncertainty: a study of a theoretical model of worry. *Behaviour Research and Therapy, 38*, 933-941. doi:10.1016/S0005-7967(99)00133-3

Ladouceur, R., Talbot, F., & Dugas, M. J. (1997). Behavioral expressions of intolerance of uncertainty in worry. Experimental findings. *Behavior Modification, 21*, 355-371. doi:10.1177/01454455970213006

Langlois, F., & Ladouceur, R. (2004). Adaptation of a GAD treatment for hypochondriasis. *Cognitive and Behavioral Practice, 11*, 393-404. doi:10.1016/S1077-7229(04)80056-7

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. *Testing, Psychometrics, Methodology in Applied Psychology, 23*, 377-394.

Lovibond, S. H., & Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales.* (2nd ed.). Sydney Psychology Foundation.

Löwe, Y. B., Decker, Y. O., Müller, Y. S., Brähler, Y. E., Schellberg, Y. D., Herzog, Y. W., & Herzberg, Y. P. (2008). Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. *Medical Care, 46*, 266-274. doi:10.1097/MLR.0b013e318160d093

Luhmann, C. C., Ishida, K., & Hajcak, G. (2011). Intolerance of uncertainty and decisions about delayed, probabilistic rewards. *Behavior Therapy, 42*, 378-386. doi:10.1016/j.beth.2010.09.002

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*, 130-149. doi:10.1037/1082-989X.1.2.130

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

Mahoney, A. E. J., & McEvoy, P. M. (2012b). Trait versus situation-specific intolerance of uncertainty in a clinical sample with anxiety and depressive disorders. *Cognitive Behaviour Therapy, 41*, 26-39. doi:10.1080/16506073.2011.622131

Mahoney, A. E. J., & McEvoy, P. M. (2012c). A transdiagnostic examination of intolerance of uncertainty across anxiety and depressive disorders. *Cognitive Behaviour Therapy, 41*, 212-222. doi:10.1080/16506073.2011.622130

Maner, J. K., & Schmidt, N. B. (2006). The role of risk avoidance in anxiety. *Behavior Therapy, 37*, 181-189. doi:10.1016/j.beth.2005.11.003

Marsh, H. W., Hau, K.-T., & Wen, Z. (2004). In search of golden rules: comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling: A Multidisciplinary Journal, 11*, 320-341. doi:10.1207/s15328007sem1103_2

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:10.1016/j.comppsych.2016.10.007

Mathews, A., & MacLeod, C. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology, 45*, 25-50. doi:10.1146/annurev.ps.45.020194.000325

Mathews, A., & Macleod, C. (2002). Induced processing biases have causal effects on anxiety. *Cognition & Emotion, 16*, 331-354. doi:10.1080/02699930143000518

Mattick, R., & Clarke, J. (1998). Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. *Behaviour Research and Therapy, 36*, 455-470. doi:10.1016/S0005-7967(97)10031-6

McEvoy, P. M., Carleton, R. N., Correa, K., Shankman, S., & Shihata, S. (in press). Intolerance of uncertainty. In B. Olatunji (Ed.), *Handbook of Anxiety and Related Disorders*: Cambridge Press.

McEvoy, P. M., & Erceg-Hurn, D. M. (2016). The search for universal transdiagnostic and trans-therapy change processes: Evidence for intolerance of uncertainty. *Journal of Anxiety Disorders, 41*, 96-107. doi:10.1016/j.janxdis.2016.02.002

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

McEvoy, P. M., & Mahoney, A. E. (2012). To be sure, to be sure: intolerance of uncertainty mediates symptoms of various anxiety disorders and depression. *Behaviour Therapy, 43*, 533-545. doi:10.1016/j.beth.2011.02.007

McEvoy, P. M., Moulds, M. L., & Mahoney, A. E. J. (2013). Mechanisms driving pre- and post-stressor repetitive negative thinking: Metacognitions, cognitive avoidance, and thought control. *Journal of Behavior Therapy and Experimental Psychiatry, 44*, 84-93. doi:10.1016/j.jbtep.2012.07.011

Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological Methods, 17*, 437-455. doi:10.1037/a0028085

Meeten, F., Dash, S. R., Scarlet, A. L. S., & Davey, G. C. L. (2012). Investigating the effect of intolerance of uncertainty on catastrophic worrying and mood. *Behaviour Research and Therapy, 50*, 690-698. doi:10.1016/j.brat.2012.08.003

Menatti, A. R., Weeks, J. W., Carleton, R. N., Morrison, A. S., Heimberg, R. G., Hope, D. A., . . . Liebowitz, M. R. (2015). The Social Interaction Phobia Scale: Continued support for the psychometric validity of the SIPS using clinical and non-clinical samples. *Journal of Anxiety Disorders, 32*, 46-55. doi:10.1016/j.janxdis.2015.03.003

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*, 487-495. doi:10.1016/0005-7967(90)90135-6

Mond, J. M., Hay, P. J., Rodgers, B., & Owen, C. (2006). Eating Disorder Examination Questionnaire (EDE-Q): Norms for young adult women. *Behaviour Research and Therapy, 44*, 53-62. doi:10.1016/j.brat.2004.12.003

Motzkin, J. C., Philippi, C. L., Wolf, R. C., Baskaya, M. K., & Koenigs, M. (2014). Ventromedial prefrontal cortex lesions alter neural and physiological correlates of anticipation. *The Journal of Neuroscience: The Official Journal of the Society for Neuroscience, 34*, 10430-10437. doi:10.1523/JNEUROSCI.1446-14.2014

Muthén, B., Kaplan, D., & Hollis, M. (1987). On structural equation modeling with data that are not missing completely at random. *Psychometrika, 52*, 431-462. doi:10.1007/BF02294365

Muthén, L. K., & Muthén, B. O. (1998-2015). *Mplus user's guide* (7th ed.). Los Angeles, CA: Author.

Myers, S. G., Fisher, P. L., & Wells, A. (2008). Belief domains of the Obsessive Beliefs Questionnaire-44 (OBQ-44) and their specific relationship with obsessive–compulsive symptoms. *Journal of Anxiety Disorders, 22*, 475-484. doi:10.1016/j.janxdis.2007.03.012

Myers, S. G., & Wells, A. (2005). Obsessive-compulsive symptoms: the contribution of metacognitions and responsibility. *Journal of Anxiety Disorders, 19*, 806-817. doi:10.1016/j.janxdis.2004.09.004

Naragon-Gainey, K. (2010). Meta-analysis of the relations of anxiety sensitivity to the depressive and anxiety disorders. *Psychological Bulletin, 136*, 128-150. doi:10.1037/a0018055

National Institute of Mental Health. (NIMH). (2016). *Behavioral assessment methods for RDoC constructs: A report by the National Advisory Mental Health Council Workgroup on Tasks and Measures for Research Domain Criteria (RDoC)*. Retrieved from https://www.nimh.nih.gov/about/advisory-boards-and-groups/namhc/reports/rdoc_council_workgroup_report_153440.pdf

Nolen-Hoeksema, S., & Watkins, E. R. (2011). A heuristic for developing transdiagnostic models of psychopathology: explaining multifinality and divergent trajectories. *Perspectives on Psychological Science, 6*, 589-609. doi:10.1177/1745691611419672

Norr, A. M., Oglesby, M. E., Capron, D. W., Raines, A. M., Korte, K. J., & Schmidt, N. B. (2013). Evaluating the unique contribution of intolerance of uncertainty relative to other cognitive vulnerability factors in anxiety psychopathology. *Journal of Affective Disorders, 151*, 136-142. doi:10.1016/j.jad.2013.05.063

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

Norton, P. J., & Mehta, P. D. (2007). Hierarchical model of vulnerabilities for emotional disorders. *Cognitive Behaviour Therapy, 36*, 240-254. doi:10.1080/16506070701628065

Norton, P. J., & Paulus, D. J. (2016). Toward a unified treatment for emotional disorders: update on the science and practice. *Behavior Therapy, 47*, 854-868. doi:10.1016/j.beth.2015.07.002

Norton, P. J., & Paulus, D. J. (2017). Transdiagnostic models of anxiety disorder: Theoretical and empirical underpinnings. *Clinical Psychology Review, 56*, 122-137. doi:10.1016/j.cpr.2017.03.004

Norton, P. J., & Price, E. C. (2007). A meta-analytic review of adult cognitive-behavioral treatment outcome across the anxiety disorders. *The Journal of Nervous and Mental Disease, 195*, 521-531. doi:10.1097/01.nmd.0000253843.70149.9a

Norton, P. J., Sexton, K. A., Walker, J. R., & Norton, G. R. (2005). Hierarchical model of vulnerabilities for anxiety: replication and extension with a clinical sample. *Cognitive Behaviour Therapy, 34*, 50-63. doi:10.1080/16506070410005401

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). New York, NY: McGraw-Hill, Inc.

O'Bryan, E. M., & McLeish, A. C. (2017). An examination of the indirect effect of intolerance of uncertainty on health anxiety through anxiety sensitivity physical concerns. *Journal of Psychopathology and Behavioral Assessment, 39*, 715-722. doi:10.1007/s10862-017-9613-y

Obsessive Compulsive Cognitions Working Group. (2001). Development and initial validation of the Obsessive Beliefs Questionnaire and the Interpretation of Intrusions Inventory. *Behaviour Research and Therapy, 39*, 987-1006. doi:10.1016/S0005-7967(00)00085-1

Obsessive Compulsive Cognitions Working Group. (2005). Psychometric validation of the Obsessive Belief Questionnaire and Interpretation of Intrusions Inventory—Part 2: Factor analyses and testing of a brief version. *Behaviour Research and Therapy, 43*, 1527-1542. doi:10.1016/j.brat.2004.07.010

Oglesby, M. E., Allan, N. P., Short, N. A., Raines, A. M., & Schmidt, N. B. (2017). Factor mixture modeling of intolerance of uncertainty. *Psychological Assessment, 29*, 435-445. doi:10.1037/pas0000357

Oglesby, M. E., Boffa, J. W., Short, N. A., Raines, A. M., & Schmidt, N. B. (2016). Intolerance of uncertainty as a predictor of post-traumatic stress symptoms following a traumatic event. *Journal of Anxiety Disorders, 41*, 82-87. doi:10.1016/j.janxdis.2016.01.005

Oglesby, M. E., Medley, A. N., Norr, A. M., Capron, D. W., Korte, K. J., & Schmidt, N. B. (2013). Intolerance of uncertainty as a vulnerability factor for hoarding behaviors. *Journal of Affective Disorders, 145*, 227-231. doi:10.1016/j.jad.2012.08.003

Oglesby, M. E., Raines, A. M., Short, N. A., Capron, D. W., & Schmidt, N. B. (2016). Interpretation bias for uncertain threat: A replication and extension. *Journal of Behavior Therapy and Experimental Psychiatry, 51*, 35-42. doi:10.1016/j.jbtep.2015.12.006

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, 48*, 427-434. doi:10.1016/j.beth.2017.01.005

Olatunji, B. O., Cisler, J. M., & Deacon, B. J. (2010). Efficacy of cognitive behavioral therapy for anxiety disorders: a review of meta-analytic findings. *Psychiatric Clinics of North America, 33*, 557-577. doi:10.1016/j.psc.2010.04.002

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

Paulus, D. J., Talkovsky, A. M., Heggeness, L. F., & Norton, P. J. (2015). Beyond negative affectivity: A hierarchical model of global and transdiagnostic vulnerabilities for emotional disorders. *Cognitive Behaviour Therapy, 44*, 389-405. doi:10.1080/16506073.2015.1017529

Pawluk, E. J., & Koerner, N. (2016). The relationship between negative urgency and generalized anxiety disorder symptoms: the role of intolerance of negative emotions and intolerance of uncertainty. *Anxiety, Stress, & Coping, 29*, 606-615. doi:10.1080/10615806.2015.1134786

Pepperdine, E., Lomax, C., & Freeston, M. H. (2018). Disentangling intolerance of uncertainty and threat appraisal in everyday situations. *Journal of Anxiety Disorders, 57*, 31-38. doi:10.1016/j.janxdis.2018.04.002

Peterson, R. (2000). A meta-analysis of variance accounted for and factor loadings in exploratory factor analysis. *A Journal of Research in Marketing, 11*, 261-275. doi:10.1023/A:1008191211004

Phillips, L. D., & Edwards, W. (1966). Conservatism in a simple probability inference task. *Journal of Experimental Psychology, 72*, 346-354. doi:10.1037/h0023653

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy, 35*, 741-756. doi:10.1016/s0005-7967(97)00022-3

Read, K. L., Comer, J. S., & Kendall, P. C. (2013). The Intolerance of Uncertainty Scale for Children (IUSC): Discriminating principal anxiety diagnoses and severity. *Psychological Assessment, 25*, 722-729. doi:10.1037/a0032392

Reilly, E. E., Anderson, L. M., Gorrell, S., Schaumberg, K., & Anderson, D. A. (2017). Expanding exposure-based interventions for eating disorders. *International Journal of Eating Disorders, 50*, 1137-1141. doi:10.1002/eat.22761

Reise, S. P. (2012). The rediscovery of bifactor measurement models. *Multivariate Behavioral Research, 47*, 667-696. doi:10.1080/00273171.2012.715555

Reise, S. P., Bonifay, W. E., & Haviland, M. G. (2013). Scoring and modeling psychological measures in the presence of multidimensionality. *Journal of Personality Assessment, 95*, 129-140. doi:10.1080/00223891.2012.725437

Reise, S. P., Moore, T. M., & Haviland, M. G. (2010). Bifactor models and rotations: Exploring the extent to which multidimensional data yield univocal scale scores. *Journal of Personality Assessment, 92*, 544-559. doi:10.1080/00223891.2010.496477

Reise, S. P., Scheines, R., Widaman, K. F., & Haviland, M. G. (2013). Multidimensionality and structural coefficient bias in structural equation modeling: A bifactor perspective. *Educational and Psychological Measurement, 73*, 5-26. doi:10.1177/0013164412449831

Renjan, V., McEvoy, P. M., Handley, A. K., & Fursland, A. (2016). Stomaching uncertainty: Relationships among intolerance of uncertainty, eating disorder pathology, and comorbid emotional symptoms. *Journal of Anxiety Disorders, 41*, 88-95. doi:10.1016/j.janxdis.2016.03.008

Reuman, L., Jacoby, R. J., Fabricant, L. E., Herring, B., & Abramowitz, J. S. (2015). Uncertainty as an anxiety cue at high and low levels of threat. *Journal of Behavior Therapy and Experimental Psychiatry, 47*, 111-119. doi:10.1016/j.jbtep.2014.12.002

Robichaud, M. (2013). Cognitive behavior therapy targeting intolerance of uncertainty: application to a clinical case of generalized anxiety disorder. *Cognitive and Behavioral Practice, 20*, 251-263. doi:10.1016/j.cbpra.2012.09.001

Rodebaugh, T. L., Woods, C. M., Thissen, D. M., Heimberg, R. G., Chambless, D. L., & Rapee, R. M. (2004). More information from fewer questions: The factor structure and item properties of the original and Brief Fear of Negative Evaluation Scale. *Psychological Assessment, 16*, 169-181. doi:10.1037/1040-3590.16.2.169

Rodriguez, A., Reise, S. P., & Haviland, M. G. (2016). Applying bifactor statistical indices in the evaluation of psychological measures. *Journal of Personality Assessment, 98*, 1-15. doi:10.1080/00223891.2015.1089249

Roemer, L., & Orsillo, S. M. (2007). An open trial of an acceptance-based behavior therapy for generalized anxiety disorder. *Behavior Therapy, 38*, 72-85. doi:10.1016/j.beth.2006.04.004

Roma, V. G., & Hope, D. A. (2017). Are we certain about which measure of intolerance of uncertainty to use yet? *Cognitive Behaviour Therapy, 46*, 327-338. doi:10.1080/16506073.2016.1252792

Rosen, N. O., & Knäuper, B. (2009). A little uncertainty goes a long way: state and trait differences in uncertainty interact to increase information seeking but also increase worry. *Health Communication, 24*, 228-238. doi:10.1080/10410230902804125

Rosen, N. O., Knäuper, B., Di Dio, P., Morrison, E., Tabing, R., Feldstain, A., . . . Rosberger, Z. (2010). The impact of intolerance of uncertainty on anxiety after receiving an informational intervention about HPV: A randomised controlled study. *Psychology & Health, 25*, 651-668. doi:10.1080/08870440902822913

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.

Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioural analysis. *Behaviour Research and Therapy, 23*, 571-583. doi:10.1016/0005-7967(85)90105-6

Salkovskis, P. M., & Forrester, E. (2002). Chapter 4 - Responsibility. In R. O. Frost & G. Steketee (Eds.), *Cognitive Approaches to Obsessions and Compulsions* (pp. 45-61). Oxford: Pergamon.

Sanchez, A., Kendall, P., & Comer, J. (2016). Evaluating the intergenerational link between maternal and child intolerance of uncertainty: A preliminary cross-sectional

examination. *Cognitive Therapy and Research, 40*, 532-539. doi:10.1007/s10608-016-9757-1

Sanchez, A. L., Cornacchio, D., Chou, T., Leyfer, O., Coxe, S., Pincus, D., & Comer, J. S. (2017). Development of a scale to evaluate young children's responses to uncertainty and low environmental structure. *Journal of Anxiety Disorders, 45*, 17-23. doi:10.1016/j.janxdis.2016.11.006

Sanfey, A. G., Loewenstein, G., McClure, S. M., & Cohen, J. D. (2006). Neuroeconomics: cross-currents in research on decision-making. *Trends in Cognitive Sciences, 10*, 108-116. doi:10.1016/j.tics.2006.01.009

Sanislow, C. A., Pine, D. S., Quinn, K. J., Kozak, M. J., Garvey, M. A., Heinssen, R. K., . . . Cuthbert, B. N. (2010). Developing constructs for psychopathology research: research domain criteria. *Journal of Abnormal Psychology, 119*, 631-639. doi:10.1037/a0020909

Sarinopoulos, I., Grupe, D. W., Mackiewicz, K. L., Herrington, J. D., Lor, M., Steege, E. E., & Nitschke, J. B. (2010). Uncertainty during anticipation modulates neural responses to aversion in human insula and amygdala. *Cerebral Cortex, 20*, 929-940. doi:10.1093/cercor/bhp155

Schienle, A., Köchel, A., Ebner, F., Reishofer, G., & Schäfer, A. (2010). Neural correlates of intolerance of uncertainty. *Neuroscience Letters, 479*, 272-276. doi:10.1016/j.neulet.2010.05.078

Schmitt, D. P., & Allik, J. (2005). Simultaneous administration of the Rosenberg Self-Esteem Scale in 53 nations: exploring the universal and culture-specific features of global self-esteem. *Journal of Personality and Social Psychology, 89*, 623-642. doi:10.1037/0022-3514.89.4.623

Schmitt, T. A., & Sass, D. A. (2011). Rotation criteria and hypothesis testing for exploratory factor analysis: implications for factor pattern loadings and interfactor forrelations. *Educational and Psychological Measurement, 71*, 95-113. doi:10.1177/0013164410387348

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*, 323-338. doi:10.3200/JOER.99.6.323-338

Sexton, K. A., & Dugas, M. J. (2009). Defining distinct negative beliefs about uncertainty: validating the factor structure of the Intolerance of Uncertainty Scale. *Psychological Assessment, 21*, 176-186. doi:10.1037/a0015827

Sexton, K. A., Norton, P. J., Walker, J. R., & Norton, G. R. (2003). Hierarchical model of generalized and specific vulnerabilities in anxiety. *Cognitive Behaviour Therapy, 32*, 82-94. doi:10.1080/16506070302321

Shafran, R. (1997). The manipulation of responsibility in obsessive-compulsive disorder. *British Journal of Clinical Psychology, 36*, 397-407. doi:10.1111/j.2044-8260.1997.tb01247.x

Shankman, S. A., & Gorka, S. M. (2015). Psychopathology research in the RDoC era: Unanswered questions and the importance of the psychophysiological unit of analysis. *International Journal of Psychophysiology, 98*, 330-337. doi:10.1016/j.ijpsycho.2015.01.001

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., . . . Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *The Journal of Clinical Psychiatry, 59*, 22-33.

Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). Pathways from uncertainty to anxiety: An evaluation of a hierarchical model of trait and disorder-specific intolerance of uncertainty on anxiety disorder symptoms. *Journal of Anxiety Disorders, 45*, 72-79. doi:10.1016/j.janxdis.2016.12.001

Shihata, 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 two-factor model? *Psychological Assessment, 30*, 893-903. doi:10.1037/pas0000540

Shihata, S., McEvoy, P. M., Mullan, B. A., & Carleton, R. N. (2016). Intolerance of uncertainty in emotional disorders: What uncertainties remain? *Journal of Anxiety Disorders, 41*, 115-124. doi:10.1016/j.janxdis.2016.05.001

Simmons, A., Matthews, S. C., Paulus, M. P., & Stein, M. B. (2008). Intolerance of uncertainty correlates with insula activation during affective ambiguity. *Neuroscience Letters, 430*, 92-97. doi:10.1016/j.neulet.2007.10.030

Smári, J., & Hólmsteinsson, H. E. (2001). Intrusive thoughts, responsibility attitudes, thought-action fusion, and chronic thought suppression in relation to obsessive compulsive symptoms. *Behavioural and Cognitive Psychotherapy, 29*, 13-20. doi:10.1017/S1352465801001035

Sookman, D., & Pinard, G. (2002). Overestimation of threat and intolerance of uncertainty in obsessive compulsive disorder. In R. O. Frost & G. Steketee (Eds.), *Cognitive*

approaches to obsessions and compulsions: Theory, assessment, and treatment (pp. 63-89). Oxford: Elsevier

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine, 166*, 1092-1097. doi:10.1001/archinte.166.10.1092

Starcevic, V., & Berle, D. (2006). Cognitive specificity of anxiety disorders: a review of selected key constructs. *Depression and Anxiety, 23*, 51-61. doi:10.1002/da.20145

Steele, A. L., O'Shea, A., Murdock, A., & Wade, T. D. (2011). Perfectionism and its relation to overevaluation of weight and shape and depression in an eating disorder sample. *International Journal of Eating Disorders, 44*, 459-464. doi:10.1002/eat.20817

Stein, D. J. (2002). Obsessive-compulsive disorder. *The Lancet, 360*, 397-405. doi:10.1016/S0140-6736(02)09620-4

Stein, M. B., & Stein, D. J. (2008). Social anxiety disorder. *The Lancet, 371*, 1115-1125. doi:10.1016/S0140-6736(08)60488-2

Steinberg, L. (2005). Cognitive and affective development in adolescence. *Trends in Cognitive Sciences, 9*, 69-74. doi:10.1016/j.tics.2004.12.005

Steinglass, J. E., Sysko, R., Glasofer, D., Albano, A. M., Simpson, H. B., & Walsh, B. T. (2011). Rationale for the application of exposure and response prevention to the treatment of anorexia nervosa. *The International Journal of Eating Disorders, 44*, 134. doi:10.1002/eat.20784

Steinhausen, H.-C. (2002). The outcome of anorexia nervosa in the 20th Century. *American Journal of Psychiatry, 159*, 1284-1293. doi:10.1176/appi.ajp.159.8.1284

Sternheim, L., & Harrison, A. (2018). The acceptability, feasibility and possible benefits of a group-based intervention targeting intolerance of uncertainty in adolescent inpatients with anorexia nervosa. *Cogent Psychology, 5*, 1-11. doi:10.1080/23311908.2018.1441594

Sternheim, L., Konstantellou, A., Startup, H., & Schmidt, U. (2011). What does uncertainty mean to women with anorexia nervosa? An interpretative phenomenological analysis. *European Eating Disorders Review, 19*, 12-24. doi:10.1002/erv.1029

Sternheim, L., Startup, H., & Schmidt, U. (2011). An experimental exploration of behavioral and cognitive–emotional aspects of intolerance of uncertainty in eating disorder patients. *Journal of Anxiety Disorders, 25*, 806-812. doi:10.1016/j.janxdis.2011.03.020

Sternheim, L., Startup, H., & Schmidt, U. (2015). Anxiety-related processes in anorexia nervosa and their relation to eating disorder pathology, depression and anxiety. *Advances in Eating Disorders: Theory, Research and Practice, 55*, 1-7. doi:10.1080/21662630.2014.948469

Sternheim, L. C., Fisher, M., Harrison, A., & Watling, R. (2017). Predicting intolerance of uncertainty in individuals with eating disorder symptoms. *Journal of Eating Disorders, 5*, 1-9. doi:10.1186/s40337-017-0152-4

Stevens, K., Rogers, T., Campbell, M., Björgvinsson, T., & Kertz, S. (2018). A transdiagnostic examination of decreased intolerance of uncertainty and treatment outcome. *Cognitive Behaviour Therapy, 47*, 19-33. doi:10.1080/16506073.2017.1338311

Storch, E. A., Roberti, J. W., & Roth, D. A. (2004). Factor structure, concurrent validity, and internal consistency of the Beck Depression Inventory - Second Edition in a sample of college students. *Depression and Anxiety, 19*, 187-189. doi:10.1002/da.20002

Stroup, W. W. (2012). *Generalized linear mixed models: Modern concepts, methods and applications*: CRC Press.

Stucky, B. D., & Edelen, M. O. (2015). Using hierarchical IRT models to create unidimensional measures from multidimensional data. In S. P. Reise & D. A. Revicki (Eds.), *Handbook of item response theory modelling: Applications to typical performance assessment* (pp. 183-206). New York, NY: Routledge.

Summers, B. J., Sarawgi, S., Fitch, K. E., Dillon, K. H., & Cougle, J. R. (2016). Six in vivo assessments of compulsive behavior: a validation study using the Obsessive–Compulsive Inventory–Revised. *Assessment, 25*, 483-497. doi:10.1177/1073191116654759

Swinbourne, J., Hunt, C., Abbott, M., Russell, J., St Clare, T., & Touyz, S. (2012). The comorbidity between eating disorders and anxiety disorders: Prevalence in an eating disorder sample and anxiety disorder sample. *Australian & New Zealand Journal of Psychiatry, 46*, 118-131. doi:10.1177/0004867411432071

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson Education.

Talkovsky, A. M., & Norton, P. J. (2016). Intolerance of uncertainty and transdiagnostic group cognitive behavioral therapy for anxiety. *Journal of Anxiety Disorders, 41*, 108-114. doi:10.1016/j.janxdis.2016.05.002

Talkovsky, A. M., & Norton, P. J. (2018). Negative affect and intolerance of uncertainty as potential mediators of change in comorbid depression in transdiagnostic CBT for anxiety. *Journal of Affective Disorders, 236*, 259-265. doi:10.1016/j.jad.2018.04.104

Tanovic, E., Gee, D. G., & Joormann, J. (2018). Intolerance of uncertainty: Neural and psychophysiological correlates of the perception of uncertainty as threatening. *Clinical Psychology Review, 60*, 87-99. doi:10.1016/j.cpr.2018.01.001

Taylor, S. (1998). The hierarchic structure of fears. *Behaviour Research and Therapy, 36*, 205-214. doi:10.1016/S0005-7967(98)00012-6

Taylor, S., Coles, M., Abramowitz, J., Wu, K., Olatunji, B., Timpano, K., . . . Tolin, D. (2010). How are dysfunctional beliefs related to obsessive-compulsive symptoms? *Journal of Cognitive Psychotherapy, 24*, 165-176. doi:10.1891/0889-8391.24.3.165

Thayer, J. F., Åhs, F., Fredrikson, M., Sollers, J. J., & Wager, T. D. (2012). A meta-analysis of heart rate variability and neuroimaging studies: Implications for heart rate variability as a marker of stress and health. *Neuroscience and Biobehavioral Reviews, 36*, 747-756. doi:10.1016/j.neubiorev.2011.11.009

Thibodeau, M. A., Carleton, R. N., Gómez-Pérez, L., & Asmundson, G. J. (2013). "What if I make a mistake?": Intolerance of uncertainty is associated with poor behavioral performance. *The Journal of Nervous and Mental Disease, 201*, 760-766. doi:10.1097/NMD.0b013e3182a21298

Thibodeau, M. A., Carleton, R. N., McEvoy, P. M., Zvolensky, M. J., Brandt, C. P., Boelen, P. A., . . . Asmundson, G. J. G. (2015). Developing scales measuring disorder-specific intolerance of uncertainty (DSIU): A new perspective on transdiagnostic. *Journal of Anxiety Disorders, 31*, 49-57. doi:10.1016/j.janxdis.2015.01.006

Thielsch, C., Andor, T., & Ehring, T. (2015). Do metacognitions and intolerance of uncertainty predict worry in everyday life? An ecological momentary assessment study. *Behavior Therapy, 46*, 532-543. doi:10.1016/j.beth.2015.05.001

Tolin, D., Brady, R., & Hannan, S. (2008). Obsessional beliefs and symptoms of obsessive–compulsive disorder in a clinical sample. *Journal of Psychopathology and Behavioral Assessment, 30*, 31-42. doi:10.1007/s10862-007-9076-7

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*, 233-242. doi:10.1016/S0887-6185(02)00182-2

Tomarken, A. J., & Waller, N. G. (2005). Structural equation modeling: Strengths, limitations, and misconceptions. *Annual Review of Clinical Psychology, 1*, 31-65. doi:10.1146/annurev.clinpsy.1.102803.144239

Treanor, M., Erisman, S., Salters-Pedneault, K., Roemer, L., & Orsillo, S. (2011). Acceptance-based behavioral therapy for GAD: effects on outcomes from three theoretical models. *Depression and Anxiety 28*, 127-136. doi:10.1002/da.20766

van der Heiden, C., Melchior, K., Muris, P., Bouwmeester, S., Bos, A. E. R., & van der Molen, H. T. (2010). A hierarchical model for the relationships between general and specific vulnerability factors and symptom levels of generalized anxiety disorder. *Journal of Anxiety Disorders, 24*, 284-289. doi:10.1016/j.janxdis.2009.12.005

van der Heiden, C., Muris, P., & van der Molen, H. T. (2012). Randomized controlled trial on the effectiveness of metacognitive therapy and intolerance of uncertainty therapy for generalized anxiety disorder. *Behaviour Research and Therapy, 50*, 100. doi:10.1016/j.brat.2011.12.005

Vasa, R. A., Kreiser, N. L., Keefer, A., Singh, V., & Mostofsky, S. H. (2018). Relationships between autism spectrum disorder and intolerance of uncertainty. *Autism Research, 11*, 636-644. doi:10.1002/aur.1916

Volz, K. G., & Gigerenzer, G. (2012). Cognitive processes in decisions under risk are not the same as in decisions under uncertainty. *Frontiers in Neuroscience, 6*, 1-6. doi:10.3389/fnins.2012.00105

Walker, S., Birrell, J., Rogers, J., Leekam, S., & Freeston, M. H. (2010). *Intolerance of uncertainty scale-revised. Unpublished manuscript*. Newcastle University.

Watson, D. (2005). Rethinking the mood and anxiety disorders: A quantitative hierarchical model for DSM-V. *Journal of Abnormal Psychology, 114*, 522-536. doi:10.1037/0021-843X.114.4.522

Weeks, J. W., Heimberg, R. G., Fresco, D. M., Hart, T. A., Turk, C. L., Schneier, F. R., & Liebowitz, M. R. (2005). Empirical validation and psychometric evaluation of the Brief Fear of Negative Evaluation Scale in patients with social anxiety disorder. *Psychological Assessment, 17*, 179-190. doi:10.1037/1040-3590.17.2.179

Weeks, J. W., Norton, P. J., & Heimberg, R. G. (2009). Exploring the latent structure of two cognitive components of social anxiety: taxometric analyses of fears of negative and positive evaluation. *Depression and Anxiety, 26*, E40-E48. doi:10.1002/da.20414

Wells, A. (2005). The metacognitive model of GAD: Assessment of meta-worry and relationship with DSM-IV generalized anxiety disorder. *Cognitive Therapy and Research, 29*, 107-121. doi:10.1007/s10608-005-1652-0

Wells, A., & Cartwright-Hatton, S. (2004). A short form of the Metacognitions Questionnaire: properties of the MCQ-30. *Behaviour Research and Therapy, 42*, 385-396. doi:10.1016/S0005-7967(03)00147-5

Wever, M., Smeets, P., & Sternheim, L. (2015). Neural correlates of intolerance of uncertainty in clinical disorders. *The Journal of Neuropsychiatry and Clinical Neurosciences, 27*, 345-353. doi:10.1176/appi.neuropsych.14120387

Wheaton, M. G., Abramowitz, J. S., Jacoby, R. J., Zwerling, J., & Rodriguez, C. I. (2016). An investigation of the role of intolerance of uncertainty in hoarding symptoms. *Journal of Affective Disorders, 193*, 208-214. doi:10.1016/j.jad.2015.12.047

Whiteford, H. A., Degenhardt, L., Rehm, J., Baxter, A. J., Ferrari, A. J., Erskine, H. E., . . . Vos, T. (2013). Global burden of disease attributable to mental and substance use disorders: findings from the global burden of disease study 2010. *The Lancet, 382*, 1575-1586. doi:10.1016/S0140-6736(13)61611-6

Whiteford, H. A., Ferrari, A. J., Degenhardt, L., Feigin, V., & Vos, T. (2015). The global burden of mental, neurological and substance use disorders: an analysis from the global burden of disease study 2010. *PLoS One, 10*, e0116820. doi:10.1371/journal.pone.0116820

Whiting, S. E., Jenkins, W. S., May, A. C., Rudy, B. M., Davis, T. E., & Reuther, E. T. (2014). The role of intolerance of uncertainty in social anxiety subtypes. *Journal of Clinical Psychology, 70*, 260-272. doi:10.1002/jclp.22024

Wilson, G. T., Grilo, C. M., & Vitousek, K. M. (2007). Psychological treatment of eating disorders. *American Psychologist, 62*, 199-216. doi:10.1037/0003-066X.62.3.199

Wittchen, H. U., Jacobi, F., Rehm, J., Gustavsson, A., Svensson, M., Jönsson, B., . . . Steinhausen, H. C. (2011). The size and burden of mental disorders and other disorders of the brain in Europe 2010. *European Neuropsychopharmacology, 21*, 655-679. doi:10.1016/j.euroneuro.2011.07.018

World Health Organization. (2013). *Mental health action plan 2013-2020*. Geneva, Switzerland.

Wright, C. J., Clark, G. I., Rock, A. J., & Coventry, W. L. (2017). Intolerance of uncertainty mediates the relationship between adult attachment and worry. *Personality and Individual Differences, 112*, 97-102. doi:10.1016/j.paid.2017.02.039

Wright, K. D., Lebell, M. A. N. A., & Carleton, R. N. (2016). Intolerance of uncertainty, anxiety sensitivity, health anxiety, and anxiety disorder symptoms in youth. *Journal of Anxiety Disorders, 41*, 35-42. doi:10.1016/j.janxdis.2016.04.011

Wuyek, L., Antony, M., & McCabe, R. (2011). Psychometric properties of the Panic Disorder Severity Scale: clinician-administered and self-report versions. *Clinical Psychology and Psychotherapy, 18*, 234-243. doi:10.1002/cpp.703

Yook, K., Kim, K.-H., Suh, S. Y., & Lee, K. S. (2010). Intolerance of uncertainty, worry, and rumination in major depressive disorder and generalized anxiety disorder. *Journal of Anxiety Disorders, 24*, 623-628. doi:10.1016/j.janxdis.2010.04.003

Zdebik, M. A., Moss, E., & Bureau, J. F. (2018). Childhood attachment and behavioural inhibition: Predicting intolerance of uncertainty in adulthood. *Development and Psychopathology, 30*, 1225-1238. doi:10.1017/s0954579417001614

Zlomke, K., & Young, J. (2009). A retrospective examination of the role of parental anxious rearing behaviors in contributing to intolerance of uncertainty. *Journal of Child and Family Studies, 18*, 670-679. doi:10.1007/s10826-009-9269-7

Appendix A

Published Article

Shihata, S., McEvoy, P. M., Mullan, B. A., & Carleton, R. N. (2016). Intolerance of uncertainty in emotional disorders: What uncertainties remain? *Journal of Anxiety Disorders, 41*, 115-124. doi:10.1016/j.janxdis.2016.05.001

Journal of Anxiety Disorders 41 (2016) 115–124

Contents lists available at ScienceDirect

Journal of Anxiety Disorders

Intolerance of uncertainty in emotional disorders: What uncertainties remain?

Sarah Shihata [a], Peter M. McEvoy [a,b,*], Barbara Ann Mullan [a], R. Nicholas Carleton [c]

[a] School of Psychology and Speech Pathology, Curtin University, Perth, Australia
[b] Centre for Clinical Interventions, Perth, Australia
[c] University of Regina, Regina, Saskatchewan, Canada

ARTICLE INFO

Article history:
Received 19 February 2016
Received in revised form 3 May 2016
Accepted 5 May 2016
Available online 6 May 2016

Keywords:
Intolerance of uncertainty
Review
Emotional disorders
Transdiagnostic
Disorder-specific
Research agenda

ABSTRACT

The current paper presents a future research agenda for intolerance of uncertainty (IU), which is a transdiagnostic risk and maintaining factor for emotional disorders. In light of the accumulating interest and promising research on IU, it is timely to emphasize the theoretical and therapeutic significance of IU, as well as to highlight what remains unknown about IU across areas such as development, assessment, behavior, threat and risk, and relationships to cognitive vulnerability factors and emotional disorders. The present paper was designed to provide a synthesis of what is known and unknown about IU, and, in doing so, proposes broad and novel directions for future research to address the remaining uncertainties in the literature.

1. Introduction

The current paper briefly reviews what is known about intolerance of uncertainty (IU) before highlighting what remains unknown. Due to rapidly increasing interest and research focus on IU, culminating in the current special issue, a review is both timely and necessary to set a future research agenda. This paper will review IU with respect to conceptual foundations and definitional issues, development, assessment, behavioral consequences, associations to threat and risk, other cognitive vulnerability factors, and emotional disorders, as well as clinical applications. Within each of these domains, what is currently known will first be briefly reviewed followed by what remains unknown. The major contribution of the current paper is the description of future research avenues to address the known unknowns.

2. Conceptual foundations of intolerance of uncertainty

2.1. What is known?

Models of psychopathology posit that uncertainty is a central feature in anxiety-related experience (Carleton, 2016a) and the incapacity to endure unknowns appears to be a robust vulnerability factor associated with a range of psychological disorders (Grupe & Nitschke, 2013; Hong & Cheung, 2015). IU was originally defined as a broad construct that reflects "cognitive, emotional, and behavioral reactions to uncertainty in everyday life situations" (Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994, p. 792). Freeston et al. (1994) speculated that people with IU may engage in worry to increase their sense of certainty and control when faced with ambiguity. The definition of IU evolved as research on IU shifted from an initial focus on generalized anxiety disorder (GAD) to other disorders. A revised and broader definition described IU as a predisposition to negatively perceive and respond to uncertain information and situations irrespective of its probability and outcomes (Ladouceur, Blais, Freeston, & Dugas, 1998; Ladouceur, Gosselin, & Dugas, 2000). IU has also been conceptualized as a cognitive filter and as the excessive tendency to perceive and interpret negative events as unacceptable (Buhr & Dugas, 2002; Dugas, Gosselin, & Ladouceur, 2001). Individuals with high IU have the tendency to appraise ambiguity as threatening and experience

* Corresponding author at: School of Psychology and Speech Pathology, Curtin University, GPO BOX U1987, Perth, Western Australia 6845, Australia.
E-mail address: peter.mcevoy@curtin.edu.au (P.M. McEvoy).

http://dx.doi.org/10.1016/j.janxdis.2016.05.001
0887-6185/

heightened physiological arousal (Greco & Roger, 2001, 2003; Hock & Krohne, 2004). Furthermore, difficulties tolerating uncertainty may represent the tendency to believe that uncertainty in itself is distressing, unfair, and should be avoided (Dugas, Marchand, & Ladouceur, 2005; Dugas, Schwartz, & Francis, 2004). Current consenseus describes IU as a "dispositional characteristic that reflects a set of negative beliefs about uncertainty and its implications" (Dugas & Robichaud, 2007), and represents an underlying fear of the unknown (Carleton, 2016b). Carleton (2016a, p. 31) recently proposed that IU represents a broad "incapacity to endure the aversive response triggered by the perceived absence of salient, key, or sufficient information".

Recent measurement research sheds light on the conceptual nature of IU, postulating that IU comprises two dimensions; prospective IU (e.g., "*I always want to know what the future has in store for me*") and inhibitory IU (e.g., "*When its time to act, uncertainty paralyzes me";* Carleton, 2012; Carleton, Sharpe, & Asmundson, 2007; Hong & Cheung, 2015; McEvoy & Mahoney, 2011), sometimes referred to as desire for predictability and uncertainty paralysis, respectively (Berenbaum, Bredemeier, & Thompson, 2008; Birrell, Meares, Wilkinson, & Freeston, 2011). Both prospective and inhibitory IU are conceptualized as responses to uncertainty such that prospective IU represents cognitive appraisals of threat related to future uncertainty while inhibitory IU represents behavioral inhibition related to uncertainty (Carleton, 2012; Carleton, Norton, & Asmundson, 2007; Einstein, 2014).

IU has predominantly been conceptualized as a dispositional trait (Mahoney & McEvoy, 2012c); however, recent research suggests distinctions can be made between trait IU and disorder-specific IU (Thibodeau et al., 2015), sometimes referred to as situation-specific IU (Mahoney & McEvoy, 2012a, 2012c). Mahoney and McEvoy (2012c) were the first to conceptualize dimensions of the IU construct as disorder-specific based on early speculations that general experiences of uncertainty may differ across disorders and thus situations (Carleton, Gosselin, & Asmundson, 2010; Tolin, Abramowitz, Brigidi, & Foa, 2003). For example, uncertainty about catastrophic consequences of physical symptoms in panic disorder may differ from uncertainty about social evaluative cues in social anxiety disorder. Thus, the nature of uncertainty may differ between emotional disorders and IU may manifest differently based on contextual factors (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013; Carleton, 2016a; Mahoney & McEvoy, 2012c). State IU can be considered as any instance of heightened negative affect in response to an uncertain stimulus, which may or may not co-occur with high trait IU or occur within the context of emotional disorders.

Mahoney and McEvoy (2012c) found that clinical participants reported higher disorder-specific IU relative to trait IU. Further, disorder-specific IU displayed a significant, but modest, association with depression and panic disorder symptoms beyond trait IU, but not for social anxiety, worry, or obsessive-compulsive disorder symptoms. Additionally, Mahoney and McEvoy (2012a) reported no significant differences between trait and disorder-specific IU amongst individuals with GAD, social anxiety disorder, and panic disorder. Thus, in line with normative descriptive research (e.g., Carleton et al., 2012), trait IU appeared comparable across disorders, supporting IU as a transdiagnostic construct.

Jensen and Heimberg (2015) extended this research by comparing diagnostically-congruent and -incongruent situations using a non-anxious control and two anxious groups. The socially anxious and obsessive-compulsive groups reported higher disorder-specific IU relative to trait or disorder-incongruent IU. Further, the socially anxious and control groups reported similar IU levels with regard to contamination concerns, while the obsessive-compulsive and control groups reported similar IU levels with regard to social interactions (Jensen & Heimberg, 2015). Thus, in line with recent theory (Carleton, 2016a), context remains a critical component for considering uncertainty threatening, even for persons reporting high trait IU and anxiety symptoms.

Thibodeau et al. (2015) also found disorder-specific IU was associated with unique variance in concordent symptom measures (e.g., disorder-specific IU in social situations predicted symptoms for social anxiety; disorder-specific IU in bodily sensations predicted symptoms for panic disorder). Relative to disorder-specific IU, trait IU explained more unique variance in GAD and obsessive-compulsive disorder, but less unique variance in social anxiety and panic disorder symptoms. Disorder-specific and trait IU accounted for similar proportions of unique variance in symptoms of health anxiety, depression, posttraumatic stress disorder, and specific phobia. Taken together, research suggests the generalizability of IU varies, with some disorders appearing more strongly associated with disorder-specific IU than trait IU (Mahoney & McEvoy, 2012a; Thibodeau et al., 2015). Moreover, expressions of disorder-specific and trait IU may be dependent on context, with intolerance increasing during exposure to disorder-congruent situations (Jensen & Heimberg, 2015; Mahoney & McEvoy, 2012a).

2.2. What is unknown?

Converging evidence highlights the possibility that IU comprises both prospective IU (desire for predictability) and inhibitory IU (uncertainty paralysis); nevertheless, future research should examine the theoretical nature of prospective and inhibitory IU, and the relationships between these two dimensions and other aspects of psychopathology, including affective, behavioral, cognitive, and interpersonal factors. For example, investigating whether prospective IU is more strongly related to approach behaviors designed to stave off future uncertainty and whether inhibitory IU is more strongly associated with avoidance behaviors to minimize exposure to uncertainty (Birrell et al., 2011).

The historical focus on trait IU has left the role of disorder-specific IU in emotional disorders less clear. Further research is needed to elucidate the nature of IU across disorders, each of which may involve varying degrees of trait and disorder-specific IU (Thibodeau et al., 2015). There is also a need to clarify the predictive nature of disorder-specific IU in emotional disorders. Disorder-specific and trait IU need to be delineated and integrated into theoretical models to provide a framework for this endeavor. Distinguishing between disorder-specific IU, trait IU, and symptoms may have important treatment implications, such as guiding targets for exposure or psychoeducation. Alternatively, for some or most disorders targeting trait IU may sufficiently generalize to disorder-specific IU, or vice versa, offering several potential avenues for reducing IU-related vulnerability for primary and comorbid emotional problems. Answers to these questions are currently unknown.

3. Development of intolerance of uncertainty

3.1. What is known?

Associations between IU, other cognitive vulnerabilities, and anxiety-related psychopathology underscore the important theoretical and clinical implications of understanding IU development processes (Barlow, Bullis, Comer, & Ametaj, 2013). For example, elucidating pathways by which transdiagnostic processes lead to multiple diagnoses (i.e., multifinality) and different disorders (i.e., divergent trajectories) in different people may be critical for advancing theory, treatment, and prevention (Nolen-Hoeksema & Watkins, 2011). Indirect research and theory implicates the developmental importance of IU (Carleton, 2016a); however, direct

research into the development of IU is nascent and is reviewed here with a focus on potential processes and developmental origins. We consider IU as a proximal transdiagnostic risk factor akin to Nolen-Hoeksema and Watkins (2011) proposed heuristic for developing transdiagnostic models, which incorporates distal factors, proximal factors, and linking mechanisms for psychopathology.

Distal risk factors may include early family contexts characterized by over-protective and controlling parenting. These parenting styles may decrease children's perceived control and self-efficacy, resulting in maladaptive cognitive strategies, negative perceptions of uncertainty, worry, and anxiety (Buhr & Dugas, 2006; Chorpita & Barlow, 1998). Zlomke and Young (2009) found participants who reported that their parents displayed adverse behaviors (i.e., anxious rearing and rejection) had significantly higher IU. Importantly, these researchers found that the relationship between anxious parenting and both anxiety and worry symptoms was mediated by IU. Dugas, Laugesen, and Bukowski (2012) conducted longitudinal research investigating the temporal relationship between IU and worry during adolescence, providing evidence that changes in IU partially mediate change in worry and vice-versa. Accordingly, Dugas et al. (2012) suggested that worry and IU have a reciprocal relationship over time, with adolescent IU potentiating worry through threatening appraisals of uncertainty and maladaptive behaviors similarly to adults (Bredemeier & Berenbaum, 2008; Gosselin et al., 2008). These researchers observed that transition periods at the start and finish of secondary school were associated with the highest levels of IU, and they suggested that multiple changes during adolescence (e.g., emotional, social, academic; Steinberg, 2005) may have a cumulative effect of increasing IU.

Recent theoretical models (see Grupe & Nitschke, 2013; Wever, Smeets, & Sternheim, 2015) implicate several neural structures that may be impacted by, and underlie the expression of, IU. The neurologically-based models are based on functional magnetic resonance imaging evidence that has implicated the insula, amygdala, anterior cingulate cortex, orbitofrontal cortex, ventromedial prefrontal cortex, dorsolateral prefrontal cortex, and posterior frontomedian cortex as related to IU (Krain et al., 2006; Motzkin, Philippi, Wolf, Baskaya, & Koenigs, 2014; Sarinopoulos et al., 2009; Schienle, Köchel, Ebner, Reishofer, & Schäfer, 2010; Simmons, Matthews, Paulus, & Stein, 2008; Thayer, Åhs, Fredrikson, Sollers, & Wager, 2012). Hyperactivation of these brain regions appears to be associated with maladaptive cognitive and behavioral processes, including hypervigilance for uncertain or threatening stimuli (Wever et al., 2015). Associations between IU and hypervigilance have also been supported by information processing studies indicating a cognitive bias (Fergus, Bardeen, & Wu, 2013; Fergus & Carleton, 2016). Similarly, uncertainty appears related to increases in heart rate variability (Thayer et al., 2012), implicating broad influence throughout the attentional networks and autonomic nervous system.

3.2. What is unknown?

There is a paucity of research on IU during childhood and adolescence; such research is critical. Different neurodevelopmental stages contribute to differences in processing uncertainty, which limits generalizability from adult studies to child populations (Krain et al., 2006). Extending research by Wright, Adams Lebell, and Carleton (2016), future research should examine associations between IU and a range of emotional disorders to inform the transdiagnostic nature of IU in child and adolescent populations. Future research using prospective and longitudinal designs are needed. Moderators may shape the effects of trait IU into particular symptoms and disorder-specific IU, helping to explain how this vulnerability results in divergent trajectories or multifinality (Nolen-Hoeksema & Watkins, 2011). Such moderation hypotheses accord with the assertion made by Thibodeau et al. (2015, p. 55) that disorder-specific IU may represent a "theoretically proximal and explicit causal intermediary" between trait IU and disorder symptoms. Trait IU may shape disorder-specific IU through learning, operant conditioning, and modelling, which would shape cognitive and behavioral responses to situational stressors and consequences. A comprehensive review of the interplay between these factors is beyond the scope of this review, but further research examining these relationships is required.

Carleton et al. (2012) suggested that rather than investigating discrete causal factors, researchers should explore a range of environmental, genetic, or biological variables that may shape IU. Identifying neural structures related to IU may explain whether IU functions as a shared or specific vulnerability factor (Simmons et al., 2008; Wever et al., 2015). Researchers have yet to explore potential links between IU and congenital biological abnormalities; as such, future researchers and theorists should consider the potential influence of genetically based dispositions that may confer risk for IU. Future researchers should strive to understand the connections between genetic, neural, and cognitive correlates, all of which may facilitate IU and psychopathology (Sanislow et al., 2010). Advancing our understanding of the neurobiological, genetic, and environmental origins of IU is important for advancing our understanding of multifinality and divergent disorder-specific trajectories, as well as preventative and therapeutic interventions (Mahoney & McEvoy, 2012b; Simmons et al., 2008; Wever et al., 2015).

4. Assessment of intolerance of uncertainty

4.1. What is known?

There are several self-report measures designed to assess IU; however, the specific content has often been revisited over the past two decades of IU theory development. The 27-item IU Scale (IUS) was the first measure developed to assess IU and responses to uncertain situations (Freeston et al., 1994). Psychometric evaluations demonstrate excellent internal consistency, test-retest reliability, and construct validity (Freeston et al., 1994); nevertheless, factor analytic evidence prior to 2007 suggested the IUS had an unstable, complex factor structure with potentially redundant items (Carleton, Norton et al., 2007). For example, consistent with its original intent, the IUS includes items that specifically relate to GAD and worry, which may impact transdiagnostic applications (Gentes & Ruscio, 2011). Complications with the IUS factor structure coupled with suggestions that item removal would be unlikely to affect scale reliability (Norton, 2005) led to the development of a 12-item short form (i.e., IU Scale, Short Form; IUS-12; Carleton, Norton et al., 2007). The IUS-12 comprised two factors, relabeled as *prospective IU* and *inhibitory IU* by McEvoy and Mahoney (2011). The IUS-12 has strong psychometric properties and is a viable transdiagnostic assessment tool for trait IU (Khawaja & Yu, 2010).

Subsequent research with the full IUS (Sexton & Dugas, 2009) and a very large sample demonstrated a reliable two factor structure (i.e., *uncertainty is unfair and spoils everything*; *uncertainty has negative behavioral and self-referent implications*), with the items for each mapping onto the IUS-12 factors (Carleton, Norton et al., 2007; McEvoy & Mahoney, 2011). The IUS and IUS-12 overlap such that both are considered defensible and generally comparable tools for assessing IU (Khawaja & Yu, 2010); however, that same conceptual overlap in assessing general reactions to uncertainty or "trait" IU has led some researchers to posit that potential biases might arise when examining IU and emotional disorders, such as an inflated association between IU and GAD relative to other disorders (Gosselin et al., 2008). In response to such concerns, the 45-item IU Inventory (IUI) was developed (Carleton, Gosselin et al., 2010;

Gosselin et al., 2008). The IUI comprises two distinct parts and, accordingly, distinguishes between trait IU (Part A) and six associated behavioral and cognitive expressions (i.e., avoidance, doubt, overestimation, worry, control, reassurance; Part B). Psychometric evidence indicates the IUI has good reliability, temporal stability, and convergent and incremental validity (Carleton, Gosselin et al., 2010; Gosselin et al., 2008).

Comer et al. (2009) revised the IUS items to ensure comprehensibility for children, resulting in the first validated measure of IU for children, the Intolerance of Uncertainty Scale for Children (IUSC). Preliminary psychometric evidence for the IUSC is promising (Comer et al., 2009). Another measure for use with children is the unpublished 12-item IU Scale-Revised (IUS-R; Walker, Birrell, Rogers, Leekam, & Freeston, 2010) based upon the IUS-12 (Carleton, Norton et al., 2007). Research exploring IU with children is increasing (Comer et al., 2009; Fialko, Bolton, & Perrin, 2012; Kertz & Woodruff-Borden, 2013); however, the use of different measures limits direct comparisons between studies.

Theoretical distinctions between trait and disorder-specific IU prompted the development of the IU Scale-Situation-Specific Version (IUS-SS; Mahoney & McEvoy, 2012c). The IUS-SS is an adapted version of the IUS-12. Respondents describe a personally distressing, regularly occurring, and specific situation within one of four disorder-specific domains (social evaluative, intrusive thoughts/repetitive behaviors, worry, panic) before completing the IUS-12 items referencing the specific situation. Psychometric evidence demonstrates a unitary factor structure, good reliability, and convergent and discriminant validity. To extend the scope of other measures by focusing IU within discrete symptom categories, the 24-item Disorder-Specific IU Scale (DSIU) was designed (Thibodeau et al., 2015). The DSIU comprises eight subscales assessing IU in the context of various disorder symptoms including GAD, obsessive-compulsive disorder, social anxiety, health anxiety, panic disorder, specific phobia, posttraumatic stress disorder, and depressive disorder. Psychometric research indicates high reliability, convergent and criterion validity, but research is required to assess the temporal stability and clinical validity of the DSIU (Thibodeau et al., 2015).

4.2. What is unknown?

Psychometric evaluations of the IUI and IUSC are limited and further testing is required within a broader array of adult and child clinical populations, respectively. All measures of IU require further validation across ethnically diverse samples. Different operational definitions underlie the development of each measure (Fergus, 2013). For example, the IUS-12 and the IUI Part A assess responses to uncertainty and the tendency to consider uncertainty intolerable, respectively. Thus, when making decisions about which self-report measures to use researchers need to consider the distinct item content of each measure (Fergus, 2013) and provide an overall theoretical framework to clearly articulate how these aspects of IU relate to each other and to other constructs. Future treatment studies also need to investigate whether existing self-report measures are able to effectively guide case formulations and treatment plans to improve outcomes for individuals with emotional disorders.

The proliferation of and focus on self-report measures has advanced our understanding of IU; however, exclusive reliance on self-report and often cross-sectional methods are also important limitations of existing research (Jacoby, Abramowitz, Buck, & Fabricant, 2014). Self-report data may be vulnerable to subjective response biases and shared method variance, which can inflate associations between variables. Cross-sectional research can provide information about the associations between theoretically related variables, but precludes the ability to draw causal conclusions. Accordingly, broad theoretical and applied progress for understanding IU will require valid and reliable multimodal assessments (Carleton, 2012, 2016a; Einstein, 2014).

5. Insights into intolerance of uncertainty from behavior

5.1. What is known?

Current research suggests that IU is characterized by cognitive, affective, and behavioral facets, and may have a broad influence on emotional disorders (Buhr & Dugas, 2002; Carleton, 2016a; Freeston et al., 1994; Thibodeau, Carleton, Gómez-Pérez, & Asmundson, 2013). Researchers have experimentally induced or manipulated uncertainty and examined the correlates of self-report IU and responses to uncertain situations (Jacoby, Abramowitz, Reuman, & Blakey, 2016). The manipulations have included tasks such as overt behavioral assessments, a typing task, bead selection tasks, and a cold pressor task. The results have indicated people with higher IU (1) prefer immediately available rewards, even when they are less probable or less valuable (Luhmann, Ishida, & Hajcak, 2011); (2) are less confident about high risk decisions, but also less likely to change their decisions despite receiving new information (Jensen, Kind, Morrison, & Heimberg, 2014); (3) are more likely to seek additional information to increase certainty in nonclinical samples (Jacoby et al., 2014, 2016; Ladouceur, Talbot, & Dugas, 1997; Rosen & Knäuper, 2009), though not consistently in clinical samples (Sternheim, Startup, & Schmidt, 2011); (4) are more likely to increase certainty by behaving, reacting, or deciding more slowly in clinical (Jacoby et al., 2014) and nonclinical samples (Jacoby et al., 2014, 2016; Thibodeau et al., 2013); and (5) are more likely to be distressed by uncertainty in clinical (Jacoby et al., 2014) and nonclinical samples (Jacoby et al., 2016). Taken together, these experimental results suggest that manipulating uncertainty may adversely impact behaviors and decision-making, even with relatively low levels of perceived threat. In addition, Jacoby et al. (2014) suggest the beads task could be modified to maximize external validity by focusing on specific idiosyncratic concerns of participants.

5.2. What is unknown?

There is a relative paucity of research exploring the relationship between self-reported IU on behavior and decision-making. A multi-modal approach will help researchers and clinicians to better assess the latent IU construct and its consequences. To advance our understanding of the associations between the latent IU construct and a broad range of behaviors, researchers should investigate behaviors characterized by higher-order processes (e.g., probability-based decision-making) as well as common daily behaviors (e.g., public speaking). Researchers should address whether behaviors are driven by uncertainty itself or by the emotional consequences associated with uncertainty (Luhmann et al., 2011), as well as understanding the compounding influence of anticipated reinforcers (e.g., threat, reward). Moreover, a variety of experimental studies should be designed to elucidate whether uncertainty and the latent IU construct are associated with explicit behavioral responses (e.g., impairment), perceptions of distress, cognitive consequences (Jacoby et al., 2016), or all three.

Researchers could manipulate trait IU, disorder-specific IU, probability, and threat across disorder-congruent and -incongruent contexts and explore the interactive effects therein on emotional symptoms and behavior. For example, uncertainty could be increased in situations pertinent to social anxiety (e.g., fear of being evaluated, performance anxiety), obsessive-compulsive concerns (e.g., contamination concerns, inflated perceptions of

responsibility), a specific phobia, or health concerns (e.g., Rosen & Knäuper, 2009), while investigating emotional and behavioral correlates, including decision-making. Within different disorders, reduced decision-making confidence in varying domains (e.g., social scenarios) may exacerbate disorder-specific concerns contributing to anxiety or depressive symptoms (e.g., fear of negative evaluation for social anxiety disorder; Jensen et al., 2014). Research involving decision-making confidence, behavior, and IU would also provide insights into the content specificity or disorder-specific aspects of IU. Methodologically varied approaches with diverse samples will enhance our understanding of the trait and state expressions of IU and psychopathology (Jacoby et al., 2014). Future researchers should examine how the prospective and inhibitory IU dimensions are differentially related to behavior across more general and disorder-specific contexts.

6. Intolerance of uncertainty, threat, and risk

6.1. What is known?

According to Krohne's (1989) coping theory, ambiguous or unpredictable situations may be viewed as threatening and difficulty tolerating uncertainty may result in an excessive tendency to search for threat cues. Vigilance to uncertainty and overestimating the probability and cost of threat appears to be involved in the development and perpetuation of fear and anxiety and engagement in safety behaviors (Mathews & MacLeod, 1994, 2002; Reuman, Jacoby, Fabricant, Herring, & Abramowitz, 2015). A link between high IU and the tendency to overestimate the likelihood of negative events has been documented (Dugas, Buhr, & Ladouceur, 2004; Dugas et al., 2005; Koerner & Dugas, 2008; Ladouceur et al., 1997), with uncertainty itself perceived as threatening. Attending to the uncertain aspects of a situation has been conceptualized as uncertainty-based reasoning (Reuman et al., 2015). Relatedly, IU may be sufficiently threatening that it leads to worry (Bredemeier & Berenbaum, 2008; Dugas, Buhr et al., 2004). Scenarios characterized by explicit uncertainty and high threat, instead of implicit or low threat, produced higher anxiety and urges to engage in safety behaviors; moreover, a low threat situation may be perceived as highly threatening when uncertainty is explicit (Reuman et al., 2015).

6.2. What is unknown?

Research examining the interaction between uncertainty and threat in anxiety and emotion is scant and more work is needed to clarify the associations. Researchers should design in vivo manipulations of threat, explicit uncertainty, and implicit uncertainty. Examining threat through vignettes or in vivo situations across a spectrum of symptoms may inform relationships between perceptions of threat and risk in disorder-specific contexts. Such designs may pose ethical challenges for researchers who will benefit most from ecologically valid scenarios; in any case, experimental and longitudinal designs are required to understand causal relationships between IU and estimations of probabilities and costs. In addition, evidence from multiple clinical samples will inform the generalizability across anxiety and depressive disorders.

7. Intolerance of uncertainty as a cognitive vulnerability process

7.1. What is known?

Recent research suggests that many vulnerability factors are associated with multiple disorders and are thus transdiagnostic (e.g., Aldao, Nolen-Hoeksema, & Schweizer, 2010; Harvey, Watkins, Mansell, & Shafran, 2004; Naragon-Gainey, 2010; Starcevic & Berle, 2006). Theory and empirical evidence has also supported a hierarchical conceptualization of emotional disorders, such that the influence of higher-order distal traits on disorder symptoms is mediated by intermediate cognitive factors (Norton & Mehta, 2007; Norton, Sexton, Walker, & Norton, 2005; Paulus, Talkovsky, Heggeness, & Norton, 2015; Sexton, Norton, Walker, & Norton, 2003; van der Heiden et al., 2010). Researchers have focused on two distal temperament factors, namely neuroticism and extraversion, and evidence for a relationship between neuroticism and psychopathology is strong (Barlow, 2002; Barlow, Sauer-Zavala, Carl, Bullis, & Ellard, 2014; Brown & Naragon-Gainey, 2013; Kotov, Gamez, Schmidt, & Watson, 2010; Watson, 2005). Neuroticism is closely related and largely overlapping with trait anxiety (Clark & Beck, 2010). Neuroticism could be referred to as reflecting a generalized biological vulnerability, although learned experiences are also likely to influence this vulnerability, as highlighted in Barlow's (2000, 2002) triple vulnerability model. IU may reflect a generalized psychological vulnerability that stems from unknowns and perceptions of absent agency over emotions and environment, all of which facilitate neuroticism (Carleton, 2016a, 2016b).

IU appears to be a transdiagnostic cognitive vulnerability factor (Carleton, 2016a) associated with a host of other factors (e.g., anxiety sensitivity; ruminative style). Hong and Cheung (2015) suggested that several cognitive vulnerabilities may share a common core of IU and, therein, fearing the unknown. Indeed, IU mediates the relationship between neuroticism and symptoms of worry, depression, social anxiety, and obsessive-compulsive disorder (Fergus & Wu, 2011; Hong, 2013; McEvoy & Mahoney, 2012; Norton & Mehta, 2007; Norton et al., 2005; Sexton et al., 2003; van der Heiden et al., 2010). Researchers have also evidenced that prospective and inhibitory IU partially mediate the link between neuroticism and emotional disorders (McEvoy & Mahoney, 2011).

7.2. What is unknown?

The need remains to disentangle the trait and disorder-specific cognitive vulnerabilities and overlapping transdiagnostic factors in emotional disorders. Carleton (2016a) has offered an overview of processes through which IU may influence psychopathology; however, substantial work remains to be done investigating the specific processes. Inconsistencies in the extant IU literature exploring those specific processes may have resulted from discrepancies in methodological and analytical procedures (Hong, 2013). Future research should continue to evaluate hierarchical models of psychopathology, including IU (Norton & Paulus, 2015; Watson, 2005), considering recent theoretical developments.

Norton and Paulus (2015) assert that hierarchical conceptualizations can aid in identifying transdiagnostic processes with incremental explanatory power beyond higher-order factors like neuroticism or negative affect. Using a meta-analytic approach, Hong and Cheung (2015) examined the overlap among a range of vulnerabilities and found a lack of support for symptom specificity. In line with this and to address limitations of prior studies, future research should include multiple vulnerabilities simultaneously to examine the unique and shared magnitude of associations with different disorder symptoms (Brown & Naragon-Gainey, 2013; Hong & Cheung, 2015; Norton & Mehta, 2007). Furthermore, researchers should investigate how IU relates to, interacts with, and predicts other potential maintaining vulnerabilities such as metacognitive beliefs, perceived control, and behavioral avoidance with longitudinal designs. Such research would increase our understanding of the general and specific importance of IU for cognitive vulnerabilities and corresponding disorder symptoms. The resulting insights will help identify risk factors and advance understanding of the

temporal precedence and the relative importance of IU and other constructs (Carleton, 2016a; Mahoney & McEvoy, 2012c; Norton & Paulus, 2015; Treanor, Erisman, Salters-Pedneault, Roemer, & Orsillo, 2011).

8. Intolerance of uncertainty as a transdiagnostic process

8.1. What is known?

IU was initially developed within the context of worry, a hallmark symptom of GAD, as outlined in the IU model (Dugas, Gagnon, Ladouceur, & Freeston, 1998; Freeston et al., 1994). IU was thought to distinguish persons with GAD from other heterogeneous anxiety disorders (Dugas et al., 2001; Dugas, Buhr et al., 2004; Dugas, Schwartz et al., 2004; Ladouceur, Dugas, Freeston, Rhéaume, & Blais, 1999); however, the assertion of broad specificity for GAD was challenged by accumulating cross-sectional and meta-analytic evidence highlighting the significance of IU to other symptom constructs and disorders (e.g., Carleton et al., 2012; Gentes & Ruscio, 2011; Hong & Cheung, 2015; McEvoy & Mahoney, 2011, 2012; Norton & Mehta, 2007; Starcevic & Berle, 2006). IU has been associated with symptoms of obsessive-compulsive disorder (Holaway, Heimberg, & Coles, 2006; Tolin et al., 2003), social anxiety disorder (Boelen & Reijntjes, 2009; Carleton, Collimore, & Asmundson, 2010), panic disorder with or without agoraphobia (Carleton, Fetzner, Hackl, & McEvoy, 2013; Fetzner, Horswill, Boelen, & Carleton, 2013), health anxiety (Boelen & Carleton, 2012; Fetzner et al., 2013; Wright, Adams Lebell, & Carleton, 2016), posttraumatic stress symptoms and disorder (Banducci, Bujarski, Bonn-Miller, Patel, & Connolly, 2016; Bardeen, Fergus, & Wu, 2013; Boelen, Reijntjes, & Smid, 2016; Fetzner et al., 2013; Oglesby, Boffa, Short, Raines, & Schmidt, 2016), and depression (de Jong-Meyer, Beck, & Riede, 2009; Gentes & Ruscio, 2011). More recently, evidence suggests IU plays an important role in eating disorders (Konstantellou, Campbell, Eisler, Simic, & Treasure, 2011; Renjan, McEvoy, Handley, Fursland, & Byrne, 2016; Sternheim et al., 2011), autism spectrum disorders (Boulter, Freeston, South, & Rodgers, 2014), prolonged grief (Boelen, 2010; Boelen et al., 2016), hoarding behaviors (Oglesby et al., 2013; Wheaton, Abramowitz, Jacoby, Zwerling, & Rodriguez, 2016), adult separation anxiety (Boelen, Reijntjes, & Carleton, 2014), and anger-related emotions (Anderson, Deschênes, & Dugas, 2016; Fracalanza, Koerner, Deschênes, & Dugas, 2014). Not only is IU associated with multiple disorders, but trait and disorder-specific IU are correlated with escalating comorbidity (Dupuy & Ladouceur, 2008; McEvoy & Mahoney, 2012; Yook, Kim, Suh, & Lee, 2010). Moreover, many clinical features of disorders can be conceptualized as efforts to alleviate or avoid uncertainty (Krohne, 1989). Taken together, the overwhelming evidence supports IU as a transdiagnostic process linked to an array of disorders.

The prospective and inhibitory dimensions of IU have been differentially associated with emotional disorder symptoms (Carleton, Norton et al., 2007; McEvoy & Mahoney, 2011). McEvoy and Mahoney (2011) found associations between prospective IU and symptoms of GAD and obsessive-compulsive disorder, while inhibitory IU was associated with symptoms of social anxiety, depression, and panic disorder, agoraphobia in a clinical sample. Their results are consistent with research linking inhibitory IU with social anxiety, depression (Carleton, Collimore et al., 2010; Mahoney & McEvoy, 2012c), and panic disorder (Boelen et al., 2016), but inconsistent with an association between inhibitory IU and GAD and obsessive-compulsive disorder (Mahoney & McEvoy, 2012c). Furthermore, inhibitory IU has been associated with posttraumatic stress disorder (Boelen et al., 2016; Fetzner et al., 2013). The results may indicate higher IU produces conflicting cognitive-motivational states. For example, prospective IU may promote approach strategies evident in some disorders, while inhibitory IU may promote avoidance behaviors (e.g., avoidance of situations that may induce panic in panic disorder). The recent conceptualization of these dimensions means relatively little research is available (e.g., Carleton, Collimore et al., 2010; Carleton, Norton et al., 2007; Mahoney & McEvoy, 2012c, 2011), and the available results have not been entirely consistent.

8.2. What is unknown?

The original IU model comprehensively outlined the centrality of IU for anxiety symptoms (Dugas et al., 1998), but was designed within the context of GAD symptoms. Despite the success and longevity of the model, the mechanisms by which IU exerts influence on worry remain less clear (Bredemeier & Berenbaum, 2008). Different cognitive and behavioral constructs may be involved at different stages of worry (Meeten, Dash, Scarlet, & Davey, 2012; Thielsch, Andor, & Ehring, 2015); as such, prospective longitudinal designs appear necessary to understand how IU and other constructs initiate and perpetuate repetitive negative thinking and cyclical interrelationships with disorder symptoms (e.g., Oglesby et al., 2016; Thielsch et al., 2015).

The relative influence of IU across disorders also remains uncertain (Mahoney & McEvoy, 2012c). Anxiety appears inherently dependent upon uncertainty (Carleton, 2016a; Grupe & Nitschke, 2013; Hong & Cheung, 2015); as such, most contemporary research has justifiably focused on anxiety disorders. Despite the current research indicating IU is transdiagnostic and phenomenologically concurrent with anxiety disorders, mood disorders, personality disorders, and normative processes, there is a relative paucity of research exploring the causal, precipitating, maintaining, mediating, and moderating aspects of the relationships. Future research should clarify the relative significance of IU dimensions across disorders.

Accordingly, researchers should explore IU as contextualized within extant cognitive-behavioral models for all such disorders, normative processes, and transdiagnostic models (Carleton, 2012; Einstein, 2014; Mahoney & McEvoy, 2012c). The exploration should explicitly incorporate IU into existing theoretical and treatment models, while also facilitating novel theoretical frameworks and broader integrations with psychology (e.g., Brosschot, Verkuil, & Thayer, 2016; Carleton, 2016a). Doing so would inform case formulation, treatment planning, and novel interventions targeting diagnosis-specific and transdiagnostic processes.

9. Intolerance of uncertainty and clinical applications

9.1. What is known?

Theoretical progression in psychopathology research has been complemented by laudable developments in the treatments of emotional disorders. In line with this, maladaptive thoughts and behavioral processes have been considered valuable targets for intervention (Barlow, 2000). There has also been a shift in perspective from diagnosis-specific conceptualizations and treatment approaches to transdiagnostic models highlighting the substantial similarities (Barlow, Allen, & Choate, 2004; Barlow et al., 2014; Norton & Paulus, 2015). Relatedly, robust relationships between IU and psychopathology implicate IU as a potentially critical transdiagnostic treatment target.

Dugas and colleagues (Dugas et al., 2010, 2003; Dugas & Ladouceur, 2000; Dugas & Robichaud, 2007) have developed a cognitive-behavioral intervention for GAD, targeting IU reductions by fostering less negative beliefs about uncertainty. The

intervention has been supported by several randomized clinical trials with moderate to large effects (Dugas et al., 2010, 2003; Gosselin, Ladouceur, Morin, Dugas, & Baillargeon, 2006; Ladouceur, Dugas et al., 2000; see Robichaud, 2013).

Research has also examined other cognitive-behavioral interventions that do not specifically target IU, but nonetheless have shown a reduction in IU and symptoms of social anxiety (Hewitt, Egan, & Rees, 2009; Mahoney & McEvoy, 2012b), health anxiety (Langlois & Ladouceur, 2004), anxiety and depressive disorders (Bomyea et al., 2015), delivered as individual and group transdiagnostic interventions (Boswell et al., 2013; Talkovsky & Norton, 2016). A randomized control trial for GAD compared the effectiveness of an IU-therapy, metacognitive therapy, and a delayed treatment control condition (van der Heiden, Muris, & van der Molen, 2012). Results indicated significant symptom reductions and clinically significant change in both therapy conditions; however, metacognitive therapy was superior across the range of outcome measures. Interestingly, metacognitive therapy was also associated with the largest reductions of IU, suggesting interventions from alternative theoretical frameworks may influence IU (McEvoy & Erceg-Hurn, 2016; van der Heiden et al., 2012).

Increasing evidence suggests that changes in IU may be driving changes in symptoms of multiple emotional disorders (i.e., transdiagnostic) and across different treatment protocols (i.e., transtherapy, e.g., McEvoy & Erceg-Hurn, 2016; Roemer & Orsillo, 2007; Treanor et al., 2011). Changes in IU have been uniquely linked to changes in repetitive negative thinking across multiple disorders and treatment programs even after controlling for trait negative affectivity (McEvoy & Erceg-Hurn, 2016). Those changes in IU were also associated with changes in GAD and social anxiety disorder symptoms, but not depression symptoms. Taken together, the results suggest that IU is a transdiagnostic change factor associated with changes in repetitive negative thinking and symptoms across different disorders and treatment interventions (Boswell et al., 2013; McEvoy & Erceg-Hurn, 2016; Talkovsky & Norton, 2016).

Abramowitz and Arch (2014) made a compelling argument that exposure-driven cognitive-behavioral treatment for obsessive-compulsive disorder may benefit from strengthening inhibitory learning of nonthreatening associations (e.g., uncertainty is intolerable), such that uncertainty becomes increasingly acceptable as normal across contexts. Abramowitz and Arch (2014) suggest treatment should emphasize tolerating uncertainty through exposure, which may strengthen inhibitory associations. Others have argued that "in many ways, all therapies can be described as attempts to mitigate IU" (Carleton, 2012; p. 942); accordingly, future researchers should examine whether principles of IU exposure can be applied transdiagnostically and across treatment protocols to support broad symptom improvements.

9.2. What is unknown?

There are many unknowns associated with IU treatment and emotional disorders. Extant cognitive-behavioral therapies can be readily modified to target fears related to IU and avoidance behaviors; however, research is needed to establish the efficacy of such treatments (Mahoney & McEvoy, 2012a). Currently IU is an implicit component within treatment protocols derived from alternative theoretical frameworks; nevertheless, research suggests that IU could also be more explicitly assessed and targeted. Evidence suggests cognitive-behavioral treatments decrease IU (Mahoney & McEvoy, 2012a), though some researchers have found evidence that directly targeting IU may be no more effective than indirectly targeting IU (van der Heiden et al., 2012). Accordingly, there is a need for more research evaluating and comparing interventions designed to directly target IU with interventions that are non-specific to IU. For a more complete understanding of change processes, Treanor et al. (2011) recommended treatment mechanism research grounded in specific theoretical models. More recently, Einstein (2014) proposed a transdiagnostic IU treatment model with several potential pathways for explicitly targeting different IU dimensions, all of which remains to be explored.

In the interim, the processes by which IU changes in therapy remain relatively unknown. Bomyea et al. (2015) found that over the course of treatment changes in IU significantly mediated changes in worry, which is an important step (Kazdin, 2007), but research is needed to understand the mechanisms of such change across different treatment interventions. Currently there are many different therapies and a thorough understanding of the most critical change mechanisms may contribute to a more parsimonious and efficient therapeutic approach. Specific (e.g., exposure) and non-specific therapeutic factors (e.g., therapist features, motivation to engage in treatment) need to be measured when evaluating treatment interventions so we can better understand the relative contributions to changes in IU.

The potential clinical utility of targeting disorder-specific IU should also be investigated. Disorder-specific IU predicts symptoms of a range of disorders (e.g., Thibodeau et al., 2015), suggesting treatment protocols may benefit from tailored modification of disorder-specific IU. For example, tolerating uncertainty about others' evaluations might improve social anxiety symptoms and relapse rates beyond reducing the perceived probability and cost of such evaluations. Thus there are questions remaining about whether clinicians should target trait IU, disorder-specific IU, or a combination of various proportions that may vary by disorder (Thibodeau et al., 2015).

Experimental and clinical research using behavioral methods to corroborate IU before, during, and after treatment would also be beneficial to assess clinical impacts more broadly (Boswell et al., 2013; McEvoy & Erceg-Hurn, 2016). Much of the available treatment literature has been carried out by the same research team and replications are needed. Moreover, there still remains a predominant focus on GAD and future studies should investigate the impact of these interventions across a broader range of disorders.

10. Continuing the search for certainties

IU is increasingly considered to be important to the development, perpetuation, and treatment of psychopathology. Basic IU research offers novel and exciting perspectives for understanding psychopathology. The current paper provides a broad IU research agenda with several methodological suggestions for exploring trait, disorder-specific, and transdiagnostic conceptualizations. The review also highlights the need to research normative responses, developmental origins, behaviors, decision-making, and cognitive vulnerabilities related to IU, while understanding relationships with threat and risk. In all cases, explicit integration of IU into theoretical and therapeutic models appears warranted. The increasing focus of research into uncertainty and IU has generated numerous avenues for exploring unknown territory in psychology; as such, future researchers should not fear the unknowns, but rather face them head on as we strive to address the uncertainties that remain.

References

Abramowitz, J. S., & Arch, J. J. (2014). Strategies for improving long-term outcomes in cognitive behavioral therapy for obsessive–compulsive disorder: insights from learning theory. *Cognitive and Behavioral Practice*, *21*, 20–31. http://dx.doi.org/10.1016/j.cbpra.2013.06.004

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: a meta-analytic review. *Clinical Psychology Review*, *30*, 217–237. http://dx.doi.org/10.1016/j.cpr.2009.11.004

Anderson, K. G., Deschênes, S. S., & Dugas, M. J. (2016). Experimental manipulation of avoidable feelings of uncertainty: effects on anger and anxiety. *Journal of Anxiety Disorders*, *41*, 50–58. http://dx.doi.org/10.1016/j.janxdis.2016.03.007
Banducci, A. N., Bujarski, S. J., Bonn-Miller, M. O., Patel, A., & Connolly, K. M. (2016). The impact of intolerance of emotional distress and uncertainty on veterans with co-occurring PTSD and substance use disorders. *Journal of Anxiety Disorders*, *41*, 73–81. http://dx.doi.org/10.1016/j.janxdis.2016.03.003
Bardeen, J., Fergus, T., & Wu, K. (2013). The interactive effect of worry and intolerance of uncertainty on posttraumatic stress symptoms. *Cognitive Therapy Research*, *37*, 742–751. http://dx.doi.org/10.1007/s10608-012-9512-1
Barlow, D. H. (2000). Unraveling the mysteries of anxiety and its disorders from the perspective of emotion theory. *American Psychologist*, *55*, 1247–1263. http://dx.doi.org/10.1037//0003-066X.55.11.1247
Barlow, D. H. (2002). *Anxiety and its disorders: the nature and treatment of anxiety and panic* (2nd ed.). New York, NY: Guilford Press.
Barlow, D. H., Allen, L. B., & Choate, M. L. (2004). Toward a unified treatment for emotional disorders. *Behavior Therapy*, *35*, 205–230. http://dx.doi.org/10.1016/S0005-7894(04)80036-4
Barlow, D. H., Bullis, J. R., Comer, J. S., & Ametaj, A. A. (2013). Evidence-based psychological treatments: an update and a way forward. *Annual Review of Clinical Psychology*, *9*, 1–27. http://dx.doi.org/10.1146/annurev-clinpsy-050212-185629
Barlow, D. H., Sauer-Zavala, S., Carl, J. R., Bullis, J. R., & Ellard, K. K. (2014). The nature, diagnosis, and treatment of neuroticism. *Clinical Psychological Science*, *2*, 344–365. http://dx.doi.org/10.1177/2167702613505532
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*, 117–125. 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*, 1198–1208. http://dx.doi.org/10.1016/j.cpr.2011.07.009
Boelen, P. A. (2010). Intolerance of uncertainty and emotional distress following the death of a loved one. *Anxiety, Stress & Coping*, *23*, 471–478. http://dx.doi.org/10.1080/10615800903494135
Boelen, P. A., & Carleton, R. N. (2012). Intolerance of uncertainty, hypochondriacal concerns, obsessive–compulsive symptoms, and worry. *The Journal of Nervous and Mental Disease*, *200*, 208–213. http://dx.doi.org/10.1097/NMD.0b013e318247cb17
Boelen, P. A., & Reijntjes, A. (2009). Intolerance of uncertainty and social anxiety. *Journal of Anxiety Disorders*, *23*, 130–135. http://dx.doi.org/10.1016/j.janxdis.2008.04.007
Boelen, P. A., Reijntjes, A., & Carleton, R. N. (2014). Intolerance of uncertainty and adult separation anxiety. *Cognitive Behaviour Therapy*, *43*, 133–144. http://dx.doi.org/10.1080/16506073.2014.888755
Boelen, P. A., Reijntjes, A., & Smid, G. (2016). Concurrent and prospective associations of intolerance of uncertainty with symptoms of prolonged grief, posttraumatic stress, and depression after bereavement. *Journal of Anxiety Disorders*, *41*, 65–72. http://dx.doi.org/10.1016/j.janxdis.2016.03.004
Bomyea, J., Ramsawh, H., Ball, T. M., Taylor, C. T., Paulus, M. P., Lang, A. J., & Stein, M. B. (2015). Intolerance of uncertainty as a mediator of reductions in worry in a cognitive behavioral treatment program for generalized anxiety disorder. *Journal of Anxiety Disorders*, *33*, 91–94. http://dx.doi.org/10.1016/j.janxdis.2015.05.004
Boswell, J. F., Thompson-Hollands, J., Farchione, T. J., & Barlow, D. H. (2013). Intolerance of uncertainty: a common factor in the treatment of emotional disorders. *Journal of Clinical Psychology*, *69*, 630–645. http://dx.doi.org/10.1002/jclp.21965
Boulter, C., Freeston, M., South, M., & Rodgers, J. (2014). Intolerance of uncertainty as a framework for understanding anxiety in children and adolescents with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *44*, 1391–1402. http://dx.doi.org/10.1007/s10803-013-2001-x
Bredemeier, K., & Berenbaum, H. (2008). Intolerance of uncertainty and perceived threat. *Behaviour Research Therapy*, *46*, 28–38. http://dx.doi.org/10.1016/j.brat.2007.09.006
Brosschot, J. F., Verkuil, B., & Thayer, J. (2016). The default response to uncertainty and the importance of perceived safety in anxiety and stress: a evolution-theoretical perspective. *Journal of Anxiety Disorders*, *41*, 22–34.
Brown, T. A., & Naragon-Gainey, K. (2013). Evaluation of the unique and specific contributions of dimensions of the triple vulnerability model to the prediction of DSM- IV anxiety and mood disorder constructs. *Behavior Therapy*, *44*(2), 277. http://dx.doi.org/10.1016/j.beth.2012.11.002
Buhr, K., & Dugas, M. J. (2002). The intolerance of uncertainty scale: psychometric properties of the english version. *Behaviour Research Therapy*, *40*, 931–945. http://dx.doi.org/10.1016/S0005-7967(01)00092-4
Buhr, K., & Dugas, M. J. (2006). Investigating the construct validity of intolerance of uncertainty and its unique relationship with worry. *Journal of Anxiety Disorders*, *20*, 222–236. http://dx.doi.org/10.1016/j.janxdis.2004.12.004
Carleton, R. N. (2012). The intolerance of uncertainty construct in the context of anxiety disorders: theoretical and practical perspectives. *Expert Review of Neurotherapeutics*, *12*, 937–947. http://dx.doi.org/10.1586/ern.12.82
Carleton, R. N. (2016a). Into the unknown: a review and synthesis of contemporary models involving uncertainty. *Journal of Anxiety Disorders*, *39*, 30–43. http://dx.doi.org/10.1016/j.janxdis.2016.02.007
Carleton, R. N. (2016b). Fear of the unknown: one fear to rule them all? *Journal of Anxiety Disorders*, *41*, 5–21. http://dx.doi.org/10.1016/j.janxdis.2016.03.011
Carleton, R. N., Collimore, K. C., & Asmundson, G. J. (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*, 189–195. http://dx.doi.org/10.1016/j.janxdis.2009.10.007
Carleton, R. N., Fetzner, M. G., Hackl, J. L., & McEvoy, P. (2013). Intolerance of uncertainty as a contributor to fear and avoidance symptoms of panic attacks. *Cognitive Behaviour Therapy*, *42*, 328–341. http://dx.doi.org/10.1080/16506073.2013.792100
Carleton, R. N., Gosselin, P., & Asmundson, G. J. G. (2010). The intolerance of uncertainty index: replication and extension with an english sample. *Psychological Assessment*, *22*, 396–406. http://dx.doi.org/10.1037/a0019230
Carleton, R. N., Mulvogue, M. K., Thibodeau, M. A., McCabe, R. E., Antony, M. M., & Asmundson, G. J. G. (2012). Increasingly certain about uncertainty: intolerance of uncertainty across anxiety and depression. *Journal of Anxiety Disorders*, *26*, 468–479. http://dx.doi.org/10.1016/j.janxdis.2012.01.011
Carleton, R. N., Norton, M. A., & Asmundson, G. J. (2007). Fearing the unknown: a short version of the intolerance of uncertainty scale. *Journal of Anxiety Disorders*, *21*, 105–117. http://dx.doi.org/10.1016/j.janxdis.2006.03.014
Carleton, R. N., Sharpe, D., & Asmundson, G. J. (2007). Anxiety sensitivity and intolerance of uncertainty: requisites of the fundamental fears? *Behaviour Research and Therapy*, *45*, 2307–2316. http://dx.doi.org/10.1016/j.brat.2007.04.006
Chorpita, B. F., & Barlow, D. H. (1998). The development of anxiety: the role of control in the early environment. *Psychological Bulletin*, *124*, 3–21. http://dx.doi.org/10.1037/0033-2909.124.1.3
Clark, D. A., & Beck, A. T. (2010). *Cognitive therapy of anxiety disorders: science and practice*. New York, NY: Guilford Press.
Comer, J. S., Roy, A. K., 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*, 402–411. http://dx.doi.org/10.1037/a0016719
de Jong-Meyer, R., Beck, B., & Riede, K. (2009). Relationships between rumination, worry, intolerance of uncertainty and metacognitive beliefs. *Personality and Individual Differences*, *46*, 547–551. http://dx.doi.org/10.1016/j.paid.2008.12.010
Dugas, M. J., Brillon, P., Savard, P., Turcotte, J., Gaudet, A., Ladouceur, R., . . . & Gervais, N. J. (2010). A randomized clinical trial of cognitive-behavioral therapy and applied relaxation for adults with generalized anxiety disorder. *Behavior Therapy*, *41*, 46–58. http://dx.doi.org/10.1016/j.beth.2008.12.004
Dugas, M. J., Buhr, K., & Ladouceur, R. (2004). The role of intolerance of uncertainty in etiology and maintenance. In: R. G. Heimberg, C. L. Turk, & D. S. Mennin (Eds.), *Generalized anxiety disorder: advances in research and practice*. New York: Guilford Press.
Dugas, M. J., Gagnon, F., Ladouceur, R., & Freeston, M. H. (1998). Generalized anxiety disorder: a preliminary test of a conceptual model. *Behaviour Research and Therapy*, *36*, 215–226. http://dx.doi.org/10.1016/S0005-7967(97)00070-3
Dugas, M. J., Gosselin, P., & Ladouceur, R. (2001). Intolerance of uncertainty and worry: investigating specificity in a nonclinical sample. *Cognitive Therapy and Research*, *25*, 551–558. http://dx.doi.org/10.1023/A:1005553414688
Dugas, M. J., & Ladouceur, R. (2000). Treatment of GAD: targeting intolerance of uncertainty in two types of worry. *Behavior Modification*, *24*, 635–657. http://dx.doi.org/10.1177/0145445500245002
Dugas, M. J., Ladouceur, R., Léger, E., Freeston, M. H., Langlois, F., Provencher, M. D., & Boisvert, J. M. (2003). Group cognitive-behavioral therapy for generalized anxiety disorder: treatment outcome and long-term follow-up. *Journal of Consulting and Clinical Psychology*, *71*, 821–825. http://dx.doi.org/10.1037/0022-006X.71.4.821
Dugas, M. J., Laugesen, N., & Bukowski, W. M. (2012). Intolerance of uncertainty, fear of anxiety, and adolescent worry. *Journal of Abnormal Child Psychology*, *40*, 863–870. http://dx.doi.org/10.1007/s10802-012-9611-1
Dugas, M. J., Marchand, A., & Ladouceur, R. (2005). Further validation of a cognitive-behavioral model of generalized anxiety disorder: diagnostic and symptom specificity. *Journal of Anxiety Disorders*, *19*, 329–343. http://dx.doi.org/10.1016/j.janxdis.2004.02.002
Dugas, M. J., & Robichaud, M. (2007). *Cognitive-behavioral treatment for generalized anxiety disorder: from science to practice*. New York, NY: Routledge.
Dugas, M. J., Schwartz, A., & Francis, K. (2004). Brief report: Intolerance of uncertainty, worry, and depression. *Cognitive Therapy and Research*, *28*, 835–842. http://dx.doi.org/10.1007/s10608-004-0669-0
Dupuy, J.-B., & Ladouceur, R. (2008). Cognitive processes of generalized anxiety disorder in comorbid generalized anxiety disorder and major depressive disorder. *Journal of Anxiety Disorders*, *22*, 505–514. http://dx.doi.org/10.1016/j.janxdis.2007.05.010
Einstein, D. A. (2014). Extension of the transdiagnostic model to focus on intolerance of uncertainty: a review of the literature and implications for treatment. *Clinical Psychology (New York)*, *21*, 280–300. http://dx.doi.org/10.1111/cpsp.12077
Fergus, T. (2013). A comparison of three self- report measures of intolerance of uncertainty: an examination of structure and incremental explanatory power in a community sample. *Psychological Assessment*, *25*, 1322–1331. http://dx.doi.org/10.1037/a0034103
Fergus, T., Bardeen, J., & Wu, K. (2013). Intolerance of uncertainty and uncertainty-related attentional biases: evidence of facilitated engagement or

disengagement difficulty? *Cognitive Therapy and Research*, *37*, 735–741. http://dx.doi.org/10.1007/s10608-012-9509-9
Fergus, T., & Carleton, R. N. (2016). Intolerance of uncertainty and attentional networks: unique associations with alerting. *Journal of Anxiety Disorders*, *41*, 59–64. http://dx.doi.org/10.1016/j.janxdis.2016.03.010
Fergus, T., & Wu, K. (2011). Searching for specificity between cognitive vulnerabilities and mood and anxiety symptoms. *Journal of Psychopathology and Behavioral Assessment*, *33*, 446–458. http://dx.doi.org/10.1007/s10862-011-9245-6
Fetzner, M., Horswill, S., Boelen, P., & Carleton, R. (2013). Intolerance of uncertainty and PTSD symptoms: exploring the construct relationship in a community sample with a heterogeneous trauma history. *Cognitive Therapy and Research*, *37*, 725–734. http://dx.doi.org/10.1007/s10608-013-9531-6
Fialko, L., Bolton, D., & Perrin, S. (2012). Applicability of a cognitive model of worry to children and adolescents. *Behaviour Research and Therapy*, *50*, 341–349. http://dx.doi.org/10.1016/j.brat.2012.02.003
Fracalanza, K., Koerner, N., Deschênes, S. S., & Dugas, M. J. (2014). Intolerance of uncertainty mediates the relation between generalized anxiety disorder symptoms and anger. *Cognitive Behaviour Therapy*, *43*, 122–132. http://dx.doi.org/10.1080/16506073.2014.888754
Freeston, M. H., Rhéaume, J., Letarte, H., Dugas, M. J., & Ladouceur, R. (1994). Why do people worry? *Personality and Individual Differences*, *17*, 791–802. http://dx.doi.org/10.1016/0191-8869(94)90048-5
Gentes, E. L., & Ruscio, A. M. (2011). A meta-analysis of the relation of intolerance of uncertainty to symptoms of generalized anxiety disorder, major depressive disorder, and obsessive–compulsive disorder. *Clinical Psychology Review*, *31*, 923–933. http://dx.doi.org/10.1016/j.cpr.2011.05.001
Gosselin, P., Ladouceur, R., Evers, A., Laverdière, A., Routhier, S., & Tremblay-Picard, M. (2008). Evaluation of intolerance of uncertainty: development and validation of a new self- report measure. *Journal of Anxiety Disorders*, *22*, 1427–1439. http://dx.doi.org/10.1016/j.janxdis.2008.02.005
Gosselin, P., Ladouceur, R., Morin, C. M., Dugas, M. J., & Baillargeon, L. (2006). Benzodiazepine discontinuation among adults with GAD: a randomized trial of cognitive- behavioral therapy. *Journal of Consulting and Clinical Psychology*, *74*, 908–919. http://dx.doi.org/10.1037/0022-006X.74.5.908
Greco, V., & Roger, D. (2001). Coping with uncertainty: the construction and validation of a new measure. *Personality and Individual Differences*, *31*, 519–534. http://dx.doi.org/10.1016/S0191-8869(00)00156-2
Greco, V., & Roger, D. (2003). Uncertainty, stress, and health. *Personality and Individual Differences*, *34*, 1057–1068. http://dx.doi.org/10.1016/S0191-8869(02)00091-0
Grupe, D. W., & Nitschke, J. B. (2013). Uncertainty and anticipation in anxiety: an integrated neurobiological and psychological perspective. *Nature Reviews Neuroscience*, *14*, 488–501. http://dx.doi.org/10.1038/nrn3524
Harvey, A., Watkins, E., Mansell, W., & Shafran, R. (2004). *Cognitive behavioural processes across psychological disorders: a transdiagnostic approach to research and treatment*. Oxford: Oxford University Press.
Hewitt, S. N., Egan, S., & Rees, C. (2009). Preliminary investigation of intolerance of uncertainty treatment for anxiety disorders. *Clinical Psychologist*, *13*, 52–58. http://dx.doi.org/10.1080/13284200802702056
Hock, M., & Krohne, H. W. (2004). Coping with threat and memory for ambiguous information: testing the repressive discontinuity hypothesis. *Emotion*, *4*, 65–86. http://dx.doi.org/10.1037/1528-3542.4.1.65
Holaway, R. M., Heimberg, R. G., & Coles, M. E. (2006). A comparison of intolerance of uncertainty in analogue obsessive-compulsive disorder and generalized anxiety disorder. *Journal of Anxiety Disorders*, *20*, 158–174. http://dx.doi.org/10.1016/j.janxdis.2005.01.002
Hong, R. Y. (2013). From dispositional traits to psychopathological symptoms: social-cognitive vulnerabilities as intervening mechanisms. *Journal of Psychopathology and Behavioral Assessment*, *35*, 407–420. http://dx.doi.org/10.1007/s10862-013-9350-9
Hong, R. Y., & Cheung, M. W. L. (2015). The structure of cognitive vulnerabilities to depression and anxiety. *Clinical Psychological Science*, *3*, 892–912. http://dx.doi.org/10.1177/2167702614553789
Jacoby, R. J., Abramowitz, J. S., Buck, B. E., & Fabricant, L. E. (2014). How is the beads task related to intolerance of uncertainty in anxiety disorders? *Journal of Anxiety Disorders*, *28*, 495–503. http://dx.doi.org/10.1016/j.janxdis.2014.05.005
Jacoby, R. J., Abramowitz, J. S., Reuman, L., & Blakey, 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. http://dx.doi.org/10.1016/j.janxdis.2016.02.003
Jensen, D., & Heimberg, R. G. (2015). Domain-specific intolerance of uncertainty in socially anxious and contamination-focused obsessive–compulsive individuals. *Cognitive Behaviour Therapy*, *44*, 54–62. http://dx.doi.org/10.1080/16506073.2014.959039
Jensen, D., Kind, A. J., Morrison, A. S., & Heimberg, R. G. (2014). Intolerance of uncertainty and immediate decision-making in high-risk situations. *Journal of Experimental Psychopathology*, *5*, 178–190. http://dx.doi.org/10.5127/jep.035113
Kazdin, A. E. (2007). Mediators and mechanisms of change in psychotherapy research. *Annual Review of Clinical Psychology*, *3*, 1–27. http://dx.doi.org/10.1146/annurev.clinpsy.3.022806.091432
Kertz, S., & Woodruff-Borden, J. (2013). The role of metacognition, intolerance of uncertainty, and negative problem orientation in children's worry. *Behavioural and Cognitive Psychotherapy*, *41*, 243–248. http://dx.doi.org/10.1017/S1352465812000641
Khawaja, N. G., & Yu, L. N. H. (2010). A comparison of the 27-item and 12-item intolerance of uncertainty scales. *Clinical Psychologist*, *14*, 97–106. http://dx.doi.org/10.1080/13284207.2010.502542
Koerner, N., & Dugas, M. J. (2008). An investigation of appraisals in individuals vulnerable to excessive worry: the role of intolerance of uncertainty. *Cognitive Therapy and Research*, *32*, 619–638. http://dx.doi.org/10.1007/s10608-007-9125-2
Konstantellou, A., Campbell, M., Eisler, I., Simic, M., & Treasure, J. (2011). Testing a cognitive model of generalized anxiety disorder in the eating disorders. *Journal of Anxiety Disorders*, *25*, 864–869. http://dx.doi.org/10.1016/j.janxdis.2011.04.005
Kotov, R., Gamez, W., Schmidt, F., & Watson, D. (2010). Linking big personality traits to anxiety, depressive, and substance use disorders: a meta-analysis. *Psychological Bulletin*, *136*, 768–821. http://dx.doi.org/10.1037/a0020327
Krain, A. L., Hefton, S., Pine, D. S., Ernst, M., Castellanos, F. X., Klein, R. G., & Milham, M. P. (2006). An fMRI examination of developmental differences in the neural correlates of uncertainty and decision-making. *The Journal of Child Psychology and Psychiatry*, *47*, 1023–1030. http://dx.doi.org/10.1111/j.1469-7610.2006.01677.x
Krohne, H. W. (1989). The concept of coping modes: relating cognitive person variables to actual coping behavior. *Advances in Behaviour Research and Therapy*, *11*, 235–248. http://dx.doi.org/10.1016/0146-6402(89)90027-1
Ladouceur, R., Blais, F., Freeston, M. H., & Dugas, M. J. (1998). Problem solving and problem orientation in generalized anxiety disorder. *Journal of Anxiety Disorders*, *12*, 139–152. http://dx.doi.org/10.1016/S0887-6185(98)00002-4
Ladouceur, R., Dugas, M. J., Freeston, M. H., Rhéaume, J., & Blais, F. (1999). Specificity of generalized anxiety disorder symptoms and processes. *Behavior Therapy*, *30*, 191–207. http://dx.doi.org/10.1016/S0005-7894(99)80003-3
Ladouceur, R., Dugas, M., Freeston, M., Leger, E., Gagnon, F., & Thibodeau, N. (2000). Efficacy of a cognitive-behavioural treatment for generalized anxiety disorder: Evaluation in a controlled clinical trial. *Journal of Consulting and Clinical Psychology*, *68*, 957–964. http://dx.doi.org/10.1037/0022-006X.68.6.957
Ladouceur, R., Gosselin, P., & Dugas, M. J. (2000). Experimental manipulation of intolerance of uncertainty: a study of a theoretical model of worry. *Behaviour Research and Therapy*, *38*(9), 933–941. http://dx.doi.org/10.1016/s0005-7967(99)00133-3
Ladouceur, R., Talbot, F., & Dugas, M. J. (1997). Behavioral expressions of intolerance of uncertainty in worry: experimental findings. *Behavior Modification*, *21*, 355–371.
Langlois, F., & Ladouceur, R. (2004). Adaptation of a GAD treatment for hypochondriasis. *Cognitive and Behavioral Practice*, *11*, 393–404. http://dx.doi.org/10.1016/S1077-7229(04)80056-7
Luhmann, C. C., Ishida, K., & Hajcak, G. (2011). Intolerance of uncertainty and decisions about delayed, probabilistic rewards. *Behavior Therapy*, *42*, 378–386. http://dx.doi.org/10.1016/j.beth.2010.09.002
Mahoney, A. E., & McEvoy, P. M. (2012a). A transdiagnostic examination of intolerance of uncertainty across anxiety and depressive disorders. *Cognitive Behaviour Therapy*, *41*, 212–222. http://dx.doi.org/10.1080/16506073.2011.622130
Mahoney, A. E., & McEvoy, P. M. (2012b). Changes in intolerance of uncertainty during cognitive behavior group therapy for social phobia. *Journal of Behavior Therapy and Experimental Psychiatry*, *43*, 849–854. http://dx.doi.org/10.1016/j.jbtep.2011.12.004
Mahoney, A. E., & McEvoy, P. M. (2012c). Trait versus situation-specific intolerance of uncertainty in a clinical sample with anxiety and depressive disorders. *Cognitive Behaviour Therapy*, *41*, 26–39. http://dx.doi.org/10.1080/16506073.2011.622131
Mathews, A., & MacLeod, C. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology*, *45*, 25–50. http://dx.doi.org/10.1146/annurev.ps.45.020194.000325
Mathews, A., & MacLeod, C. (2002). Induced processing biases have causal effects on anxiety. *Cognition & Emotion*, *16*, 331–354. http://dx.doi.org/10.1080/02699930143000518
McEvoy, P. M., & Erceg-Hurn, D. M. (2016). The search for universal transdiagnostic and trans-therapy change processes: Evidence for intolerance of uncertainty. *Journal of Anxiety Disorders*, *41*, 96–107. http://dx.doi.org/10.1016/j.janxdis.2016.02.002
McEvoy, P. M., & Mahoney, A. E. (2011). Achieving certainty about the structure of intolerance of uncertainty in a treatment-seeking sample with anxiety and depression. *Journal of Anxiety Disorders*, *25*, 112–122. http://dx.doi.org/10.1016/j.janxdis.2010.08.010
McEvoy, P. M., & Mahoney, A. E. (2012). To be sure, to be sure: intolerance of uncertainty mediates symptoms of various anxiety disorders and depression. *Behavior Therapy*, *43*, 533–545. http://dx.doi.org/10.1016/j.beth.2011.02.007
Meeten, F., Dash, S. R., Scarlet, A. L., & Davey, G. C. (2012). Investigating the effect of intolerance of uncertainty on catastrophic worrying and mood. *Behaviour Research and Therapy*, *50*, 690–698. http://dx.doi.org/10.1016/j.brat.2012.08.003
Motzkin, J. C., Philippi, C. L., Wolf, R. C., Baskaya, M. K., & Koenigs, M. (2014). Ventromedial prefrontal cortex lesions alter neural and physiological correlates of anticipation. *The Journal of Neuroscience: The Official Journal of the Society for Neuroscience*, *34*, 10430–10437. http://dx.doi.org/10.1523/JNEUROSCI.1446-14.2014
Naragon-Gainey, K. (2010). Meta-analysis of the relations of anxiety sensitivity to the depressive and anxiety disorders. *Psychological Bulletin*, *136*, 128–150. http://dx.doi.org/10.1037/a0018055

Nolen-Hoeksema, S., & Watkins, E. R. (2011). A heuristic for developing transdiagnostic models of psychopathology: explaining multifinality and divergent trajectories. *Perspectives on Psychological Science*, *6*, 589–609. http://dx.doi.org/10.1177/1745691611419672

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

Norton, P. J., & Mehta, P. D. (2007). Hierarchical model of vulnerabilities for emotional disorders. *Cognitive Behaviour Therapy*, *36*, 240–254. http://dx.doi.org/10.1080/16506070701628065

Norton, P. J., & Paulus, D. J. (2015). Toward a unified treatment for emotional disorders: update on the science and practice. *Behavior Therapy*, http://dx.doi.org/10.1016/j.beth.2015.07.002

Norton, P. J., Sexton, K. A., Walker, J. R., & Norton, G. R. (2005). Hierarchical model of vulnerabilities for anxiety: replication and extension with a clinical sample. *Cognitive Behaviour Therapy*, *34*, 50–63. http://dx.doi.org/10.1080/16506070410005401

Oglesby, M. E., Boffa, J. W., Short, N. A., Raines, A. M., & Schmidt, N. B. (2016). Intolerance of uncertainty as a predictor of post-traumatic stress symptoms following a traumatic event. *Journal of Anxiety Disorders*, *41*, 82–87. http://dx.doi.org/10.1016/j.janxdis.2016.01.005

Oglesby, M. E., Medley, A. N., Norr, A. M., Capron, D. W., Korte, K. J., & Schmidt, N. B. (2013). Intolerance of uncertainty as a vulnerability factor for hoarding behaviors. *Journal of Affective Disorders*, *145*, 227–231. http://dx.doi.org/10.1016/j.jad.2012.08.003

Paulus, D. J., Talkovsky, A. M., Heggeness, L. F., & Norton, P. J. (2015). Beyond negative affectivity: a hierarchical model of global and transdiagnostic vulnerabilities for emotional disorders. *Cognitive Behaviour Therapy*, *44*, 389–405. http://dx.doi.org/10.1080/16506073.2015.1017529

Renjan, V., McEvoy, P. M., Handley, A. K., Fursland, A., & Byrne, S. (2016). Stomaching uncertainty: relationships among intolerance of uncertainty, eating disorder pathology, and comorbid emotional symptoms. *Journal of Anxiety Disorders*, *41*, 88–95. http://dx.doi.org/10.1016/j.janxdis.2016.03.008

Reuman, L., Jacoby, R. J., Fabricant, L. E., Herring, B., & Abramowitz, J. S. (2015). Uncertainty as an anxiety cue at high and low levels of threat. *Journal of Behavior Therapy and Experimental Psychiatry*, *47*, 111–119. http://dx.doi.org/10.1016/j.jbtep.2014.12.002

Robichaud, M. (2013). Cognitive behavior therapy targeting intolerance of uncertainty: application to a clinical case of generalized anxiety disorder. *Cognitive and Behavioral Practice*, *20*, 251–263. http://dx.doi.org/10.1016/j.cbpra.2012.09.001

Roemer, L., & Orsillo, S. M. (2007). An open trial of an acceptance-based behavior therapy for generalized anxiety disorder. *Behavior Therapy*, *38*, 72–85. http://dx.doi.org/10.1016/j.beth.2006.04.004

Rosen, N., & Knäuper, B. (2009). A little uncertainty goes a long way: state and trait differences in uncertainty interact to increase information seeking but also increase worry. *Health Communication*, *24*, 228–238. http://dx.doi.org/10.1080/10410230902804125

Sanislow, C. A., Pine, D. S., Quinn, K. J., Kozak, M. J., Garvey, M. A., Heinssen, R. K., . . . & Cuthbert, B. N. (2010). Developing constructs for psychopathology research: research domain criteria. *Journal of Abnormal Psychology*, *119*, 631–639. http://dx.doi.org/10.1037/a0020909

Sarinopoulos, I., Grupe, D. W., Mackiewicz, K. L., Herrington, J. D., Lor, M., Steege, E. E., & Nitschke, J. B. (2009). Uncertainty during anticipation modulates neural responses to aversion in human insula and amygdala. *Cerebral Cortex*, *20*, 929–940. http://dx.doi.org/10.1093/cercor/bhp155

Schienle, A., Köchel, A., Ebner, F., Reishofer, G., & Schäfer, A. (2010). Neural correlates of intolerance of uncertainty. *Neuroscience Letters*, *479*, 272–276. http://dx.doi.org/10.1016/j.neulet.2010.05.078

Sexton, K. A., & Dugas, M. J. (2009). Defining distinct negative beliefs about uncertainty: validating the factor structure of the intolerance of uncertainty scale. *Psychological Assessment*, *21*, 176–186. http://dx.doi.org/10.1037/a0015827

Sexton, K. A., Norton, P. J., Walker, J. R., & Norton, G. R. (2003). Hierarchical model of generalized and specific vulnerabilities in anxiety. *Cognitive Behaviour Therapy*, *32*, 82–94. http://dx.doi.org/10.1080/16506070302321

Simmons, A., Matthews, S. C., Paulus, M. P., & Stein, M. B. (2008). Intolerance of uncertainty correlates with insula activation during affective ambiguity. *Neuroscience Letters*, *430*, 92–97. http://dx.doi.org/10.1016/j.neulet.2007.10.030

Starcevic, V., & Berle, D. (2006). Cognitive specificity of anxiety disorders: a review of selected key constructs. *Depression and Anxiety*, *23*, 51–61. http://dx.doi.org/10.1002/da.20145

Steinberg, L. (2005). Cognitive and affective development in adolescence. *Trends in Cognitive Sciences*, *9*, 69–74. http://dx.doi.org/10.1016/j.tics.2004.12.005

Sternheim, L., Startup, H., & Schmidt, U. (2011). An experimental exploration of behavioral and cognitive-emotional aspects of intolerance of uncertainty in eating disorder patients. *Journal of Anxiety Disorders*, *25*, 806–812. http://dx.doi.org/10.1016/j.janxdis.2011.03.020

Talkovsky, A. M., & Norton, P. J. (2016). Intolerance of uncertainty and transdiagnostic group cognitive behavioral therapy for anxiety. *Journal of Anxiety Disorders*, *41*, 108–114. http://dx.doi.org/10.1016/j.janxdis.2016.05.002

Thayer, J. F., Åhs, F., Fredrikson, M., Sollers, J. J., & Wager, T. D. (2012). A meta-analysis of heart rate variability and neuroimaging studies: implications for heart rate variability as a marker of stress and health. *Neuroscience and Biobehavioral Reviews*, *36*, 747–756. http://dx.doi.org/10.1016/j.neubiorev.2011.11.009

Thibodeau, M. A., Carleton, R. N., Gómez-Pérez, L., & Asmundson, G. J. (2013). What if I make a mistake? Intolerance of uncertainty is associated with poor behavioral performance. *The Journal of Nervous and Mental Disease*, *201*, 760–766. http://dx.doi.org/10.1097/NMD.0b013e3182a21298

Thibodeau, M. A., Carleton, R. N., McEvoy, P. M., Zvolensky, M. J., Brandt, C. P., Boelen, P. A., . . . & Asmundson, G. J. (2015). Developing scales measuring disorder-specific intolerance of uncertainty (DSIU): a new perspective on transdiagnostic. *Journal of Anxiety Disorders*, *31*, 49–57. http://dx.doi.org/10.1016/j.janxdis.2015.01.006

Thielsch, C., Andor, T., & Ehring, T. (2015). Do metacognitions and intolerance of uncertainty predict worry in everyday life? An ecological momentary assessment study. *Behavior Therapy*, *46*, 532–543. http://dx.doi.org/10.1016/j.beth.2015.05.001

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*, 233–242. http://dx.doi.org/10.1016/S0887-6185(02)00182-2

Treanor, M., Erisman, S., Salters-Pedneault, K., Roemer, L., & Orsillo, S. (2011). Acceptance-based behavioral therapy for GAD: Effects on outcomes from three theoretical models. *Depression and Anxiety*, *28*, 127–136. http://dx.doi.org/10.1002/da.20766

van der Heiden, C., Melchior, K., Muris, P., Bouwmeester, S., Bos, A. E. R., & van der Molen, H. T. (2010). A hierarchical model for the relationships between general and specific vulnerability factors and symptom levels of generalized anxiety disorder. *Journal of Anxiety Disorders*, *24*, 284–289. http://dx.doi.org/10.1016/j.janxdis.2009.12.005

van der Heiden, C., Muris, P., & van der Molen, H. T. (2012). Randomized controlled trial on the effectiveness of metacognitive therapy and intolerance-of-uncertainty therapy for generalized anxiety disorder. *Behaviour Research and Therapy*, *50*, 100. http://dx.doi.org/10.1016/j.brat.2011.12.005

Walker, S., Birrell, J., Rogers, J., Leekam, S., & Freeston, M. H. (2010). *Intolerance of uncertainty scale-revised. Unpublished manuscript*. Newcastle University.

Watson, D. (2005). Rethinking the mood and anxiety disorders: a quantitative hierarchical model for DSM-V. *Journal of Abnormal Psychology*, *114*, 522–536. http://dx.doi.org/10.1037/0021-843X.114.4.522

Wever, M., Smeets, P., & Sternheim, L. (2015). Neural correlates of intolerance of uncertainty in clinical disorders. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *27*, 345–353. http://dx.doi.org/10.1176/appi.neuropsych.14120387

Wheaton, M. G., Abramowitz, J. S., Jacoby, R. J., Zwerling, J., & Rodriguez, C. I. (2016). An investigation of the role of intolerance of uncertainty in hoarding symptoms. *Journal of Affective Disorders*, *193*, 208–214. http://dx.doi.org/10.1016/j.jad.2015.12.047

Wright, K. D., Adams Lebell, M. A., & Carleton, R. N. (2016). Intolerance of uncertainty, anxiety sensitivity, health anxiety, and anxiety disorder symptoms in youth. *Journal of Anxiety Disorders*, *41*, 35–42.

Yook, K., Kim, K. H., Suh, S. Y., & Lee, K. S. (2010). Intolerance of uncertainty, worry, and rumination in major depressive disorder and generalized anxiety disorder. *Journal of Anxiety Disorders*, *24*, 623–628. http://dx.doi.org/10.1016/j.janxdis.2010.04.003

Zlomke, K., & Young, J. (2009). A retrospective examination of the role of parental anxious rearing behaviors in contributing to intolerance of uncertainty. *Journal of Child and Family Studies*, *18*, 670–679. http://dx.doi.org/10.1007/s10826-009-9269-7

Appendix B

Prepublication Article

Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). A bifactor model of intolerance of intolerance of uncertainty in undergraduate and clinical samples: Do we need to reconsider the two-factor model? *Psychological Assessment, 30*, 893-903. doi:10.1037/pas0000540.

A bifactor model of intolerance of uncertainty in undergraduate and clinical samples: Do we need to reconsider the two-factor model?

Sarah Shihata[1], Peter M. McEvoy[1, 2], and Barbara Ann Mullan[3, 4]

[1] School of Psychology and Speech Pathology, Curtin University, Perth, Australia

[2] Centre of Clinical Interventions, Perth, Australia

[3] Health Psychology and Behavioral Medicine Research Group, Curtin University, Perth, Australia

[4] School of Psychology, University of Sydney, Sydney, Australia

Submitted: 24/02/2017

Revised and resubmitted: 23/05/2017

Revised and resubmitted: 15/08/2017

Correspondence concerning this article should be addressed to Peter McEvoy, Ph.D., School of Psychology and Speech Pathology, Curtin University, GPO BOX U1987, Perth, Western Australia, 6845, Australia, Phone: +618 9266 7279. Fax: +618 9266 2464. Email: peter.mcevoy@curtin.edu.au.

Abstract

The theorized role that intolerance of uncertainty (IU) plays in the acquisition, maintenance, and treatment of multiple emotional disorders underscores the importance of valid assessment tools. Research using the Intolerance of Uncertainty Scale-Short form (IUS-12) has conceptualized IU along two dimensions, namely, prospective IU and inhibitory IU. However, recent research has cast doubt on the separability of these dimensions. The aim of the current study was to evaluate the fit of competing measurement models of the IUS-12 in separate undergraduate (N = 506) and clinical (N = 524) samples. Unidimensional, correlated two-factor, and bifactor models were tested using confirmatory factor analysis. The results of both studies supported a bifactor model consisting of a strong general IU factor. The general IU factor explained the majority of unique variance in the IUS-12, and suggested that a total score is generally appropriate for assessing IU. The general IU factor was most strongly and consistently associated with symptoms of multiple disorders. The inhibitory IU group factor was more weakly associated with most symptom measures in the clinical sample, but only with social phobia symptoms in the undergraduate sample. The prospective IU group factor was only separable from the general IU factor in the undergraduate sample, and did not explain unique variance in disorder symptoms.

Public Significance Statement: The present study supports a bifactor model of the Intolerance of Uncertainty Scale-Short Form, and suggests that the total score is generally appropriate for assessing intolerance of uncertainty (IU) in undergraduate and clinical samples. Additionally, it highlights the relative contributions of general, prospective (cognitive), and inhibitory (behavioral) aspects of IU to symptoms of emotional disorders.

Keywords: intolerance of uncertainty, IUS-12, confirmatory factor analysis, bifactor model, psychometrics, measurement, assessment

A bifactor model of intolerance of uncertainty in undergraduate and clinical samples: Do we need to reconsider the two-factor model?

Intolerance of uncertainty (IU) is a dispositional trait that reflects a fear of the unknown and an "incapacity to endure the aversive response triggered by the perceived absence of salient, key, or sufficient information, and sustained by the associated perception of uncertainty" (Carleton, 2016, p. 31). IU is posited to be central to psychopathology as difficulty tolerating uncertainty may contribute to maladaptive cognitions (e.g., worry) and behaviors (e.g., avoidance) evident in emotional disorders (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013; Carleton, 2016). These maladaptive cognitive and behavioral processes may reflect attempts to alleviate uncertainty and increase control and, as such, engagement in such strategies perpetuates IU and associated emotional distress and anxiety (Boswell et al., 2013).

A substantial body of research suggests that IU is a robust transdiagnostic risk factor associated with multiple types of psychopathology (e.g., anxiety, mood, and eating disorders; Carleton, 2012; Hong & Cheung, 2015; Mahoney & McEvoy, 2012b; Renjan, McEvoy, Handley, & Fursland, 2016; Shihata, McEvoy, Mullan, & Carleton, 2016). As such, IU has been conceptualized as a generalized underlying mechanism for anxious pathology and a core feature in anxiety-related experience (Boswell et al., 2013; Carleton, 2016; Harvey, Watkins, Mansell, & Shafran, 2004). IU has been implicated as a potentially critical transdiagnostic treatment target. Treatment protocols that directly and indirectly target IU have been supported as efficacious, resulting in symptom reduction and clinically significant change (Dugas & Robichaud, 2007; McEvoy & Erceg-Hurn, 2016; van der Heiden, Muris, & van der Molen, 2012). Moreover, changes in IU may contribute to changes in disorder symptoms across different clinical interventions, suggesting that IU is transdiagnostic and

transtherapeutic in nature (McEvoy & Erceg-Hurn, 2016; Treanor, Erisman, Salters-Pedneault, Roemer, & Orsillo, 2011).

The role IU is theorized to play in the development, maintenance, and treatment of multiple emotional disorders highlights the importance of valid measures of IU. Over the last two decades there has been an increasing interest in IU, which has been accompanied by the development of a number of self-report measures designed to assess IU. Psychometric research on the first measure of IU, the 27-item IU Scale (IUS), provided initial evidence of construct validity, and internal and test-retest reliability of the total score (Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994). However, inconsistencies with the factor structure and length of the IUS, as well as suggestions of potential redundancy amongst items (Carleton, Norton, & Asmundson, 2007; McEvoy & Mahoney, 2011; Norton, 2005), led to the development of the revised 12-item IUS, Short Form (IUS-12; Carleton et al., 2007). The IUS-12 demonstrated strong psychometric properties and a high correlation with the original IUS (r = .96). Measurement research suggests that the IUS-12 consists of two highly correlated and replicable factors that yield two subscales: a 7-item prospective IU subscale assessing desire for predictability and cognitive appraisals about future uncertainty, and a 5-item inhibitory IU subscale assessing behavioural inhibition or avoidance when faced with uncertainty. The IUS-12 total and subscale scores have showed good construct validity, internal reliability (Cronbach's α of .91 for the total scale and .85 for both subscale scores), and test-retest reliability over a two-week interval (r = .77, Carleton et al., 2007; Khawaja & Yu, 2010).

Prior research investigating IU has computed either the IUS-12 total score, the prospective IU and inhibitory IU subscale scores, or both the total and subscale scores (Carleton, Fetzner, Hackl, & McEvoy, 2013; Carleton, Mulvogue, et al., 2012; Mahoney & McEvoy, 2012b). Differential associations have been found between prospective and

inhibitory IU and symptoms of emotional disorders, such that prospective IU appears to be more strongly related to generalized anxiety disorder and obsessive-compulsive disorder, whereas inhibitory IU appears to be more strongly related to symptoms of social anxiety, panic disorder, depression, and posttraumatic stress disorder (Boelen, Reijntjes, & Smid, 2016; Mahoney & McEvoy, 2012a; McEvoy & Mahoney, 2011). Given the relatively recent conceptualization of these subscales there is limited research and the results are not entirely consistent. Moreover, recent research has begun to question the separability of these subscales (Hale et al., 2016; Lauriola, Mosca, & Carleton, 2016).

The different approaches to using the IUS-12 (i.e., computing subscale versus total scores) are based on the underlying assumptions that the prospective and inhibitory IU subscales reflect theoretically distinct constructs beyond the total scale, and/or that each subscale reflects the same general IU construct (Reise, Bonifay, & Haviland, 2013). Reise, Moore, and Haviland (2010) assert that a correlated-traits model and differential relations between subscales and external variables do not provide sufficient evidence for estimating subscale scores. Rodriguez, Reise, and Haviland, (2016, p. 234) assert that "differential correlates are the expectation" as any subscales that are not perfectly correlated will have differential predictive utility because each subscale is a combination of the underlying general factor and a separate group factor (Reise et al., 2010). Moreover, the multidimensionality present in the data may impact the interpretability of the total score, and the apparent reliability of the subscales or narrow dimensional traits may be a reflection of a more general trait IU (Reise et al., 2010). Without empirical justification, interpreting subscale scores as reflecting a meaningful latent construct distinct from a general IU factor may be misguided (Rodriguez et al., 2016). In line with this, Hale et al. (2016) asserted that the computation and interpretation of the prospective IU and inhibitory IU subscale scores in past research was not psychometrically justified. Bifactor modelling is one option for

assessing the assumptions that the multidimensional IUS-12 subscales capture unique variance after accounting for the total scale, or alternatively that they reflect a single underlying construct (Reise et al., 2010). Bifactor models, which retain a general factor but also recognize the multidimensionality caused by group factors, are becoming increasingly applied to psychological and clinical constructs (see Reise et al., 2010, for a comprehensive review). Adopting a bifactor approach can inform researchers and clinicians on the psychometric structure of a measure, including the properties of total and subscale scores (and whether total and/or subscale scores should be computed), as well as how a measure should be modelled in structural equation modelling (SEM; Reise et al., 2013; Reise et al., 2010).

Only two studies to date have tested a bifactor model using the IUS-12. Hale et al. (2016) compared unidimensional, two-factor correlated traits, and bifactor models in an undergraduate sample. Results revealed that the bifactor model yielded the best fit to the data, indicating the presence of a strong general IU factor with substantially higher reliability and that explained a greater proportion of shared variance (80%) than the prospective and inhibitory IU group factors. Similarly, Lauriola et al. (2016) compared unidimensional, two-factor, second-order hierarchical, and bifactor models of the IUS-12 (Italian translation) using an undergraduate sample. Consistent with Hale et al.'s (2016) findings, Lauriola et al. (2016) found the bifactor model exhibited superior fit, and the general IU factor was more reliable and explained a greater amount of common variance (75%) than either group factor. Therefore, despite past studies reporting results using both IUS-12 total and subscale scores (Mahoney & McEvoy, 2012a; McEvoy & Mahoney, 2011), both Hale et al. (2016) and Lauriola et al. (2016) recommended computing only IUS-12 total scores and suggested the IUS-12 has a predominantly unidimensional structure.

While this research appears to support bifactor models of the IUS-12, it is limited to only one study using the English version in an undergraduate sample and none in a clinical population. It is plausible that prospective IU and inhibitory IU are more differentiated at clinical than non-clinical levels of psychopathology. For instance, at clinical levels of anxiety there is evidence that neural structures such as the amygdala are more strongly activated and therefore play a greater role in identifying and focusing attention on perceived threats in states of uncertainty (general IU), and the insula plays a greater role in prospective IU by guiding predictions about subjective feelings of future events (Wever, Smeets, & Sternheim, 2015). In contrast, hyperactivation of the amygdala, in conjunction with *hypo*activation of neural structures that inhibit the freeze response (e.g., ventromedial prefrontal cortex), may contribute to inhibitory IU (Grupe & Nitschke, 2013). Further research investigating bifactor models are therefore required to determine if the initial findings of a predominant common factor in undergraduates is replicated in clinical samples, or rather whether the group factors are more separable and provide unique predictive utility in a clinical sample.

Improving understanding of the structure of the IUS-12 is also important due to its recent inclusion as a key behavioral assessment method of potential threat (Negative Valence System) in the National Institute of Mental Health's Research Domain Criteria (RDoC) initiative (National Institute of Mental Health [NIMH], 2016). The aim of the RDoC initiative is to identify transdiagnostic, dimensional constructs reflecting the core mechanisms of psychopathology across units of analysis (e.g., neural circuitry, physiology, genes, self-report) as an alternative to categorical nomenclature (Berenbaum, 2013; Shankman & Gorka, 2015). Moreover, the transdiagnostic and transtherapeutic relevance of IU to psychopathology underscores the importance of valid measures and research that informs the scoring and interpretation of the IUS-12.

The aim of the present study was to use bifactor modelling to elucidate the extent to which the IUS-12 yields a total score in undergraduate and clinical samples, and thus whether scoring the prospective IU and inhibitory IU subscales is psychometrically justified, and to inform how the IUS-12 should be used in structural models that examine IU (Reise et al., 2013; Rodriguez et al., 2016). The first hypothesis was that a bifactor model would provide the best fit relative to the unidimensional and two-factor correlated models in an undergraduate sample, and that most variance in the IUS-12 would be explained by the general IU factor, thereby replicating Hale et al. (2016) and Lauriola et al.'s (2016) findings. We extended this previous research to a clinical sample with anxiety and depressive disorders. It was possible that the findings from the undergraduate sample would be replicated. However, it was also plausible that the prospective IU and inhibitory IU group factors would be more separable from the general factor at clinical levels of anxiety, and that these group factors would explain a substantial proportion of reliable variance in the IUS-12. The second hypothesis was that the general IU factor would be a strong predictor of symptoms of multiple emotional disorders in both the undergraduate and clinical samples. If the group factors are found to be separable in the clinical sample, it would be expected that they will explain unique variance in symptoms beyond the general factor.

Method

Participants and Procedure

Undergraduate Sample. Participants (N = 506) were undergraduate psychology students aged between 18 and 55 (M = 21.00; SD = 4.91; 80% female). Participants were recruited via the university's research participant pool through an online experiment database and completed the questionnaire battery online at their convenience. Participants read an information statement and were then directed to an online survey hosted by Qualtrics, where they completed demographic information and the IUS-12 along with a battery of standardized

self-report measures used as part of a larger study (Shihata, McEvoy, & Mullan, 2017). Informed consent was obtained from all participants. The IUS-12 was presented first followed by the Disorder-Specific IU Scale (Thibodeau et al., 2015; data not reported here) with the remaining questionnaires randomized. Participants were debriefed and received course credit for their participation. Institutional ethics approval was obtained prior to the commencement of this study (HR34/2015-2).

Clinical Sample. Participants (N = 524) were referred by health professionals to a specialist service for the treatment of anxiety and/or depressive disorders. Prior to the initial assessment session participants were posted a standard questionnaire battery that was completed and brought to the initial assessment. At the initial assessment participants were diagnosed via a structured diagnostic interview (Mini International Diagnostic Interview; Sheehan et al., 1998) administered by a masters- or doctorate-level Clinical Psychologist. Inclusion criteria for this study was a principal Diagnostic and Statistical Manual for Mental Disorders (DSM-IV; American Psychiatric Association, 1994) anxiety or depressive disorder (major depressive disorder or dysthymia). Participants were aged between 18 and 69 (M = 33.67; SD = 12.24; 66% female). The proportion of participants meeting criteria for principal anxiety and depressive disorders were as follows; social phobia (n =144), generalized anxiety disorder (n = 101), panic disorder with or without agoraphobia (n = 21), specific phobia (n = 7), major depressive disorder (current and in partial remission; n = 222), dysthymic disorder (n =19), anxiety disorder not otherwise specified (n = 8), and depressive disorder not otherwise specified (n = 2). A total of 27% of the sample met criteria for having one diagnosis, 43% had two diagnoses, and 30% had three or more diagnoses. Data on education and marital status were available for 483 participants, with 51% employed, 32% with a university education qualification, 13% with a technical or trade certificate, and 55% who

completed high school or less. Half of the sample were single (55%), with the remaining 34% either married or with a live in partner, and 10% either widowed, separated, or divorced.

Measures

Undergraduate Sample.

Intolerance of Uncertainty Scale, Short Form (IUS-12; Carleton et al., 2007). The IUS-12 was developed to measure negative beliefs about and reactions to uncertainty. Participants responded to each item on a five-point scale from *not at all characteristic of me* (1) to *entirely characteristic of me* (5). The IUS-12 total and subscale scores have demonstrated strong psychometric properties including good internal and test-retest reliability and construct validity in diverse populations (Carleton et al., 2007; Khawaja & Yu, 2010; McEvoy & Mahoney, 2011).

Generalized Anxiety Disorder-7 (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006). The GAD-7 was designed to assess the severity of symptoms of generalized anxiety disorder. Participants indicated how often, in the last two weeks, they felt bothered by a range of symptoms along a four-point scale ranging from *not at all* (0) to *nearly every day* (3). Psychometric support indicates evidence of good reliability, construct, discriminant, and factorial validity (Carleton, Mulvogue et al., 2012; Löwe et al., 2008).

Social Interaction Phobia Scale (SIPS; Carleton et al., 2009). The 14-item SIPS measures symptoms of social phobia including cognitive, emotional, and behavioral reactions to social interactions (Carleton et al., 2009). Participants responded to each item by indicating the extent to which they were bothered by symptoms along a five-point scale ranging from *not at all characteristic of me* (0) to *extremely characteristic of me* (4). Previous research has supported a three-factor model wherein each subscale assesses a different dimension of social anxiety (social interaction anxiety, fear of overt evaluation, and fear of attracting attention). The SIPS total and subscale scores have demonstrated excellent reliability in both clinical

and non-clinical samples and strong factorial, convergent, and discriminant validity (Carleton et al., 2009; Menatti et al., 2015).

Panic Disorder Severity Scale-Self-Report (PDSS-SR; Houck, Spiegel, Shear, & Rucci, 2002). The 5-item PDSS-SR assesses the severity of panic disorder symptoms. Participants responded to each item by indicating the frequency, distress, and avoidance behaviors associated with panic attacks along a five-point scale ranging from *none* (0) to *extreme* (4). Psychometric evidence indicates acceptable validity and internal reliability (Houck et al., 2002; Wuyek, Antony, & McCabe, 2011).

Clinical Sample.

IUS-12 (Carleton et al., 2007). As described above.

Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988). The widely used 21-item BAI was designed to assess subjective, neurophysiologic, autonomic, and panic-related symptoms of anxiety. Participants indicated the extent to which they felt bothered by a range of symptoms during the past week along a four-point scale ranging from *not at all* (0) to *severely – I could barely stand it* (3). Psychometric support indicates evidence of good reliability and validity (Beck et al., 1988).

Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996). The 21-item BDI-II is a widely used instrument designed to measure the severity of depressive symptoms during the previous two weeks. Participants responded to each item and statement group along a four-point scale from *symptom not present* (0) to *very intense* (3). Although prior studies have reported equivocal factor structures, recent psychometric research suggests computing a total score (Brouwer, Meijer, & Zevalkink, 2012). Psychometric evidence indicates the BDI-II has good construct validity and high internal and test-retest reliability (Beck et al., 1996; Storch, Roberti, & Roth, 2004).

Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990). The 16-item PSWQ is a widely used measure of pathological worry. Participants responded to each item statement on a five-point scale ranging from *not at all typical of me* (1) to *very typical of me* (5). The PSWQ has demonstrated high internal and test-retest reliability and good construct validity in clinical and non-clinical populations (Brown, Antony, & Barlow, 1992; Meyer et al., 1990).

Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998). The 20-item SIAS was designed to assess anxiety symptoms including cognitive, behavioral, and affective reactions associated with social interactions. Participants responded to items on a five-point scale ranging from *not at all characteristic or true of me* (0) to *extremely characteristic or true of me* (4). The SIAS total score has demonstrated evidence of good reliability as well as convergent and discriminant validity (Mattick & Clarke, 1998).

Data Analysis

Preliminary data screening of distributions, skewness, and kurtosis were performed in SPSS 22.0.

Measurement Models and Evaluation. Confirmatory factor analysis (CFA) using mean-and variance-adjusted weighted least squares (WLSMV) estimation was conducted in Mplus 7.4 (Muthén & Muthén, 1998-2015) to assess the relative fit of the competing IUS-12 measurement models. The use of WLSMV estimation is appropriate as the item responses of the IUS-12 are ordered-categorical data (Brown, 2006). This approach is consistent with the WLSMV estimation procedure used in previous bifactor studies on the IUS-12 (Hale et al., 2016) and other anxiety-related measures (Ebesutani, McLeish, Luberto, Young, & Maack, 2014; Fergus & Bardeen, 2017). The IUS-12 bifactor model was tested against a unidimensional and two-factor correlated model mirroring extant studies (Hale et al., 2016; Lauriola et al., 2016), and to evaluate whether each of these models would demonstrate

comparable fits in our samples. The unidimensional model consisted of each of the IUS-12 items loading onto a single latent factor. The two-factor correlated model consisted of seven items with loadings on a prospective IU group factor and five items with loadings on an inhibitory IU group factor, as reported by Carleton et al. (2007). The bifactor model consisted of all 12 items loading on a general IU factor as well as on their specific group factor. Consistent with Hale et al. (2016), the covariances of all of the factors were fixed to zero.

A number of fit indices were examined to evaluate the fit of competing models including the chi-square goodness of fit statistic (χ^2), where a non-significant value suggests an acceptable fit. However, the chi-square statistic is influenced by sample size and in large samples often rejects the model (Tabachnick & Fidell, 2013). Additional fit indices included the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA) with 90% confidence intervals (CIs). For the CFI and TLI, values greater than .90 and .95 indicate an acceptable and excellent fit, respectively (Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). For the RMSEA values close to .08 and .06 indicate an acceptable fit (lower values correspond with closer fit) and the upper CI limit should not exceed .10 (Hu & Bentler, 1999; Kline, 2016; Marsh et al., 2004). Model comparisons were evaluated using chi-square difference tests (using the DIFFTEST function in Mplus; Muthén & Muthén, 1998-2015).

Bifactor Model and Evaluation. Consistent with a bifactor model-based approach, a number of other statistical indices were calculated to better inform the psychometric properties of the total and subscale scores and use of the IUS-12 as a latent variable in SEM (see Rodriguez et al., 2016 for review). Coefficient omega (ω) and omega subscale (ω_S) is a model-based estimate of internal reliability that can be applied to both the general factor and group factors, respectively. The coefficient omega represents the proportion of variance in raw scores for the total scale and each subscale that is explained by all sources of common

variance (i.e., both the general factor and each group factor). Omega hierarchical (omegaH or ω_H) represents the proportion of variance in IUS-12 total scores that is explained by the general factor. Omega hierarchical subscale (omegaHS or ω_{HS}) represents the reliability of a subscale score (or the unique variance of each group factor) after controlling for the variance accounted for by the general factor (Reise et al., 2013). Construct replicability (*H*) represents the quality of an item set or indicators and the reproducibility of a latent variable, and thus, its use in an SEM measurement model (Rodriguez et al., 2016). A high *H* value (greater than .70; Hancock & Mueller, 2001) suggests a well-defined latent variable, which is likely to be stable and replicable, whereas a low *H* value indicates a poorly defined variable, which is likely to change across studies.

Explained common variance (ECV) and percent uncontaminated correlations (PUC) are indices that inform whether a bifactor structure with a strong general factor should be modelled as a unidimensional or multidimensional (bifactor) measurement model in SEM. ECV reflects the proportion of all common variance explained by the general factor relative to the group factors (Rodriguez et al., 2016). A high ECV value (greater than .70 or .80; Rodriguez et al., 2016) lends support for a strong general factor as well as the unidimensionality of a scale's items. In addition, item-explained common variance (I-ECV) represents the proportion of common variance for each IUS-12 item accounted for by the general factor. For the I-ECV, values greater than .80 typically suggest that the IUS-12 items primarily reflect the general factor relative to the group factor and represent a unidimensional item set (Stucky & Edelen, 2015). The ECV is useful to interpret alongside the PUC, which reflects the percent of IUS-12 item covariances influenced by the variance explained by the general factor and group factors (Rodriguez et al., 2016). Thus, the higher the PUC, the more the correlation matrix reflects the general factor (Rodriguez et al., 2016). Parameter bias less than 10% to 15% is considered acceptable, and as such, does not present a serious concern

(Muthén, Kaplan, & Hollis, 1987). Moreover, Reise, Schienes, Widaman, and Haviland (2013, p. 22) state that when omegaH values for the general factor are greater than .70, ECV values are greater than .60, and PUC values are lower than .80, then the multidimensionality in the data is "not severe enough" to impact modelling and interpretation of the IUS-12 as a largely unidimensional measure.

Structural Model. CFA was also used to assess the measurement models of each other measure to be used in the structural model (see Supplementary Material). A structural model was used to assess the incremental validity of the group factor's beyond the general IU factor to symptoms of multiple emotional disorders in the undergraduate (GAD-7, PDSS-SR, SIPS) and clinical sample (BAI, BDI-II, PSWQ, SIAS). Standardized beta estimates were used to examine the strength of the pathways in both samples.

Results

Preliminary Analyses

Scale total scores for the student and clinical samples were normally distributed as evidenced by acceptable skewness (< 2) and kurtosis (<7) levels (Tabachnick & Fidell, 2013). Using Mahalanobis Distance, no influential multivariate outliers were identified. Multicollinearity was not a problem. Descriptive statistics, internal reliabilities (Cronbach's α), and bivariate correlations for the undergraduate and clinical samples are reported in Table 1.

[Table 1 near here]

IUS-12 Measurement Models

The goodness-of-fit statistics for the measurement models tested in the undergraduate sample and clinical sample are displayed in Table 2. In the student and clinical samples, the unidimensional model and the two-factor correlated model provided a marginal fit. The CFI and TLI values met specified guidelines; however, the RMSEA was elevated. A

unidimensional model is nested in a two-factor correlated model (Reise et al., 2010), and, as such, the two-factor correlated model was found to fit the data significantly better than the unidimensional model as indicated by a significant chi-square difference. With the exception of a significant chi-square value, the bifactor model, which consisted of a prospective IU and inhibitory IU group factor, displayed a good fit to the data in the undergraduate sample. Although the RMSEA was slightly high, the upper limit of the RMSEA did not exceed .10. A significant chi-square difference indicated that the bifactor model fit the data significantly better than the correlated two-factor model. Although the bifactor model was characterized by a prospective IU and inhibitory IU group factor, it is important to note that the prospective IU group factor was marked by a single strong loading item (.94) with the other items on this group factor demonstrating relatively low loadings (-.03 to .18).

[Table 2 near here]

In the clinical sample, the bifactor model did not produce an admissible solution and it included negative residual variances, and is therefore not presented here. The model indicated that there was a problem involving the prospective IU group factor. The specific problems were explored and minor modifications were made including fixing residual variances to zero for various combinations of problematic items with negative standardized loadings and removing specific indicators based on non-significant loadings. All of these modifications continued to produce inadmissible solutions. Thus, the bifactor model was modified by removing the prospective IU group factor, which yielded an admissible bifactor model consisting of a general factor and the inhibitory IU group factor that provided a good model fit. The bifactor model fit the data significantly better than the competing two-factor correlated model as indicated by a significant chi-square difference. The standardized factor loadings for the one-factor, two-factor correlated, and bifactor models are presented in Tables 3 (undergraduate sample) and 4 (clinical sample).

[Table 3 near here]

[Table 4 near here]

Evaluation of the IUS-12 through a Bifactor Model Framework

In the undergraduate and clinical samples, most of the IUS-12 items displayed statistically significant and stronger loadings on the general factor than on the group factors. Higher loadings (>.05) on the general factor suggests that the items primarily represent the general IU construct and suggests against computing the subscale scores (Reise et al., 2010).

Omega Reliability Coefficients. In the student and clinical sample, the omega coefficients for the general IU factor and group factors were high. Inspection of omegaH suggested that in both samples 90% of the variance in IUS-12 total scores can be explained by individual differences on the general factor. A comparison between omegaH and omega provides further support that the general IU factor explained a large proportion of variance in total scores (ω_H/ω; .90/.95 = 95%). Moreover, the multidimensionality resulting from the group factors (prospective IU and inhibitory IU in the undergraduate sample; inhibitory IU in the clinical sample) was found to explain only 5% (ω-ω_H; .95-.90) of the variance in IUS-12 total scores. Thus, despite the presence of some multidimensionality, IUS-12 total scores can be practically considered to be a unidimensional representation of trait IU. As can be seen in Table 3 and Table 4, OmegaH for the group factors were low, particularly when compared to their corresponding coefficient omega values. These results suggest that (a) the general IU factor represents the dominant source of variance in the total IUS-12 score, (b) much of the reliable variance in the subscale scores was explained by the general IU factor, (c) there is only a small proportion of common variance remaining after controlling for the general factor, and therefore, (d) the low reliability of the prospective IU and inhibitory IU group factors provides support against their scoring and interpretation.

Construct Replicability. In both samples, the low *H* value of the inhibitory IU group factor suggests that it is a poorly defined and unstable latent variable that is likely to be difficult to interpret within an SEM context. In contrast, the high *H* values of the general factor suggests that it is a well-defined, stable, and replicable latent variable. The results also suggest that researchers can have confidence in the predictive utility of the general IU factor when estimating its relationships with external variables in a structural model. In the undergraduate sample, the prospective IU group factor also displayed a high *H* value, however, it is important to note that *H* values are disproportionately influenced by items with high factor loadings (Rodriguez et al., 2016). Most items on the prospective IU group factor displayed low loadings with the exception of item 2 (.94), which may have caused the high construct replicability estimate (see Table 3). Therefore, the construct replicability of the prospective IU group factor may be misleading and it may not represent a meaningful or empirically identifiable latent construct.

ECV and PUC. In the student sample, the general IU factor explained 80% of the common variance, whereas 20% of the common variance was shared amongst the prospective and inhibitory IU group factors. Similarly, in the clinical sample, the general factor explained 86% of the common variance, whereas 14% of the common variance was shared with the inhibitory IU group factor. The high ECV values provided support for a strong general IU factor and the unidimensionality of the IUS-12 items. Of the IUS-12 items, 67% (undergraduate) and 75% (clinical) had I-ECV values greater than .80. The average I-ECV value was .85 (range .27 to 1.00) and .89 (range .42 to 1.00) in the undergraduate and clinical samples, respectively, with only three items with I-ECV values lower than .80 (item 2, 6, 7 in the undergraduate sample; items 6, 7, 10 in the clinical sample). Most of the IUS-12 items had high I-ECV values indicating that these items are stronger indicators of general IU and contribute substantially less to the measurement of their respective group factors.

In the undergraduate sample, the PUC value indicated that the general IU factor accounted for approximately half of the item correlations of the IUS-12. In the clinical sample, the PUC value indicated that the general factor accounted for the majority of the IUS-12 item correlations. The average relative parameter bias was acceptable (5% and 8% across IUS-12 items in the undergraduate and clinical samples, respectively) indicating that despite the poorer fit of the unidimensional model, the presence of some multidimensionality in the data will not introduce problematic levels of parameter bias when modelling the IUS-12 as unidimensional in an SEM framework (Muthén et al., 1987; Rodriguez et al., 2016).

Structural Regression Model

Undergraduate Sample. The final bifactor models were used in all structural models. Standardized beta estimates from the structural regression models are reported in Table 5. The structural model provided an excellent fit to the data, χ^2 (624) =1161.473, $p < .001$, CFI = .985, TLI = .983, and RMSEA = .041 (90% CI [.038 to .045]). The general IU factor was significantly associated with generalized anxiety disorder and panic disorder symptoms; however, the prospective IU and inhibitory IU group factors were not (see Table 5). The general IU factor and inhibitory IU group factor were also significantly associated with symptoms of social phobia. The model explained 47% (R^2) of the variance in symptoms of generalized anxiety disorder, 52% in fear of attracting attention, 44% in fear of overt evaluation, 39% in social interaction anxiety, and 33% in panic disorder.[1]

Clinical Sample. The structural model provided an acceptable fit to the data, χ^2 (3879) = 6643.759, $p < .001$, CFI = .929, TLI = .927, and RMSEA = .037 (90% CI [.035 to .038]). The general IU factor and inhibitory IU group factor were significantly associated with symptoms of anxiety, depression, and social anxiety. As can be seen in Table 5, the general IU factor, but not the inhibitory IU group factor, was significantly associated with

worry symptoms. The model explained 41% (R^2) of the variance in pathological worry, 26% in anxiety, and 21% in depression and social anxiety symptoms.

[Table 5 near here].

Discussion

IU is becoming increasingly recognized as a robust transdiagnostic cognitive vulnerability in the conceptualization and treatment of psychopathology (NIMH, 2016). The IUS-12 has become a widely used measure with strong psychometric properties and is considered a viable transdiagnostic assessment tool (Carleton et al., 2007; Khawaja & Yu, 2010). However, bifactor models have recently been investigated in undergraduate samples as alternatives to the previously established two-factor correlated model, which has important implications for the computation of total versus subscale scores (Hale et al., 2016; Lauriola et al., 2016). The present study replicated and extended this research by examining the structure and predictive validity of the IUS-12 across both undergraduate and treatment-seeking clinical samples.

The correlated two-factor model reported in previous studies was replicated in both the undergraduate and treatment-seeking samples. Also consistent with previous research, the bifactor model provided a superior fit (Hale et al., 2016; Lauriola et al., 2016), although there were important differences across the samples. In the undergraduate sample the IUS-12 bifactor model consisted of a general IU factor and two group factors (prospective IU and inhibitory IU), whereas in the treatment-seeking sample, the bifactor model consisted of a general IU factor and only one group factor (inhibitory IU). Although the prospective IU group factor emerged in the undergraduate sample, it did not appear to be a strong factor as evidenced by its low reliability and that most of the items demonstrated low loadings, with the exception of the very high loading of item 2. Thus, the results suggest that in both samples, the structure of the IUS-12 was primarily characterized by a general IU factor and

an inhibitory IU group factor. The overwhelming majority of the variance in the IUS-12 scores was attributed to the general IU factor in both the undergraduate (80%) and clinical (86%) samples. These results are consistent with the findings of two recently published studies with undergraduate samples that reported that the general IU factor explained approximately 80% (Hale et al., 2016) and 75% (Lauriola et al., 2016) of the shared variance in IUS-12 scores. Further, the majority of the reliable variance in the prospective and inhibitory IU subscale scores was found to be explained by the general IU factor.

In both the undergraduate and clinical samples, the general IU factor was most strongly and consistently associated with emotional disorder symptoms. In the student sample, the prospective IU group factor was not significantly associated with any assessed symptoms of emotional disorder. Moreover, the inhibitory IU group factor was only uniquely, although more weakly, associated with symptoms of social phobia. In the clinical sample, the inhibitory IU group factor was also most strongly associated with social anxiety symptoms, but also more weakly with anxiety and depression, which is consistent with previous research using treatment-seeking samples (McEvoy & Mahoney, 2011). Overall, the general IU factor demonstrated the most consistent transdiagnostic predictive utility, with inhibitory IU demonstrating weaker transdiagnostic associations but only in the clinical sample. Although the inhibitory IU group factor demonstrated some unique predictive utility, this finding requires replication due to the low reliability and construct reproducibility index of this group factor. The general IU factor shared the strongest association with worry, which is consistent with previous research that has found a strong association with pathological worry and generalized anxiety disorder, and with the initial conceptualization of IU as a core feature in worry and generalized anxiety disorder (Dugas, Gosselin, & Ladouceur, 2001; Freeston et al., 1994).

The study findings have research and clinical implications. The present results suggest that researchers and clinicians should consider using the total score but not the subscale scores, which is line with recommendations made by other research groups (Hale et al., 2016; Lauriola et al., 2016). The results indicated that the general IU factor is a reliable and well-defined latent variable and that the IUS-12 can be represented as a unidimensional model with little parameter bias. The prospective IU group factor may not be separable or have unique predictive utility in undergraduate and clinical samples. From a theoretical stance, the results may suggest that prospective IU (cognitive appraisals about uncertainty) may not need to be independently interpreted from the general IU factor and rather should be considered a fundamental aspect of general IU. While the inhibitory IU group factor explained only a small proportion of reliable variance in the IUS-12, and therefore need not be considered separate from the general factor, we found that this factor did uniquely and weakly predict social phobia symptoms in undergraduates, and anxiety, social anxiety, and depression in the clinical sample. The greater contribution of inhibitory IU in the clinical sample may be a function of the different measures used across the samples, although it is also possible that inhibitory IU reflects the activation of inhibitory neural pathways at clinical levels of anxiety (Wever et al., 2015). This possibility requires further investigation, and if supported suggests that cognitive-behavioral or exposure-based therapy that aims to build tolerance for uncertainty would benefit from a focus on both the cognitive and behavioral aspects of IU.

The current study is not without limitations, which may inform future research directions. In contrast to the clinical sample who were diagnosed via a structured diagnostic assessment, the undergraduate sample were not subject to diagnostic screening. Thus, we could not rule out that the undergraduate sample did not contain participants with clinical symptom levels. However, undergraduate samples are commonly used in this research area as they allow for exploration of the dimensional nature of IU through the entire range of

symptoms, which is consistent with the NIMH's RDoC initiative (Kozak & Cuthbert, 2016). Nonetheless, it would be valuable to examine the bifactor model in community and other clinical samples to increase confidence in modelling the IUS-12 as a single unidimensional latent variable when investigating structural models. Moreover, the present study used only self-report measures and did not include specific items to assess for carelessness in responding. Finally, the IUS-12 assesses self-reported trait IU rather than real time responses to uncertainty. It is also important to note that the bifactor approach examines the structure of a particular measure, in this case the IUS-12, and not the nature of the underlying the construct and its associated neurobiological or psychobiological effect (Bonifay, Lane, & Reise, 2017). It may be that high inhibitory IU and associated neural circuitry play a more important role (e.g., freezing) during exposure to uncertainty in a salient personal domain, but that a trait self-report measure is unable to comprehensively capture this process distinctly from general IU. Future research that assesses multiple units of analysis (e.g., self-report, behavioral, physiological, neurocircuitry) would be useful for identifying how these processes interact to maintain anxiety and intolerance within the context of uncertainty (Bonifay et al., 2017; Kozac & Cuthbert, 2016).

The current study makes an important incremental contribution to recent literature by replicating the structure of the IUS-12 in an undergraduate sample, but also by extending this approach to a clinical sample within the same study to facilitate comparisons. This study also modelled the predictive utility of the general IU factor and group factors, and provided support for the transdiagnostic nature of general IU (undergraduate and clinical samples) and inhibitory IU (clinical sample only). The multidimensionality of the IUS-12 scores does not appear to be substantive, and therefore use of the IUS-12 total score (and not subscale scores) is recommended. The IUS-12 total score displayed strong reliability and predictive validity.

Researchers and clinicians should also have increased confidence that scores of the IUS-12 can be regarded as a primarily unidimensional representation of general trait IU.

Footnote

[1]All models using the undergraduate sample were re-run without participants who completed the questionnaires faster (n=0 due to a positively skewed distribution) or slower (n=21) than two standard deviations from the mean, and again without participants who completed the survey faster than an average of three seconds per item (n=16). These models were an attempt to guard against undue influence from careless responses. The pattern of findings from these models was identical, and the excluded subgroups did not significantly differ to the remaining group on total IUS-12 scores (ps > .05), so only the analyses with the full sample are reported.

References

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin, 103*, 411–423. doi:10.1037/0033-2909.103.3.411

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology, 56*, 893–897. doi:10.1037/0022-006X.56.6.893

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory-II.* San Antonio, TX: Psychological Corporation.

Berenbaum, H. (2013). Classification and psychopathology research. *Journal of Abnormal Psychology, 122*, 894-901. doi:10.1037/a0033096

Boelen, P. A., Reijntjes, A., & Smid, G. E. (2016). Concurrent and prospective associations of intolerance of uncertainty with symptoms of prolonged grief, posttraumatic stress, and depression after bereavement. *Journal of Anxiety Disorders, 41*, 65–72. doi:10.1016/j.janxdis.2016.03.004

Bonifay, W., Lane, S. P., & Reise, S. P. (2017). Three concerns with applying a bifactor model as a structure of psychopathology. *Clinical Psychological Science, 5*, 184-186. doi: 10.1177/2167702616657069

Boswell, J. F., Thompson-Hollands, J., Farchione, T. J., & Barlow, D. H. (2013). Intolerance of uncertainty: a common factor in the treatment of emotional disorders. *Journal of Clinical Psychology, 69*, 630-645. doi:10.1002/jclp.21965

Brouwer, D., Meijer, R. R., & Zevalkink, J. (2013). On the factor structure of the Beck Depression Inventory–II: G is the key. *Psychological Assessment, 25*, 136–145. doi:10.1037/a0029228

Brown, T. (2006). *Confirmatory factor analysis for applied research.* New York: Guildford.

Brown, T. A., Antony, M. M., & Barlow, D. H. (1992). Psychometric properties of the Penn State Worry Questionnaire in a clinical anxiety disorders sample. *Behaviour Research and Therapy, 30*, 33–37. doi:10.1016/0005-7967(92)90093-V

Bryne, B. M. (2012). *Structural equation modelling with Mplus: Basic concepts, applications, and programming*. New York: Routledge.

Carleton, R. N. (2012). The intolerance of uncertainty construct in the context of anxiety disorders: theoretical and practical perspectives. *Expert Review of Neurotherapeutics, 12*, 937-947. doi:10.1586/ern.12.82

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

Carleton, R. N., Collimore, K. C., Asmundson, G. J., McCabe, R. E., Rowa, K., & Antony, M. M. (2009). Refining and validating the Social Interaction Anxiety Scale and the Social Phobia Scale. *Depression and Anxiety, 26*, E71-E81. doi:10.1002/da.20480

Carleton, R. N., Fetzner, M. G., Hackl, J. L., & McEvoy, P. (2013). Intolerance of uncertainty as a contributor to fear and avoidance symptoms of panic attacks. *Cognitive Behaviour Therapy, 42*, 328-341. doi:10.1080/16506073.2013.792100

Carleton, R. N., Mulvogue, M. K., Thibodeau, M. A., McCabe, R. E., Antony, M. M., & Asmundson, G. J. G. (2012). Increasingly certain about uncertainty: Intolerance of uncertainty across anxiety and depression. *Journal of Anxiety Disorders, 26*, 468-479. doi:10.1016/j.janxdis.2012.01.011

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

Dugas, M. J., Gosselin, P., & Ladouceur, R. (2001). Intolerance of uncertainty and worry: Investigating specificity in a nonclinical sample. *Cognitive Therapy and Research, 25*, 551-558. doi:10.1023/A:1005553414688

Dugas, M. J., & Robichaud, M. (2007). *Cognitive-behavioral treatment for generalized anxiety disorder: From science to practice.* New York, NY: Routledge.

Ebesutani, C., McLeish, A. C., Luberto, C. M., Young, J., & Maack, D. J. (2013). A bifactor model of anxiety sensitivity: Analysis of the Anxiety Sensitivity Index-3. *Journal of Psychopathology and Behavioral Assessment, 36*, 452–464. doi:10.1007/s10862-013-9400-3

Fergus, T. A., & Bardeen, J. R. (2017). The Metacognitions Questionnaire-30: An examination of a bifactor model and measurement invariance among men and women in a community sample. *Assessment*. 1-12. doi:10.1177/1073191116685807

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

Grupe, D. W., & Nitschke, J. B. (2013). Uncertainty and anticipation in anxiety: An integrated neurobiological and psychological perspective. *Nature Reviews Neuroscience, 14*, 488–501. doi:10.1038/nrn3524

Hale, W., Richmond, M., Bennett, J., Berzins, T., Fields, A., Weber, D., … Osman, A. (2015). Resolving uncertainty about the Intolerance of Uncertainty Scale–12: Application of modern psychometric strategies. *Journal of Personality Assessment, 98*, 200–208. doi:10.1080/00223891.2015.1070355

Hancock, G. R., & Mueller, R. O. (2001). Rethinking construct reliability within latent variable systems. In R. Cudeck, S. du Toit, & D. Sorbom (Eds.), *Structural equation modeling: Present and future - A Festschrift in honor of Karl Joreskog*, 195-216. Lincolnwood, IL: Scientific Software International.

Harvey, A., Watkins, E., Mansell, W., & Shafran, R. (2004). *Cognitive behavioural processes across psychological disorders: A transdiagnostic approach to research and treatment*. Oxford: Oxford University Press.

Hong, R. Y., & Cheung, M. W. L. (2015). The structure of cognitive vulnerabilities to depression and anxiety: Evidence for a common core etiologic process based on a meta-analytic review. *Clinical Psychological Science, 3*, 892-912. doi:10.1177/2167702614553789

Houck, P. R., Spiegel, D. A., Shear, M. K., & Rucci, P. (2002). Reliability of the self-report version of the Panic Disorder Severity Scale. *Depression and Anxiety, 15*, 183-185. doi:10.1002/da.10049

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Convential criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*, 1-55. doi:10.1080/10705519909540118

Khawaja, N. G., & Yu, L. N. H. (2010). A comparison of the 27-item and 12-item intolerance of uncertainty scales. *Clinical Psychologist, 14*, 97-106. doi:10.1080/13284207.2010.502542

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). New York, NY: Guildford.

Kozak, M. J., & Cuthbert, B. N. (2016). The NIMH research domain criteria initiative: background, issues, and pragmatics. *Psychophysiology, 53*, 286-297. doi:10.1111/psyp.12518

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

Löwe, B., Decker, O., Müller, S., Brähler, E., Schellberg, D., Herzog, W., & Herzberg, P. Y. (2008). Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. *Medical Care, 46*, 266-274. doi:10.1097/MLR.0b013e318160d093

Mahoney, A. E., & McEvoy, P. M. (2012a). Trait versus situation-specific intolerance of uncertainty in a clinical sample with anxiety and depressive disorders. *Cognitive Behaviour Therapy, 41*, 26-39. doi:10.1080/16506073.2011.622131

Mahoney, A. E., & McEvoy, P. M. (2012b). A transdiagnostic examination of intolerance of uncertainty across anxiety and depressive disorders. *Cognitive Behaviour Therapy, 41*, 212-222. doi:10.1080/16506073.2011.622130

Marsh, H. W., Hau, K., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralising Hu and Bentler's (1999) findings. *Structural Equation Modeling: A Multidisciplinary Journal, 11*, 320-341. doi:10.1207/s15328007sem1103_2

Mattick, R. P., & Clarke, J. C. (1998). Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. *Behaviour Research and Therapy*, *36*, 455–470. doi:10.1016/S0005-7967(97)10031-6

McEvoy, P. M., & Erceg-Hurn, D. M. (2016). The search for universal transdiagnostic and trans-therapy change processes: Evidence for intolerance of uncertainty. *Journal of Anxiety Disorders, 41*, 96-107. doi:10.1016/j.janxdis.2016.02.002

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

Menatti, A. R., Weeks, J. W., Carleton, R. N., Morrison, A. S., Heimberg, R. G., Hope, D. A., … Liebowitz, M. R. (2015). The Social Interaction Phobia Scale: Continued support for the psychometric validity of the SIPS using clinical and non-clinical samples. *Journal of Anxiety Disorders, 32*, 46–55. doi:10.1016/j.janxdis.2015.03.003

Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the Penn State Worry Questionnaire. *Behaviour Research Therapy, 28*, 487-495. doi**:**10.1016/0005-7967(90)90135-6

Muthén, B., Kaplan, D., & Hollis, M. (1987). On structural equation modeling with data that are not missing completely at random. *Psychometrika, 52*, 431-462. doi:10.1007/bf02294365

Muthén, L. K., & Muthén, B. O. (1998-2015). *Mplus User's Guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.

National Institute of Mental Health (NIMH, 2016). Behavioral Assessment Methods for RDoC Constructs: A report by the National Advisory Mental Health Council Workgroup on Tasks and Measures for Research Domain Criteria (RDoC). Retrieved from https://www.nimh.nih.gov/about/advisory-boards-and-groups/namhc/reports/rdoc_council_workgroup_report_153440.pdf

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

Reise, S. P., Bonifay, W. E., & Haviland, M. G. (2013). Scoring and modeling psychological

measures in the presence of multidimensionality. *Journal of Personality Assessment, 95*, 129-140. doi:10.1080/00223891.2012.725437

Reise, S. P., Moore, T. M., & Haviland, M. G. (2010). Bifactor models and rotations: Exploring the extent to which multidimensional data yield univocal scale scores. *Journal of Personality Assessment, 92*, 544–559. doi:10.1080/00223891.2010.496477

Reise, S. P., Scheines, R., Widaman, K. F., & Haviland, M. G. (2013). Multidimensionality and structural coefficient bias in structural equation modeling. *Educational and Psychological Measurement, 73*, 5–26. doi:10.1177/0013164412449831

Renjan, V., McEvoy, P. M., Handley, A. K., & Fursland, A. (2016). Stomaching uncertainty: Relationships among intolerance of uncertainty, eating disorder pathology, and comorbid emotional symptoms. *Journal of Anxiety Disorders, 41*, 88-95. doi:10.1016/j.janxdis.2016.03.008

Rodriguez, A., Reise, S. P., & Haviland, M. G. (2016). Applying bifactor statistical indices in the evaluation of psychological measures. *Journal of Personality Assessment, 98*, 223-237. doi:10.1080/00223891.2015.1117928

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,* 323-338. doi:10.3200/JOER.99.6.323-338

Shankman, S. A., & Gorka, S. M. (2015). Psychopathology research in the RDoC era: Unanswered questions and the importance of the psychophysiological unit of analysis. *International Journal of Psychophysiology, 98*, 330-337. doi:10.1016/j.ijpsycho.2015.01.001

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., . . . Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (MINI): The

development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry, 59* (Suppl. 20), 22-33.

Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). Pathways from uncertainty to anxiety: An evaluation of a hierarchical model of trait and disorder-specific intolerance of uncertainty on anxiety disorder symptoms. *Journal of Anxiety Disorders, 45*, 72-79. doi:10.1016/j.janxdis.2016.12.001

Shihata, S., McEvoy, P. M., Mullan, B. A., & Carleton, R. N. (2016). Intolerance of uncertainty in emotional disorders: What uncertainties remain? *Journal of Anxiety Disorders, 41*, 115-124. doi:10.1016/j.janxdis.2016.05.001

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine, 166*, 1092-1097. doi:10.1001/archinte.166.10.1092

Storch, E., Roberti, J., & Roth, D. (2004). Factor structure, concurrent validity, and internal consistency of the Beck Depression Inventory- second edition in a sample of college students. *Depression and Anxiety, 19*, 187-189. doi:10.1002/da.20002

Stucky, B. D., & Edelen, M. O. (2015). Using hierarchical IRT models to create unidimensional
measures from multidimensional data. In S. P. Reise & D. A. Revicki (Eds.), *Handbook of item response theory modelling: Applications to typical performance assessment*, 183-206. New York: Routledge.

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston: Pearson Education.

Thibodeau, M. A., Carleton, R. N., McEvoy, P. M., Zvolensky, M. J., Brandt, C. P., Boelen, P. A., . . . Asmundson, G. J. (2015). Developing scales measuring disorder-specific

intolerance of uncertainty (DSIU): A new perspective on transdiagnostic. *Journal of Anxiety Disorders, 31*, 49-57. doi:10.1016/j.janxdis.2015.01.006

Treanor, M., Erisman, S., Salters-Pedneault, K., Roemer, L., & Orsillo, S. (2011). Acceptance- based behavioral therapy for GAD: Effects on outcomes from three theoretical models. *Depression and Anxiety, 28*, 127-136. doi:10.1002/da.20766

van der Heiden, C., Muris, P., & van der Molen, H. T. (2012). Randomized controlled trial on the effectiveness of metacognitive therapy and intolerance-of-uncertainty therapy for generalized anxiety disorder. *Behaviour Research and Therapy, 50*, 100. doi:10.1016/j.brat.2011.12.005

Wever, M., Smeets, P., & Sternheim, L. (2015). Neural correlates of intolerance of uncertainty in clinical disorders. *The Journal of Neuropsychiatry and Clinical Neurosciences, 27*, 345-353. doi: 10.1176/appi.neuropsych.14120387

Wuyek, L. A., Antony, M. M., & McCabe, R. E. (2011). Psychometric properties of the Panic Disorder Severity Scale: Clinician-administered and self-report versions. *Clinical Psychology and Psychotherapy, 18*, 234-243. doi:10.1002/cpp.703

Table 1

Descriptive Statistics, Cronbach's Alpha, and Bivariate Correlations in the Undergraduate and Clinical Samples

	Mean	SD	1	2	3	4	5	6	7	8	9
Undergraduate sample (N = 506)											
1. IUS-12	33.25	9.80	.92								
2. GAD-7	7.06	5.38	.62*	.92							
3. SIPS	17.21	13.85	.62*	.62*	.96						
4. PDSS-SR	2.36	2.99	.44*	.63*	.48*	.85					
Clinical sample (N = 524)											
5. IUS-12	37.83	10.79					.93				
6. BAI	19.34	19.34					.45*	.93			
7. BDI-II	26.05	26.05					.41*	.58*	.91		
8. PSWQ	61.88	61.88					.56*	.43*	.36*	.91	
9. SIAS	45.42	45.42					.35*	.32*	.32*	.29*	.94

Note. Cronbach's alphas are on the diagonal. SD = standard deviation; IUS-12 = Intolerance of Uncertainty Scale-Short Form; GAD-7 = Generalized Anxiety Disorder-7; SIPS = Social Interaction Phobia Scale; PDSS-SR = Panic Disorder Severity Scale, Self-Report; BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory; PSWQ = Penn State Worry Questionnaire; SIAS = Social Interaction Anxiety Scale.

* $p < .001$.

Table 2

Goodness-of-Fit Statistics for the Measurement Models

Model	χ^2 (df)	$\Delta\chi^2$ (df)	CFI	TLI	RMSEA	RMSEA 90% CI LL	RMSEA 90% CI UP
Undergraduate sample							
Bifactor	207.72 (42)		.981	.970	.088	.077	.100
Correlated two-factor	349.30 (53)	132.33 (11)[b*]	.966	.958	.105	.095	.116
One-factor	443.25 (54)	61.28 (1)[a*]	.955	.946	.119	.109	.130
Clinical sample							
Bifactor	246.08 (49)		.980	.973	.088	.077	.099
Correlated two-factor	490.96 (53)	155.41 (4)[b]*	.955	.944	.126	.116	.136
One-factor	729.64 (54)	100.34 (1)[a]	.931	.916	.155	.145	.165

Note. CFI = comparative fit index; TLI = Tucker-Lewis fit index; RMSEA = root mean square error of approximation; CI = confidence interval; LL = lower limit; UP = upper limit. Models computed using mean-and variance-adjusted weighted least squares (WLSMV) estimation. $\Delta\chi^2$ computed using Mplus 7.4 DIFFTEST function.

[a] $\Delta\chi^2$ comparing unidimensional and correlated two-factor models in both samples. [b] $\Delta\chi^2$ comparing bifactor and correlated two-factor models in both samples.

* $p < .001$.

Table 3

Standardized Factor Loadings for the Measurement Models of the Intolerance of Uncertainty Scale in an Undergraduate Sample

		One-factor	Two-factor correlated		Bifactor model		
Item			Prospective	Inhibitory	General	Prospective	Inhibitory
1	Unforeseen events upset me greatly	.73	.75		.72	.17	
2	It frustrates me not having all the information I need	.62	.64		.57	.94	
4	One should always look ahead so as to avoid surprises	.69	.71		.70	.07	
5	A small unforeseen event can spoil everything, even with the best of planning	.78	.81		.82	-.03	
8	I always want to know what the future has in store for me	.68	.70		.69	.10	
9	I can't stand being taken by surprise	.78	.80		.81	-.04	
11	I should be able to organize everything in advance	.70	.71		.69	.18	
3	Uncertainty keeps me from living a full life	.79		.82	.79		.15
6	When it's time to act, uncertainty paralyses me	.82		.83	.72		.55
7	When I am uncertain I can't function very well	.82		.84	.74		.44
10	The smallest doubt can stop me from acting	.78		.79	.72		.34
12	I must get away from all uncertain situations	.83		.85	.82		.16
	Coefficient omega				ω = .95	ω_S = .92	ω_S = .92
					ω_H = .90	ω_{HS} = .07	ω_{HS} = .15
	H				.94	.88	.46
	ECV				.80		
	PUC				.53		

Note. N = 506. ω = omega; ω_S = omegaS; ω_H = omegaH; ω_{HS} = omegaHS; H = construct replicability; ECV = explained common variance; PUC = percent uncontaminated correlations. In the two-factor correlated model, the correlation between the factors was .91.

Table 4

Standardized Factor Loadings for the Measurement Models of the Intolerance of Uncertainty Scale in a Clinical Sample

		One-factor	Two-factor correlated		Bifactor	
Item			Prospective	Inhibitory	General	Inhibitory
1	Unforeseen events upset me greatly	.75	.78		.78	
2	It frustrates me not having all the information I need	.71	.73		.73	
4	One should always look ahead so as to avoid surprises	.74	.76		.76	
5	A small unforeseen event can spoil everything, even with the best of planning	.75	.77		.77	
8	I always want to know what the future has in store for me	.74	.76		.76	
9	I can't stand being taken by surprise	.78	.81		.80	
11	I should be able to organize everything in advance	.70	.72		.72	
3	Uncertainty keeps me from living a full life	.75		.78	.72	.25
6	When it's time to act, uncertainty paralyses me	.83		.84	.61	.72
7	When I am uncertain I can't function very well	.87		.89	.70	.56
10	The smallest doubt can stop me from acting	.76		.79	.69	.38
12	I must get away from all uncertain situations	.79		.83	.78	.18
	Coefficient omega				ω = .95	ω_S = .92
					ω_H = .90	ω_{HS} = .24
	H				.94	.64
	ECV				.86	
	PUC				.85	

Note. N = 524. ω = omega; ω_S = omegaS; ω_H = omegaH; ω_{HS} = omegaHS; H = construct replicability; ECV = explained common variance; PUC = percent uncontaminated correlations. In the two-factor correlated model, the correlation between the factors was .85.

Table 5

Summary of Structural Regression Model for the Undergraduate and Clinical Samples

	General Factor				Inhibitory IU Group Factor				Prospective IU Group Factor			
			CI				CI				CI	
	β	SE	LL	UP	*β*	SE	LL	UP	*β*	SE	LL	UP
Undergraduate												
GAD-7	.68*	.03	.62	.74	.08	.06	-.04	.19	.05	.06	-.07	.16
PDSS-SR	.56*	.05	.47	.65	.07	.08	-.08	.23	-.10	.08	-.25	.05
SIPS												
SIA	.57*	.04	.50	.64	.25*	.06	.13	.36	-.01	.06	-.13	.10
FOE	.62*	.03	.56	.69	.23*	.06	.12	.34	-.01	.06	-.13	.10
FAA	.68*	.03	.61	.75	.22*	.06	.10	.34	-.09	.06	-.21	.03
Clinical												
BAI	.45*	.04	.38	.53	.24*	.04	.15	.32				
BDI-II	.42*	.04	.34	.49	.19*	.05	.10	.28				
PSWQ	.63*	.03	.58	.69	.08	.04	-.00	.16				
SIAS	.31*	.04	.23	.39	.33*	.04	.25	.42				

Note. IU = Intolerance of Uncertainty; GAD-7 = Generalized Anxiety Disorder-7; PDSS-SR = Panic Disorder Severity Scale, Self-Report; SIPS = Social Interaction Phobia Scale; SIA = Social Interaction Anxiety Subscale; FOE = Fear of Overt Evaluation Subscale; FAA = Fear of Attracting Attention Subscale; BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory; PSWQ = Penn State Worry Questionnaire; SIAS = Social Interaction Anxiety Scale. CI = 95% confidence interval; LL = lower limit; UP = upper limit.

* $p < .001$.

Appendix C

Published Article

Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). Pathways from uncertainty to anxiety: An evaluation of a hierarchical model of trait and disorder-specific intolerance of uncertainty on anxiety disorder symptoms. *Journal of Anxiety Disorders, 45*, 72-79. doi:10.1016/j.janxdis.2016.12.001

Journal of Anxiety Disorders 45 (2017) 72–79

Contents lists available at ScienceDirect

Journal of Anxiety Disorders

Pathways from uncertainty to anxiety: An evaluation of a hierarchical model of trait and disorder-specific intolerance of uncertainty on anxiety disorder symptoms

Sarah Shihata [a], Peter M. McEvoy [a,b,*], Barbara A. Mullan [c,d]

[a] School of Psychology and Speech Pathology, Curtin University, Perth, Australia
[b] Centre of Clinical Interventions, Perth, Australia
[c] Health Psychology and Behavioural Medicine Research Group, Curtin University, Perth, Australia
[d] School of Psychology, University of Sydney, Sydney, Australia

ARTICLE INFO

Article history:
Received 18 November 2016
Received in revised form 5 December 2016
Accepted 5 December 2016
Available online 8 December 2016

Keywords:
Intolerance of uncertainty
Anxiety disorders
Transdiagnostic
Disorder-specific
Cognitive vulnerability

ABSTRACT

Uncertainty is central to anxiety-related pathology and intolerance of uncertainty (IU) appears to be a transdiagnostic risk and maintaining factor. The aim of the present study was to evaluate a hierarchical model to identify the unique contributions of trait and disorder-specific IU (i.e., uncertainty specific to generalised anxiety disorder, social anxiety, obsessive compulsive disorder, and panic disorder) to disorder-specific symptoms, beyond other disorder-specific cognitive vulnerabilities (i.e., negative metacognitive beliefs, fear of negative evaluation, inflated responsibility, and agoraphobic cognitions, respectively). Participants ($N = 506$) completed a battery of online questionnaires. Structural equation modelling was used to evaluate model fit, as well as direct and indirect pathways. Trait and disorder-specific IU were significantly associated with multiple cognitive vulnerability factors and disorder symptoms. Indirect effects between trait IU and symptoms were observed through disorder-specific IU and cognitive vulnerabilities. The relative contribution of trait IU and disorder-specific IU to symptoms varied and theoretical and clinical implications are highlighted. Limitations include the cross-sectional design and reliance on self-report. Avenues for further research include a need for replication and extension of the model in different samples and using experimental and multi-method research methods.

1. Introduction

The development and maintenance of anxiety disorders can be attributed to both common and specific vulnerabilities (Barlow, 2000; Brown & Naragon-Gainey, 2013). Models of psychopathology suggest that intolerance of uncertainty (IU) is a core feature in anxiety-related experience (Carleton, 2016), and the past decade has seen IU gain considerable attention as a robust and common vulnerability factor implicated in multiple psychological disorders (Carleton, Mulvogue et al., 2012; Mahoney & McEvoy, 2012a; Renjan, McEvoy, Handley, & Fursland, 2016; Shihata, McEvoy, Mullan, & Carleton, 2016). IU is conceptualised as a trait-like disposition that reflects a fundamental fear of the unknown and negative beliefs about uncertainty and its associated implications (Carleton, 2012; Dugas & Robichaud, 2007).

Initial research on IU focused primarily on its relationship with worry and generalised anxiety disorder (Dugas, Gagnon, Ladouceur, & Freeston, 1998; Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994); however, it has since been found to be associated with a range of emotional disorder symptoms, suggesting that it is transdiagnostic in nature (Carleton, 2012; Gentes & Ruscio, 2011; Hong & Cheung, 2015; Mahoney & McEvoy, 2012b). Measurement research suggests that IU comprises both prospective (i.e., cognitive appraisals) and inhibitory (i.e., behavioural apprehension) responses to uncertainty (Carleton, Sharpe, & Asmundson, 2007; McEvoy & Mahoney, 2011). Moreover, maladaptive cognitions (e.g., worry, obsessional doubt) and behaviours (e.g., avoidance, compulsions) evident in a range of psychological disorders may reflect attempts to gain certainty and control and, therein, may be driven by IU (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013; Krohne, 1989). As such, IU may reflect a transdiagnostic or general psychological vulnerability that confers elevated risk to multiple disorders (Carleton, Mulvogue et al., 2012; Harvey, Watkins, Mansell, & Shafran, 2004) in line with Barlow's (2000) triple vul-

* Corresponding author at: School of Psychology and Speech Pathology, Curtin University, GPO BOX U1987, Perth, Western Australia 6845, Australia.
E-mail address: peter.mcevoy@curtin.edu.au (P.M. McEvoy).

http://dx.doi.org/10.1016/j.janxdis.2016.12.001
0887-6185/

nerability model. Barlow (2000) posits that emotional disorders are a function of general biological and psychological mechanisms as well as more disorder-specific vulnerabilities. Whereas the general mechanisms increase vulnerability to multiple emotional disorders, the disorder-specific factors may influence the development and expression of different emotional disorders (Boswell et al., 2013). Although IU has been implicated in a wide range of disorders much less is known about how a general risk factor such as IU may lead to the development of multifinality (i.e., comorbidity) and divergent trajectories (i.e., expressions of different disorders; Nolen-Hoeksema & Watkins, 2011). Thibodeau et al. (2015, p. 55) suggested that disorder-specific IU may reflect "a theoretically proximal and explicit causal intermediary" between trait IU and symptoms of emotional disorders.

Current research highlights a conceptual distinction between dispositional trait IU (i.e., general experiences of uncertainty) and disorder-specific IU (i.e., the specific focus of uncertainty differs between emotional disorders; Boswell et al., 2013; Carleton, 2016; Carleton, Collimore, & Asmundson, 2010; Mahoney & McEvoy, 2012b). For example, the focus of uncertainty prevalent in panic disorder (e.g., uncertainty about when a panic attack may occur) may differ from the focus of uncertainty in obsessive compulsive disorder (e.g., uncertainty about causing harm). Prior research demonstrates that clinical participants report higher disorder-specific IU relative to trait IU (Jensen & Heimberg, 2015; Mahoney & McEvoy, 2012b). Extending this work, Thibodeau et al. (2015) found strong associations between disorder-specific IU and trait IU, and that disorder-specific IU explained unique variance in respective disorder symptoms beyond trait IU. In contrast to previous research suggesting trait IU is comparable across emotional disorders (Carleton, Mulvogue et al., 2012; Mahoney & McEvoy, 2012a), Thibodeau et al. (2015) found that the generalisability of IU varied; trait IU displayed stronger associations with symptoms of generalised anxiety disorder and obsessive compulsive disorder, while disorder-specific IU was found to be a stronger predictor of social anxiety and panic disorder symptoms. Trait and disorder-specific IU similarly predicted symptoms of depression and specific phobia. Inconsistencies in findings about the generalisability of IU may be due to analytical and methodological differences (e.g., use of different disorder-specific IU measures). Further, the research to date has typically focused on the relationships between trait IU, disorder-specific IU, and emotional disorder symptoms and, as such, the significance and differentiation of disorder-specific IU relative to other vulnerability factors has not been investigated.

Researchers suggest that emotional disorders may be best delineated within a structural framework of general and specific factors (Hong & Cheung, 2015; Taylor, 1998). In line with this, hierarchical conceptualisations of psychopathology that include IU have been supported such that overarching general traits are believed to influence emotional symptoms through intermediate disorder-specific vulnerability factors (Hong, 2013; Norton & Mehta, 2007; Paulus, Talkovsky, Heggeness, & Norton, 2015; Sexton, Norton, Walker, & Norton, 2003; van der Heiden et al., 2010). In their meta-analysis Hong and Cheung (2015) found that several vulnerabilities underlying depression and anxiety may share a common core of IU and, thereby, a fundamental fear of the unknown. Taken together, prior research underscores the importance of IU relative to other vulnerability processes (Carleton, 2016), and whilst considerable research has been conducted on trait IU, the role of disorder-specific IU remains less clear. No studies have examined the relationships between trait IU as a higher-order distal factor, and disorder-specific IU and disorder symptomology as intermediate- and lower-order factors, respectively, relative to other specific vulnerabilities.

The aim of the present study was to evaluate a hierarchical model of transdiagnostic and disorder-specific vulnerabilities for symptoms of generalised anxiety disorder, social anxiety disorder, obsessive compulsive disorder,[1] and panic disorder. For each symptom measure an additional key cognitive vulnerability factor articulated in disorder-specific cognitive models was selected and evaluated in this study: negative metacognitions in generalised anxiety disorder (Wells, 2005); fear of negative evaluation in social anxiety disorder (Rapee & Heimberg, 1997); inflated responsibility in obsessive compulsive disorder (Salkovskis, 1985); and agoraphobic cognitions in panic disorder (Goldstein & Chambless, 1978). Further, we aimed to extend previous work (Norton & Mehta, 2007; van der Heiden et al., 2010) by employing structural equation modelling (SEM) techniques to examine the direct and specific indirect effects between the constructs of interest. Our first hypothesis was that trait IU would significantly predict each of the disorder-specific IU subscales, disorder-specific cognitive vulnerabilities, and anxiety disorder symptoms. Our second hypothesis was that disorder-specific IU would account for unique variance in disorder-specific vulnerabilities and concordant disorder symptoms, beyond trait IU. Our third hypothesis was that each of the disorder-specific vulnerabilities would significantly predict their concordant disorder symptoms. Our fourth hypothesis was that each of the disorder-specific IU subscales and other vulnerabilities would carry significant indirect effects between trait IU and disorder-specific symptoms.

2. Method

2.1. Participants

Participants were 506 undergraduate psychology students (80.20% female) aged between 18 and 55 years ($M = 21$; $SD = 4.91$) who were recruited via the university's research participant pool. The majority of the sample identified as Caucasian (68.20%). Eligibility criteria required participants to be over 18 years of age. Based on moderate correlations found in previous studies investigating relationships between disorder-specific IU and symptom measures (Thibodeau et al., 2015), this sample size was adequate to investigate the final structural model (MacCallum, Browne, & Sugawara, 1996). Taxometric research provides support for the dimensionality of disorder symptoms and associated vulnerability factors, including IU (Carleton, Weeks et al., 2012; Haslam, Williams, Kyrios, McKay, & Taylor, 2005; Weeks, Norton, & Heimberg, 2009), and therefore we recruited an unselected sample.

2.2. Measures

Intolerance of Uncertainty Scale, Short Form (IUS-12; Carleton, Norton, & Asmundson, 2007). The 12-item IUS-12, adapted from the original 27-item IUS (Freeston et al., 1994) and designed to assess negative beliefs about uncertainty, was employed as a measure of trait IU. Participants responded to each item on a five-point scale from *not at all characteristic of me* (1) to *entirely characteristic of me* (5). The IUS-12 has a high correlation with the IUS ($r = 0.96$; Carleton, Norton et al., 2007) and strong psychometric properties (Khawaja & Yu, 2010). Internal consistencies for all measures were high and are reported in Table 1.

Disorder-Specific Intolerance of Uncertainty Scale (DSIU; Thibodeau et al., 2015). The 24-item DSIU comprises eight three-item subscales that assess disorder-specific IU pertaining to different disorders including generalised anxiety disorder (IU-GAD), social anxiety (IU-SAD), obsessive compulsive disorder

[1] Obsessive compulsive disorder was included to assess a broader array of emotional disorder symptoms, although it is acknowledged that it is not considered an anxiety disorder in current nosology.

Table 1
Descriptive statistics, Cronbach's alpha, and bivariate correlations between all study variables.

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. IUS-12	33.25	9.80	0.92												
2. IU-GAD	5.68	3.31	0.78*	0.91											
3. IU-SAD	5.31	3.59	0.64*	0.61*	0.92										
4. IU-OCD	5.60	2.96	0.55*	0.52*	0.48*	0.85									
5. IU-PD	2.39	3.30	0.53*	0.47*	0.49*	0.41*	0.96								
6. MCQ-neg	12.44	5.26	0.66*	0.69*	0.56*	0.44*	0.52*	0.93							
7. BFNE-S	15.42	9.45	0.62*	0.62*	0.76*	0.42*	0.41*	0.64*	0.97						
8. OBQ-Res	31.01	10.95	0.51*	0.46*	0.43*	0.47*	0.33*	0.43*	0.46*	0.91					
9. ACQ	24.20	9.69	0.55*	0.50*	0.50*	0.38*	0.58*	0.69*	0.58*	0.44*	0.91				
10. GAD-7	7.06	5.38	0.62*	0.64*	0.53*	0.44*	0.55*	0.77*	0.59*	0.44*	0.68*	0.92			
11. SIPS	17.21	13.85	0.62*	0.56*	0.79*	0.42*	0.47*	0.62*	0.76*	0.46*	0.64*	0.62*	0.96		
12. OCI-R	16.90	13.28	0.61*	0.56*	0.49*	0.54*	0.51*	0.59*	0.49*	0.48*	0.62*	0.59*	0.58*	0.93	
13. PDSS-SR	2.36	2.99	0.44*	0.47*	0.45*	0.30*	0.62*	0.60*	0.47*	0.35*	0.59*	0.63*	0.48*	0.45*	0.85

Note: Cronbach's alphas are on the diagonal. SD, standard deviation; IUS-12, Intolerance of Uncertainty Scale, Short Form; IU, intolerance of uncertainty; GAD, generalised anxiety disorder; SAD, social anxiety disorder; OCD, obsessive compulsive disorder; PD, panic disorder; MCQ-neg, negative metacognitions subscale from the Meta-cognitions Questionnaire-30; BFNE-S, Brief Fear of Negative Evaluation Scale, Straightforward Items; OBQ-Res, responsibility subscale from the Obsessive-Beliefs Questionnaire-44; ACQ, Agoraphobic Cognitions Questionnaire; GAD-7, Generalised Anxiety Disorder-7; SIPS, Social Interaction Phobia Scale; OCI-R, Obsessive Compulsive Inventory-Revised; PDSS-SR, Panic Disorder Severity Scale, Self-Report.
* $p < 0.001$.

(IU-OCD), panic disorder (IU-PD), health anxiety, specific phobia, posttraumatic stress disorder, and depressive disorder. Participants responded to items on a five-point scale ranging from *not at all* (0) to *extremely* (4). Psychometric evidence indicates convergent and criterion validity. The disorder-specific IU-GAD, IU-SAD, IU-OCD, and IU-PD subscales were used in the present study.

Meta-cognitions Questionnarie-30 (MCQ-30; Wells & Cartwright-Hatton, 2004). The short form MCQ-30 was used as a measure of metacognitive beliefs and monitoring (Cartwright-Hatton & Wells, 1997). Participants indicated their level of agreement with each item on a four-point scale from *do not agree* (1) to *agree very much* (4). The MCQ-30 comprises five subscales; positive beliefs about worry, negative metacognitions about the uncontrollability and danger of worry, cognitive confidence, need to control thoughts, and cognitive self-consciousness. Research evidence indicates the MCQ-30 has good temporal stability, and factorial and convergent validity (McEvoy, Moulds, & Mahoney, 2013; Wells & Cartwright-Hatton, 2004). The six-item negative metacognitions subscale was employed in the present study.

Brief Fear of Negative Evaluation Scale, Straightforward Items (BFNE-S; Rodebaugh et al., 2004). The adapted 8-item BFNE-S is a widely used measure designed to measure fears pertaining to negative evaluation from others and comprises only the straightforward-worded items (Carleton, Sharpe et al., 2007; Weeks et al., 2005). Respondents rated items on a five-point scale ranging from *not at all characteristic of me* (1) to *extremely characteristic of me* (5). The BFNE-S is reported to be a more reliable and valid indicator of fear of negative evaluation than the alternative measure comprising reverse-scored items (Rodebaugh et al., 2004; Weeks et al., 2005). Psychometric research indicates good construct and factorial validity (Carleton, Collimore, & Asmundson, 2007; Rodebaugh et al., 2004).

Obsessive-Beliefs Questionnaire-44 (OBQ-44; Obsessive Compulsive Cognitions Working Group [OCCWG], 2005). The OBQ-44, revised from the original lengthier OBQ (OCCWG, 2001), was designed to assess dysfunctional belief domains related to obsessive compulsive disorder. The OBQ-44 comprises three factors; responsibility/threat estimation (OBQ-RT), importance/control of thoughts, and perfectionism/certainty. Participants rated items on a seven-point scale from *disagree very much* (1) to *agree very much* (7). Psychometric evidence demonstrates temporal stability and construct validity (OCCWG, 2005). This study used only the 16-item OBQ-RT subscale. However, measurement research suggests that the responsibility and overestimation of threat items load on two distinct factors (Myers, Fisher, & Wells, 2008) and that overestimation of threat may be representative of a general anxious pathology (Sookman & Pinard, 2002); as such, we were interested in examining inflated responsibility as a specific vulnerability of obsessive compulsive disorder and thereby analyses were conducted using only the eight responsibility items (Myers et al., 2008).

Agoraphobic Cognitions Questionnaire (ACQ; Chambless, Caputo, Bright, & Gallagher, 1984). The 14-item ACQ measures the frequency of catastrophic, negative thoughts about the consequences of anxiety and comprises two subscales pertinent to physical concerns and social/behavioural concerns. Participants indicated how often a thought occurred during an anxiety-provoking experience on a five-point scale ranging from *thought never occurs* (1) to *thought always occurs* (5). Psychometric research indicates temporal stability and construct validity (Chambless et al., 1984).

Generalised Anxiety Disorder-7 (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006). The 7-item GAD-7 assesses the severity of generalised anxiety disorder symptoms. Participants responded to each symptom statement indicating how often, in the last two weeks, they felt bothered by such symptoms along a four-point scale from *not at all* (0) to *nearly every day* (3). The GAD-7 demonstrates good construct, discriminant, and factorial validity (Carleton, Mulvogue et al., 2012; Löwe et al., 2008).

Social Interaction Phobia Scale (SIPS; Carleton et al., 2009). The 14-item SIPS assesses social phobia symptoms reflecting cognitive, behavioural, and affective responses to social interactions (Carleton et al., 2009). Participants indicated the extent to which they felt bothered by symptoms on a five-point scale ranging from *not at all characteristic of me* (0) to *extremely characteristic of me* (4). Psychometric support indicates the SIPS has good factorial, convergent, and discriminant validity (Carleton et al., 2009; Reilly, Carleton, & Weeks, 2012).

Obsessive Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). The 18-item short-form OCI-R was adapted from the original OCI (Foa, Kozak, Salkovskis, Coles, & Amir, 1998) and designed to assess obsessive compulsive symptom severity. Respondents indicated the degree to which they felt distressed or bothered by obsessive compulsive symptoms in the last month on a five-point scale from *not at all* (0) to *extremely* (4). The OCI-R comprises six three-item subscales; washing, checking, obsessions, mental neutralising, ordering, and hoarding. Psychometric support indicates evidence of acceptable reliability and validity (Foa et al., 2002).

Panic Disorder Severity Scale-Self Report (PDSS-SR; Houck, Spiegel, Shear, & Rucci, 2002). The 5-item PDSS-SR measures panic

symptoms and was developed through a two-item removal process from the original, clinician administered PDSS (Shear et al., 2001). Participants responded to each item on a five-point scale from *none* (0) to *extreme* (4). Research evidence indicates acceptable validity (Houck et al., 2002; Wuyek, Antony, & McCabe, 2011).

2.3. Procedure

Participants were recruited from the undergraduate psychology research pool through an online experiment database (SONA) to participate in a study of "Uncertainty and Emotion". After reading an information statement and consent form, participants were directed to an online survey hosted by Qualtrics. All participants provided informed consent. Participants completed demographic information and the standardised self-report questionnaires. The IUS-12 and DSIU were presented first; thereafter, the measures were randomised to minimise potential order effects of fatigue and carelessness in responding. Participants were debriefed and granted coursework credit for participation. Prior to the commencement of this study, institutional ethics approval was obtained (HR34/2015).

2.4. Data analysis

Preliminary analyses were conducted in SPSS 22.0 to screen the data for missing values, outliers, and normality, and to calculate basic descriptive and internal reliability statistics. Assessment of the measurement models for each measure using confirmatory factor analysis (CFA) and the hypothesised model using SEM with maximum likelihood estimation were performed in Mplus 7.4 (Muthén & Muthén, 1998–2015). To determine model fit for the measurement and structural model, fit statistics, factor loadings, and modification indices were examined. Model fit indices included the chi-square goodness of fit statistic where a non-significant value indicates an acceptable fit; however, the chi-square statistic is sensitive to sample size and often rejects the model in large samples (Tabachnick & Fidell, 2013). For a more comprehensive assessment of model fit, supplementary incremental indices included the comparative fit index (CFI) and the Tucker-Lewis index (TLI), as well as absolute indices such as the root mean square error of approximation (RMSEA) with 90% confidence intervals (CIs), and the standardised root mean square residual (SRMR). For the CFI and TLI, values greater than 0.90 and 0.95 generally indicate an acceptable and excellent fit to the data, respectively (Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). For the RMSEA and SRMR values close to 0.08 are indicative of an acceptable fit, and values close to 0.06 and 0.05, respectively, are indicative of a close fit (Hu & Bentler, 1999; Marsh et al., 2004). Standardised estimates were used to assess the strength of structural pathways. Further to evaluating direct pathways, the strength of the total and specific indirect effects and their 95% CIs were estimated using bootstrapping with at least 1000 repeated samples. Bootstrapping accounts for non-normality of the sampling distribution and the indirect effects were considered meaningful if the upper and lower limits of the CI did not encompass zero (Hayes, 2009).

3. Results

3.1. Preliminary analyses

Participants ($n = 91$) were excluded if more than 5% of their data were missing, they completed the survey more than once (only the earliest response was analysed), and/or they failed to meet eligibility criteria (under 18 years), thereby resulting in a final sample size of 506 participants. Missing values analysis, using Little's MCAR test, indicated that data was missing completely at random, χ^2 (4) = 5.33, $p = 0.255$. Accordingly, missing data were replaced using the expectation maximisation method (Muthén & Muthén, 1998–2015; Tabachnick & Fidell, 2013). Data screening indicated no problematic distributional properties as evidenced by acceptable levels of skewness (i.e., <2) and kurtosis (i.e., <7) values, and inspection of histograms (Curran, West, & Finch, 1996; Tabachnick & Fidell, 2013). There were no multivariate outliers (i.e., using a $p < 0.001$ criterion for Mahalanobis D^2) and multicollinearty was not an issue. Descriptive statistics and correlations for all study variables are reported in Table 1. Inspection of the bivariate correlations indicated moderate to large significant associations between trait IU, all disorder-specific IU subscales, cognitive vulnerabilities, and disorder symptoms. Cronbach's alphas for all measures were high (Table 1).

3.2. Measurement models

An independent CFA was conducted to evaluate the measurement model of each individual measure used in the final structural model. For models that displayed a poor fit, modification indices were inspected and error covariances were freed if it was deemed theoretically defensible (e.g., items were similarly worded or overlapped in content). The factor loadings of the models were significant and ranged from 0.47 to 0.95. For a detailed summary of the measurement models, including fit values and modifications, interested readers can refer to Supplementary Material.

3.3. Structural model

An examination of the fit statistics revealed that the structural model provided an acceptable fit to the data, χ^2 (2278) = 4809.70, $p < 0.001$, CFI = 0.92, TLI = 0.92, SRMR = 0.06, and RMSEA = 0.05 (90% CI [0.045–0.049]). The standardised parameter estimates for the structural pathways are displayed in Fig. 1.

Generalised Anxiety Disorder symptoms. The total effect of trait IU on GAD symptoms was significant ($\beta = 0.78$, SE = 0.02, $p < 0.001$, 95% CI = 0.73–0.82): the direct effect ($\beta = 0.33$, SE = 0.10, $p = 0.001$, 95% CI = 0.13–0.52) and total indirect effect ($\beta = 0.46$, SE = 0.09, $p < 0.001$, 95% CI = 0.28–0.62) were both significant. Within the indirect effect, negative metacognitions made a significant contribution ($\beta = 0.34$, SE = 0.06, $p < 0.001$, 95% CI = 0.22–0.47), but disorder-specific IU-GAD did not ($\beta = 0.00$, SE = 0.08, $p = 0.957$, 95% CI = −0.15 to 0.16). There was also a significant indirect path between trait IU and symptoms through IU-GAD and negative metacognitions, respectively ($\beta = 0.11$, SE = 0.05, $p = 0.028$, 95% CI = 0.02–0.22).

Social Anxiety Disorder symptoms. The total effect of trait IU on social anxiety disorder symptoms was significant ($\beta = 0.75$, SE = 0.03, $p < 0.001$, 95% CI = 0.70–0.80): both the direct effect ($\beta = 0.20$, SE = 0.06, $p = 0.001$, 95% CI = 0.09–0.32) and total indirect effect ($\beta = 0.56$, SE = 0.05, $p < 0.001$, 95% CI = 0.46–0.64) were significant. Within the indirect effect, disorder-specific IU-SAD ($\beta = 0.35$, SE = 0.05, $p < 0.001$, 95% CI = 0.26–0.44) and fear of negative evaluation ($\beta = 0.09$, SE = 0.03, $p < 0.001$, 95% CI = 0.04–0.14) made significant contributions. An additional significant indirect effect was found from trait IU to symptoms through IU-SAD and fear of negative evaluation, respectively ($\beta = 0.12$, SE = 0.03, $p < 0.001$, 95% CI = 0.06–0.17).

Obsessive Compulsive Disorder symptoms. An examination of the total effect of trait IU on symptoms of obsessive compulsive disorder was significant ($\beta = 0.74$, SE = 0.03, $p < 0.001$, 95% CI = 0.68–0.80): the direct effect ($\beta = 0.57$, SE = 0.06, $p < 0.001$, 95% CI = 0.45–0.69) and total indirect effect ($\beta = 0.18$, SE = 0.04, $p < 0.001$, 95% CI = 0.10–0.26) were both significant. Within the indirect effect, disorder-specific IU-OCD made a significant contribution ($\beta = 0.14$,

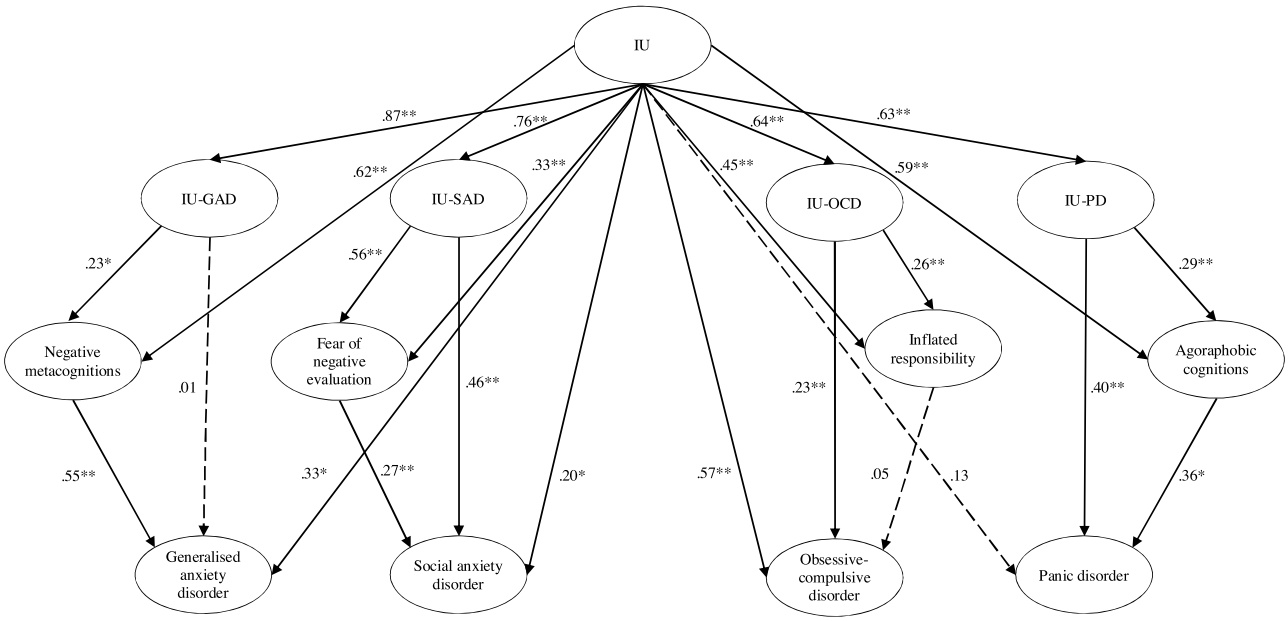


Fig. 1. Structural model with direct pathways. Standardised path coefficients are shown. Significant pathways are continuous, whereas non-significant pathways are dashed. IU = trait intolerance of uncertainty, GAD = generalised anxiety disorder, SAD = social anxiety disorder, OCD = obsessive compulsive disorder, PD = panic disorder. IU-GAD, IU-SAD, IU-OCD, and IU-PD are disorder-specific IU latent constructs. $^{*}p < 0.05$. $^{**}p < 0.001$.

SE = 0.04, $p < 0.001$, 95% CI = 0.07–0.22), but inflated responsibility did not ($\beta = 0.02$, SE = 0.02, $p = 0.285$, 95% CI = −0.02 to 0.06).

Panic Disorder symptoms. The total effect of trait IU on panic disorder symptoms was significant ($\beta = 0.65$, SE = 0.04, $p < 0.001$, 95% CI = 0.57–0.72); interestingly, the direct effect was not significant ($\beta = 0.13$, SE = 0.08, $p = 0.124$, 95% CI = −0.04 to 0.29). The total indirect effect of trait IU on panic disorder symptoms was significant ($\beta = 0.53$, SE = 0.07, $p < 0.001$, 95% CI = 0.39–0.66). Within the indirect effect both disorder-specific IU-PD ($\beta = 0.25$, SE = 0.05, $p < 0.001$, 95% CI = 0.16–0.34) and agoraphobic cognitions ($\beta = 0.21$, SE = 0.06, $p = 0.001$, 95% CI = 0.09–0.34) made significant contributions. An additional significant indirect effect of IU on panic disorder symptoms was found through IU-PD and agoraphobic cognitions, respectively ($\beta = 0.07$, SE = 0.02, $p = 0.01$, 95% CI = 0.02 to 0.12).

The model explained more variance in disorder-specific IU-GAD compared to disorder-specific IU-SAD, IU-OCD, and IU-PD (see Table 2). The model explained a greater proportion of variance in fear of negative evaluation, negative metacognitions, and agoraphobic cognitions than inflated responsibility. Further, the model explained a substantial proportion of variance in all symptom measures (59–75%).

4. Discussion

Theory and evidence suggest that transdiagnostic and disorder-specific vulnerabilities contribute to the development and maintenance of anxiety-related pathology (Barlow, 2000; Norton & Mehta, 2007). While accumulating literature underscores the transdiagnostic significance of IU, recent findings suggest a distinction between trait and disorder-specific manifestations of IU. The present study evaluated a hierarchical model to identify the unique contributions of trait and disorder-specific IU to symptoms of multiple disorders, after controlling for other established disorder-specific cognitive vulnerabilities.

Trait IU was robustly associated with each of the disorder-specific IU subscales, as well as disorder-specific vulnerabilities (i.e., negative metacognitions, fear of negative evaluation, inflated responsibility, and agoraphobic cognitions), and disorder symptoms (i.e., generalised anxiety disorder, social anxiety, and obsessive compulsive disorder). These results contribute to a sizeable body of research indicating that IU is associated with a host of other vulnerabilities and a broad range of disorder symptomology and, therein, lend support to conceptualisations of IU as transdiagnostic and a general vulnerability for anxiety (Carleton, 2012; Gentes & Ruscio, 2011; Hong & Cheung, 2015; Mahoney & McEvoy, 2012a). Contrary to our hypothesis, when disorder-specific IU-PD and agoraphobic cognitions were taken into account, trait IU did not have a direct effect on panic disorder. This is inconsistent with research demonstrating direct effects and associations between IU and panic symptoms (Boswell et al., 2013; Carleton et al., 2014); however, it is important to note that these studies only assessed trait IU, but not disorder-specific IU, within the context of panic disorder. Our findings align with prior work that examines both trait and disorder-specific IU in panic symptoms and that suggests that trait IU has lesser influence than disorder-specific IU on panic disorder relative to other disorders (Mahoney & McEvoy, 2012b; Thibodeau et al., 2015). Our findings suggest that a core cognitive maintaining factor for panic disorder may be a disorder-specific uncertainty about the potentially catastrophic consequences of one's bodily sensations and physical symptoms, rather than a more generalised trait IU.

Each disorder-specific IU subscale was found to predict its concordant disorder-specific vulnerabilities and disorder symptoms with the exception of IU-GAD. Trait IU but not disorder-specific IU-GAD predicted generalised anxiety disorder symptoms. A possible explanation for this finding is that the measure of disorder-specific IU-GAD assesses broad uncertainty (i.e., uncertainty about everything), and therefore it may not account for unique variance beyond that captured by the IUS-12 which is a measure of general trait IU. Nevertheless, these findings extend prior work suggesting that IU has disorder-specific facets and that context may be a critical component of perceiving and responding to uncertainty, and perhaps more so for disorders other than generalised anxiety disorder (Jensen & Heimberg, 2015; Mahoney & McEvoy, 2012b; Thibodeau et al., 2015). The results revealed that the relative contributions of trait IU and disorder-specific IU to symptoms varied; trait IU had stronger associations with symptoms of generalised anxiety disorder and obsessive compulsive disorder, whereas disorder-specific

Table 2
Proportion of variance (R^2) in each construct explained by the final structural model.

Disorder	Disorder-specific IU	Cognitive Vulnerability	Symptoms
Generalised anxiety disorder	76%	68% (negative metacognitions)	71%
Social anxiety disorder	57%	70% (fear of negative evaluation)	75%
Obsessive compulsive disorder	40%	42% (inflated responsibility)	59%
Panic disorder	39%	63% (agoraphobic cognitions)	63%

IU was found to be a stronger predictor of symptoms of social anxiety and panic disorder. These findings are highly consistent with previous research investigating the generalisability of IU to various emotional disorder symptoms (Mahoney & McEvoy, 2012b; Thibodeau et al., 2015). This study extends our knowledge of the direct and indirect role of trait and disorder-specific IU to disorder symptoms beyond key disorder-specific cognitive vulnerability factors.

Each disorder-specific vulnerability factor significantly predicted concordant emotional disorder symptoms (e.g., fear of negative evaluation predicted social anxiety disorder). These results converge with the original conceptual models of each disorder that underscore the primacy of key disorder-specific variables in predicting symptoms (Goldstein & Chambless, 1978; Rapee & Heimberg, 1997; Salkovskis, 1985; Wells, 2005). In contrast, inflated responsibility did not emerge as a significant predictor of obsessive compulsive symptoms. This finding differs from past work that attests to the central role of responsibility in obsessive compulsive disorder symptoms (Shafran, 1997; Smari & Holmsteinsson, 2001; Taylor et al., 2010), but it is broadly consistent with studies that have found responsibility does not uniquely contribute to symptoms when taking into account additional belief domains (Gwilliam, Wells, & Cartwright-Hatton, 2004; Myers et al., 2008; Myers & Wells, 2005). Our findings suggest that if individuals are able to tolerate uncertainty in general and with respect to obsessive compulsive concerns, then they may not need to assume responsibility for preventing harm. Thus, IU may have a more primary role in obsessive compulsive disorder symptoms than responsibility. While there are inconsistencies in the literature regarding the role of different belief domains in obsessive compulsive symptoms, other research highlights the primacy of metacognitive beliefs (e.g., importance and control of thoughts; Myers et al., 2008; Myers & Wells, 2005). Thus, the relative independent contribution of IU and other metacognitive beliefs to obsessive compulsive symptoms requires further exploration.

In addition to its direct effect on symptoms, trait IU was also found to have a modest indirect effect on emotional disorder symptoms. As the current study was cross-sectional causal inferences cannot be made, nonetheless the pattern of significant indirect effects provides some initial empirical evidence that trait IU may influence disorder symptoms through its effect on disorder-specific IU (i.e., IU-SAD, IU-OCD, and IU-PD) and disorder-specific vulnerabilities (i.e., negative metacognitions, fear of negative evaluation, and agoraphobic cognitions). Furthermore, indirect effects also indicated that panic and social anxiety-related disorder-specific IU may also increase the risk of agoraphobic cognitions and fear of negative evaluation, respectively. For example, trait IU may influence or interact with disorder-specific social-evaluative IU (e.g., uncertainty about the thoughts of others in social situations), and reinforce negative beliefs about social catastrophe (e.g., *"I am afraid that others will not approve of me"*, *"I often worry that I will say or do wrong things"*) and, in turn, social anxiety symptoms. Similarly, panic-related IU (e.g., uncertainty about the implications of a physical sensation) may reinforce agoraphobic cognitions (e.g., "*I am going to pass out*", "*I will have a heart attack*") and, in turn, panic symptoms. Together, these findings support the conceptualisation of disorder-specific IU as a proximal and unique pathway between trait IU and particular disorder symptoms (e.g., panic disorder; Thibodeau et al., 2015), and highlight the need to incorporate IU into models of psychopathology.

These findings also have clinical implications. IU is posited to be a potential transdiagnostic treatment target (Boswell et al., 2013; Dugas & Ladouceur, 2000), and more recently, a trans-therapy mechanism (McEvoy & Erceg-Hurn, 2016). The robust relationships found in this study highlight the potential value of explicitly incorporating IU into treatment protocols. Cognitive-behavioural or exposure-based interventions with the aim of restructuring beliefs about or building tolerance of uncertainty may be of benefit. Our findings suggest that individuals with generalised anxiety disorder may benefit from challenging thoughts about uncertainty in general, whereas individuals with panic disorder may require a focus on uncertainty about the potential implications of physical sensations. For example, traditional interventions target the threat-appraisal (e.g., "my chest tightness is a definite sign of a heart attack") via methods such as interoceptive exposure (e.g., Andrews et al., 2003). Our findings suggest that it may be important to explicitly and directly target tolerance of the inherent uncertainty about the meaning of physical symptoms for individuals with panic disorder. For instance, clients may be encouraged to acknowledge that a heart attack is only one of many potential outcomes of the physical symptom, consider more benign alternatives, and/or acknowledge that we cannot be completely sure about the correct interpretation. The focus would then shift to strengthening clients' capacity to adopt a more curious stance towards their ability to manage the uncomfortable physical and emotional symptoms associated with this uncertainty. The goal in therapy would shift from immediately seeking certainty about the meaning of a particular symptom to building acceptance and tolerance for uncertainty. Our results suggest that for individuals with social anxiety disorder and obsessive compulsive disorder, targeting general and disorder-specific IU in therapy may be complementary and additive. Interestingly, the fact that inflated responsibility did not have a direct effect on obsessive compulsive disorder symptoms after controlling for trait and disorder-specific IU invites the intriguing speculation that, if individuals can tolerate uncertainty related to their obsessions, then they do not tend to assume responsibility for preventing their feared outcomes. This finding suggests that targeting IU may be more critical in obsessive compulsive disorder than responsibility. Future intervention studies are required to verify these possibilities.

The current findings should be interpreted with study limitations in mind, which also offer additional avenues for future research. Although SEM incorporates directional hypotheses, the cross-sectional design precludes causal inferences. Future research in this area would benefit from experimental, longitudinal, and treatment studies. It is important to note that the model rejected the null hypothesis for an exact fit and that while the fit indices were good there was room for improvement. An issue in SEM is the possibility of alternative models and while the modification indices suggested improvements could be made we opted to accept our current model. Researchers recommend that modifications be based on statistical and theoretical considerations (Bryne, 2012); as such, the suggested modifications were not deemed theoretically defensible. Further research is warranted to replicate, extend,

and explore improvements to the model. Although research supports the dimensional conceptualisation of anxiety constructs and thus we aimed to obtain a comprehensive range of severity scores (Carleton, Weeks et al., 2012; Sexton et al., 2003), future research needs to examine whether the current results generalise to other community samples as well as clinical populations. Consistent with research in this area, we relied solely on subjective self-report data and future studies should aim to employ multi-method approaches (e.g., clinical interviews; Hong, 2013). A related limitation is that this study did not include specific items to assess for respondent carelessness and/or fatigue. This study extended extant research by investigating a comprehensive set of vulnerabilities as well as disorder-specific factors. The disorder-specific cognitive vulnerabilities were selected on the basis that they are key maintaining factors in contemporary cognitive theories for each disorder. However, it is important to acknowledge that additional factors within each theory were not assessed and were therefore excluded from the model. Future research should investigate the contribution that trait and disorder-specific IU make to the prediction of disorder symptoms beyond other maintaining vulnerability factors included within these models. Incorporating additional symptom and intermediary variables (e.g., avoidance, anxiety sensitivity) is critical for increasing our understanding of how common and distinct mechanisms interact to influence multifinality and divergent trajectories to emotional disorders.

Notwithstanding these limitations, the current study makes an important contribution to the emotional disorder literature by examining the role of distal transdiagnostic and more proximal disorder-specific vulnerabilities. The results of this study indicate different pathways from uncertainty to anxiety, with trait IU representing a general anxiety vulnerability that influences disorder-specific IU, as well as a range of other disorder-specific vulnerabilities and emotional disorder symptomology. Indirect effects highlight the significance of differentiating between trait and disorder-specific manifestations of IU. Delineating the mechanisms by which IU exerts influence on psychopathology presents an important avenue for theoretical and clinical advancement.

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.2016.12.001.

References

Andrews, G., Creamer, M., Crino, R., Hunt, C., Lampe, L., & Page, A. (2003). *The treatment of anxiety disorders: Clinician guides and patient manuals* (2nd ed.). Cambridge: Cambridge University Press.

Barlow, D. (2000). Unraveling the mysteries of anxiety and its disorders from the perspective of emotion theory. *American Psychologist*, *55*, 1247–1263. http://dx.doi.org/10.1037//0003-066X.55.11.1247

Boswell, J. F., Thompson-Hollands, J., Farchione, T. J., & Barlow, D. H. (2013). Intolerance of uncertainty: A common factor in the treatment of emotional disorders. *Journal of Clinical Psychology*, *69*, 630–645. http://dx.doi.org/10.1002/jclp.21965

Brown, T. A., & Naragon-Gainey, K. (2013). Evaluation of the unique and specific contributions of dimensions of the triple vulnerability model to the prediction of DSM- IV anxiety and mood disorder constructs. *Behavior Therapy*, *44*, 277. http://dx.doi.org/10.1016/j.beth.2012.11.002

Bryne, B. M. (2012). *Structural equation modelling with Mplus: Basic concepts, applications, and programming*. New York: Routledge.

Carleton, R. N., Collimore, K. C., Asmundson, G. J., McCabe, R. E., Rowa, K., & Antony, M. M. (2009). Refining and validating the social interaction anxiety scale and the social phobia scale. *Depression and Anxiety*, *26*, E71–E81. http://dx.doi.org/10.1002/da.20480

Carleton, R. N., Collimore, K. C., & Asmundson, G. J. (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*, 189–195. http://dx.doi.org/10.1016/j.janxdis.2009.10.007

Carleton, R. N., Duranceau, S., Freeston, M. H., Boelen, P. A., McCabe, R. E., & Antony, M. M. (2014). But it might be a heart attack: intolerance of uncertainty and panic disorder symptoms. *Journal of Anxiety Disorders*, *28*, 463–470. http://dx.doi.org/10.1016/j.janxdis.2014.04.006

Carleton, R. N. (2012). The intolerance of uncertainty construct in the context of anxiety disorders: Theoretical and practical perspectives. *Expert Review of Neurotherapeutics*, *12*, 937–947. http://dx.doi.org/10.1586/ern.12.82

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

Carleton, R. N., Collimore, K. C., & Asmundson, G. J. (2007). Social anxiety and fear of negative evaluation: Construct validity of the BFNE-II. *Journal of Anxiety Disorders*, *21*, 131–141. http://dx.doi.org/10.1016/j.janxdis.2006.03.010

Carleton, R. N., Mulvogue, M. K., Thibodeau, M. A., McCabe, R. E., Antony, M. M., & Asmundson, G. J. G. (2012). Increasingly certain about uncertainty: Intolerance of uncertainty across anxiety and depression. *Journal of Anxiety Disorders*, *26*, 468–479. http://dx.doi.org/10.1016/j.janxdis.2012.01.011

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

Carleton, R. N., Sharpe, D., & Asmundson, G. J. (2007). Anxiety sensitivity and intolerance of uncertainty: Requisites of the fundamental fears? *Behaviour Research and Therapy*, *45*, 2307–2316. http://dx.doi.org/10.1016/j.brat.2007.04.006

Carleton, R. N., Weeks, J. W., Howell, A. N., Asmundson, G. J., Antony, M. M., & McCabe, R. E. (2012). Assessing the latent structure of the intolerance of uncertainty construct: an initial taxometric analysis. *Journal of Anxiety Disorders*, *26*, 150–157. http://dx.doi.org/10.1016/j.janxdis.2011.10.006

Cartwright-Hatton, S., & Wells, A. (1997). Beliefs about worry and intrusions: the Meta-Cognitions Questionnaire and its correlates. *Journal of Anxiety Disorders*, *11*, 279–296. http://dx.doi.org/10.1016/S0887-6185(97)00011-X

Chambless, D. L., Caputo, G. C., Bright, P., & Gallagher, R. (1984). Assessment of fear of fear in agoraphobics: The body sensations questionnaire and the agoraphobic cognitions questionnaire. *Journal of Consulting and Clinical Psychology*, *52*, 1090–1097. http://dx.doi.org/10.1037//0022-006X.52.6.1090

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods*, *1*, 16–29. http://dx.doi.org/10.1037/1082-989X.1.1.16

Dugas, M. J., & Ladouceur, R. (2000). Treatment of GAD. Targeting intolerance of uncertainty in two types of worry. *Behavior Modification*, *24*, 635–657. http://dx.doi.org/10.1177/0145445500245002

Dugas, M. J., & Robichaud, M. (2007). *Cognitive-behavioral treatment for generalized anxiety disorder: from science to practice*. New York, NY: Routledge.

Dugas, M. J., Gagnon, F., Ladouceur, R., & Freeston, M. H. (1998). Generalized anxiety disorder: A preliminary test of a conceptual model. *Behaviour Research and Therapy*, *36*, 215–226. http://dx.doi.org/10.1016/S0005-7967(97)00070-3

Foa, E. B., Kozak, M. J., Salkovskis, P. M., Coles, M. E., & Amir, N. (1998). The validation of a new obsessive compulsive disorder scale: The obsessive-compulsive Inventory. *Psychological Assessment*, *10*, 206–214. http://dx.doi.org/10.1037/1040-3590.10.3.206

Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., & Salkovskis, P. M. (2002). The obsessive compulsive Inventory: Development and validation of a short version. *Psychological Assessment*, *14*, 485–496. http://dx.doi.org/10.1037//1040-3590.14.4.485

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

Gentes, E. L., & Ruscio, A. M. (2011). A meta-analysis of the relation of intolerance of uncertainty to symptoms of generalized anxiety disorder, major depressive disorder, and obsessive compulsive disorder. *Clinical Psychology Review*, *31*, 923–933. http://dx.doi.org/10.1016/j.cpr.2011.05.001

Goldstein, A. J., & Chambless, D. L. (1978). A reanalysis of agoraphobia. *Behavior Therapy*, *9*, 47–59. http://dx.doi.org/10.1016/S0005-7894(78)80053-7

Gwilliam, P., Wells, A., & Cartwright-Hatton, S. (2004). Does meta-cognition or responsibility predict obsessive compulsive symptoms: A test of the metacognitive model. *Clinical Psychology and Psychotherapy*, *11*, 137–144. http://dx.doi.org/10.1002/cpp.402

Harvey, A., Watkins, E., Mansell, W., & Shafran, R. (2004). *Cognitive behavioural processes across psychological disorders: A transdiagnostic approach to research and treatment*. Oxford: Oxford University Press.

Haslam, N., Williams, B. J., Kyrios, M., McKay, D., & Taylor, S. (2005). Subtyping obsessive compulsive disorder: A taxometric analysis. *Behavior Therapy*, *36*, 381–391. http://dx.doi.org/10.1016/S0005-7894(05)80120-0

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*, *76*, 408–420. http://dx.doi.org/10.1080/03637750903310360

Hong, R. Y., & Cheung, M. W. L. (2015). The structure of cognitive vulnerabilities to depression and anxiety: Evidence for a common core etiologic process based on a meta-analytic review. *Clinical Psychological Science*, *3*, 892–912. http://dx.doi.org/10.1177/2167702614553789

Hong, R. Y. (2013). From dispositional traits to psychopathological symptoms: Social-cognitive vulnerabilities as intervening mechanisms. *Journal of Psychopathology and Behavioural Assessment*, *35*, 407–420. http://dx.doi.org/10.1007/s10862-013-9350-9

Houck, P. R., Spiegel, D. A., Shear, M. K., & Rucci, P. (2002). Reliability of the self-report version of the panic disorder severity scale. *Depression and Anxiety*, *15*, 183–185. http://dx.doi.org/10.1002/da.10049

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Convential criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*, 1–55. http://dx.doi.org/10.1080/10705519909540118

Jensen, D., & Heimberg, R. G. (2015). Domain-specific intolerance of uncertainty in socially anxious and contamination-focused obsessive compulsive individuals. *Cognitive Behaviour Therapy*, *44*, 54–62. http://dx.doi.org/10.1080/16506073.2014.959039

Khawaja, N. G., & Yu, L. N. H. (2010). A comparison of the 27-item and 12-item intolerance of uncertainty scales. *Clinical Psychologist*, *14*, 97–106. http://dx.doi.org/10.1080/13284207.2010.502542

Krohne, H. W. (1989). The concept of coping modes: relating cognitive person variables to actual coping behavior. *Advances in Behaviour Research and Therapy*, *11*, 235–248. http://dx.doi.org/10.1016/0146-6402(89)90027-1

Löwe, B., Decker, O., Müller, S., Brähler, E., Schellberg, D., Herzog, W., & Herzberg, P. Y. (2008). Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. *Medical Care*, *46*, 266–274. http://dx.doi.org/10.1097/MLR.0b013e318160d093

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, *1*, 130–149. http://dx.doi.org/10.1037/1082-989X.1.2.130

Mahoney, A. E., & McEvoy, P. M. (2012a). A transdiagnostic examination of intolerance of uncertainty across anxiety and depressive disorders. *Cognitive Behaviour Therapy*, *41*, 212–222. http://dx.doi.org/10.1080/16506073.2011.622130

Mahoney, A. E., & McEvoy, P. M. (2012b). Trait versus situation-specific intolerance of uncertainty in a clinical sample with anxiety and depressive disorders. *Cognitive Behaviour Therapy*, *41*, 26–39. http://dx.doi.org/10.1080/16506073.2011.622131

Marsh, H. W., Hau, K., & Wen, Z. (2004). In search of golden rules: comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralising Hu and Bentler's (1999) findings. *Structural Equation Modeling: A Multidisciplinary Journal*, *11*, 320–341. http://dx.doi.org/10.1207/s15328007sem1103_2

McEvoy, P. M., & Erceg-Hurn, D. M. (2016). The search for universal transdiagnostic and trans-therapy change processes: evidence for intolerance of uncertainty. *Journal of Anxiety Disorders*, *41*, 96–107. http://dx.doi.org/10.1016/j.janxdis.2016.02.002

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

McEvoy, P. M., Moulds, M. L., & Mahoney, A. E. (2013). Mechanisms driving pre- and post-stressor repetitive negative thinking: Metacognitions, cognitive avoidance, and thought control. *Journal of Behaviour Therapy and Experimental Psychiatry*, *44*, 84–93. http://dx.doi.org/10.1016/j.jbtep.2012.07.011

Muthén, L. K., & Muthén, B. O. (1998). *Mplus user's guide* 1998–2015.(7th ed.). Los Angeles, CA: Muthén & Muthén.

Myers, S. G., & Wells, A. (2005). Obsessive compulsive symptoms: The contribution of metacognitions and responsibility. *Journal of Anxiety Disorders*, *19*, 806–817. http://dx.doi.org/10.1016/j.janxdis.2004.09.004

Myers, S. G., Fisher, P. L., & Wells, A. (2008). Belief domains of the Obsessive Beliefs Questionnaire-44 (OBQ-44) and their specific relationship with obsessive compulsive symptoms. *Journal of Anxiety Disorders*, *22*, 475–484. http://dx.doi.org/10.1016/j.janxdis.2007.03.012

Nolen-Hoeksema, S., & Watkins, E. R. (2011). A heuristic for developing transdiagnostic models of psychopathology: explaining multifinality and divergent trajectories. *Perspectives on Psychological Science*, *6*, 589–609. http://dx.doi.org/10.1177/1745691611419672

Norton, P. J., & Mehta, P. D. (2007). Hierarchical model of vulnerabilities for emotional disorders. *Cognitive Behaviour Therapy*, *36*, 240–254. http://dx.doi.org/10.1080/16506070701628065

Obsessive Compulsive Cognitions Working Group. (2001). Development and initial validation of the obsessive beliefs questionnaire and the interpretation of intrusions inventory. *Behaviour Research and Therapy*, *39*, 987–1006. http://dx.doi.org/10.1016/S0005-7967(00)00085-1

Obsessive Compulsive Cognitions Working Group. (2005). Psychometric validation of the obsessive belief questionnaire and interpretation of intrusions inventory – Part 2: Factor analyses and testing of a brief version. *Behaviour Research and Therapy*, *43*, 1527–1542. http://dx.doi.org/10.1016/j.brat.2004.07.010

Paulus, D. J., Talkovsky, A. M., Heggeness, L. F., & Norton, P. J. (2015). Beyond negative affectivity: A hierarchical model of global and transdiagnostic vulnerabilities for emotional disorders. *Cognitive Behaviour Therapy*, *44*, 389–405. http://dx.doi.org/10.1080/16506073.2015.1017529

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy*, *35*, 741–756. http://dx.doi.org/10.1016/S0005-7967(97)00022-3

Reilly, A. R., Carleton, R. N., & Weeks, J. W. (2012). Psychometric evaluation of the social interaction phobia scale. *Anxiety, Stress, & Coping*, *25*, 529–542. http://dx.doi.org/10.1080/10615806.2011.598150

Renjan, V., McEvoy, P. M., Handley, A. K., & Fursland, A. (2016). Stomaching uncertainty: Relationships among intolerance of uncertainty, eating disorder pathology, and comorbid emotional symptoms. *Journal of Anxiety Disorders*, *41*, 88–95. http://dx.doi.org/10.1016/j.janxdis.2016.03.008

Rodebaugh, T. L., Woods, C. M., Thissen, D. M., Heimberg, R. G., Chambless, D. L., & Rapee, R. M. (2004). More information from fewer questions: The factor structure and item properties of the original and brief fear of negative evaluation scale. *Psychological Assessment*, *16*, 169–181. http://dx.doi.org/10.1037/1040-3590.16.2.169

Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioural analysis. *Behaviour Research and Therapy*, *23*, 571–583. http://dx.doi.org/10.1016/0005-7967(85)90105-6

Sexton, K. A., Norton, P. J., Walker, J. R., & Norton, G. R. (2003). Hierarchical model of generalized and specific vulnerabilities in anxiety. *Cognitive Behaviour Therapy*, *32*, 82–94. http://dx.doi.org/10.1080/16506070302321

Shafran, R. (1997). The manipulation of responsibility in obsessive compulsive disorder. *British Journal of Clinical Psychology*, *36*, 397–407. http://dx.doi.org/10.1111/j.2044-8260.1997.tb01247.x

Shear, M. K., Rucci, P., Williams, J., Frank, E., Grochocinski, V., Vander Bilt, J., & Wang, T. (2001). Reliability and validity of the Panic Disorder Severity Scale: Replication and extension. *Journal of Psychiatric Research*, *35*, 293–296. http://dx.doi.org/10.1016/S0022-3956(01)00028-0

Shihata, S., McEvoy, P. M., Mullan, B. A., & Carleton, R. N. (2016). Intolerance of uncertainty in emotional disorders: What uncertainties remain? *Journal of Anxiety Disorders*, *41*, 115–124. http://dx.doi.org/10.1016/j.janxdis.2016.05.001

Smari, J., & Holmsteinsson, H. E. (2001). Intrusive thoughts, responsibility attitudes, thought-action fusion, and chronic thought suppression in relation to obsessive compulsive symptoms. *Behavioural and Cognitive Psychotherapy*, *29*, 13–20. http://dx.doi.org/10.1017/S1352465801001035

Sookman, D., & Pinard, G. (2002). Overestimation of threat and intolerance of uncertainty in obsessive compulsive disorder. In: R. O. Frost, & G. Steketee (Eds.), *Cognitive approaches to obsessions and compulsions: Theory, assessment, and treatment* (pp. 63–89). Oxford: Elsevier.

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, *166*, 1092–1097. http://dx.doi.org/10.1001/archinte.166.10.1092

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston: Pearson Education.

Taylor, S., Coles, M. E., Abramowitz, J. S., Wu, K. D., Olatunji, B. O., Timpano, K. R., & Tolin, D. F. (2010). How are dysfunctional beliefs related to obsessive compulsive symptoms? *Journal of Cognitive Psychotherapy: An International Quarterly*, *24*, 165–176. http://dx.doi.org/10.1891/0889-8391.24.3.165

Taylor, S. (1998). The hierarchic structure of fears. *Behaviour Research and Therapy*, *36*, 205–214. http://dx.doi.org/10.1016/S0005-7967(98)00012-6

Thibodeau, M. A., Carleton, R. N., McEvoy, P. M., Zvolensky, M. J., Brandt, C. P., Boelen, P. A., & Asmundson, G. J. (2015). Developing scales measuring disorder-specific intolerance of uncertainty (DSIU): A new perspective on transdiagnostic. *Journal of Anxiety Disorders*, *31*, 49–57. http://dx.doi.org/10.1016/j.janxdis.2015.01.006

Weeks, J. W., Heimberg, R. G., Fresco, D. M., Hart, T. A., Turk, C. L., Schneier, F. R., & Liebowitz, M. R. (2005). Empirical validation and psychometric evaluation of the Brief Fear of Negative Evaluation Scale in patients with social anxiety disorder. *Psychological Assessment*, *17*, 179–190. http://dx.doi.org/10.1037/1040-3590.17.2.179

Weeks, J. W., Norton, P. J., & Heimberg, R. G. (2009). Exploring the latent structure of two cognitive components of social anxiety: Taxometric analyses of fears of negative and positive evaluation. *Depression and Anxiety*, *26*, E40–E48. http://dx.doi.org/10.1002/da.20414

Wells, A., & Cartwright-Hatton, S. (2004). A short form of the metacognitions questionnaire: Properties of the MCQ-30. *Behaviour Research and Therapy*, *42*, 385–396. http://dx.doi.org/10.1016/S0005-7967(03)00147-5

Wells, A. (2005). The metacognitive model of GAD: Assessment of meta-worry and relationship with DSM-IV generalized anxiety disorder. *Cognitive Therapy and Research*, *29*, 107–121. http://dx.doi.org/10.1007/s10608-005-1652-0

Wuyek, L. A., Antony, M. M., & McCabe, R. E. (2011). Psychometric properties of the panic disorder severity scale: Clinician-administered and self-report versions. *Clinical Psychology and Psychotherapy*, *18*, 234–243. http://dx.doi.org/10.1002/cpp.703

van der Heiden, C., Melchior, K., Muris, P., Bouwmeester, S., Bos, A. E. R., & van der Molen, H. T. (2010). A hierarchical model for the relationships between general and specific vulnerability factors and symptom levels of generalized anxiety disorder. *Journal of Anxiety Disorders*, *24*, 284–289. http://dx.doi.org/10.1016/j.janxdis.2009.12.005

Appendix D

Confirmation of Author Contributions

Curtin University

School of Psychology

GPO Box U1987
Perth Western Australia 6845

Telephone +61 8 9266 7279
Facsimile +61 8 9266 2464
Email sarah.shihata@curtin.edu.au
Web curtin.edu.au

School of Psychology
Curtin University
GPO Box U1987
Perth, Western Australia, 6845

To whom it may concern,

I, Sarah Shihata, was the major contributor to the conceptualisation, coordination, and implementation of my PhD project, *A transdiagnostic investigation of intolerance of uncertainty on anxiety symptomology and decision-making,* which resulted in the following publication:

Shihata, S., McEvoy, P. M., Mullan, B. A., & Carleton, R. N. (2016). Intolerance of uncertainty in emotional disorders: What uncertainties remain? *Journal of Anxiety Disorders*, *41*, 115-124. doi:10.1016/j.janxdis.2016.05.001

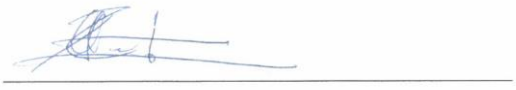
I am the lead author and it was primarily my responsibility to conceptualise, collect and analyse the data, and draft and edit the present paper, which is included in my PhD thesis. This paper provided a review of the literature pertaining to intolerance of uncertainty and areas of development, assessment, behaviour, and relationships to cognitive vulnerability factors and emotional disorder symptoms. This paper highlighted what remains unknown and, in doing so, presents a future research agenda.

Sarah Shihata 

I, as a Co-Author, endorse that this level of contribution by the candidate indicated above is appropriate. As a Co-Author, I contributed to the development of the research and interpretation of the data.

Peter McEvoy 

Barbara Mullan 

Nicholas Carleton 

Curtin University

School of Psychology

GPO Box U1987
Perth Western Australia 6845

Telephone +61 8 9266 7279
Facsimile +61 8 9266 2464
Email sarah.shihata@curtin.edu.au
Web curtin.edu.au

School of Psychology
Curtin University
GPO Box U1987
Perth, Western Australia, 6845

To whom it may concern,

I, Sarah Shihata, was the major contributor to the conceptualisation, coordination, and implementation of my PhD project, *A transdiagnostic investigation of intolerance of uncertainty on anxiety symptomology and decision-making*, which resulted in the following publication:

Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). A bifactor model of intolerance of uncertainty in undergraduate and clinical samples: Do we need to reconsider the two-factor model? *Psychological Assessment, 30*, 893-903. doi:10.1037/pas0000540.

I am the lead author and it was primarily my responsibility to conceptualise, analyse the data, draft and edit the present paper, which is included in my PhD thesis. This paper investigated the psychometric properties of a widely used measure of intolerance of uncertainty by comparing the fit of competing measurement models (unidimensional, correlated two-factor, and bifactor models) in separate undergraduate and clinical samples.

Sarah Shihata 

I, as a Co-Author, endorse that this level of contribution by the candidate indicated above is appropriate. As a Co-Author, I contributed to the development of the research, statistical analyses, and interpretation of the data.

Peter McEvoy 

Barbara Mullan 

Curtin University

School of Psychology

GPO Box U1987
Perth Western Australia 6845

Telephone +61 8 9266 7279
Facsimile +61 8 9266 2464
Email sarah.shihata@curtin.edu.au
Web curtin.edu.au

School of Psychology
Curtin University
GPO Box U1987
Perth, Western Australia, 6845

To whom it may concern,

I, Sarah Shihata, was the major contributor to the conceptualisation, coordination, and implementation of my PhD project, *A transdiagnostic investigation of intolerance of uncertainty on anxiety symptomology and decision-making,* which resulted in the following publication:

Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). Pathways from uncertainty to anxiety: An evaluation of a hierarchical model of trait and disorder-specific intolerance of uncertainty on anxiety disorder symptoms. *Journal of Anxiety Disorders, 45*, 72-79. doi:10.1016/j.janxdis.2016.12.001

I am the lead author and it was primarily my responsibility to conceptualise, collect and analyse the data, and draft and edit the present paper, which is included in my PhD thesis. This paper investigated the relative strength of the direct and indirect pathways between intolerance of uncertainty (IU), disorder-specific IU, key disorder-specific vulnerability factors, and symptoms of multiple anxiety disorders in an undergraduate sample.

Sarah Shihata 

I, as a Co-Author, endorse that this level of contribution by the candidate indicated above is appropriate. As a Co-Author, I contributed to the development of the research, statistical analyses, and interpretation of the data.

Peter McEvoy 

Barbara Mullan 

Appendix E

Ethics Approval Document for Research Project

MEMORANDUM

Curtin University

To:	A/Professor Peter McEvoy School of Psychology and Speech Pathology
CC:	A/Professor Peter McEvoy
From	Professor Peter O'Leary, Chair HREC
Subject	Ethics approval Approval number: HR34/2015
Date	18-Feb-15

Office of Research and Development
Human Research Ethics Office

TELEPHONE 9266 2784
FACSIMILE 9266 3793
EMAIL hrec@curtin.edu.au

Thank you for your application submitted to the Human Research Ethics Office for the project: 6068

A Transdiagnostic Investigation of the Impact of Intolerance of Uncertainty on Anxiety Symptomology and Decision-making

Your application was reviewed by Human Research Ethics Committee at Curtin University at their meeting on the 3/02/2015

Thankyou for providing the additional information requested by the Human Research Ethics Committee. The information you provided was satisfactory and your proposal is now approved.

Please note the following conditions of approval:

1. Approval is granted for a period of four years from **19-Feb-15** to **19-Feb-19**
2. Research must be conducted as stated in the approved protocol.
3. Any amendments to the approved protocol must be approved by the Ethics Office.
4. An annual progress report must be submitted to the Ethics Office annually, on the anniversary of approval.
5. All adverse events must be reported to the Ethics Office.
6. A completion report must be submitted to the Ethics Office on completion of the project.
7. Data must be stored in accordance with WAUSDA and Curtin University policy.
8. The Ethics Office may conduct a randomly identified audit of a proportion of research projects approved by the HREC.

Should you have any queries about the consideration of your project please contact the Ethics Support Officer for your faculty, or the Ethics Office at hrec@curtin.edu.au or on 9266 2784. All human research ethics forms and guidelines are available on the ethics website.

Yours sincerely,

Professor Peter O'Leary
Chair, Human Research Ethics Committee

Appendix F

Ethics Approval Document for Research Project

Curtin University

Office of Research and Development

GPO Box U1987
Perth Western Australia 6845

Telephone +61 8 9266 7863
Facsimile +61 8 9266 3793
Web research.curtin.edu.au

20-Feb-2017

Name: Peter McEvoy
Department/School: School of Psychology and Speech Pathology
Email: Peter.Mcevoy@curtin.edu.au

Dear Peter McEvoy

RE: Amendment approval
Approval number: HR34/2015

Thank you for submitting an amendment request to the Human Research Ethics Office for the project **A Transdiagnostic Investigation of the Impact of Intolerance of Uncertainty on Anxiety Symptomology and Decision-making**.

Your amendment request has been reviewed and the review outcome is: **Approved**

The amendment approval number is HR34/2015-02 approved on 20-Feb-2017.

The following amendments were approved:

- An amendment to the use of this previously collected data to further evaluate the structure of the Intolerance of Uncertainty, Short Form (IUS-12). As per quality improvement exemption from North Metropolitan Health Service Mental Health Human Research Ethics Committee (QI 2014_21) on the 7 November 2014.

Any special conditions noted in the original approval letter still apply.

Standard conditions of approval

1. Research must be conducted according to the approved proposal
2. Report in a timely manner anything that might warrant review of ethical approval of the project including:
   - proposed changes to the approved proposal or conduct of the study
   - unanticipated problems that might affect continued ethical acceptability of the project
   - major deviations from the approved proposal and/or regulatory guidelines
   - serious adverse events
3. Amendments to the proposal must be approved by the Human Research Ethics Office before they are implemented (except where an amendment is undertaken to eliminate an immediate risk to participants)
4. An annual progress report must be submitted to the Human Research Ethics Office on or before the anniversary of approval and a completion report submitted on completion of the project
5. Personnel working on this project must be adequately qualified by education, training and experience for their role, or supervised
6. Personnel must disclose any actual or potential conflicts of interest, including any financial or other interest or affiliation, that bears on this

project
7. Changes to personnel working on this project must be reported to the Human Research Ethics Office
8. Data and primary materials must be retained and stored in accordance with the Western Australian University Sector Disposal Authority (WAUSDA) and the Curtin University Research Data and Primary Materials policy
9. Where practicable, results of the research should be made available to the research participants in a timely and clear manner
10. Unless prohibited by contractual obligations, results of the research should be disseminated in a manner that will allow public scrutiny; the Human Research Ethics Office must be informed of any constraints on publication
11. Ethics approval is dependent upon ongoing compliance of the research with the Australian Code for the Responsible Conduct of Research, the National Statement on Ethical Conduct in Human Research, applicable legal requirements, and with Curtin University policies, procedures and governance requirements
12. The Human Research Ethics Office may conduct audits on a portion of approved projects.

Should you have any queries regarding consideration of your project, please contact the Ethics Support Officer for your faculty or the Ethics Office at hrec@curtin.edu.au or on 9266 2784.

Yours sincerely

Professor Peter O'Leary
Chair, Human Research Ethics Committee

Appendix G

Ethics Approval Document for Research Project

Curtin University

Office of Research and Development

GPO Box U1987
Perth Western Australia 6845

Telephone +61 8 9266 7863
Facsimile +61 8 9266 3793
Web research.curtin.edu.au

08-Aug-2016

Name: Peter McEvoy
Department/School: School of Psychology and Speech Pathology
Email: Peter.Mcevoy@curtin.edu.au

Dear Peter McEvoy

RE: Ethics approval
Approval number: HRE2016-0182

Thank you for submitting your application to the Human Research Ethics Office for the project **Intolerance of uncertainty and eating disorder psychopathology**.

Your application was reviewed through the Curtin University low risk ethics review process.

The review outcome is: **Approved**.

Your proposal meets the requirements described in National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research (2007)*.

Approval is granted for a period of one year from **08-Aug-2016** to **07-Aug-2017**. Continuation of approval will be granted on an annual basis following submission of an annual report.

Personnel authorised to work on this project:

Name	Role
Shihata, Sarah S	Student
McEvoy, Peter	CI
Mullan, Barbara	Co-Inv

Standard conditions of approval

1. Research must be conducted according to the approved proposal
2. Report in a timely manner anything that might warrant review of ethical approval of the project including:
   - proposed changes to the approved proposal or conduct of the study
   - unanticipated problems that might affect continued ethical acceptability of the project
   - major deviations from the approved proposal and/or regulatory guidelines

- serious adverse events

3. Amendments to the proposal must be approved by the Human Research Ethics Office before they are implemented (except where an amendment is undertaken to eliminate an immediate risk to participants)
4. An annual progress report must be submitted to the Human Research Ethics Office on or before the anniversary of approval and a completion report submitted on completion of the project
5. Personnel working on this project must be adequately qualified by education, training and experience for their role, or supervised
6. Personnel must disclose any actual or potential conflicts of interest, including any financial or other interest or affiliation, that bears on this project
7. Changes to personnel working on this project must be reported to the Human Research Ethics Office
8. Data and primary materials must be retained and stored in accordance with the Western Australian University Sector Disposal Authority (WAUSDA) and the Curtin University Research Data and Primary Materials policy
9. Where practicable, results of the research should be made available to the research participants in a timely and clear manner
10. Unless prohibited by contractual obligations, results of the research should be disseminated in a manner that will allow public scrutiny; the Human Research Ethics Office must be informed of any constraints on publication
11. Ethics approval is dependent upon ongoing compliance of the research with the Australian Code for the Responsible Conduct of Research, the National Statement on Ethical Conduct in Human Research, applicable legal requirements, and with Curtin University policies, procedures and governance requirements
12. The Human Research Ethics Office may conduct audits on a portion of approved projects.

Special Conditions of Approval

Nil.

This letter constitutes ethical approval only. This project may not proceed until you have met all of the Curtin University research governance requirements.

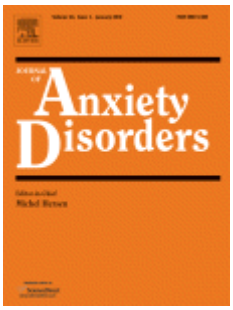
Should you have any queries regarding consideration of your project, please contact the Ethics Support Officer for your faculty or the Ethics Office at hrec@curtin.edu.au or on 9266 2784.

Yours sincerely

Dr Catherine Gangell
Manager, Research Integrity

Appendix H

Permission to Use Copyright Material



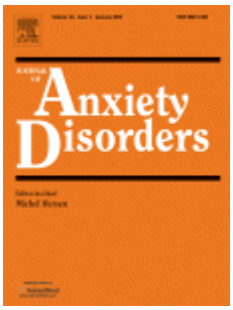
Title: Intolerance of uncertainty in emotional disorders: What uncertainties remain?

Author: Sarah Shihata,Peter M. McEvoy,Barbara Ann Mullan,R. Nicholas Carleton

Publication: Journal of Anxiety Disorders

Publisher: Elsevier

Date: June 2016



Title: Pathways from uncertainty to anxiety: An evaluation of a hierarchical model of trait and disorder-specific intolerance of uncertainty on anxiety disorder symptoms

Author: Sarah Shihata,Peter M. McEvoy,Barbara A. Mullan

Publication: Journal of Anxiety Disorders

Publisher: Elsevier

Date: January 2017

Copyright

Elsevier

Describes the rights related to the publication and distribution of research. It governs how authors (as well as their employers or funders), publishers and the wider general public can use, publish and distribute articles or books.

In order for Elsevier to publish and disseminate research articles, we need publishing rights. This is determined by a publishing agreement between the author and Elsevier. This agreement deals with the transfer or license of the copyright to Elsevier and authors retain significant rights to use and share their own published articles. Elsevier supports the need for authors to share, disseminate and maximize the impact of their research and these rights, in Elsevier proprietary journals* are defined below:

For subscription articles

Authors transfer copyright to the publisher as part of a journal publishing agreement, but have the right to:

- Share their article for Personal Use, Internal Institutional Use and Scholarly Sharing purposes, with a DOI link to the version of record on ScienceDirect (and with the Creative Commons CC-BY-NC- ND license for author manuscript versions)
- Retain patent, trademark and other intellectual property rights (including research data).
- Proper attribution and credit for the published work.

For open access articles

Authors sign an exclusive license agreement, where authors have copyright but license exclusive rights in their article to the publisher**. In this case authors have the right to:

- Share their article in the same ways permitted to third parties under the relevant user license (together with Personal Use rights) so long as it contains a CrossMark logo, the end user license, and a DOI link to the version of record on ScienceDirect.
- Retain patent, trademark and other intellectual property rights (including research data).
- Proper attribution and credit for the published work.

***Please note that society or third party owned journals may have different publishing agreements. Please see the journal's guide for authors for journal specific copyright information.**

****This includes the right for the publisher to make and authorize commercial use, please see "Rights granted to Elsevier" for more details.**

Help and Support

- Download a sample publishing agreement for subscription articles in English and French.
- Download a sample publishing agreement for open access articles for authors choosing a commercial user license and non-commercial user license.
- For authors who wish to self-archive see our sharing guidelines
- See our author pages for further details about how to promote your article.
- For use of Elsevier material not defined below please see our permissions page or FAQs or email us at the permissions help desk.

Government employees

Elsevier has specific publishing agreements with certain government and inter-governmental organizations for their employee authors. These agreements enable authors to retain substantially the same rights as detailed in the "Author Rights section" but are specifically tailored for employees from the relevant organizations, including:

- World Bank
- World Health Organization
- For US government employees, works created within the scope of their employment are considered to be public domain and Elsevier's publishing agreements do not require a transfer or license of rights for such works.
- In the UK and certain commonwealth countries, a work created by a government employee is copyrightable but the government may own the copyright (Crown copyright). Click here for information about UK government employees publishing open access

Rights granted to Elsevier

For both subscription and open access articles, published in proprietary titles, Elsevier is granted the following rights:

- The exclusive right to publish and distribute an article, and to grant rights to others, including for commercial purposes.
- For open access articles, Elsevier will apply the relevant third party user license where Elsevier publishes the article on its online platforms.
- The right to provide the article in all forms and media so the article can be used on the latest technology even after publication.
- The authority to enforce the rights in the article, on behalf of an author, against third parties, for example in the case of plagiarism or copyright infringement.

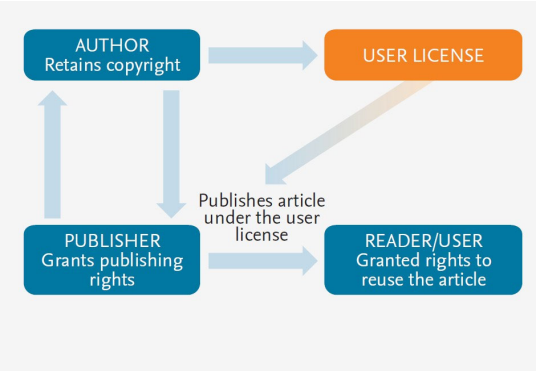
Protecting author rights

Copyright aims to protect the specific way the article has been written to describe an experiment and the results. Elsevier is committed to its authors to protect and defend their work and their reputation and takes allegations of infringement, plagiarism, ethic disputes and fraud very seriously.

If an author becomes aware of a possible plagiarism, fraud or infringement we recommend contacting their Elsevier publishing contact who can then liaise with our in-house legal department. Note that certain open access user licenses may permit quite broad re-use that might otherwise be counted as copyright infringement. For details about how to seek permission to use an article see our permission page.

Open access

How copyright works with open access licenses



For Elsevier proprietary journals the following steps apply:

1. Authors sign a publishing agreement where they will have copyright but grant broad publishing and distribution rights to the publisher, including the right to publish the article on Elsevier's online platforms.
2. The author chooses an end user license under which readers can use and share the article.
3. The publisher makes the article available online with the author's choice of end user license.

Internet Posting Guidelines

Update effective November 25, 2015

If a paper is unpublished, the author may distribute it on the Internet or post it on a website but should label the paper with the date and with a statement that the paper has not (yet) been published and is not therefore the authoritative document of record. (Example: "Draft version 1.3, 1/5/16. This paper has not been peer reviewed. Please do not copy or cite without author's permission.")

Authors of articles published in APA journals — the authoritative document, i.e., peer reviewed publication of record — may post a prepublication copy of the final manuscript, as accepted for publication as a word processing file, on their personal website, their employer's server, in their institution's repository, reference managers (e.g., Mendeley) and author social networks (e.g., Academia.edu and ResearchGate) after it is accepted for publication.

The following conditions would prevail:

The posted prepublication copy of the manuscript must carry an APA copyright notice and include a link to the authoritative document on the APA website using the article's digital object identifier (DOI) that may be found on the first page of the published article, in the upper right-hand corner.

Further, the posted prepublication copy of the manuscript must include the following statement: "©**American Psychological Association, [Year]. This paper is not the copy of record and may not exactly replicate the authoritative document published in the APA journal. Please do not copy or cite without author's permission. The final article is available, upon publication, at: [ARTICLE DOI]**"

APA does not provide electronic copies of the authoritative document for authors to post online, and authors are not permitted to scan in the APA typeset version of the published article.

Authors are not permitted to download and subsequently post the APA typeset version of the published article (i.e., the authoritative document of record).