

Cognitive and affective mechanisms underlying intolerance of uncertainty

Author:

Chen, Jessamine

Publication Date:

2018

DOI:

<https://doi.org/10.26190/unsworks/21304>

License:

<https://creativecommons.org/licenses/by-nc-nd/3.0/au/>

Link to license to see what you are allowed to do with this resource.

Downloaded from <http://hdl.handle.net/1959.4/62969> in <https://unsworks.unsw.edu.au> on 2024-05-02

Cognitive and Affective Mechanisms Underlying Intolerance of Uncertainty

Jessamine Tsan-Hsiang Chen
Bachelor of Psychology (Honours)
Master of Psychology (Clinical)

Submitted in partial fulfilment of the requirements for the degree of
Doctor of Philosophy



School of Psychology, Faculty of Science
The University of New South Wales

December 2018



FOR OFFICE USE ONLY Date of completion of requirements for Award:

INCLUSION OF PUBLICATIONS STATEMENT

UNSW is supportive of candidates publishing their research results during their candidature as detailed in the UNSW Thesis Examination Procedure.

Publications can be used in their thesis in lieu of a Chapter if:

- The student contributed greater than 50% of the content in the publication and is the “primary author”, ie. the student was responsible primarily for the planning, execution and preparation of the work for publication
- The student has approval to include the publication in their thesis in lieu of a Chapter from their supervisor and Postgraduate Coordinator.
- The publication is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in the thesis

Please indicate whether this thesis contains published material or not.

☐

This thesis contains no publications, either published or submitted for publication (if this box is checked, you may delete all the material on page 2)

☒

Some of the work described in this thesis has been published and it has been documented in the relevant Chapters with acknowledgement (if this box is checked, you may delete all the material on page 2)

☐

This thesis has publications (either published or submitted for publication) incorporated into it in lieu of a chapter and the details are presented below

CANDIDATE'S DECLARATION

I declare that:

- I have complied with the Thesis Examination Procedure
- where I have used a publication in lieu of a Chapter, the listed publication(s) below meet(s) the requirements to be included in the thesis.

Name	Signature	Date (dd/mm/yy)
Jessamine Chen		05/12/18

Postgraduate Coordinator's Declaration (to be filled in where publications are used in lieu of Chapters)

I declare that:

- the information below is accurate
- where listed publication(s) have been used in lieu of Chapter(s), their use complies with the Thesis Examination Procedure
- the minimum requirements for the format of the thesis have been met.

PGC's Name	PGC's Signature	Date (dd/mm/yy)

ORIGINALITY STATEMENT

‘I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the award of any other degree or diploma at UNSW or any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the research by others, with whom I have worked at UNSW or elsewhere, is explicitly acknowledged in the thesis. I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project's design and conception or in style, presentation and linguistic expression is acknowledged.’

Signed: _____

Date: _____

COPYRIGHT STATEMENT

'I hereby grant the University of New South Wales or its agents the right to archive and to make available my thesis or dissertation in whole or part in the University libraries in all forms of media, now or here after known, subject to the provisions of the Copyright Act 1968. I retain all proprietary rights, such as patent rights. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

I also authorise University Microfilms to use the 350 word abstract of my thesis in Dissertation Abstract International (this is applicable to doctoral theses only).

I have either used no substantial portions of copyright material in my thesis or I have obtained permission to use copyright material; where permission has not been granted I have applied/will apply for a partial restriction of the digital copy of my thesis or dissertation.'

Signed

Date

AUTHENTICITY STATEMENT

'I certify that the Library deposit digital copy is a direct equivalent of the final officially approved version of my thesis. No emendation of content has occurred and if there are any minor variations in formatting, they are the result of the conversion to digital format.'

Signed

Date

Acknowledgements

I wish to thank Professor Peter Lovibond for his generous supervision and mentoring throughout my PhD candidature. Peter, I am truly grateful for your guidance, encouragement, and endless patience. The knowledge and advice you impart have helped me navigate many academic and personal challenges involved in the PhD process. Thank you for inspiring me to become a better researcher and a better clinician.

Thank you to Professor Jessica Grisham. Jessica, I am so grateful that you kindly stepped in to assist with the final stage of my PhD candidature. Thank you also to Professor Kim Felmingham and Professor Richard Bryant. To Kim, thank you for providing feedback on the experimental design and data analyses for Experiments 1 and 2. To Richard, many thanks for your valuable feedback on the early draft of the literature review.

Sincere thanks to Dr Oren Griffiths for his assistance with programming of Experiment 5. To my wonderful colleagues at the WSLHD Anxiety Treatment and Research Unit – Eva, Yasmeen, and Michelle – thank you for your warm support and assistance with participant recruitment. Many thanks to all the students at UNSW and the patients who gave their time to participate in my experiments. To all my dear friends – Yin, Anna, Kim, Melizza, and Katie – this long and difficult journey was only possible because of your friendships, words of encouragement and welcome distraction.

Finally and most importantly, I would like to thank my family for their unwavering support and continued patience. To my mother, thank you for all the sacrifices you have made to afford me the opportunities that you never had. To my brother Darren, I am so grateful for your support which has helped me to keep things in perspective.

Presentations and Publications

Conference Presentations:

Chen, J. T.-H. & Lovibond, P. F. (September, 2013). *Emotional responses and biased estimates of aversion in Intolerance of Uncertainty: Implications for Generalised Anxiety Disorder*. Paper presented at the 43rd European Association for Behavioural and Cognitive Therapies (EABCT) Annual Congress, Marrakech, Morocco.

Chen, J. T.-H. & Lovibond, P. F. (July, 2013). *Emotional responses and biased estimates of aversion in Intolerance of Uncertainty: Implications for Generalised Anxiety Disorder*. Paper presented at the seventh World Congress of Behavioral and Cognitive Therapies (WCBCT), Lima, Peru.

Chen, J. T.-H. & Lovibond, P. F. (October, 2012). *Emotional responses and biased estimates of aversion in Intolerance of Uncertainty: Implications for Generalised Anxiety Disorder*. Paper presented at the 35th Australian Association for Cognitive Behavioural Therapy (AACBT) National Conference, Sanctuary Cove, QLD, Australia.

Chen, J. T.-H. & Felmingham, K. L. (October, 2011). *Experimental manipulation of Intolerance of Uncertainty: Investigation of underlying mechanisms*. Paper presented at the 34th Association for Australian Cognitive Behavioural Therapy (AACBT) National Conference, Sydney, NSW, Australia.

Peer-Reviewed Journal Publications:

Experiment 3

Chen, J. T.-H., & Lovibond, P. F. (2016). Intolerance of uncertainty is associated with increased threat appraisal and negative affect under ambiguity but not uncertainty. *Behavior Therapy*, 47(1), 42-53. doi:10.1016/j.beth.2015.09.004

Abstract

This thesis aimed to investigate the mechanisms underlying the construct of Intolerance of Uncertainty (IU), in terms of cognitive bias and negative affect. Experiments 1 and 2 examined appraisal dimensions in relation to positive, negative, and ambiguous scenarios across various life domains. In addition, written feedback was used to manipulate task-related uncertainty. Findings indicated that high levels of IU were associated with greater concern and greater estimates of probability and cost of negative outcomes in response to all three scenario types. The biggest between-group difference in concern was observed for the positive scenarios. High levels of IU were associated with lower confidence in problem-solving abilities, particularly in response to ambiguous situations. The uncertainty manipulation did not elicit a strong effect on high IU participants, possibly due to ceiling effects for their ratings of concern, probability, and cost. Similar patterns of manipulation results were observed in a sample of participants with clinical generalised anxiety disorder (GAD). IU was found to share a robust association with rumination, though only IU predicted appraisal biases in GAD. Appraisal bias in response to ambiguous situations was further examined in Experiments 3, 4, and 5 using a modified covariation bias paradigm. IU was associated with enhanced threat appraisal bias and negative affect. Importantly, uncertainty about the occurrence of a negative outcome was more likely to be perceived as threatening if information required for calibrating the relative probability of a negative outcome was unavailable (ambiguous threat). The final experiment examined IU across anxiety disorders. Findings showed that IU was not specific to GAD, though it was more elevated in GAD and obsessive-compulsive disorder, relative to social anxiety disorder, panic disorder with/without agoraphobia, and hoarding disorder.

Collectively, findings converge on the conclusion that IU is associated with enhanced threat appraisal bias and negative affect in response to ambiguous situations. Furthermore, the association of IU with a number of anxiety disorders is consistent with the notion that IU may be a shared factor in anxiety psychopathology. These conclusions have important clinical implications for further advancing the treatment for pathological worry/GAD, and for the broader anxiety psychopathology.

Table of Contents

List of Figures.....	xiii
List of Tables	xv
CHAPTER 1: Theoretical Conceptualisations of Worry	1
Fundamental Characteristics of Pathological Worry.....	1
Information-Processing Bias in Pathological Worry.....	3
Perpetuation of Worry	7
Worry as Cognitive Avoidance.....	7
Metacognitive Beliefs about Worry.....	10
Emotion Dysregulation and Worry.....	12
Shared Emphasis across Extant Models of Worry	13
Treatment Implications of Contemporary Theoretical Models of GAD.....	14
Limitations of the Extant Research on GAD/Worry	15
Conclusions	20
CHAPTER 2: Overview of the Intolerance of Uncertainty Model.....	22
Development of the Intolerance of Uncertainty Model.....	24
Pathways from Intolerance of Uncertainty to Worry	26
Direct Mechanism: Threat-Biased Appraisal of Ambiguous Information	27
Indirect Mechanisms of Intolerance of Uncertainty	29
Mechanism #1: Cognitive Avoidance	30
Mechanism #2: Positive Beliefs about Worry.....	31
Mechanism #3: Problem Solving Orientation	32
Measurement of Intolerance of Uncertainty.....	33
Other Measures of Reactions to Uncertainty	38
Limitations of the Current Research on Intolerance of Uncertainty	40
Is Intolerance of Uncertainty Specific to Worry/GAD?	40
Methodological Considerations	42
Summary and Conclusion	48
Research Questions and Organisation of Remaining Chapters.....	49
CHAPTER 3: Intolerance of Uncertainty and Appraisal of Ambiguous Situations	
(Experiment 1).....	51
Method.....	57
Participants.....	57

Materials and Measures	58
Procedure	64
Scoring and Analysis	65
Results	66
Group Classification	66
Manipulation Efficacy Check	68
Effects of Ambiguous Feedback on Appraisal	69
Correlation and Regression Analyses	82
Discussion	84
CHAPTER 4: Intolerance of Uncertainty and Appraisal of Ambiguous Situations in GAD (Experiment 2)	92
Method.....	96
Participants.....	96
Design	98
Materials and Measures	98
Results	100
Manipulation Efficacy Check	100
Effects of Ambiguous Feedback on Appraisal	101
Intolerance of Uncertainty, GAD Status, and Appraisal of Ambiguous Situations ...	118
Intolerance of Uncertainty, Rumination, and Appraisal of Ambiguous Situations	121
Discussion	121
CHAPTER 5: Intolerance of Uncertainty under Ambiguity in Non-Clinical Individuals- Part I (Experiment 3)	129
Method.....	134
Participants.....	134
Materials and Measures	134
Procedure	136
Scoring and Analysis	137
Results	138
Online Expectancy Ratings.....	139
Post-Experiment Covariation Estimates	141
Post-Experiment Mood Ratings.....	143
Skin Conductance	144

Correlations.....	145
Discussion	148
CHAPTER 6: Intolerance of Uncertainty under Ambiguity in Non-Clinical Individuals- Part II (Experiment 4)	155
Method.....	156
Participants.....	156
Materials and Measures	157
Scoring and Analysis	157
Results	157
Online Expectancy Ratings.....	158
Post-Experiment Covariation Estimates	160
Post-Experiment Mood Ratings.....	163
Skin Conductance	164
Correlations.....	166
Discussion	168
CHAPTER 7: Threat Appraisal under Ambiguity in GAD (Experiment 5).....	176
Method.....	179
Participants.....	179
Materials and Measures	181
Scoring and Analysis	182
Results	182
Online Expectancy Ratings.....	183
Post-Experiment Covariation Estimates	185
Post-Experiment Mood Ratings.....	187
Correlations between Outcome Variables and Self-Report Measures.....	188
The Role of Intolerance of Uncertainty in Threat Appraisal Bias and Negative Affect	190
Mediation Analyses	192
Discussion	195
CHAPTER 8: Intolerance of Uncertainty across Anxiety and Related Disorders (Experiment 6)	202
Method.....	211
Participants.....	211

Materials and Measures	212
Procedure	216
Scoring and Analysis	216
Results	217
Correlations between IU and Trait Measures	222
Intolerance of Uncertainty and Anxiety Symptom Measures.....	223
Intolerance of Uncertainty and Depression	225
Correlations between Trait and Symptom Measures	226
Cognitive Avoidance and Symptom Measures.....	228
Negative Problem Orientation and Symptom Measures.....	228
Discussion	229
CHAPTER 9: General Discussion	238
Summary of the Empirical Findings	240
Interpretations of the Empirical Findings.....	244
Appraisal Bias in Intolerance of Uncertainty	245
Impact of Different Levels of Uncertainty	248
Dual Character of Intolerance of Uncertainty.....	248
Specificity of Intolerance of Uncertainty.....	250
The Role of Repetitive Thinking in Intolerance of Uncertainty	252
Intolerance of Uncertainty, Negative Problem Orientation, and Cognitive Avoidance	253
Clinical Implications	256
Limitations and Future Research.....	260
Autonomic Arousal in Intolerance of Uncertainty	261
Personality Diatheses in Intolerance of Uncertainty.....	263
Intolerance of Uncertainty in Hierarchical Structure of Psychopathology	264
Conclusions	269
References	271
Appendices	327

List of Figures

<i>Figure 2.1.</i> Proposed mechanisms of IU's contribution to worry (Dugas et al., 1998).....	27
<i>Figure 3.1.</i> Mean concern ratings (%) at baseline (T1) and post-manipulation (T2).	71
<i>Figure 3.2.</i> Mean controllability ratings (%) at baseline (T1) and post-manipulation (T2).	73
<i>Figure 3.3.</i> Mean confidence ratings (%) at baseline (T1) and post-manipulation (T2).	75
<i>Figure 3.4.</i> Mean negative outcome probability ratings (%) at baseline (T1) and post-manipulation (T2).....	77
<i>Figure 3.5.</i> Mean negative outcome cost ratings (%) at baseline (T1) and post-manipulation (T2).....	79
<i>Figure 3.6.</i> Mean predictability ratings (%) at baseline (T1) and post-manipulation (T2).	81
<i>Figure 4.1.</i> Mean concern ratings (%) at baseline (T1) and post-manipulation (T2).	103
<i>Figure 4.2.</i> Mean controllability ratings (%) at baseline (T1) and post-manipulation.	106
<i>Figure 4.3.</i> Mean confidence ratings (%) at baseline (T1) and post-manipulation (T2). ..	108
<i>Figure 4.4.</i> Mean negative outcome probability ratings (%) at baseline (T1) and post-manipulation (T2).....	110
<i>Figure 4.5.</i> Mean negative outcome cost ratings (%) at baseline (T1) and post-manipulation (T2).....	113
<i>Figure 4.6.</i> Mean predictability ratings (%) at baseline (T1) and post-manipulation (T2).	115
<i>Figure 5.1.</i> Mean aversive picture expectancy ratings.	140
<i>Figure 5.2.</i> Mean post-experiment cue-aversion covariation estimates for each cue.	142
<i>Figure 5.3.</i> Mean post-experiment mood ratings for each cue.	144
<i>Figure 5.4.</i> Mean change in log-corrected skin conductance level for each cue.	145
<i>Figure 6.1.</i> Mean aversive picture expectancy ratings for each cue.	159
<i>Figure 6.2.</i> Mean post-experiment cue-aversion covariation estimates for each cue.	161
<i>Figure 6.3.</i> Mean post-experiment mood ratings for each cue.	163
<i>Figure 6.4.</i> Mean change in log-corrected skin conductance level for each cue.	165
<i>Figure 7.1.</i> Mean aversive picture expectancy ratings for each cue.	184
<i>Figure 7.2.</i> Mean post-experiment cue-aversion covariation estimates for each cue.	186
<i>Figure 7.3.</i> Mean post-experiment mood ratings for each cue	187

<i>Figure 7.4.</i> Mediation analysis suggests that Intolerance of Uncertainty is associated with biased appraisal of ambiguous threat (difference in expectancy ratings to the ambiguous and uncertain cues) indirectly via GAD status.	194
<i>Figure 8.1.</i> Mean total IUS-12 for the three participant groups.	220

List of Tables

Table 2.1 The Intolerance of Uncertainty Scale- 27 item (Freeston et al., 1994).....	34
Table 2.2 Summary of factor analysis studies for the 27-item Intolerance of Uncertainty Scale (IUS-27) and the 12-item IUS (IUS-12).....	36
Table 3.1 Means (<i>M</i>) and standard deviations (<i>SD</i>) for all self-report variables by IU group	67
Table 3.2 Means (<i>M</i>) and standard deviations (<i>SD</i>) for all self-report variables by manipulation group.. ..	68
Table 3.3 Pearson bivariate zero-order correlation coefficients for self-report and outcome variables for the ambiguous scenarios.	83
Table 4.1 Demographic description of participants	98
Table 4.2 Means (<i>M</i>) and standard deviations (<i>SD</i>) for all self-report variables by controls and GAD participants.....	100
Table 4.3 Pearson bivariate correlation coefficients for self-report questionnaires and outcome variables for the ambiguous scenarios	117
Table 4.4 Linear regression analysis for total IUS-12 and GAD status as a set of variables predicting outcome variables for the ambiguous scenarios	120
Table 5.1 Means (<i>M</i>) and standard deviations (<i>SD</i>) for all self-report variables by IU group	139
Table 5.2 Pearson bivariate correlation coefficients for outcome (target cues) and self- report variables.....	147
Table 6.1 Means (<i>M</i>) and standard deviations (<i>SD</i>) for all self-report variables by IU group	158
Table 6.2 Pearson bivariate correlation coefficients for outcome (target cues) and self- report variables.....	167
Table 7.1 Demographic description of participants	180
Table 7.2 Means (<i>M</i>) and standard deviations (<i>SD</i>) for all self-report variables for the Control and GAD groups	183
Table 7.3 Pearson bivariate correlation coefficients for outcome and self-report variables	189

Table 7.4 Crosstab analysis for the number of High and Low IU individuals in each of the two participant groups.....	191
Table 8.1 Sample characteristics for diagnostic groups based on primary diagnosis.	219
Table 8.2 Means (<i>M</i>) and standard deviations (<i>SD</i>) for self -report variables by diagnostic group.	221
Table 8.3 Correlations between IU and trait measures	222
Table 8.4 Means and standard deviations for symptom measures and bivariate correlations between IU, trait and symptom measures	227

CHAPTER 1

Theoretical Conceptualisations of Worry

Intolerance of Uncertainty (IU; Dugas, Gagnon, Ladouceur, & Freeston, 1998) has gained increasing interest in the contemporary anxiety disorder literature as a cognitive vulnerability factor for excessive and uncontrollable worry, the cardinal feature of GAD (American Psychiatric Association, 2013) and other emotional disorders. The IU theoretical model provides a promising framework for further advancing the current understanding and treatment of pathological worry. Before examining the empirical value of the IU model, this chapter will first review extant basic theoretical premises about pathological worry, some of which have been incorporated into the IU model. Chapter 2 will review the development of and the empirical evidence for the IU model.

Fundamental Characteristics of Pathological Worry

The phenomenon of worry is embedded in a person's ability to generate mental representations of future events in order to plan, identify, and solve problems. This universal cognitive phenomenon generally serves constructive functions when it is objective, controllable, and brief (Tallis & Eysenck, 1994). On the other hand, because worry involves thinking repetitively about current/future stressors, it can lead to detrimental effects, such as increased negative affect, interference with cognitive functioning, and disruption to physiological processes (Borkovec, Ray, & Stöber, 1998). Since the publication of the DSM-III (American Psychiatric Association, 1980), worry has been recognised as an important part of anxiety aetiology. Notwithstanding that worry is also

present in other anxiety disorders (Barlow, Blanchard, Vermilyea, Vermilyea, & DiNardo, 1986; Borkovec, 1994; Brown, Antony, & Barlow, 1992) and in depression (Starcevic, 1995), it has generally been considered as the defining feature of generalised anxiety disorder (GAD; American Psychiatric Association, 2013).

Historically, it has been suggested that GAD may be a relatively pure manifestation of high trait anxiety, as it is relatively difficult to define a cutoff point that qualitatively distinguishes normal anxiety from GAD (Rapee, 1991). Nonetheless, contemporary GAD research has endeavoured to delineate qualitative and quantitative differences between normal and pathological worry. Content-wise, clinical GAD patients have reported worrying more about miscellaneous issues (e.g., car transmission problems, breaking a plate, or being late for an appointment) relative to non-clinical subjects (Craske, Rapee, Jackel, & Barlow, 1989; Roemer, Molina, & Borkovec, 1997). Some studies (e.g., Sanderson & Barlow, 1990) have also shown that clinical GAD patients worry more about miscellaneous issues than patients with other anxiety disorders, such as obsessive-compulsive disorder (OCD; American Psychiatric Association, 2013), social phobia, panic disorder with agoraphobia, and simple phobia.

Dugas, Freeston, et al. (1998) compared worry themes (relationships, work, finances, physical threat, and the future) in primary GAD patients, secondary GAD patients, and other anxiety disorder patients (OCD, social phobia, and panic disorder with agoraphobia). Results showed that primary GAD patients worry more about the future compared to secondary GAD and other anxiety disorder patients. Relative to gender- and age-matched healthy control participants, clinical GAD patients also endorse worrying about a wider range of topics (Roemer et al., 1997), spend more time engaged in worry

(Craske et al., 1989), and rate their worrying as uncontrollable (Borkovec, Robinson, Pruzinsky, & DePree, 1983; England & Dickerson, 1988; Parkinson & Rachman, 1981).

Information-Processing Bias in Pathological Worry

Beyond content categories of worry, GAD worriers also report a great proportion of worries without an immediately identifiable external trigger, suggesting that pathological worries can be triggered by subtle stimuli (Craske et al., 1989). One possible explanation is related to selective processing of threats (Mogg & Bradley, 2005). Research into the role of information processing bias in anxiety disorders in part began with the early cognitive theories of Beck (1976; Beck, Rush, Shaw, & Emery, 1979). Beck and colleagues developed a schema model, arguing that the type of emotional information and the manner in which it is processed is critical to the aetiology, maintenance, and treatment of emotional disorders. Importantly, maladaptive cognitive structures (“danger schemata”) are said to automatically facilitate the encoding and retrieval of threatening information. This schema model subsequently informed the development of various cognitive models of anxiety disorders, including panic disorder (Clark, 1986), OCD (Salkovskis, 1989), health anxiety (Warwick & Salkovskis, 1990), and social anxiety disorder (Stopa & Clark, 1993). Although these theories differ somewhat depending on the specific anxiety disorder, they share the view that a selective bias for threat information in attention, interpretation, and memory is central to distinguishing anxious from non-anxious states (Beck, Emery, & Greenberg, 1985).

Early empirical support for the association between anxious states and information processing bias predominantly emerged from studies using a modified Stroop colour-naming task (Stroop, 1938). In a standard Stroop task, participants are required to name the

ink colour in which words are written while ignoring the word content. If the words themselves are colour names (e.g., 'Red') that conflict with the ink colour in which they are written (e.g., the colour blue), the speed of colour-naming is said to be slowed compared to when colour names are congruent with the ink colour in which the words are written. When two processes are carried out in parallel, the phenomenon where one process (word reading) interferes with the other (colour naming), is known as the Stroop effect. The phenomenon of Stroop effect underscores the argument of automatic/involuntary versus controlled/voluntary processing of attention (MacLeod & Dunbar, 1988). Automatic processing is said to occur more rapidly and relies little upon cognitive resources, whereas controlled/voluntary processing is slower and requires more cognitive resources (MacLeod, 1991).

The influence of automatic or controlled processing has been examined in anxious individuals in studies using variations of the Stroop task. For example, relative to non-anxious individuals, anxious patients are slower in naming the colour of threat-related words (e.g., 'Disease') compared to non-threat words (e.g., 'Hobby') (Mathews & MacLeod, 1985; Mogg, Mathews, & Weinman, 1989). Mathews and MacLeod (1986) further demonstrated differential reaction times in anxious but not control participants when threat-related rather than neutral words were presented to the unattended ear in a dichotic listening task. Taken together, these findings highlight an overall strong tendency among anxious individuals to allocate more attentional resources to threat-related distractors compared to non-anxious controls. Although characterised as "generally anxious patients" and "in anxious state", the clinical participants recruited for these studies were arguably early equivalents to the diagnostic category of GAD.

Mathews et al. (1995) used a modified Stroop task and found that GAD patients were slower than non-anxious control participants in naming the colour of threat-related words. Following seven sessions of anxiety management training, which consisted of relaxation, cognitive coping strategies and graded exposure, the difference between the groups in the interference effect of threat-related words was no longer evident. Furthermore, reduction in anxiety symptoms was associated with a decreased tendency to selectively process threatening information. However, data on changes in worry levels were unavailable, thus it is unclear to what extent the change in processing bias was associated with reduction in self-report worry. Bradley, Mogg, Millar, and White (1995) and Mogg, Bradley, Millar, and White (1995) also found greatest reduction in threat interference effects among GAD patients without comorbid depression following six sessions of cognitive therapies. Furthermore, reduced interference effects of threat-related words over time were associated with a reduction in self-reported anxious thoughts about physical health concerns and social concerns. This relationship was also maintained over a 20-month period (Mogg et al., 1995).

Attentional bias in individuals with heightened anxiety vulnerability has also been demonstrated using the dot-probe task (MacLeod, Mathews, & Tata, 1986). In a typical dot probe task, participants view pairs of words on a computer screen. One word appears just above the centre of the screen, the other just below. Following termination of the word pair presentation, a small dot probe immediately appears in the location previously occupied by either word. Participants are then required to press a response button as quickly as possible whenever such probes are detected. Relative latencies to detect probes in each of the two screen positions provide an index of the impact of threat-related stimuli on the distribution

of visual attention. Individuals with high trait anxiety and clinically anxious individuals have also been shown to respond more rapidly to targets appearing in the location of threat-related words compared to non-threat words, indicating an attentional bias towards threat (MacLeod & Mathews, 1988) (MacLeod et al., 1986; Mogg, Mathews, & Eysenck, 1992).

There is also evidence suggesting that attentional bias makes a causal contribution to worry (Hayes, Hirsch, & Mathews, 2010; Ruscio & Borkovec, 2004). Krebs and colleagues (2010) trained university students without self-reported excessive worry to direct their attention to either threat-related or neutral words on a modified dot-probe task. Incorrect detection of the probe identity was followed immediately by a short tone to signal error. During the training phase of this task, participants viewed a word pair on the computer screen, one of which was emotionally negative (e.g., “horror”) and the other was emotionally neutral in content (e.g., “wagons”). When the word pair disappeared from the screen, a small probe, which consisted either a single pixel or two adjacent pixels, was presented in either of the two screen locations previously occupied by one of the words. Because this procedure involved a contingency between word valence and target location, participants were encouraged to direct their attention to neutral or threat-related stimuli respectively. Participants who were induced to direct attention towards threat-related words reported experiencing more negative thought intrusions following instructed worry. This effect was not observed in participants who were induced towards neutral words, suggesting that attention to threats may exacerbate worry persistence particularly when explicit information is provided.

A key idea emerged from the findings above is that worriers habitually attend to threat-related or information. When the awareness of worry-prone individuals is habitually

and selectively attuned to threat-related stimuli, this processing strategy may be part of the cognitive mechanism(s) that underlie worries (Hirsch et al., 2011). Research into attentional bias in the broader anxiety disorder literature has debated whether elevated anxiety vulnerability is associated with selective engagement with or disengagement from threat-related stimuli (e.g., Amir, Elias, Klumpp, & Przeworski, 2003; Garner, Mogg, & Bradley, 2006; Koster, Crombez, Verschuere, & De Houwer, 2004). Within the worry/GAD research, there is limited evidence that biased attentional engagement with threat-related stimuli may be more critical than biased attentional disengagement from such information in causally contributing to worry-related negative thought intrusions (Hirsch et al., 2011).

Perpetuation of Worry

The question as to why excessive worry persists when it causes frequent distress with little apparent benefit has long been the central subject of GAD research. Since the beginning of the 1990s, a number of theoretical models of worry have been developed to conceptualise maladaptive cognitive processes and dysfunctional schemas that perpetuate worry. These major models are discussed below.

Worry as Cognitive Avoidance

Generally considered as the seminal theoretical model of pathological worry, the avoidance model developed by Borkovec and colleagues posits that worry serves to avoid arousal responses provoked by threatening mental images of feared outcomes (Borkovec, 1994; Borkovec, Alcaine, & Behar, 2004). Worriers are said to engage in cognitive strategies automatically and voluntarily in response to the arousal. On the one hand, mental

images of threatening situations are automatically converted into verbal-linguistic thoughts (i.e., an internal dialogue) about the situation in question (Borkovec & Inz, 1990; Borkovec et al., 1998; Freeston, Dugas, & Ladouceur, 1996). On the other hand, voluntary cognitive avoidance strategies include using various distraction tactics (Borkovec & Roemer, 1995) and suppressing worrisome thoughts (Dugas & Koerner, 2005; Dugas et al., 2007). In the short term, worrying might reduce perceived physiological reactivity associated with the mental imagery. Paradoxically, this cognitive form of avoidance is said to interfere with processing of feared images, thereby perpetuating arousal responses over time (Borkovec & Hu, 1990).

Supporting evidence for the proposition that worry is primarily verbal-linguistic first emerged from a clinical study in which GAD patients and non-anxious control participants were asked to describe their mental content during a period of self-relaxation and during the subsequent period of worrying (Borkovec & Inz, 1990). During the 10-min period of relaxation, GAD patients reported nearly equal amounts of thought and imagery whereas non-anxious participants reported experiencing predominantly imagery. During the 10-min period of worrying, non-anxious participants reported a shift from image predominance to thought predominance. Borkovec and Inz (1990) also found that following 12 sessions of a combined treatment package, which consisted of applied relaxation, coping desensitisation and cognitive therapy, GAD patients showed a shift in the thought-imagery ratio from thought predominance to image predominance. Data from non-clinical population have also shown a significantly greater amount of thoughts reported by excessive worriers while worrying compared to ordinary worriers (Freeston et al., 1996). This group difference was not observed for the amount of imagery experienced.

Having established that worry is predominantly of verbal-linguistic nature, Borkovec and colleagues sought to establish the relationship between worry and suppression of sympathetic activation in response to feared material. Traditionally, cardiovascular symptoms such as increased heart rate and heart palpitations have been the physiological hallmark of anxiety. Borkovec and Hu (1990) examined heart rate changes in women with speech anxiety who were randomly assigned to neutral, relaxing, or worrisome thinking condition prior to imagining a public speaking scenario. Although heart rate responsivity did not differ between the three conditions, participants in the worrisome thinking condition showed the least heart rate response during the subsequent imagery period compared to individuals in the relaxing and neutral thinking conditions. However, in a follow-up study that also recruited women with speech anxiety, there was no evidence of differential heart rate responsivity during the subsequent speech imagery between the relaxation group and the general-worry group (Borkovec, Lyonfields, Wiser, & Diehl, 1993).

Borkovec et al. (1993) pre-trained participants to worry with an emphasis on the thoughts, the images, or the affect experienced during worry. They found that participants in the thought-worry condition showed less heart rate activity during imagery compared to participants in the relaxation condition. The authors therefore concluded that it was the worrisome thinking aspect of worry (rather than thinking generally about worry) that prevented the processing of fearful imagery. According to Borkovec and colleagues (2004), one possible explanation for worry's suppressing effects on somatic reactions to phobic imagery could be that worry absorbs attentional and other cognitive resources. As

such, it may be difficult to shift attention away from the worry process to some other stimulus, such as a phobic image.

Borkovec and colleagues also argued that worry is associated with a general suppression of sympathetic activation (Borkovec et al., 2004). This assertion is based on physiological studies demonstrating the association between worry and reduced autonomic variability (Hoehn-Saric & McLeod, 1988; Hoehn-Saric, McLeod, & Zimmerli, 1989; Lyonfields, Borkovec, & Thayer, 1995; Thayer, Friedman, & Borkovec, 1996).

Metacognitive Beliefs about Worry

According to the metacognitive model of worry, individuals with GAD hold both positive and negative beliefs about worry (Cartwright-Hatton & Wells, 1997; Wells, 1994, 1995; Wells & Carter, 2001; Wells & Cartwright-Hatton, 2004). Individuals with GAD are said to have rigid positive beliefs about advantages of using worry as a coping strategy. For example, they might believe that worry helps them to deal with problems more effectively (Wells, 1994). Positive beliefs are linked to Type 1 worry, which is said to comprise sequences of catastrophic thoughts about a range of external events and non-cognitive internal events, such as physical symptoms (Wells, 1997). Negative scenarios are contemplated in a "What if?" questioning style, prompting attempts to generate and/or plan coping options. In the short-term, Type 1 worrying may increase anxiety and associated cognitive and somatic symptoms. However, when worrying persists over a protracted time period, during which the worrier is able to complete a worrisome task, the ensuing reduction of anxiety is likely to lead to positive reinforcement of beliefs about the usefulness of worry (Hebert, Dugas, Tulloch, & Holowka, 2014). Worry is said to continue

until it is either temporarily displaced by competing worries or when the worrier feels they have considered and formulated an action plan for every possible negative outcome.

Worriers also appear to hold conflicting negative beliefs concerning the potential consequences of such repetitive thinking. These negative beliefs contribute to Type 2 worry, which concerns worrying thoughts per se and centres on themes of uncontrollability of worry and the potential dangerous consequences of worry for mental and physical well-being (Wells, 1997). Worrying may be perceived as “dangerous” if the worrier believes it could lead to losing control of their mind, going crazy, or causing bodily damage (Wells, 1994; Wells & Cartwright-Hatton, 2004). These metacognitive negative beliefs about worry subsequently result in behaviours intended to avert the dangers of worrying. Examples of these behaviours include avoiding particular types of stimuli or situations that may trigger worrying, seeking reassurance from others in order to terminate worrying, or engaging in activities as distractions in order to shift worry (Wells & Carter, 1999).

The metacognitive model asserts that positive beliefs are not specific to GAD, despite its contribution to the early development of GAD (Fisher & Wells, 2011). Rather, negative beliefs about worry may play a more important role in triggering full-blown GAD (Fisher & Wells, 2011; Wells, 2004). When negative beliefs exacerbate anxiety, which the person interprets as evidence supporting concerns about the consequences of worrying, it becomes difficult to “feel safe enough” to terminate worrying. Consequently, both types of worry persist.

Although individuals with GAD do not substantially differ in their reported positive beliefs about worry compared to non-worried anxious individuals (Davis & Valentiner, 2000) or high-worriers without GAD (Ruscio & Borkovec, 2004), GAD individuals appear

to endorse more negative metacognitive beliefs about the danger and uncontrollable nature of worry than high worriers without GAD (Ruscio & Borkovec, 2004). Clinical data have also demonstrated that negative beliefs, but not positive beliefs, predict worry (Kertz & Woodruff-Borden, 2011; Sica, Steketee, Ghisi, Chiri, & Franceschini, 2007; van der Heiden et al., 2010; Wells & Carter, 1999, 2001). Even when both positive and negative beliefs about worry are correlated with GAD symptoms and trait worrying, studies using sequential regression have reported that only negative beliefs predict GAD symptoms after controlling for trait worrying (e.g., Penney, Mazmanian, & Rudanycz, 2013). A non-clinical study (Nassif, 1999) demonstrated that negative beliefs about the uncontrollability and dangers of worrying predicted the onset of GAD 12 to 15 weeks later in non-patients.

Emotion Dysregulation and Worry

In the early 2000's Mennin and colleagues contested that although the avoidance model of worry (Borkovec et al., 2004) is useful for understanding the relationship between worry and avoidance of the imagery and physiological arousal associated with negative emotion, the theory has not adequately addressed the fundamental characteristics of the emotional experiences that prompt avoidance strategies such as worry (Mennin, Heimberg, Turk, & Fresco, 2005). The emotion dysregulation model (Mennin, Heimberg, Turk, & Fresco, 2002) therefore sets out to conceptualise the way in which individuals with GAD regulate their emotional experiences in general. The model posits that compared to individuals without GAD, individuals with GAD: 1) experience emotions more intensely; 2) experience marked difficulties identifying, describing, and clarifying their emotional experiences; 3) are prone to greater negative reactivity to emotions by endorsing catastrophic beliefs concerning the consequences of emotions (including anxiety, sadness,

anger, and positive emotions); and 4) struggle to manage or soothe themselves when they experience negative emotions (Mennin, 2004; Mennin et al., 2002). Within the emotion dysregulation model, GAD reflects these four interrelated deficits in emotional functioning.

Preliminary evidence for the emotional regulation model was provided by an analogue study where undergraduates with self-reported GAD demonstrated heightened intensity of emotions, poorer understanding of emotions, stronger negative reactivity to emotions, and more maladaptive management of emotions compared to control participants (Study 1; Mennin et al., 2005). Similarly, treatment-seeking GAD patients reported greater deficits in the above mentioned four areas compared to community participants (Studies 2; Mennin et al., 2005). Exacerbated negative emotions and difficulties in regulating the negative mood were demonstrated in GAD patients following a negative mood induction. In particular, GAD patients reported more difficulties understanding their emotional state and accepting their emotions. They also believed that they have less influence over the course of their emotions (Study 3; Mennin et al., 2005).

Relative to undergraduates with self-reported social anxiety and controls, those with self-reported GAD have also been shown to express greater emotional intensity and greater negative reactivity to depressive moods (Turk, Heimberg, Luterek, Mennin, & Fresco, 2005). Furthermore, indices of poor emotion regulation have been shown to predict GAD after controlling for worry, anxiety, and depression (Mennin et al., 2005).

Shared Emphasis across Extant Models of Worry

The theoretical models reviewed so far agree in their characterisation of the perseverative nature of worry in response to a wide range of triggering thoughts, feelings,

and events. These models also share a common emphasis on the role of experiential avoidance as a maladaptive emotion regulation strategy. For example, the avoidance model conceptualises worry as a strategy for avoiding somatic arousal provoked by fearful imagery (Borkovec et al., 1993), whereas the metacognitive model targets higher level cognitive strategies that worriers use to avoid worrying about worry (Wells, 1995). The emotion dysregulation model identifies worry as one of several ineffective coping strategies to avoid distressing emotions (Mennin et al., 2002). These theoretical models also agree that when worry becomes excessive and uncontrollable, it can impair emotional processing, disrupt coping, and exacerbate anxiety (Behar, DiMarco, Hekler, Mohlman, & Staples, 2009).

Treatment Implications of Contemporary Theoretical Models of GAD

The fact that experiential avoidance is a common emphasis across different aetiological models of GAD has influenced various contemporary intervention approaches to targeting pathological worry. For example, an intervention based on the emotion dysregulation model aims to assist clients with GAD to become more flexible with responding to arousing emotional experience and better able to modulate emotional experience. This is achieved primarily through the practice of mindful attending to somatic and emotional cues (Mennin, Fresco, Ritter, & Heimberg, 2015; Mennin et al., 2002). Metacognitive therapy, on the other hand, addresses catastrophic interpretation of the symptoms associated with worry through strategies such as delaying worrying in response to negative thoughts and modifying meta-beliefs about the dangerousness of worrying (Wells, 2010; Wells et al., 2010). Acceptance-based therapy for GAD (Roemer & Orsillo, 2002) underscores the role of judgment and experiential avoidance in paradoxically

worsening distress and interference. Treatment thus focuses on enhancing awareness of the habitual nature of anxious responding and on acceptance of unpleasant internal experiences (Avdagic, Morrissey, & Boschen, 2014; Roemer & Orsillo, 2007). Similarly, an integrative cognitive behavioural treatment protocol seeks to address emotional processing avoidance in GAD clients in interpersonal contexts (Newman et al., 2011).

Limitations of the Extant Research on GAD/Worry

Although the theoretical models reviewed above have made a significant contribution to the current understanding of pathological worry, the extent to which each model adequately addresses the causal relationship between proposed constructs and worry remains an important issue in GAD research (Fisher & Wells, 2011). This is in part because research studies examining theoretical models of GAD have been subject to several methodological limitations (Behar et al., 2009). Notably, the majority of empirical studies on theoretical models of GAD have used self-report and correlational designs to assess the relationship between proposed theoretical constructs and worry. This is particularly evident in studies examining the metacognitive model (Cartwright-Hatton & Wells, 1997; Wells & Carter, 1999, 2001; Wells & Papageorgiou, 1998) and the emotion dysregulation model (e.g., McLaughlin, Mennin, & Farach, 2007; Mennin et al., 2005; Turk et al., 2005).

Although correlations between self-reported cognitive vulnerability (e.g., positive metacognitive beliefs) and a disorder characteristic (e.g., worry tendency) are informative for preliminary testing of hypotheses, evidence regarding the causal mechanisms that underpin these correlations is lacking within the GAD literature (Hirsch & Mathews, 2012). From this perspective, more experimental research beyond correlational designs is needed to establish the causal role of cognitive constructs in pathological forms of worry and GAD.

The metacognitive model provides an example of the limitations of correlational designs. Although there are data showing that GAD individuals do endorse more positive beliefs about worry than healthy controls (e.g., Dugas, Gagnon, Ladouceur, & Freeston, 1998; Wells, 1995), other studies have shown that individuals with GAD do not differ substantially from non-anxious individuals in self-reported positive beliefs (Cartwright-Hatton & Wells, 1997; Davis & Valentiner, 2000), or high worriers without GAD (Ruscio & Borkovec, 2004). When cognitive constructs such as positive metacognitive beliefs are identified in clinical as well as non-clinical populations, having positive metacognitive beliefs does not necessary mean a person has pathological levels of worry or GAD (Fisher & Wells, 2011). Further research is therefore required to understand the underlying mechanisms by which positive metacognitive beliefs contribute to excessive and uncontrollable worries whereas others do not (Wells, 2010).

Granted it can be difficult to directly observe many proposed cognitive constructs associated with worry, researchers often rely on self-report of internal experiences. Standardised self-report measures of cognitive constructs within major theoretical models of GAD/worry generally demonstrate good psychometric properties (e.g., the Meta-Cognitions Questionnaire; Cartwright-Hatton & Wells, 1997; the Difficulties with Emotion Regulation Scale; Gratz & Roemer, 2004; the Cognitive Avoidance Questionnaire; Sexton & Dugas, 2008). However, self-report measures are inevitably associated with a degree of bias because different individuals can assign different meanings to the same concepts, and some individuals have a tendency to over-report/under-report more so than others (Starcevic & Berle, 2006). In addition to self-report measures, there remains a need for

other types of measures, such as physiological and behavioural measures, to examine the causal effect of proposed cognitive constructs on levels of worry (McLaughlin et al., 2007).

Although investigations of Borkovec's cognitive avoidance model have extended beyond the use of self-report, the model has been criticised for lacking direct support from a priori experimental tests of its central tenets that worry precludes physiological reactivity to fearful emotion inductions (e.g., Behar et al., 2009). Replication studies have also shown increased arousal during periods of worry when a more sensitive measurement of small heart rate effects was used (Vrana, Cuthbert, & Lang, 1989; Vrana & Lang, 1990).

In the aforementioned study by Borkovec et al. (1993), physiological arousal was examined by calculating the degree of change from worry/relaxation periods to periods of imaginal exposure. However, some researchers have questioned the validity of using worry as the baseline to which cardiovascular response to emotional stimuli is compared in studies demonstrating reduced physiological reactivity to fearful stimuli following worry induction. (e.g., Newman & Llera, 2011; Peasley-Miklus & Vrana, 2000; Stapinski, Abbott, & Rapee, 2010). There is evidence that when a pre-manipulation resting baseline is used as the comparison point to evaluate the degree of anxious arousal during fear exposure, the arousal dampening properties of preceding worry are no longer evident (Peasley-Miklus & Vrana, 2000; Stapinski et al., 2010).

Evidence for increased arousal during worry has been reported by studies assessing changes in skin conductance level instead of heart rate changes (Andor, Gerlach, & Rist, 2008; Hofmann et al., 2005; Stapinski et al., 2010), and when alternative worry induction procedures are employed (York, Borkovec, Vasey, & Stern, 1987). Furthermore, in studies where despite demonstrating lowered physiological reactivity in response to fearful

imagery, both individuals with and without GAD endorse increased negative affect when induced into a worried state (Andor et al., 2008; Llera & Newman, 2010), suggesting that worry may not necessarily facilitate emotional suppression or avoidance as argued by the cognitive avoidance model. Rather, it could be that worry leads to a heightened negative emotional state which may be sustained across the worry induction and even following worry termination (Brosschot, Van Dijk, & Thayer, 2007; Llera & Newman, 2014).

If worry does increase emotional reactivity in response to subsequent exposure to fearful stimuli, then additional data may be needed to track changes in negative emotionality from baseline to worry inductions (Llera & Newman, 2014). Related to this is also the question as to how increased negative affect impacts on subsequent processing of physiological and subjective reactivity to a stressor in individuals experiencing excessive and uncontrollable worry (Llera & Newman, 2010).

In summary, a substantial body of evidence challenges the hypothesis that worry enables avoidance of emotion. Nonetheless, it is important to recognise that the cognitive avoidance model has been pivotal in motivating researchers to revisit basic research into the complex pattern of perseverations in cognitive, affective, and autonomic processes in pathological worry. For example, reflecting on their early findings of reduced autonomic arousal to fearful imagery exposure following worry induction (Borkovec & Hu, 1990; Borkovec et al., 1983), Borkovec and colleagues (Thayer et al., 1996) noted that changes in heart rate responses, which reflect sympathetic activity of the nervous system, may not be a reliable measure for assessing the autonomic characteristics of GAD and worry. Increased arousal as a result of worry may reflect a deficit in the inhibitory activity of the parasympathetic nervous system (Brosschot et al., 2007; Thayer et al., 1996). Thayer et al.

(1996) found that worry in individuals with clinical GAD was associated with reduced heart rate variability, which has been considered by some researchers to be a reliable indicator of parasympathetic activity (Levy, 1984; Levy, 1990; Uijtdehaage & Thayer, 1989). Impaired cardiac vagal function, as indicated by reductions in heart rate variability, provides a useful avenue for further exploring autonomic inflexibility and its relationship with chronic worry (Hoehn-Saric & McLeod, 1988).

Another limitation shared by existing theoretical models of worry concerns direct investigations of threat appraisal. One of the key assumptions in major theoretical models of worry is that worry precludes emotional processing of fear which in turn reinforces threat appraisal (Borkovec et al., 2004; Mennin, Turk, Heimberg, & Carmin, 2004; Wells, 1995). Interestingly, investigations examining the major theoretical models have not yet provided strong empirical support for this assumption. Stapinski and colleagues (2010) evaluated threat associations on a task where clinical GAD participants were instructed to worry, imaginally process or relax in response to an anxiety-provoking stimulus (information about possible health risks of mobile phone usage). Participants in the worry manipulation condition showed evidence of inflated threat expectancies compared to other modes of processing, and this effect persisted following re-exposure to the anxiety-provoking stimulus. Current major theoretical models of worry may benefit from further research into the role of threat expectancies as possible mechanisms that mediate the causal relationship between proposed theoretical constructs (i.e., cognitive avoidance, metacognitive beliefs about worry, and emotion dysregulation) and worry. For example, previous studies have shown that compared to non-worriers, chronic worriers rate aversive outcomes as more probable (Berenbaum, Thompson, & Bredemeier, 2007; Berenbaum,

Thompson, & Pomerantz, 2007; Vasey & Borkovec, 1992), and they rate the cost of the aversive outcome as being greater (Berenbaum, Thompson, & Pomerantz, 2007; Butler & Mathews, 1983; Ruscio & Borkovec, 2004). There is also evidence that inflated estimates of probability and cost of hypothetical events are associated with worry severity (Butler & Mathews, 1983; Butler & Matthews, 1987; MacLeod, Williams, & Bekerian, 1991).

Conclusions

A review of extant theoretical models of worry highlights the considerable advances that have been made in the contemporary understanding of worry. Interestingly, However, the methodological issues discussed in this chapter also highlights a need for more basic research examining the physiological and cognitive mechanisms underlying the perpetuation of worry (Behar et al., 2009). This is a pertinent issue considering the limited success of even the best evidence-based psychological treatments for GAD (Cuijpers et al., 2014; Durham, Chambers, McDonald, Power, & Major, 2003).

Between 1998 and 2008, only 22% of GAD publications were devoted to process issues (namely cognitive, behavioural and emotional variables associated with GAD) compared to 44% devoted to treatment issues (Dugas, Anderson, Deschenes, & Donegan, 2010). With treatment research now essentially making up almost half of the GAD publications, the GAD literature has further shifted away from basic research examining the predictive components of theoretical models. GAD is recurrent and chronic in presentation (Fricchione, 2004), with a low rate of remission and recovery (Hunot, Churchill, Teixeira, & Silva de Lima, 2007; Yonkers, Massion, Warshaw, & Keller, 1996). In order to enhance our ability to provide effective clinical intervention for worry/GAD, additional empirical

evidence is needed to clarify mechanisms of change that facilitate changes in studies that have demonstrated treatment responses in individuals.

Arguably, chronic, excessive and uncontrollable worry and anxiety can be challenging to study in laboratory conditions. Within the panic disorder literature, the laboratory context has been used repeatedly to provoke and study panic attacks and anxiety sensitivity (e.g., Bernstein, Zvolensky, Marshall, & Schmidt, 2009). For OCD, virtual environments have been simulated to study compulsive checking behaviour (e.g., van den Hout & Kindt, 2003). Within the meta-cognitive model of worry, positive beliefs about worry are thought to precede the development of negative beliefs about worry (Wells, 1995). However, it can be challenging to examine this time-dependent prediction in the context of a cross-sectional study (Davis & Valentiner, 2000). Alternative experimental paradigms are therefore needed to determine underlying causal constructs of worry. In view of the methodological limitations in current theoretical model of worry, it appears that each model would benefit from additional research to provide more explanatory power regarding the causal role of specific proposed constructs in worry. A related question is whether, when combined together, these individual constructs (i.e., cognitive avoidance, metacognitive beliefs, and emotion dysregulation) would provide a more comprehensive account of the development and maintenance of pathological worry (Berenbaum, Bredemeier, & Thompson, 2008).

CHAPTER 2

Overview of the Intolerance of Uncertainty Model

In view of the limitations of extant GAD research discussed in Chapter 1, the Intolerance of Uncertainty (IU) model (Dugas, Gagnon, et al., 1998; Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994) has emerged as a promising framework for further improving current understanding and treatment of GAD. Conceptualised as a trait-like variable, IU refers to a set of maladaptive negative beliefs about uncertainty and its implications (Dugas & Robichaud, 2007, p. 24). These beliefs reflect two main themes: dislike of uncertainty (Carleton, Sharpe, & Asmundson, 2007; Freeston, Rhéaume, et al., 1994) and biased appraisal under uncertainty (Dugas, Hedayati, et al., 2005; Koerner & Dugas, 2008). The IU model asserts that these negative beliefs may play an integral role in the aetiology of pathological worry in GAD (Dugas, Gagnon, et al., 1998).

Conventional cognitive treatment aims to teach the principles of challenging unhelpful thinking, whatever the content of that thinking might be. However, for many GAD patients who frequently experience intrusive worries, worry themes often shift from day to day; thus the target of exposure or cognitive restructuring might change on a regular basis. The cycle of going from challenging one worry to the next can inadvertently become an exercise of chasing “moving targets” for these individuals (Robichaud, 2013b). Furthermore, clinical worries often involve a vague fear about hypothetical future outcomes that are not necessarily amenable to traditional exposure techniques (Borkovec et al., 2004; Robichaud, 2013b). Considering these limitations of conventional GAD treatment, a more systematic approach to addressing unhelpful worry is needed, rather than going from one

thought challenging to the next. This rationale is in line with other contemporary GAD treatment approaches, such as the acceptance-based model of GAD (Roemer, Salters, Raffa, & Orsillo, 2005) and metacognitive model (Wells, 2010). The IU model aims to address the underlying fear structure of worry rather than daily worry contents or associated anxious arousal through somatic management strategies (Robichaud, 2013b).

The construct of IU has been shown to have a robust association with worry (e.g., Dugas, Freeston, & Ladouceur, 1997; Dugas, Gagnon, et al., 1998; Dugas, Ladouceur, Boisvert, & Freeston, 1996; Dugas, Schwartz, & Francis, 2004; Ruggiero et al., 2012; van der Heiden et al., 2010). There is also evidence that IU is overall more highly related to worry than to symptoms of other anxiety disorders (e.g., Buhr & Dugas, 2006; Dugas, Gosselin, & Ladouceur, 2001; Sexton, Norton, Walker, & Norton, 2003). Clinically, individuals with GAD have reported higher levels of IU than those without a diagnosis of anxiety disorder (Ladouceur et al., 1999). Furthermore, data from controlled clinical trials suggests that cognitive-behavioural therapy protocols targeting IU can effectively improve GAD symptoms (Dugas, 2000; Dugas, Brillon, et al., 2010; Dugas et al., 2003). More recently, Bomyea et al. (2015) examined the relationship between reduction in worry and IU over the course of cognitive behavioural therapy for individuals with GAD, finding that reductions in IU accounted for 59% of the reductions in worry observed over the course of treatment. Interestingly, change in worry did not mediate change in IU, suggesting that changes in IU are not simply concomitants of changes in worry. Despite considerable clinical and research interest in IU, much remains to be clarified about the phenomenology and specificity of this construct (Behar et al., 2009; Birrell, Meares, Wilkinson, & Freeston,

2011). This chapter provides an overview of the IU model and a review of its empirical basis.

Development of the Intolerance of Uncertainty Model

The development of the IU model was in part inspired by an earlier body of literature on (in)tolerance of ambiguity (IA; Frenkel-Brunswik, 1949). The construct of IA was conceived as a personality variable that relates to an individual's general tendency to interpret ambiguous situations as threatening; and to respond to novel and complex situations with discomfort and avoidance (Budner, 1962). This construct was mainly applied to non-clinical fields, such as management. Since its conception in the 1940's, efforts to measure IA have resulted in several self-report measures, many of which have been criticised as conceptually disparate, having low internal reliability, and lacking adequate validity evidence (Norton, 1975). Overall, the progress in the IA research has been limited mostly by divergent measures with poor psychometric properties and a lack of experimental studies to operationalise this construct (Furnham & Marks, 2013). Nonetheless, interests in the role of ambiguity has remained in broader stress management research.

In examining individual differences in coping with stress, Krohne (1989); (Krohne, 1993) postulated that the level of ambiguity of a situation is determined by its unpredictability, complexity, and insolubility. Subjective uncertainty caused by specific aspects of ambiguous situations may be perceived as the central threat, and emotional arousal may be triggered by cues prior to entering an aversive situation (Krohne, 1989, p. 237). Meanwhile, a body of cognitive bias research began to focus on the tendency amongst high worriers to interpret ambiguous events as threatening (Butler & Mathews,

1983; 1987; Russell & Davey, 1993). Behavioural data also emerged in the early 90's showing that worriers are slower on decision tasks when the stimuli are ambiguous and the correct response is unclear (Meyer, Miller, Metzger, & Borkovec, 1990; Tallis, Eysenck, & Mathews, 1991). Taken together, the literature on IA and extant cognitive models of GAD, along with research on the role of ambiguity in appraisal bias, helped inform the development of the IU model (Dugas & Robichaud, 2007).

Many of the preliminary hypotheses regarding the role of IU in the development and maintenance of GAD were also derived from the IU researchers' clinical observations. In particular, it was observed that although standard therapeutic techniques (e.g., cognitive restructuring) were effective in helping GAD patients to become more realistic in their estimates regarding probability and cost of a feared outcome, they continued to be preoccupied with the possibility that the outcome could still occur (Dugas, Buhr, & Ladouceur, 2004). Dugas and colleagues (2004) even observed that some GAD patients preferred a problem to have a relatively certain negative outcome than an uncertain one. The theoretical model of IU conceptualises catastrophic cognitions about uncertainty as the primary pathogenic mechanism driving the process of worrying (Freeston, Rhéaume, et al., 1994) with secondary foci on emotional and behavioural components (Dugas, Gagnon, et al., 1998).

The definition of IU itself has undergone a number of revisions, beginning with a broad reference to "cognitive, emotional, and behavioural reactions to uncertainty in everyday life situations" (Freeston, Rhéaume, et al., 1994, p. 792). In an experimental study where participants were asked to estimate the proportion of black and white marbles in a bag, Ladouceur, Talbot, and Dugas (1997) found a positive association of IU with the

number of cues required before responding on a moderately ambiguous task. This association between IU and certainty-seeking behaviour, however, was not observed on unambiguous or highly ambiguous tasks, suggesting that individuals with high levels of IU have a lower threshold of tolerance of ambiguity. Ladouceur et al. (1997) argued that IU should therefore be defined as “the way in which an individual perceives information in uncertain situations and responds to this information with a set of cognitive, emotional and behavioural reactions.” However, the nature of this perceptual bias had yet to be clarified at this point.

Ladouceur, Gosselin, and Dugas (2000) subsequently asserted that even when two individuals perceive identical probability and consequences of an uncertain situation occurring, their thresholds of tolerance towards the situation might differ. The researchers therefore proposed to define IU as “a predisposition to react negatively to an uncertain event or situation, independent of its probability of occurrence and of its associated consequences” (p. 934). Interestingly, Dugas, Gosselin, et al. (2001) defined IU as “the excessive tendency of an individual to consider it unacceptable that *a negative event* may occur, however small the probability of its occurrence.” (Dugas, Gosselin, et al., 2001). Overall, the definition of IU has largely remained broad, though it consistently points to biased threat appraisal and negative affect in response to uncertainty.

Pathways from Intolerance of Uncertainty to Worry

Within the IU model, IU is said to contribute to worry both directly and indirectly: directly by amplifying a person’s general tendency to make threat-consistent appraisals of ambiguous information (biased appraisal); and indirectly by exacerbating other information processes that have been identified in existing cognitive models of GAD (Ladouceur et al.,

1997). These mechanisms include cognitive avoidance (Borkovec, 1994), metacognitive beliefs about worry (Wells, 1995), and problem orientation (D'Zurilla & Nezu, 1990). Figure 2.1 depicts the proposed mechanisms via which IU contributes to worry based on the model described by Dugas et al. (1998).

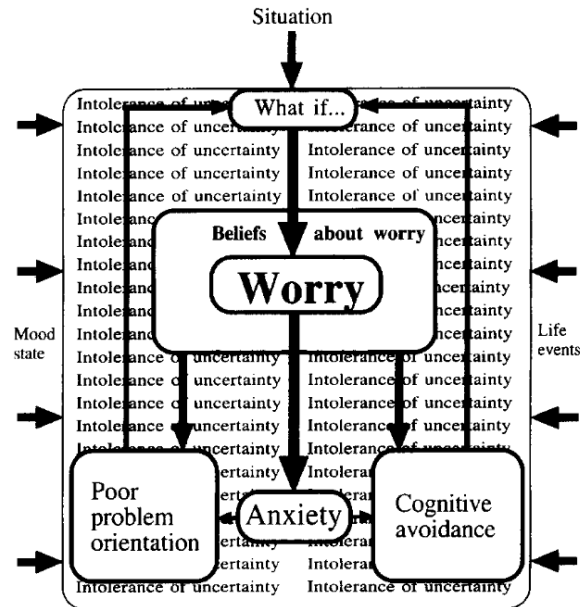


Figure 2.1. Proposed mechanisms of IU's contribution to worry (Dugas et al., 1998).

Direct Mechanism: Threat-Biased Appraisal of Ambiguous Information

Evidence for the direct contribution of IU to worry primarily draws upon existing findings on information processing in the development and maintenance of anxiety (Dugas & Robichaud, 2007). According to the information processing model of anxiety (Beck & Clark, 1997), clinical anxiety is characterised by biases in three stages of information processing. These include selective attention towards negative and personally relevant information at the initial registration of a threat stimulus; preliminary

cognitive/affective/physiological/behavioural responses as part of the automatic activation of a primal threat mode; and schema-driven processing in the secondary activation of more elaborative and reflective modes of thinking. Within the GAD literature, it has been well established that individuals with GAD have a tendency to focus their attention on stimuli that are indicative of physical or psychological threat (attentional bias; Mogg & Bradley, 2005); and make threat-consistent appraisals of ambiguous information (biased appraisal; Butler & Matthews, 1987).

Non-clinical data have demonstrated the association of IU and worry with biased perception of ambiguous situations. Dugas, Hedayati, et al. (2005) hypothesised that IU is associated with a specific information processing bias involved in the aetiology of excessive worry. They found that individuals with high levels of IU rated fictional ambiguous diary entries as more threatening, compared to those with low IU. Koerner and Dugas (2008) replicated this finding and found that individuals high on the IU measure reported greater concern across all scenario types (positive, negative, and ambiguous) compared to those low on IU, with the greatest between-group difference found for ambiguous scenarios.

As mentioned earlier, Ladouceur et al. (1997) investigated the relationship between individual differences in IU and performance on a task with varying levels of ambiguity. Results showed that individuals with high levels of IU required more information when making decisions in moderately ambiguous situations. This finding suggests that low confidence in decision-making may alter appraisal of ambiguous situations, thus leading to prolonged anxiety about these situations. Ladouceur and colleagues asserted that although highly ambiguous events may increase worry in most people, individuals who are intolerant

of uncertainty are likely to seek out more information to attain levels of perceived certainty that are comparable to those of individuals who are more tolerant of uncertainty. Taken together, the above findings are consistent with current cognitive models that individual differences in appraisal of threat-relevant materials as a contributing factor to the aetiology of excessive worry and GAD (Beck & Clark, 1997).

Dugas, Hedayati, et al. (2005) suggested that IU may lead to excessive worry via “the combination of enhanced activation of internal representations of uncertain information (resulting from selective attention, greater elaborative encoding, and/or selective recall) and the tendency to make threatening interpretations of ambiguous information” (p.67). Dugas and Robichaud (2007) also speculated that “individuals who are intolerant of uncertainty may be at risk for developing GAD because they tend to: 1) make threatening interpretations of ambiguous information; 2) perform poorly in moderately ambiguous situations; and 3) have particularly low confidence in their decisions when anxious.” (pp. 34-35). Koerner and Dugas (2008) posited that individual differences in perceived controllability may explain why uncertainty is distressing to some but not others. Perceived controllability refers to the degree to which one perceives any personal control over the course and outcome of a particular situation (Davey, Hampton, Farrell, & Davidson, 1992). If a person perceives uncertain situations as being beyond their control or ability to respond effectively, this perception is said to reinforce a low tolerance for uncertainty.

Indirect Mechanisms of Intolerance of Uncertainty

The IU model also proposes IU can influence worry indirectly via three other constructs, including cognitive avoidance (Borkovec, 1994), positive beliefs about worry

(Wells, 1995), and negative problem orientation (D'Zurilla & Nezu, 1990). As discussed in Chapter 1, these three constructs are known for their role in the maintenance of worry. The IU model conceptualises IU as a higher-order process that “at least partially accounts for the relationship of the other three variables to GAD” (Robichaud, 2013b). The relationship between these three constructs and IU is discussed below.

Mechanism #1: Cognitive Avoidance

IU is said to contribute to worry indirectly by amplifying cognitive avoidance (Dugas, Gagnon, et al., 1998). Much of this proposition draws upon the avoidance model of worry (Borkovec, 1994; Borkovec et al., 2004) which characterises worry as a strategy to avoid arousal responses provoked by threatening mental images of feared outcomes. As described in Chapter 1, the cognitive avoidance model posits that worriers engage in cognitive strategies both automatically and voluntarily in response to arousal. Mental images of threatening situations are said to be automatically converted into verbal-linguistic thoughts (i.e., an internal dialogue) about the situation in question (Borkovec & Inz, 1990; Borkovec et al., 1998; Freeston et al., 1996). The worrier might also engage in deliberate strategies such as distraction (Borkovec & Roemer, 1995) or thought suppression to avoid arousal associated with worrisome images (Dugas et al., 2007). In the short term, worrying might reduce perceived physiological reactivity associated with the mental imagery. Over time, however, this cognitive form of avoidance is said to preclude the worrier from processing feared images, thereby perpetuating arousal responses over time (Borkovec & Hu, 1990).

As discussed in Chapter 1, empirical support for the cognitive avoidance theory has been equivocal. As for the IU model, no studies to date have directly examined the

relationship between IU and cognitive avoidance strategies aside from limited adolescent data which supports a modest association of IU with self-reported thought suppression (Laugesen, Dugas, & Bukowski, 2003). Nonetheless, there is preliminary evidence on the association of explicit cognitive avoidance strategies (e.g., thought suppression, thought substitution, distraction, avoidance of threatening stimuli, and the transformation of images into thoughts) with worry in GAD individuals (Gosselin et al., 2002; Sexton & Dugas, 2008; Sexton & Dugas, 2009b).

Mechanism #2: Positive Beliefs about Worry

As mentioned in Chapter 1, the metacognitive model of worry identifies that individuals with GAD hold positive metacognitive belief about the perceived usefulness of worry, as well as negative metacognitive beliefs about the danger of worry (Cartwright-Hatton & Wells, 1997; Wells, 1994, 1995; Wells & Carter, 2001; Wells & Cartwright-Hatton, 2004). Although the metacognitive belief model considers negative beliefs about worry as the main contributing factor to worry more so than positive beliefs (Wells & Carter, 2001), the IU model argues that positive beliefs are involved in the development and maintenance of GAD despite not being specific to the disorder (Dugas & Robichaud, 2007). IU research examining the role of positive beliefs about worry have identified five common positive beliefs about worry: 1) worry facilitates problem solving; 2) worry enhances motivation; (3) worry protects against negative emotions; (4) worry prevents negative outcomes; and (5) worry reflects a positive personality trait (Hebert et al., 2014).

Support for the contribution of IU to worry above and beyond metacognitive beliefs has been limited and inconsistent. Earlier data suggested that IU is a better predictor of GAD severity than either positive beliefs about worry or cognitive avoidance (Dugas et al.,

2007). More recently, however, both IU and negative metacognitive beliefs have been shown to predict unique variance in GAD symptoms (Tan, Moulding, Nedeljkovic, & Kyrios, 2010), although Thielsch, Andor, and Ehring (2015) found that IU did not account for additional variance in worry after controlling for negative metacognitions.

Mechanism #3: Problem Solving Orientation

The IU model suggests that negative problem solving orientation may be a variable underlying GAD that is not shared by other anxiety disorders (Ladouceur et al., 1999). Problem orientation refers to beliefs related to a person's perceived ability to solve problems, and expected outcomes (D'Zurilla & Nezu, 1990). Having a negative problem orientation interferes with a person's ability to apply problem-solving skills effectively over time, as they 1) lack confidence in their problem solving ability; 2) perceive problems as threats, 3) become easily frustrated when dealing with a problem; and 4) are pessimistic about the outcome of problem-solving efforts (D'Zurilla & Goldfried, 1971; D'Zurilla & Nezu, 1990). Negative problem orientation has been implicated in the development and maintenance of excessive worry (Borkovec, 1985; Ladouceur, Blais, Freeston, & Dugas, 1998; Robichaud & Dugas, 2005a). A number of studies using self-report questionnaires have found that problem orientation, but not actual problem-solving skills, is significantly related to worry in college students (Davey, 1994; Davey et al., 1992; Davey, Jubb, & Cameron, 1996; Dugas, Letarte, Rhéaume, Freeston, & Ladouceur, 1995) and GAD patients (Dugas, Gagnon, et al., 1998; Ladouceur et al., 1998). Specifically, lower problem orientation scores on the Social Problem-Solving Inventory (SPSI; D'Zurilla & Nezu, 1990) are associated with higher levels of trait worry.

The IU model proposes that the IU schema is activated when a person is faced with ambiguous situations, exacerbating perceived difficulties which may not actually exist, and thus contributes to hypothetical worries or biased appraisal of ambiguous situations (Freeston, Rhéaume, et al., 1994; Koerner & Dugas, 2006, 2008). When problems do in fact arise, individuals with high levels of IU may be more likely to focus on uncertain aspects of a problem and interpret these aspects as threatening, leading to prolonged worry (Dugas et al., 1997). Some evidence supporting this hypothesis comes from work by Dugas et al. (1997) and Ladouceur et al. (1998), who found that IU and problem orientation made common as well as a unique contributions to the prediction of worry.

Measurement of Intolerance of Uncertainty

IU is typically assessed by the Intolerance of Uncertainty Scale (IUS; English translation: Buhr & Dugas, 2002; French version: Freeston, Rhéaume, et al., 1994). The IUS is a 27-item self-report measure assessing general cognitive, behavioural, and cognitive reactions to uncertain situations (e.g., “it frustrates me not having all the information I need”) and its perceived consequences (e.g., “uncertainty keeps me from sleeping soundly”). The 27 items of the IUS are shown in Table 2.1.

The IUS has been shown to distinguish between non-clinical worriers and individuals with GAD (Dugas, Gagnon, et al., 1998; Dugas et al., 2007). It has also demonstrated good internal consistency ($\alpha = .94$; Buhr & Dugas, 2002) and sound test-retest reliability ($r = .78$; Dugas et al., 1997). Furthermore, responses to the IUS appear to remain relatively stable over five-week period (Buhr & Dugas, 2002, 2006), though it is not yet clear the extent to which the IUS is sensitive to state changes in anxiety. Carleton and

colleagues (2007) developed a 12-item version of the IUS, which maintains “exemplary internal consistency” ($\alpha = .96$), and is highly correlated with the original 27-item version.

Table 2.1

The Intolerance of Uncertainty Scale- 27 item (Freeston et al., 1994).

1. Uncertainty stops me from having a firm opinion.
 2. Being uncertain means that a person is disorganized
 3. Uncertainty makes life intolerable.
 4. It's unfair not having any guarantees in life.
 5. My mind can't be relaxed if I don't know what will happen tomorrow.
 6. Uncertainty makes me uneasy, anxious, or stressed.
 7. Unforeseen events upset me greatly.
 8. It frustrates me not having all the information I need.
 9. Uncertainty keeps me from living a full life.
 10. One should always look ahead so as to avoid surprises.
 11. A small unforeseen event can spoil everything, even with the best of planning.
 12. When it's time to act, uncertainty paralyses me.
 13. Being uncertain means that I am not first rate.
 14. When I am uncertain, I can't go forward.
 15. When I am uncertain I can't function very well.
 16. Unlike me, others always seem to know where they are going with their lives.
 17. Uncertainty makes me vulnerable, unhappy, or sad.
 18. I always want to know what the future has in store for me.
 19. I can't stand being taken by surprise.
 20. The smallest doubt can stop me from acting.
 21. I should be able to organize everything in advance.
 22. Being uncertain means that I lack confidence.
 23. I think it's unfair that other people seem sure about their future.
 24. Uncertainty keeps me from sleeping soundly.
 25. I must get away from all uncertain situations.
 26. The ambiguities in life stress me
 27. I can't stand being undecided about my future.
-

Although the IUS (Freeston, Rhéaume, et al., 1994), has demonstrated robust psychometric properties, relatively little is known about exactly what the IUS is measuring (Birrell et al., 2011). Developers of the IUS (Freeston, Rhéaume, et al., 1994) initially identified five factors to reflect that 1) uncertainty is unacceptable and should be avoided (e.g., “I always want to know what the future has in store for me”); 2) being uncertain reflects badly on a person (e.g., “Being uncertain means that a person is disorganised); 3) uncertainty causes frustration (e.g., It’s unfair not having any guarantees in life”); 4) uncertainty causes stress (“The ambiguities in life stress me”); and that 5) uncertainty prevents action (e.g., “When it comes to act, uncertainty paralyses me”). Of note, the theoretical factors proposed in Freeston, Rhéaume, et al. (1994) were intended to provide evidence for the content validity of IU, rather than subscales (Sexton & Dugas, 2009a). Subsequent attempts to identify factor structures of the IUS have yielded mixed results. Table 2.2 provides a summary of factor analysis studies for the IUS.

Table 2.2

Summary of factor analysis studies for the 27-item Intolerance of Uncertainty Scale (IUS-27) and the 12-item IUS (IUS-12).

Scale	Study	Sample	Results
IUS-27	Freeston, Rhéaume, et al. (1994)	French-speaking undergraduates (N = 216; 102 women)	5-factor structure: 1) Uncertainty is unacceptable and should be avoided 2) Being uncertain reflects badly on a person 3) Uncertainty is frustrating 4) Uncertainty causes distress 5) Uncertainty prevents action
	Buhr and Dugas (2002)	English-speaking undergraduates (N = 276; 213 women)	4-factor structure: 1) Uncertainty leads to the inability to act 2) Uncertainty is stressful and upsetting 3) Unexpected events are negative and should be avoided 4) Being uncertain about the future is unfair
	Norton (2005)	Undergraduates (N = 449) of 4 racial groups: African American, Caucasian, Hispanic/Latino, Southeast Asian	Factor structure was poorly interpretable among any of the racial groups
	Berenbaum et al. (2008)	University students (N = 239)	4-factor structure: 1) Desire for Predictability 2) Uncertainty Paralysis 3) Uncertainty Distress 4) Inflexible Uncertainty Beliefs
	Sexton and Dugas (2009a)	Non-clinical undergraduate students and adults from the community (N = 1230)	2-factor structure: 1) Uncertainty has negative behavioral and self-referent implications 2) Uncertainty is unfair and spoils everything
IUS-12	Carleton, Norton, et al. (2007)	Undergraduates (N = 254; 193 women)	12-item 2-factor structure: 1) Prospective Anxiety 2) Inhibitory Anxiety

Confirmatory factor analysis studies (Carleton, Norton, et al., 2007; Norton, Sexton, Walker, & Norton, 2005) have reported inconsistent findings on replications of either a four-factor structure (Buhr & Dugas, 2002) or a five-factor structure (Freeston, Rhéaume, et al., 1994). Furthermore, of the four-factor structure identified by Berenbaum et al. (2008), only two factors (Desire for Predictability and Uncertainty Paralysis) overlapped substantially with those identified by Buhr and Dugas (2002).

McEvoy and Mahoney (2011) suggested that one potential explanation for the failure of factor analysis studies to identify robustly separable and replicable factors is that IU may be best conceptualised as a unitary construct. In addition, responses to the IUS may be more homogenous at sub-threshold levels than at clinical levels, thus using undergraduate samples might militate against the detection of clinically relevant multidimensional aspects of IU that are only separable at pathological levels.

A more recent review of nine factor analysis studies suggests that a two-factor structure of the IUS is most likely to demonstrate stability (Birrell et al., 2011). These factors represent 1) desire for predictability, and 2) uncertainty paralysis (Berenbaum et al., 2008). The “desire for predictability” factor is said to represent an active approach to uncertainty. That is, uncertainty motivates the individual to seek what they perceive as sufficient amount of information in order to increase the predictability of a situation. On the other hand, the “uncertainty paralysis” factor refers to a sense of feeling immobilised or unable to function in the face of uncertainty. It seems that the items subsumed under the “uncertainty paralysis” factor reflect physical sensations as part of the fight/flight response. Birrell et al. (2011) speculated that feeling paralysed by uncertainty is also likely to be the

result of cognitive processing of uncertainty, such as cognitive avoidance and a maladaptive approach to cognitive problem-solving.

The issue of factor structure aside, there appears to be an incongruence between the proposed definition of IU and the principal measure of this construct, the IUS. A more recent definition, that IU is “a cognitive bias that affects how a person perceives, interprets, and responds to uncertain situations on a cognitive, emotional, and behavioural level” (Dugas, Schwartz, et al., 2004, p. 835), underscores the IU model’s tenet that IU contributes to worry/GAD directly by promoting threat-consistent appraisals of uncertain information (Dugas, Buhr, et al., 2004). Although the items in the IUS (Freeston, Rhéaume, et al., 1994) reflect the extent to which an individual finds uncertainty unacceptable (e.g., ‘it’s unfair having no guarantees in life’), distressing (e.g., ‘unforeseen events upset me greatly’), or disruptive (e.g., ‘when it’s time to act, uncertainty paralyses me’), very few items in the measure directly assess threat appraisal bias.

Other Measures of Reactions to Uncertainty

Although the IUS has been widely used, it is not the only scale that measures a person’s reactions to uncertainty. Greco and Roger (2001) developed the Uncertainty Response Scale (URS), which measures the stressful effects of uncertainty and the role of uncertainty in illness behaviour. Greco and Roger (2001) argued that the URS provides a measure of responses to uncertainty, as opposed to a general aversion of uncertainty measured by the IUS. Exploratory and confirmatory factor analyses suggest that the URS consists of three factors. The “Emotional Uncertainty” factors measures the degree to which an individual responds to uncertainty in a maladaptive way (i.e. with anxiety and sadness). The “Desire for Change” factor assesses the degree to which an individual enjoys

novelty, uncertainty, and change (e.g., “I find the prospect of change exciting and stimulating”). Finally, the “Cognitive Uncertainty” factor assesses the degree to which an individual prefers order, planning, and structure in an uncertain environment (e.g., “I like to plan ahead in detail rather than leaving things to chance”). As well as demonstrating high internal and re-test reliabilities, the Emotional Uncertainty items of the URS predict both systolic and diastolic blood pressure in response to anticipation of possible threat (Greco & Roger, 2003). However, there are no replications of these findings.

Gosselin et al. (2008) pointed out that the IUS appears to evaluate general reactions to uncertainty rather than the tendency to consider uncertainty to be intolerable or unacceptable. As such, the authors developed the Intolerance of Uncertainty Inventory (IUI; Gosselin et al., 2008), a 45-item French scale proposed to measure manifestations of IU, including reactions to uncertainty, ambiguous situations, and the future. The scale consists of two parts. Part A (15 items) assesses general unacceptability of uncertainty. Part B (30 items) assesses manifestations of uncertainty approximating more common anxiety disorder symptoms. Exploratory and confirmatory factor analysis results supported the IUI’s reliability (Cronbach $\alpha = .96$), convergent validity (as demonstrated by strong correlations with the IUS and the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990)), and temporal stability. Carleton et al. (2010) subsequently examined the psychometric stability of the English version of the IUI (now known as Intolerance of Uncertainty Index), and reported a unitary structure for Part A and a three-factor structure for Part B. Regression results also suggested that Parts A and B each provides incremental validity in measures of worry, GAD symptoms, negative problem orientation, and depression. However, because both the Gosselin et al. (2008) and Carleton et al. (2010)

studies used undergraduate and community samples respectively, these results remain to be replicated in clinical samples.

Limitations of the Current Research on Intolerance of Uncertainty

Although the preceding review of the IU literature highlights the key role of IU in worry and GAD, there is limited evidence explicitly assessing whether and how IU contributes to worry via cognitive avoidance, metacognitive beliefs, and negative problem orientation. A number of conceptual and empirical limitations regarding the IU model's proposed mechanisms remain to be clarified.

Is Intolerance of Uncertainty Specific to Worry/GAD?

Although the IU construct has been associated predominantly (conceptually and empirically) with worry and GAD (Dugas, Gosselin, et al., 2001), the specificity of IU as a risk factor for worry has been questioned by evidence supporting the association of IU with other anxiety disorders. In particular, IU has been associated with symptoms of social anxiety disorder (Boelen & Reijntjes, 2009; Teale Sapach, Carleton, Mulvogue, Weeks, & Heimberg, 2015), posttraumatic stress disorder (PTSD; Fetzner, Horswill, Boelen, & Carleton, 2013), and separation anxiety (Boelen, Reijntjes, & Carleton, 2014). Beyond anxiety disorders, there is preliminary evidence suggesting IU is associated with eating disorders (Konstantellou & Reynolds, 2010) and obsessive-compulsive and related disorders, such as obsessive-compulsive disorder (OCD; Holaway, Heimberg, & Coles, 2006; Lind & Boschen, 2009; Steketee, Frost, & Cohen, 1998; Tolin, Abramowitz, Brigidi, & Foa, 2003) and hoarding (Baldwin, Whitford, & Grisham, 2017; Oglesby et al., 2013; Wheaton, Abramowitz, Jacoby, Zwerling, & Rodriguez, 2016). More recently, Cowie,

Clementi, and Alfano (2016) found the highest levels of IU in children six to 11 years of age with comorbid GAD, followed by children with pure GAD, and healthy controls. The researchers concluded that IU may serve as a broad cognitive risk factor for more severe (e.g., comorbid) forms of affective psychopathology. Although the above findings are at odds with proposals that IU contributes to the unique development and clinical presentation of worry/GAD, it would be relevant to consider degree of specificity rather than invoking the concept of specificity in any absolute way (Starcevic & Berle, 2006).

Garber and Hollon (1991) suggest that specificity can be at least defined as either broad or narrow. Broad specificity asks whether a model is specific to a particular disorder relative to the general higher-order class of disorders to which that disorder belongs. In this case, is IU unique to worry/GAD or is it distributed more generally among a heterogeneous group of anxious patients? The implication is that if the latter was true, then IU is unlikely to be a causal factor for worry, because psychopathology is presumed to be “*comprised of a number of etiologically distinct nosological entities*” (Garber & Hollon, 1991, p. 132). Narrow specificity, on the other hand, asks whether a model is specific to a particular disorder relative to each other disorder belonging to the same higher-order class. In this case, does IU distinguish GAD patients from those with OCD, or those with MDD (Gentes & Ruscio, 2011)?

The bulk of IU research to date appears to support the broad specificity of IU to GAD relative to other anxiety disorders (Dugas, Gosselin, et al., 2001; Ladouceur et al., 1999), as it is more strongly related to worry than to obsessions and compulsions, depression, and panic sensations (Buhr & Dugas, 2006; Dugas, Gosselin, et al., 2001; Dugas, Schwartz, et al., 2004; Sexton et al., 2003). On the other hand, evidence supporting

significant associations of IU with symptoms of OCD (Gentes & Ruscio, 2011; Steketee et al., 1998), social anxiety (Boelen & Reijntjes, 2009), and depression (McEvoy & Mahoney, 2012) would suggest that IU lacks a narrow specificity to GAD (Gentes & Ruscio, 2011).

Does it matter that IU appears to lack narrow specificity? More importantly, is specificity either necessary or sufficient for establishing the causal relationship of IU to worry? When non-specificity is observed, it typically is assumed that the construct in question is not a cause of the disorder, but is instead a non-specific consequence of general psychopathology (Garber & Hollon, 1991). Some authors argue that a construct may be non-specific, but still causal (Dugas & Robichaud, 2007; Garber & Hollon, 1991). IU may therefore have a particular relevance to GAD despite a lack of narrow specificity, because it potentially represents one aspect of a broader construct, such as perceived control (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013).

Methodological Considerations

A review of the IU literature reveals that the majority of evidence supporting hypothesised pathways from IU to worry have been based on studies with correlational designs. Although correlational data provide useful preliminary hypotheses regarding the construct of IU, current understanding of the causal relationship of IU to worry and underlying mechanisms of IU can benefit from further research using experimental manipulation of uncertainty/ambiguity. The few experimental studies that exist in the IU literature attempted to manipulate IU beliefs, but it could be argued that these studies manipulated levels of uncertainty in the experimental conditions instead.

For example, Ladouceur et al. (2000) used a computerised roulette game to manipulate undergraduates' belief about their chances of winning. To increase/decrease IU, the authors provided instructions which led participants to believe that the uncertainty of the situation was either acceptable or unacceptable, without changing the actual probability of winning or the consequences associated with the situation. Specifically, participants in the increased IU condition were told that the probability of winning (one chance in three) was low compared to the probability of winning in the preceding year (thus increasing their belief that their probability of winning was unacceptable). Participants in the decreased IU condition were told that the probability of winning was very high compared to the probability of winning in the preceding year. To increase the "cost" of losing, all participants were told that an amount of \$100 would be donated to a fictional charity foundation only if they won more than their initial \$20 bankroll. Post-experiment questionnaire showed a higher level of task-related worry amongst participants in the increased IU condition relative to participants in the decreased IU condition. In particular, participants in the increased IU condition reported worrying about possible consequences of not succeeding at the task. Although the authors subsequently concluded that increased IU resulted in increased worry, it could be argued that the experimental design represents a manipulation of the probability and cost of winning rather than a direct manipulation of IU beliefs per se.

To date, a small number of studies have experimentally manipulated IU beliefs. Grenier and Ladouceur (2004) instructed participants to first imagine that they had ingested a medication that caused an unpredictable effect, followed by repeating aloud general statements either reflecting increased intolerance (e.g., *"It's hard to live with several*

possibilities"; "It frustrates me to not know what will happen to me") or decreased intolerance (e.g., "I have to live with different possibilities"; "It does not bother me not knowing what will happen to me"). Participants in the increased IU condition demonstrated higher levels of worry compared to participants in the decreased IU condition. A more recent study by Meeten, Dash, Scarlet, and Davey (2012) used short stories in which the character was described as either having high or low IU, as manipulation of IU beliefs. Participants in the high IU group reported more catastrophic worries compared to those in the low IU group, and increased levels of sadness and anxiety were observed in the high as compared to the low IU group following IU manipulation.

Considering that IU represents a set of beliefs about the meaning and consequences of uncertainty, it might be more experimentally feasible to manipulate uncertainty, rather than IU beliefs. de Bruin and colleagues (2006) investigated whether individual differences in IU are predictive of (state) worry in response to experimental situations that are either high or low in uncertainty. Participants in this study completed an intelligent task which they were unaware was unsolvable. Task uncertainty was manipulated by providing pre-task instruction to half of the participants that the task was designed for measuring the IQ of young teenagers, so they would probably do very well on the task. The researchers hypothesised that the discrepancy between participants' expected task difficulty and the actual task difficulty would increase feelings of uncertainty. The other half of the participants were told that the task was developed to measure the IQ of highly gifted people, thus it would be perfectly normal if they did not answer all the items correctly (feelings of uncertainty should decrease as there was little discrepancy between expected task difficulty and the actual task difficulty). The authors found that IUS scores were

positively correlated with task-related state worry, and IUS scores emerged as a strong predictor of worry, suggesting that individual differences in IU predict worry in a situation that elicits low to moderate levels of uncertainty more so than in a situation of high uncertainty.

Luhmann, Ishida, and Hajcak (2011) examined the relationship between decision-making and IU in a non-clinical sample by manipulating participants' expected waiting period for monetary rewards. Participants had to choose either small low-probability rewards available immediately at the beginning of each trial, or large high-probability rewards only available after delay (without knowing whether they would actually obtain the chosen reward). Results showed that high IU individuals preferred the immediate but less valuable and predictable reward, suggesting willingness to give up monetary gains to avoid waiting in a state of uncertainty. However, there were no data available on individual differences in task-related worry, thus conclusions could not be drawn regarding the extent to which IU was associated with task-related state worry.

Although existing experimental studies have demonstrated an effect of uncertainty on worry, very few studies have directly investigated whether the decision-making behaviours observed in among high IU individuals are driven by a biased perception of uncertain situations, or a difficulty associated with acceptance of uncertainty. Reports of high IU individuals appraising ambiguous situations as more disconcerting compared to low IU individuals would suggest the role of appraisal bias in decision-making (Dugas, Hedayati, et al., 2005; Koerner & Dugas, 2008).

Most of the experimental manipulation studies reviewed so far rely heavily on the use of innocuous performance tasks, where the only "cost" of reduced certainty is a modest

decrease in task accuracy (Dugas, Hedayati, et al., 2005; Ladouceur et al., 1997; Luhmann et al., 2011). Given that worry primarily involves issues in the social contexts, which are inherently ambiguous (i.e., work, relationship, family etc.; Lovibond & Rapee, 1993; Tallis et al., 1991), manipulating uncertainty associated with a wider range of general life domains may be more salient and potentially more anxiety-provoking. To date, two studies (Dugas, Hedayati, et al., 2005; Koerner & Dugas, 2008) have directly examined the relationship between IU and worry using vignettes that pertain to general life domains (relationships, health, work performance etc.). Results indicated that non-clinical individuals with high levels of IU consistently worried about uncertainty related to general domains of life, more so than those with lower IU. Research on GAD has produced more inconsistent results, partly due to the difficulty in identifying stimuli that encapsulate the numerous worry themes with which GAD patients are typically preoccupied (Borkovec et al., 1983). Stapinski et al. (2010) employed an experimental manipulation in which they instructed GAD patients to worry, imaginally process, or relax in response to an anxiety trigger (“health risks” resulting from mobile phone usage). Results supported the detrimental impact of worry, demonstrating maintained threat expectancies and decreased control perceptions compared to other modes of processing. More of this type of methodological design, where process variables underlying GAD are examined in the context of unidimensional standardised worry topics, is needed for advancing IU research.

Finally, studies of the relationship between IU and worry have typically used unselected undergraduate student samples with traits of GAD (e.g., de Bruin et al., 2006; Grenier & Ladouceur, 2004; Koerner & Dugas, 2008; Ladouceur et al., 2000; Ladouceur et al., 1997; Meeten et al., 2012). A movement towards investigations focusing on

manipulating uncertainty in individuals with GAD (who presumably are highly intolerant of uncertainty) and non-clinical individuals may help to further clarify the mechanisms of IU and its clinical implications (Ladouceur et al., 1997). Previously, GAD individuals have been shown to report experience of strong negative affect elicited by situations that are not necessarily evocative to controls (Mennin et al., 2005). Further research is therefore needed to compare the mechanisms underlying IU in both clinical and non-clinical samples. Potentially, there may be different threat perception thresholds for uncertainty. Studies which employ formal diagnostic procedures, such as the Anxiety and Related Disorders Interview Schedule for DSM-5 (ADIS-5; Brown & Barlow, 2014), in both community and clinical samples, are also needed to examine the role of attentional bias in IU.

Extending IU research to patients seeking treatment for GAD would also provide the opportunity to further investigate the relationship between IU, worry and rumination in relation to appraisal of ambiguous situations. Rumination, a repetitive thought process about one's own negative affect (Nolen-Hoeksema, 1991), sadness (Conway, Csank, Holm, & Blake, 2000) and/or failure experiences (Spasojevic & Alloy, 2001), has been found to predict changes in both anxiety and depression symptoms (Nolen-Hoeksema, 2000). Worry thoughts typically focus on problem-solving regarding future events; whereas ruminative thoughts are more focused on past failures and/or losses (Beck, Brown, Steer, Eidelson, & Riskind, 1987; Papageorgiou & Wells, 1999). Rumination and worry are potentially related types of repetitive thinking, albeit differing in content and temporal orientation (Smith & Alloy, 2009).

Considering the possible overlap between rumination and worry, one area of research interest is the role of IU in rumination and worry. Previously, studies have shown

an association of elevated levels of IU with severe symptoms of depression in undergraduate students (de Jong-Meyer, Beck, & Riede, 2009; Dugas, Schwartz, et al., 2004), and individuals meeting diagnostic criteria for major depressive disorder (McEvoy & Mahoney, 2011; van der Heiden et al., 2010; Yook, Kim, Suh, & Lee, 2010). These findings, along with existing data on the association of IU with anxiety disorders (Koerner & Dugas, 2006), underscore the possibility that IU potentially plays a role as an underlying cognitive bias in anxiety and depression psychopathology (Carleton et al., 2012; Yook et al., 2010). Yook et al. (2010) found that worry partially mediated the relationship between IU and anxiety although rumination fully mediated the relationship between IU and depression, suggesting that worry and rumination might affect the relationship between IU, anxiety, and depression differently. The role of repetitive thoughts in mediating the relationship between IU and appraisal biases in ambiguous situations needs to be further examined.

Summary and Conclusion

Collectively, a concentrated body of research supports the role of IU in the development and maintenance of worry/GAD. The IU model proposes direct and indirect mechanisms via which IU contributes to worry: directly by initiating biased threat appraisals of ambiguous information; and indirectly by influencing subsidiary mechanisms that have previously been linked to GAD, including cognitive avoidance, metacognitive beliefs about worry, and negative problem orientation. Despite increasing clinical interest in targeting IU as part of GAD treatment protocols, the phenomenology of this construct has remained largely vague. Although the principal measure of IU, the IUS (Freeston, Rhéaume, et al., 1994), appears to demonstrate strong psychometric properties, the extent

to which the IUS items reflect biased threat appraisal remains to be further investigated. Much also remains to be clarified with regards to the model's proposed mechanisms and the specificity of IU to worry/GAD.

The IU literature would also benefit from replicating experimental findings in clinical samples, as the majority of current data on IU come from university student samples, which are less representative of the clinical population at large. In view of the model's hypothesis that IU directly contributes to worry by facilitating biased appraisal of ambiguous information, direct manipulation of uncertainty can be useful for elucidating the mechanism mediating IU and worry. Given that GAD is characterised by diffuse concerns about the inherent uncertainty of daily living (work, interpersonal relationship, health etc.), it would be valuable for IU experimental research to use stimuli that encapsulate worry domains that are of central concern to GAD individuals. This may be particularly relevant when examining individual differences in cognitive, behavioural, and affective responses to uncertain situations.

Research Questions and Organisation of Remaining Chapters

The overarching aim of the current research project is to clarify the conceptual coherence of IU. Key research questions of interest include:

- Are high IU individuals biased in their appraisal of uncertain situations? To what extent do high IU individuals differ from low IU individuals in calibrating threat probability and cost of uncertain outcomes? These questions will be examined experimentally in both undergraduate and clinical samples. The first two experiments (Chapters 3 and 4) will use positive, negative and ambiguous scenarios

to examine threat perception, controllability, and problem orientation, before using an experimental manipulation of uncertainty to examine the impact of uncertainty on subsequent threat appraisal.

- Is IU better characterised as biased threat appraisal, or negative affect, or both? Under what kind of uncertain condition is threat appraisal bias more likely to emerge? Three experiments (Chapters 5-7) will further examine threat appraisal and affective response with both undergraduate and clinical samples using a modified covariation bias paradigm.
- Is IU specific to GAD? To what extent is IU associated with other anxiety disorders? The final experiment (Chapter 8) will conduct a cross-sectional examination of IU in a clinical sample with heterogeneous principal anxiety disorder diagnoses (GAD, social anxiety disorder, panic disorder, OCD, and hoarding disorder).

CHAPTER 3

Intolerance of Uncertainty and Appraisal of Ambiguous Situations

(Experiment 1)

A review of existing research on the IU model in Chapter 2 highlights a need for further investigation of the mechanisms of IU and its role in worry. Central to this investigation is clarifying the cognitive and affective experiences of information processing in individuals who are intolerant of uncertainty.

One of the key hypotheses of the IU model is that unambiguously negative events do not necessarily elicit appraisal bias among individuals with high IU. Rather, biased appraisal of an ambiguous situation (where outcome is uncertain) might best characterise the cognitive vulnerability in IU (Dugas, Buhr, et al., 2004; Koerner & Dugas, 2008). Dugas, Hedayati, et al. (2005) investigated this hypothesis in two separate studies. In the first study, the authors found a positive association between self-reported IU levels and recall of words denoting uncertainty (e.g., “Unclear”, “Unpredictable”). In the second study, individuals with high levels of IU demonstrated a greater level of concern about ambiguous vignettes (e.g., “Although on my way out tonight I was stopped in the street”) relative to those with low levels of IU.

Also using a vignette study, Koerner and Dugas (2008) extended the findings from the second study of Dugas, Hedayati, et al. (2005) and found that high IU individuals reported greater levels of concerns across positive, negative, and the ambiguous scenarios relative to low IU individuals. The strongest between-group difference was found in the ambiguous scenarios. Furthermore, appraisal of ambiguous situations mediated the

relationship between IU and worry. Taken together, the above findings are consistent with the notion that high levels of IU are associated with biased appraisal of ambiguous information by way of showing inflated concern relative to low IU individuals. However, there is relatively limited research explicitly addressing the nature of such appraisal bias in IU, particularly in terms of probability and cost estimates. In the broader worry/GAD literature, individuals who rate negative outcomes as more likely to occur show higher levels of worry than individuals who report lower likelihood ratings (Berenbaum, Thompson, & Bredemeier, 2007; Berenbaum, Thompson, & Pomerantz, 2007; Butler & Mathews, 1983; MacLeod et al., 1991). Higher levels of worrying have also been associated with an increase in perceived cost of negative outcomes (Berenbaum, Thompson, & Bredemeier, 2007; Berenbaum, Thompson, & Pomerantz, 2007; Butler & Mathews, 1983). Furthermore, evidence from cognitive bias research supports the hypothesis that individuals with GAD have a tendency to make threat-consistent appraisals and interpretations of ambiguous information (MacLeod & Rutherford, 2004).

To date, very few studies from the IU literature have directly examined the link between IU and estimation of outcome probability and cost of threats with respect to ambiguous situations. Bredemeier and Berenbaum (2008) examined the relationship between two aspects of the 27-item IUS, uncertainty paralysis and desire for predictability, and probability and cost estimation of unambiguous threats. Uncertainty paralysis refers to a sense of feeling unable to function in the face of uncertainty (e.g., “When I am uncertain I can’t go forward”), whereas desire for predictability refers to a strong preference for knowing what will happen in the future (e.g., “I always want to know what the future has in store for me”). Bredemeier and Berenbaum (2008) found that uncertainty paralysis was

positively associated with both perceived probabilities and perceived costs for negative outcomes (e.g., “your health deteriorating”). Desire for predictability was also positively associated with cost estimates. Interestingly, desire for predictability was negatively associated with probability estimates specifically for negative outcomes that are unlikely to occur, suggesting that IU may contribute to worry independently of perceived threat (Bredemeier & Berenbaum, 2008; Dugas, Gosselin, et al., 2001).

Considering that the data reported by Bredemeier and Berenbaum (2008) speak to appraisal of unambiguous threats, it would be useful to further investigate the contribution of IU to worry via biased appraisal of ambiguous situations. Findings from Dugas, Hedayati, et al. (2005) and Koerner and Dugas (2008) suggest that over-estimation of threat outcome probability and cost with respect to ambiguous situations may help to distinguish individuals who are highly intolerant of uncertainty from low IU individuals.

Examining more specific appraisal dimensions that have been implicated in pathological worry could also help to further understand why high IU individuals find ambiguous situations distressing. For example, a decrease in perceived control over negative events has been hypothesised as a generalised vulnerability factor that increases the risk of developing an anxiety disorder and contributes to the maintenance and exacerbation of anxiety symptoms (Barlow, 2002). To date, there is little research on the relationship between IU and perceived controllability. Similarly, the construct of negative problem orientation is embedded in the IU model (Dugas, Gagnon, et al., 1998; Robichaud & Dugas, 2005a), following a body of research showing that worry often reflects poor problem-solving confidence (Borkovec, 1985; Davey, 1994; Dugas et al., 1995; Stöber, Tepperwien, & Staak, 2000). However, apart from one study by Dugas et al. (1997) who

reported that IU and problem orientation are strong predictors of trait-like worry in undergraduate students, there is little research that explicitly addresses the relationship between IU and problem orientation in response to ambiguous situations. Finally, although desire for predictability has been identified as one of the dimensions of IU (Berenbaum et al., 2008), it is not clear if and to what extent high and low IU individuals differ in perception of their ability to anticipate or predict what will occur in the future.

As IU represents a set of trait-like beliefs about the meaning and consequences of uncertainty, it might be more experimentally feasible to manipulate uncertainty of a task, rather than IU beliefs. To date, there is limited research on how individuals high in IU respond to uncertainty using experimental manipulations. de Bruin et al. (2006) asked undergraduate participants to complete a set of word-association tasks. The authors manipulated participants' level of uncertainty by providing pre-task information to half of the participants that they would probably do well as the tasks were developed to measure the IQ of young teenagers (easy task condition). The other half of the participants were informed that the task was developed to measure the IQ of highly gifted people (difficult task condition). Participants were unaware that half of the task was in fact unsolvable. When participants expected to perform well but struggled with the task, this experience rendered them feeling more uncertain about their performance. Results showed that IUS scores were positively associated with task-related worry. Contrary to the authors' prediction, however, participants in the difficult task condition did not differ from those in the easy task condition in terms of self-reported worry.

Experimental manipulation of task uncertainty may also affect high IU individuals in ways other than increasing worry severity. Ladouceur et al. (1997) found that the more

intolerant an individual was the more cues they sought before responding in a moderately ambiguous inference task. Rosen and Knäuper (2009) manipulated both IU beliefs and situational uncertainty (regarding possible contraction of a fictitious viral infection) and found that participants in the increased IU belief and high situational uncertainty condition sought information and worried more than participants in the decreased IU belief and low situational uncertainty condition. Together, the above findings highlight a tendency amongst high IU individuals to engage in active, approach-focused behaviours in order to increase feelings of certainty. However, further clarification is necessary to establish the way in which high IU individuals respond to uncertain situations, as the nature of these responses would help to explain the mechanisms of IU in worry.

The Current Study

The aim of Experiment 1 was to extend the work of Koerner and Dugas (2008) on biased appraisal of ambiguous situations in individuals with high IU. Using two groups of participants with extremely low and extremely high IU levels, we first examined levels of concern as well as other appraisal dimensions in response to ambiguous situations. These additional appraisal dimensions include probability and cost estimates of negative outcomes, perception of controllability, confidence in problem-solving abilities, and perception of predictability. It was predicted that in response to ambiguous situations, high IU participants would show 1) greater levels of concern (replicating Koerner & Dugas, 2008), 2) overestimation of threat outcome probability, 3) overestimation of cost in response to ambiguous scenarios, 4) less controllability, 5) less confidence in problem-solving abilities, and 6) less predictability, relative to low IU participants.

The second aim of the current study was to investigate the impact of experimental manipulation of uncertainty on individuals with high IU, using written feedback which has been shown to be an effective manipulation methodology for inducing feelings of uncertainty and generate cognitions consistent with the feedback (Rosen & Knäuper, 2009). In the current study, participants received either ambiguous or unambiguous feedback in writing. The bogus ambiguous feedback was designed to evoke feelings of uncertainty in participants about their relative performance on the first vignette task, without any direction as to how they could improve their performance on the second vignette task.

Hypotheses with respect to the effect of manipulation were based on the initiation-termination account that worry may be terminated when an individual achieves a sense of closure where they have taken all the actions that could reasonably be taken to cope with a threat (Berenbaum, 2010). It is unclear from Berenbaum (2010) whether such actions necessarily represent efficient strategies, or they reflect a tendency amongst GAD individuals to seek reassurance (ref). If the latter, then it could be expected that compared to low IU participants, high IU participants in the current study who received the ambiguous feedback may attempt to take actions that help them to cope with feelings of uncertainty. This may be manifested in a further shift in their ratings on the second vignette task, instead of repeating response patterns as on the first vignette task. That is, high IU participants were expected to show a further increase in ratings of concern, negative outcome probability and cost ratings, and a further decrease in ratings of controllability, problem-solving confidence, and outcome predictability.

Method

Participants

Prospective participants were selected from a pool of 92 undergraduate psychology students using cut-off scores derived from the undergraduate norms for the IUS-12 total scores ($M = 25.85$, $SD = 9.45$) reported by Carleton et al. (2007). Participants were classified as either having high IUS-12 scores (39 or above) or low IU scores (23 or below). These cut-off scores correspond to the top 10% and bottom 40% of the sample used to validate the IUS-12 (Carleton, Norton, et al., 2007). The cut-off for the High IU group is similar to the mean IUS-12 score of 40.38 for a sample of clinical GAD participants reported by Carleton et al. (2012).

Considering that existing research has mostly examined IU as a trait-like variable (Buhr & Dugas, 2002), it could be expected that individual IUS-12 scores would remain relatively stable over the period between initial screening and the main study. The IUS-12 was re-administered at the end of the experiment to confirm group membership. 12 participants were excluded as their post-experiment IUS-12 scores differed considerably from their screening IUS-12 responses, leaving a sample of 40 low IU participants (14 men, 26 women) and 40 high IU participants (10 men, 30 women). The final sample comprised 80 participants (24 men, 30%; 56 women, 70%, $M_{\text{age}} = 21.14$ years, $SD = 4.81$). Participants were randomly allocated to either the unambiguous feedback ($n = 39$) or ambiguous feedback ($n = 41$) condition. Randomisation of participants was conducted within the high and low IU samples. Participants received either course credit or cash payment for their participation.

The current study was designed with a sample size comparable to previous studies that investigated differences between IU groups in response to manipulation of ambiguity (de Bruin et al., 2006; Ladouceur et al., 2000). A power analysis showed that the current study had approximately 75% power to detect a moderate effect size (Cohen's $d = 0.60$) for between-group contrasts and Group x repeat interaction contrasts.

Materials and Measures

Vignette Task

The vignette task used in the present study was based on the task used by Koerner and Dugas (2008), with additional appraisal dimensions for the purpose of the current experiment. In addition to ratings of concern (*“How concerned would you be in this situation?”*), five appraisal dimensions were included to assess 1) controllability (*“How in control would you feel in this situation?”*), 2) confidence in problem-solving effectiveness (*“How confident would you feel about solving any unforeseen problem(s) that may arise in this situation?”*), 3) negative outcome probability (*“How likely do you think a negative outcome will occur?”*), 4) cost of negative outcome (*“How bad would the negative outcome be?”*), and 5) outcome predictability (*“How much do you think you can predict the outcome?”*). Following Koerner and Dugas (2008), ratings were made on a five-point scale.

The vignettes used in the current study were selected from a pool of 90 vignettes (30 positive, 30 negative, and 30 ambiguous scenarios), all of which were worded in the first person. Each of the vignette tasks consisted of 10 positive, 10 negative, and 10 ambiguous scenarios. The vignettes covered 11 content areas: friendships, romantic

relationships, family relationships, academic performance, work competence, finances, one's own health, health of loved ones, threat of physical harm, or danger, the future, and self-concept. Of the 90 vignettes, 52 originated from Koerner and Dugas (2008), who selected their vignettes from the Ambiguous/Unambiguous Situations Diary (AUSD; Davey et al., 1992). An additional 38 vignettes were constructed as the original 52 were insufficient for the needs of the experiment. The AUSD assesses appraisal biases and is composed of positive, negative, and ambiguous scenarios, which have been used in previous studies examining the relation of worry-related processes to the interpretation of ambiguous situations (Davey et al., 1992; Dugas, Hedayati, et al., 2005; Rassin & Muris, 2005).

The additional 38 vignettes were constructed and pilot tested with ten participants who were unaware of the aims of the main experiment. Of the 38 vignettes, 19 were positive scenarios and 19 negative. Participants evaluated the valence of each scenario on a nine-point scale from 1 (*Not at all pleasant*) to 9 (*Very pleasant*), as well as ambiguity of each scenario, also on a nine-point scale from 1 (*Not at all ambiguous*) to 9 (*Very ambiguous*). Furthermore, participants were asked to classify each scenario into one of the 11 content area categories described earlier. As expected, the positive scenarios were rated as most pleasant, ($M = 7.78$, $SD = .40$), and the negative scenarios least pleasant ($M = 1.85$, $SD = .79$). A one-way within-subjects analysis of variance (ANOVA) was performed to test for differential valence ratings between the three types of scenarios. Results showed that the positive scenarios were rated as significantly more pleasant relative to the negative and the ambiguous scenarios, $F(1, 9) = 228.43$, $p < .05$; 95% CI (in SD units) = 6.82, 9.22. Furthermore, the ambiguous scenarios were rated as significantly more pleasant than the

negative scenarios, $F(1, 9) = 266.43$, $p < .05$; 95% CI = 4.28, 5.66.

The ambiguous scenarios were rated as most ambiguous ($M = 6.38$, $SD = 1.22$), and the positive scenarios least ambiguous ($M = 2.59$, $SD = 1.26$). Results from a one-way within-subjects ANOVA showed that the ambiguous scenarios were rated as significantly more ambiguous relative to the positive and negative scenarios, $F(1, 9) = 21.60$, $p < .05$; 95% CI = 1.06, 3.07, with no difference between the positive and negative scenario types, $F(1, 9) = 3.18$, $p = .11$; 95% CI = -1.72, .20.

Manipulation Feedback

To maximise experimental control, the performance feedback provided to participants were presented in a written format. In the ambiguous feedback condition, participants were informed that based on their responses to the first vignette task, their performance was not clear, that their sensitivity to interpersonal situations varied and it was not clear what level of appraisal skills they have. In the unambiguous feedback condition, unambiguously positive feedback was given to the participants with regard to their interpersonal sensitivity and appraisal skills. The two different types of feedback are attached in Appendix A.

A pilot study was carried out to ascertain the degree of ambiguity and pleasantness for the ambiguous feedback relative to the unambiguous feedback. A convenience sample of 21 individuals (eight men, 13 women, $M_{\text{age}} = 33.60$ years, $SD = 5.12$) participated in the pilot study. Participants were asked to read the ambiguous and unambiguous feedback statements, and rate each statement the level of pleasantness (1 = *Not at all pleasant* and 9 = *Very pleasant*) and ambiguity (1 = *Not at all ambiguous* and 9 = *Very ambiguous*) on a nine-point scale. One-sample t test results revealed that not only was the ambiguous

feedback ($M = 7.10$, $SD = 1.61$) rated as significantly more ambiguous than the neutral rating of 5, $t(20) = 5.97$, $p < .05$, it was also rated as significantly more ambiguous than the unambiguous feedback ($M = 2.90$, $SD = 1.73$); $t(20) = 12.98$, $p < .05$. The unambiguous feedback ($M = 8.10$, $SD = .89$) was also rated as significantly more pleasant than the ambiguous feedback ($M = 4.14$, $SD = 1.01$), $t(20) = 6.85$, $p < .05$. All correlations between pleasantness and ambiguity ratings for each feedback were negative and non-significant.

Self-report Questionnaires

The 12-item Intolerance of Uncertainty Scale (Carleton, Norton, et al., 2007) was used to define the two IU membership groups. The IUS-12 is a short form of the original 27-item IUS (Freeston, Rhéaume, et al., 1994) that measures reactions to uncertainty, ambiguous situations, and the future. Items are scored on a five-point scale ranging from 1 (*Not at all characteristic of me*) to 5 (*Extremely characteristic of me*), and total scores can range from 12 to 60. The IUS-12 has excellent internal consistency and correlates highly with the original scale, $r = .96$ (Carleton, Norton, et al., 2007; McEvoy & Mahoney, 2011). Additionally, confirmatory factor analyses have demonstrated the stability of the two-factor structure of the IUS-12 (Carleton et al., 2007), $\chi^2(119) = 307.66$, $p < .001$; GFI = .95; AGFI = .93; CFI = .93; RMSEA = .041 (90% CI: .04-.05) (Helsen, Van den Bussche, Vlaeyen, & Goubert, 2013). Psychometric properties of the IUS-12 have been replicated in clinical and nonclinical samples (Carleton, Norton, et al., 2007; Carleton, Sharpe, et al., 2007; McEvoy & Mahoney, 2011). Cronbach's alpha for the current sample was .94 for the total score.

The Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) was used to assess participants' self-reported tendency to worry. This is a 16-item non-content based measure of the intensity and excessiveness of worry, with excellent internal consistency (α

= .86 -.93; Molina & Borkovec, 1994). Additionally, correlations between the PSWQ and measures of anxiety, depression, and emotional control have supported the construct, convergent and discriminant validity of the measure in clinical and community samples (Brown et al., 1992). The PSWQ has also demonstrated good test–retest reliability ($r = .74$ to $.92$) across time frames of two-ten weeks in undergraduate samples (Meyer et al., 1990; Molina & Borkovec, 1994). Cronbach’s alpha for the current sample was .95 for the total score.

The 21-item Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995) were used to assess participants’ state depression, anxiety, and stress symptoms. Responses to each item are answered using a four-point rating-scale from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much, or most of the time*) relating to the past week. The depression scale has high internal consistency with Cronbach’s alpha ranging from .88 - .94 (Antony, Bieling, Cox, Enns, & Swinson, 1998; Henry & Crawford, 2005). The convergent and discriminant validity of the DASS has been demonstrated through its correlation with other measures of depression, anxiety, positive affect, and negative affect (Crawford & Henry, 2003). Cronbach’s alpha for the current sample was .91 (depression), .84 (anxiety), and .89 (stress).

The Cognitive Avoidance Questionnaire (CAQ; Gosselin et al., 2002; English translation, Sexton & Dugas, 2008) is a 25-item scale that assess the use of five cognitive avoidance strategies, including Thought Suppression, Thought Substitution, Distraction, Avoidance of Threatening Stimuli and the Transformation of Images into Thoughts. The English version of the CAQ has demonstrated excellent internal consistency ($\alpha = .95$) and sound stability over four to six weeks (test-retest reliability $r = .85$ for the total scale)

(Sexton & Dugas, 2008), comparable to the original French version (Gosselin et al., 2002). Additionally, the CAQ has demonstrated evidence of convergent and divergent validity with measures of worry, thought suppression, and dispositional coping styles (Sexton & Dugas, 2008). Cronbach's alpha for the current sample was .96 for the total score.

The 12-item Negative Problem Orientation Questionnaire (NPOQ; Gosselin, Pelletier, & Ladouceur, 2001; English translation, Robichaud & Dugas, 2005a, 2005b) assesses a general predisposition in negative problem orientation, including perceived threat of problems to well-being, ineffectiveness or lack of confidence in one's own problem solving abilities, the tendency to be pessimistic about the outcome, and low frustration tolerance. The English version of the NPOQ has demonstrated excellent internal consistency ($\alpha = .92$), good re-test reliability ($r = .80, p < .01$), and good convergent and discriminant validity (Robichaud & Dugas, 2005a, 2005b). Cronbach's alpha for the current sample was .97 for the total score.

Manipulation checks

Six questions were administered following the completion of the second vignette task to check that the performance feedback was effective. These questions included:

- 1) *Not being sure of performing well concerned me.*
- 2) *If I had been sure of performing well, I would have been less bothered by the task.*
- 3) *I found it was a shame that there were no guarantees that I was performing well.*
- 4) *If I had been sure of performing well, I would have been less preoccupied by the task.*
- 5) *The uncertainty of performing well caused me distress.*
- 6) *Not being sure of performing well affected my confidence.*

Participants were asked to rate on a five-point scale ranging from 1 (*Not at all characteristic of me*) to 5 (*Entirely characteristic of me*) the extent to which each state was characteristic of them. The manipulation check items were modelled after the manipulation check items used by Ladouceur et al. (2000), relating to participants' beliefs about uncertainty regarding the performance feedback. All the manipulation check items were positively and significantly correlated with the full IUS-12 scale (correlation coefficients ranged from .24 to .69, all p 's < .05).

Procedure

Participants were provided with details about the nature of the tasks involved in the experiment, including reading vignettes, providing ratings, and completing self-report questionnaires. After completing informed consent, participants were asked to complete the first vignette task, which consisted of reading 30 scenarios, and to imagine that the events described therein were happening to them personally. For each scenario, participants were asked to provide ratings for the six outcome variables (concern, controllability, confidence in problem-solving abilities, outcome probability, cost, and predictability). Upon completing the first vignette task, participants received either ambiguous or unambiguous feedback with respect to how well they could evaluate the appropriate level of concern in various common situations. Participants then proceeded to complete the second vignette task, followed by the manipulation check and the self-report measure battery. Upon completion of all tasks, participants were debriefed about the full objectives, hypotheses and clinical implications of the current experiment and were given an opportunity to ask questions. The task took approximately 50-60 minutes to complete.

Scoring and Analysis

Ratings on each of the appraisal domains were linearly transformed to a scale ranging from 0 to 100%. The current experiment followed a 2 x 2 x (3) x (2) factorial design, where IU Group (Low IU vs. High IU) and Feedback Condition (Ambiguous vs. Unambiguous) constituted between-groups factors. The two within-subjects factors refer to Scenario Type (positive, negative, and ambiguous) and Time (baseline and post-manipulation). The dependent variables, including concern, perceptions of controllability and problem-solving effectiveness, probability and cost of negative outcomes, and predictability, were analysed as dependent variables by a set of planned non-orthogonal contrasts using a multivariate, repeated measures model, with the decision-wise error rate set at $\alpha = .05$ (O'Brien & Kaiser, 1985).

The group contrasts compared 1) the High IU to the Low IU group, and 2) the Ambiguous Feedback condition to the Unambiguous Feedback condition. The time contrast examined the difference between responses at baseline (T1) and post-manipulation (T2). The scenario contrasts examined the difference between 1) the negative and positive scenarios, 2) the positive and ambiguous scenarios, and 3) between the negative and ambiguous scenarios. As the scenario factor (positive/ambiguous/negative) did not lend itself to orthogonal contrasts, three pair-wise contrasts were tested for this factor alone. Bonferroni correction was not used in order to maintain power and comparability with the remaining analyses. All interactions between IU Group, Feedback Condition, Time, and Scenario Type contrasts were also tested. For each contrast, effect sizes are reported using standardised 95% confidence intervals (CI; scaled in SD units). All reported analyses were conducted using the PSY Statistical Program (Bird, Hadzi-Pavlovic, & Isaac, 2000).

Follow-up exploratory analyses were also conducted in order to clarify the pattern of results within- and between-groups for each dependent measure. In order to maintain statistical power, these exploratory analyses did not involve any correction for inflation of Type 1 errors. Therefore, these exploratory results should be interpreted with caution.

Results

Group Classification

Koerner and Dugas (2008) found that 51% of their high IU participants had cognitive and somatic symptoms, as indexed on the Worry and Anxiety Questionnaire (WAQ; Dugas, Freeston, et al., 2001), consistent with a diagnosis of GAD. However, 59% of their low IU participants also met the cognitive and somatic criteria for GAD using the same measure. The current experiment used the PSWQ (Meyer et al., 1990) to assess severity of worry. It has been suggested that a cut-off score of 62 on the PSWQ would accurately detect 75% of GAD participants and can accurately identify non-cases of GAD with 86% specificity (Behar, Alcaine, Zuellig, & Borkovec, 2003). In the current study, 50% of the High IU participants showed a PSWQ score greater than the cut-off score of 62, and only 5% of participants in the Low IU group scored greater than the cut-off score. Thus, the classification approach used for the current sample yielded two groups that were far less overlapped in IU and worry compared to the group classification method used in Koerner and Dugas (2008).

The means and standard deviations on the self-report questionnaires for both IU groups are presented in Table 3.1. As expected, the High IU group reported a significantly

higher mean IUS-12 score than the Low IU group, $t(76) = 17.19$, $p < .05$. The High IU group also reported a significantly higher mean PSWQ score, $t(78) = 8.13$, $p < .05$, and a higher mean DASS-Depression score, $t(78) = 5.42$, $p < .05$, than the Low IU group. As shown in Table 3.2, there was no significant mean difference between the feedback groups on all post-experiment self-report questionnaires. Furthermore, there was no significant association between participant gender and IU group, $\chi^2 = .95$, $p > .05$.

Table 3.1.

Means (M) and standard deviations (SD) for all self-report variables by IU group.

	Low IU (n = 40)		High IU (n = 40)		$t(1, 78)$
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Total IUS-12	23.10	4.87	44.33	5.98	17.19 [*]
Prospective IU	15.11	3.45	26.46	3.71	13.90 [*]
Inhibitory IU	8.11	2.19	17.87	3.72	13.99 [*]
PSWQ	42.20	10.76	61.03	9.92	8.13 [*]
DASS Depression	5.25	5.63	15.35	10.34	5.42 [*]
DASS Anxiety	3.63	3.69	14.00	9.61	6.38 [*]
DASS Stress	7.10	5.89	20.40	10.61	6.93 [*]
CAQ Total	55.05	18.75	81.78	16.59	6.75 [*]
NPOQ	20.38	7.69	39.50	10.54	9.27 [*]

^{*} $p < .05$

Table 3.2.

Means (M) and standard deviations (SD) for all self-report variables by manipulation group.

	Unambiguous Feedback (n = 39)		Ambiguous Feedback (n = 41)		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i> (1, 78)
Total IUS-12	33.24	11.16	34.18	12.84	.34
Prospective IU	20.34	6.32	21.36	7.16	.66
Inhibitory IU	12.89	5.44	13.21	6.17	.23
PSWQ	50.74	12.69	52.44	15.22	.54
DASS Depression	10.26	8.71	10.34	10.68	.04
DASS Anxiety	7.97	7.81	9.61	9.89	.82
DASS Stress	13.28	10.08	14.20	11.63	.38
CAQ Total	67.05	20.93	69.71	23.42	.53
NPOQ	30.15	13.56	29.73	13.19	.14

Manipulation Efficacy Check

Ratings on the manipulation check items were linearly transformed to a scale ranging from 0 (*Not at all characteristic of me*) to 100% (*Extremely characteristic of me*) for the purpose of consistency in data presentation across the manipulation check and main analyses. No significant skew was observed following linear transformation. Responses were averaged over the six manipulation check items for each participant to form a composite score. The Ambiguous Feedback condition showed a greater absolute mean score ($M = 51.02$, $SD = 24.06$) relative to the Unambiguous Feedback condition ($M = 44.11$, $SD = 23.21$). In particular, there was a significant difference between the two feedback groups in response to the question “*If I had been sure of performing well, I would have been less bothered by the task*”, $t(70) = 2.69$, $p < .01$. However, the difference in mean

scores between the two manipulation conditions did not reach statistical significance, $t(70)$, 1.24, $p = .22$. The High IU group ($M = 62.96$, $SD = 15.62$) reported a significantly greater mean score in response to the manipulation check items relative to the Low IU group ($M = 32.82$, $SD = 20.62$), $t(70) = 6.96$, $p < .01$. There was no interaction between IU Group and Feedback Condition ($F < 1$).

Effects of Ambiguous Feedback on Appraisal

Results from contrast analyses for baseline appraisals showed a similar overall pattern of responses as post-manipulation data. As such, the results reported below pertain to post-manipulation data only.

Concern

Figure 3.1 shows mean concern ratings at baseline (T1) and post-manipulation (T2) for the positive scenarios (top panel), negative scenarios (middle panel), and ambiguous scenarios (bottom panel). The four participant groups represent Low and High IU participants who received unambiguous feedback or ambiguous feedback.

Averaged across Feedback Condition and Time, the High IU group showed significantly greater concern in all scenario types relative to the Low IU group, $F(1, 76) = 21.60$, $p < .05$; 95% CI = .46, 1.15. In particular, the High IU group reported significantly greater concern for ambiguous scenarios than the Low IU group, $F(1, 78) = 27.18$, $p < .05$; 95% CI = .72, 1.61.

There was no significant difference in concern ratings between the two feedback groups averaged over IU Group, Time, and Scenario Type ($F < 1$), nor between T1 and T2 ($F = 2.69$). Averaged across IU Group, Feedback Condition and Time, participants

reported significantly greater concern for the negative scenarios ($M = 81.42$, $SD = 11.86$) than positive scenarios ($M = 37.17$, $SD = 30.11$), $F(1, 76) = 227.11$, $p < .05$; 95% CI = 1.87, 2.44. For this comparison, High IU participants showed particularly greater concern with respect to the positive scenarios ($M = 48.09$, $SD = 30.70$) relative to the Low IU group ($M = 26.25$, $SD = 25.48$) averaged across time, leading to a significant interaction between the negative-positive comparison and IU Group, $F(1, 76) = 4.09$, $p < .05$; 95% CI = .01, 1.15.

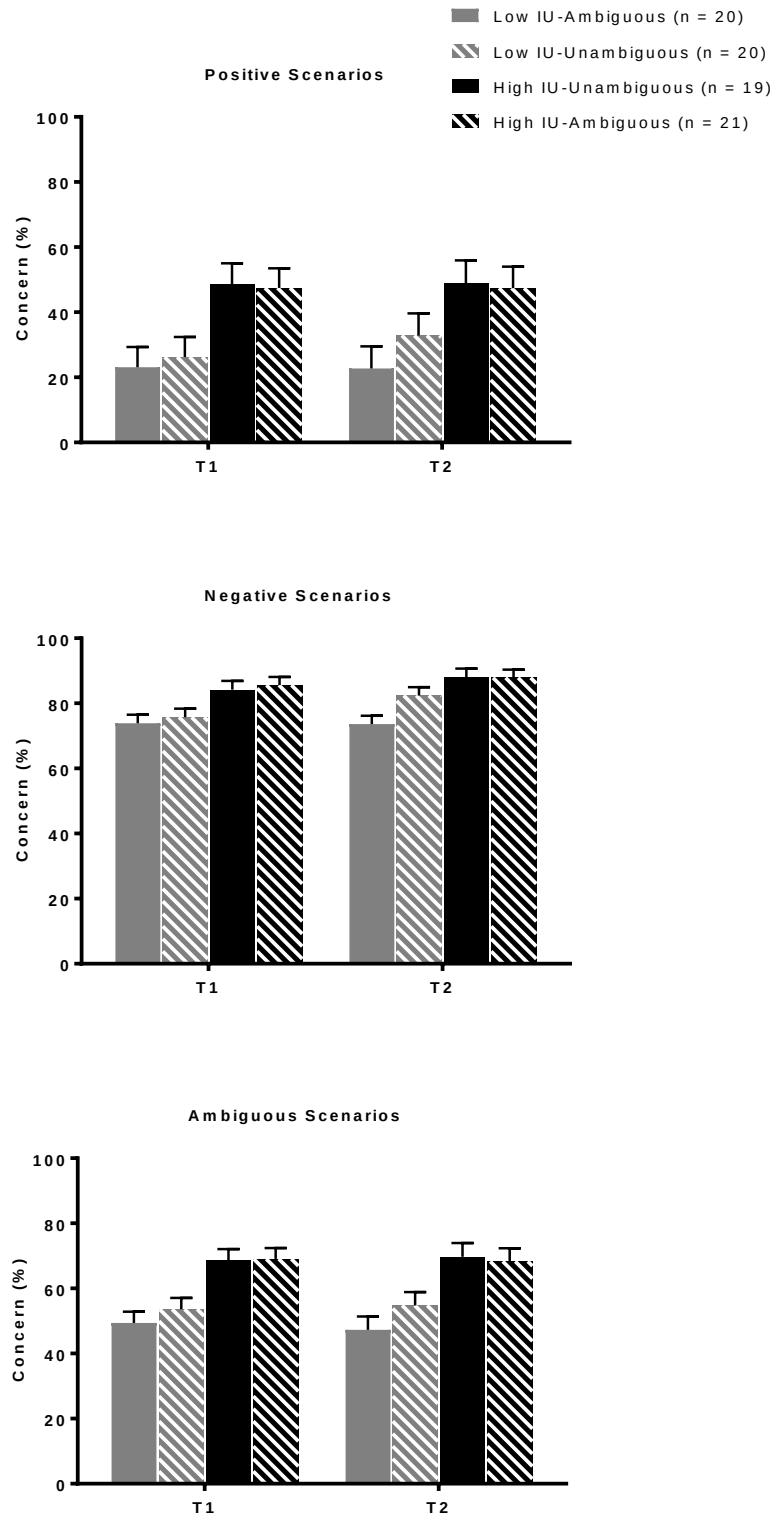


Figure 3.1. Mean concern ratings (%) at baseline (T1) and post-manipulation (T2).

Participants reported an intermediate level of concern for the ambiguous scenarios ($M = 60.08$, $SD = 17.47$), which was significantly greater than the positive scenarios, $F(1, 76) = 109.48$, $p < .05$; 95% CI = .90, 1.33, and lower than the negative scenarios, $F(1, 76) = 277.02$, $p < .05$; 95% CI = .92, 1.16. There was a significant interaction between the ambiguous-negative comparison and IU Group, $F(1, 78) = 8.92$, $p < .05$; 95% CI = .12, .62, reflecting a smaller difference between High and Low IU groups for the negative scenarios compared to the ambiguous scenarios. None of the other Scenario Type $\times$ IU Group interaction effects was significant ($F_s < 1$).

Controllability

Figure 3.2 shows the mean controllability ratings at baseline (T1) and post-manipulation (T2). There was no significant difference between IU groups averaged over scenario types and time, $F(1, 76) = 2.04$, $p = .15$; 95% CI = -.09, .55, nor between the two feedback groups ($F < 1$). Although the overall comparison between T1 and T2 did not reveal any significant difference ($F = 1.80$), there was an interaction between this comparison and IU Group, $F(1, 76) = 4.36$, $p < .05$; 95% CI = .01, .47. This interaction was mostly driven by a significant decrease in controllability ratings by the Low IU group at T2 relative to T1, $F(1, 39) = 5.26$, $p < .05$; 95% CI = .03, .49. The pattern of means for the Low IU group indicates a slightly greater decrease in perceived controllability in participants who received the ambiguous feedback relative to those who received the unambiguous feedback.

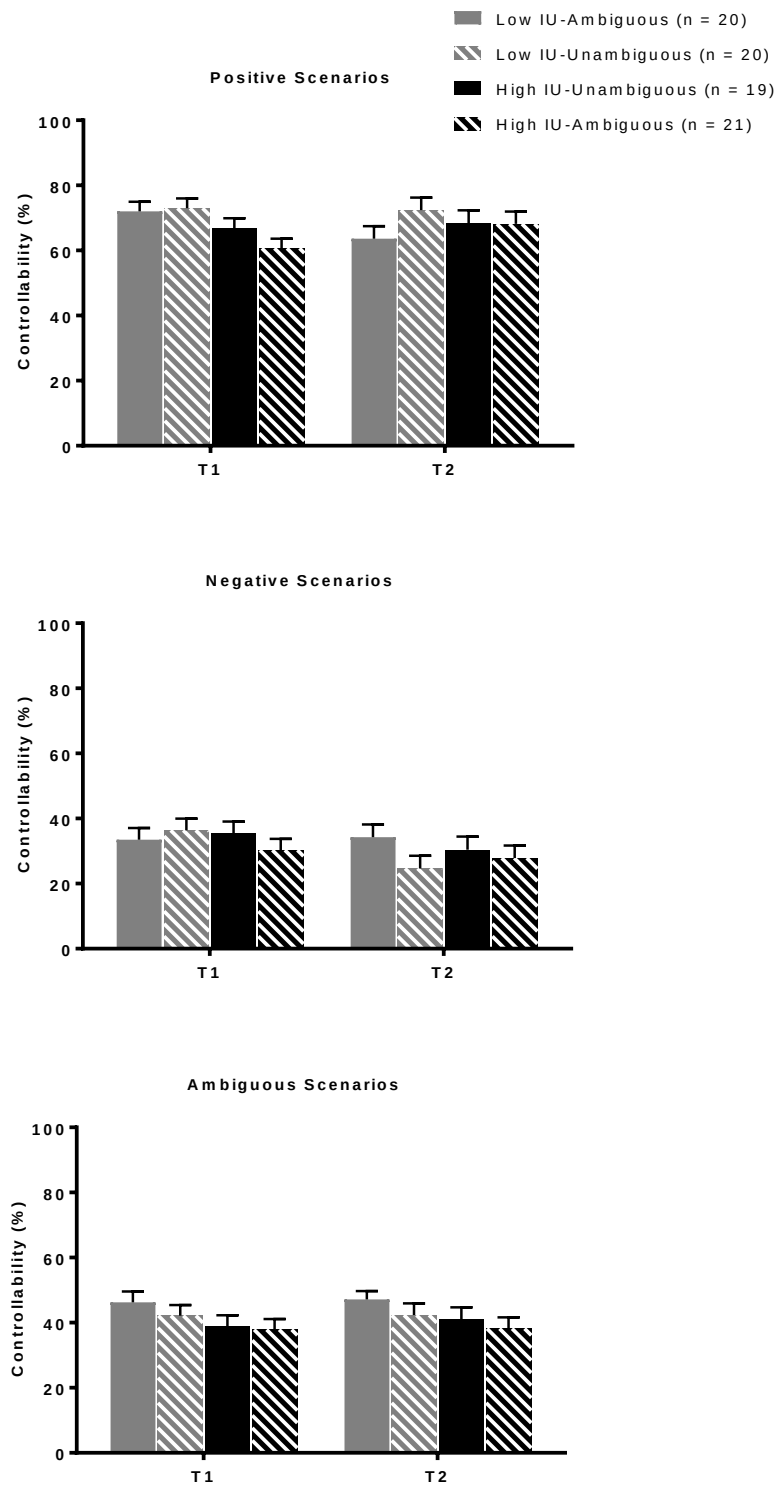


Figure 3.2. Mean controllability ratings (%) at baseline (T1) and post-manipulation (T2).

Participants reported significantly more controllability for positive scenarios relative to the negative scenarios, $F(1, 76) = 287.64, p < .05$; 95% CI = 2.03, 2.58. Controllability ratings for the ambiguous scenarios were significantly lower than the positive scenarios, $F(1, 76) = 248.49, p < .05$; 95% CI = 1.46, 1.88, and greater than the negative scenarios, $F(1, 76) = 83.16, p < .05$; 95% CI = .50, .78. None of the other Scenario Type $\times$ IU Group interaction effects was significant (largest $F = 3.69$).

Confidence in Problem-Solving Effectiveness.

Figure 3.3 shows the mean confidence ratings at baseline (T1) and post-manipulation (T2). Averaged across scenario types and time, High IU participants reported significantly lower level of confidence in their problem-solving abilities relative to Low IU participants, $F(1, 76) = 17.69, p < .05$; 95% CI = .38, 1.06. Averaged across scenario types, time, and IU groups, there was no difference between the two feedback groups, $F(1, 76) = 1.74, p = .19$; 95% CI = -.12, .57. There was no difference in confidence ratings between T1 and T2 ($F < 1$). Participants reported significantly greater confidence in their problem-solving abilities for the positive scenarios relative to the negative scenarios, $F(1, 76) = 351.54, p < .05$; 95% CI = 2.08, 2.58. Confidence ratings for the ambiguous scenarios were significantly lower than the positive scenarios, $F(1, 76) = 274.31, p < .05$; 95% CI = 1.31, 1.67, and greater than the negative scenarios, $F(1, 76) = 137.84, p < .05$; 95% CI = .70, .99. None of the Scenario Type $\times$ IU Group interaction effects was significant (largest $F = 1.47$).

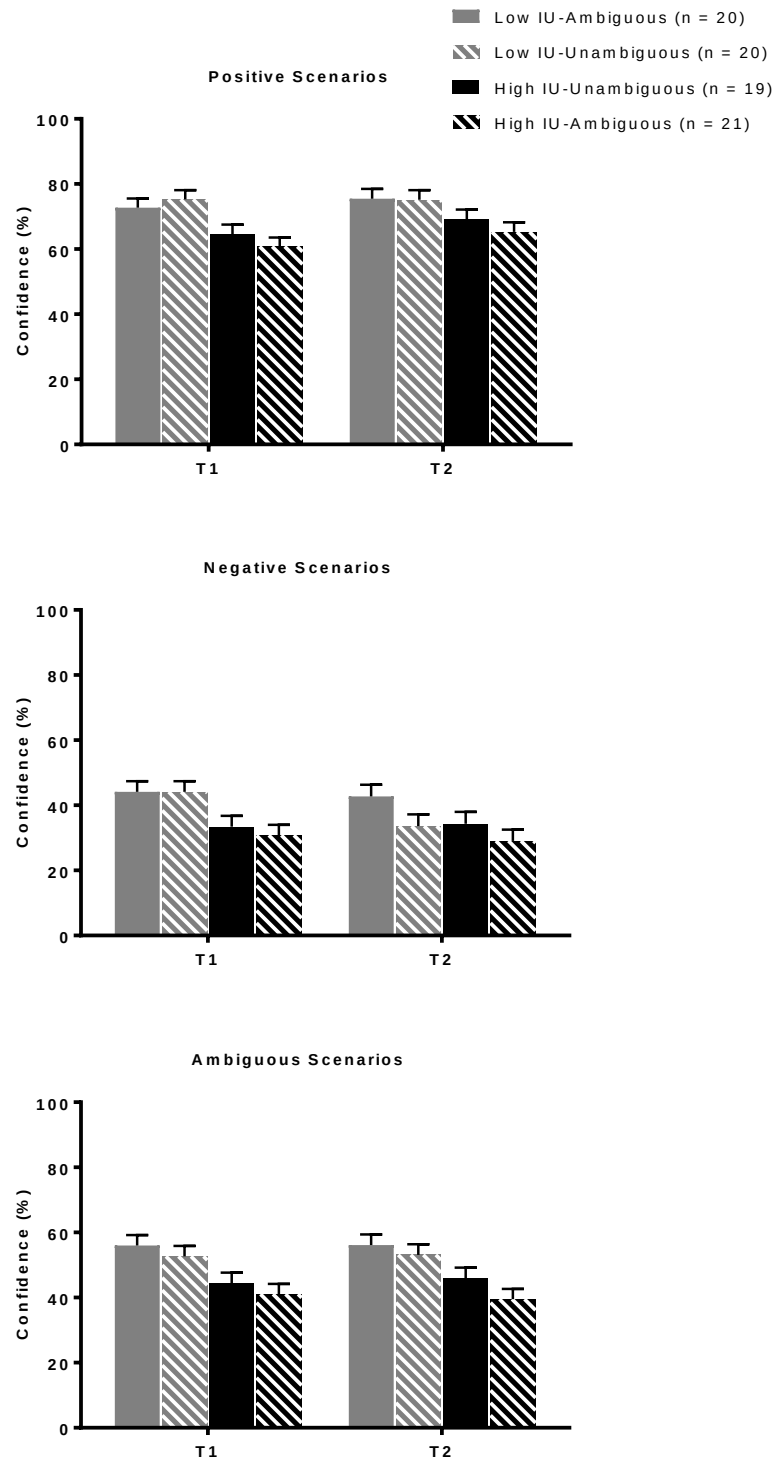


Figure 3.3. Mean confidence ratings (%) at baseline (T1) and post-manipulation (T2).

Negative Outcome Probability

Figure 3.4 shows the mean negative outcome probability ratings at baseline (T1) and post-manipulation (T2). Averaged across feedback groups, scenario types and time, High IU participants reported significantly greater negative outcome probability relative to Low IU participants, $F(1, 76) = 23.04$, $p < .05$; 95% CI = .46, 1.11. Averaged across IU groups, scenario types and time, there was no significant difference between the two feedback groups, $F(1, 76) = 1.62$, $p = .21$; 95% CI = -.53, .12. There was no significant difference in probability ratings between T1 and T2 ($F = 2.61$).

Participants indicated significantly greater probability of a negative outcome for the negative scenarios relative to the positive scenarios, $F(1, 76) = 501.53$, $p < .05$; 95% CI = 2.72, 3.25. Probability ratings for the ambiguous scenarios were greater than the positive scenarios, $F(1, 78) = 298.20$, $p < .05$; 95% CI = 1.40, 1.76, and lower than the negative scenarios, $F(1, 78) = 237.87$, $p < .05$; 95% CI = 1.23, 1.59. None of the Scenario Type $\times$ IU Group interaction effects was significant (largest $F = 2.08$).

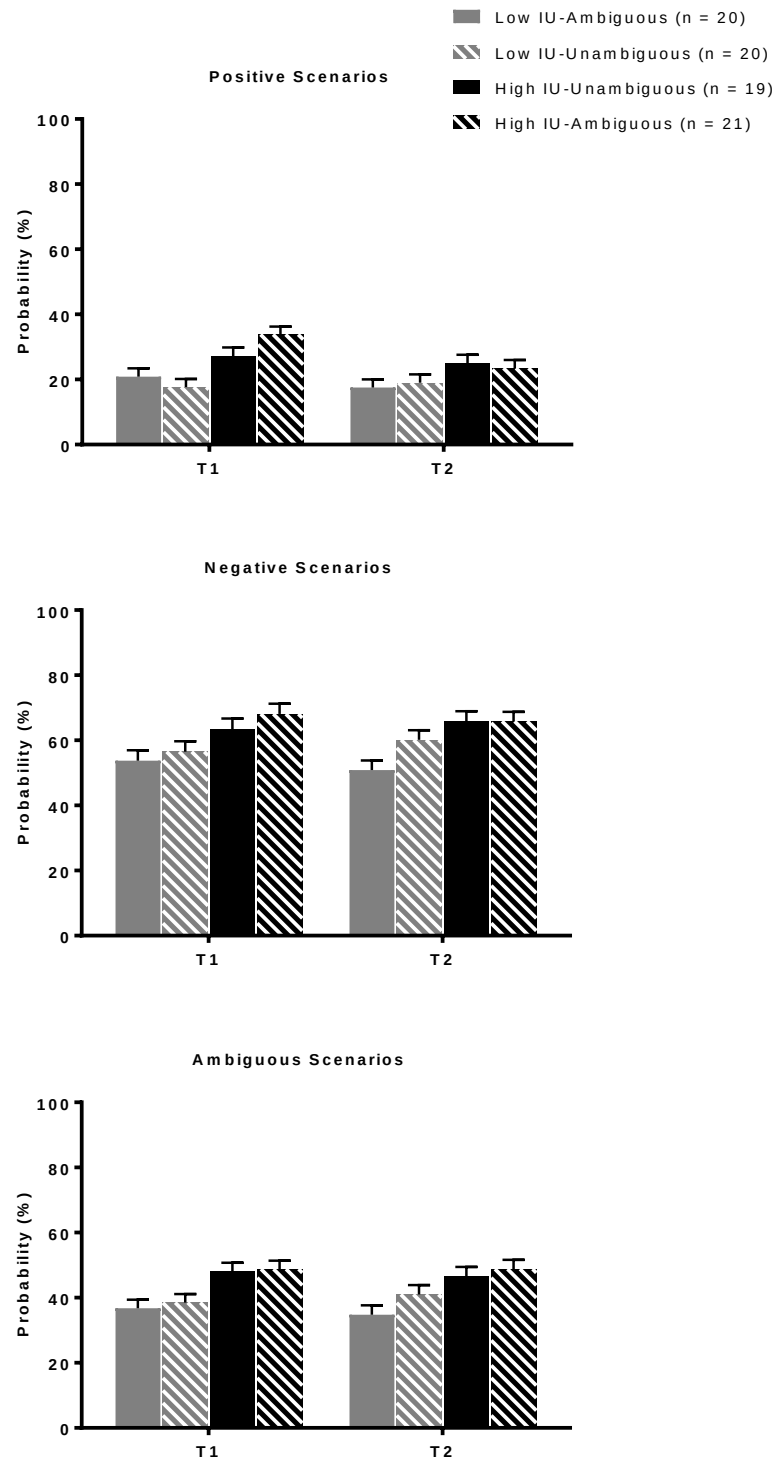


Figure 3.4. Mean negative outcome probability ratings (%) at baseline (T1) and post-manipulation (T2).

Negative Outcome Cost

Figure 3.5 shows the mean cost ratings at baseline (T1) and post-manipulation (T2). Averaged across feedback groups, scenario types and time, High IU participants reported significantly greater cost associated with a negative outcome relative to Low IU participants, $F(1, 76) = 9.97, p < .05$; 95% CI = .22, .97. Averaged across IU groups, scenario types and time, there was no significant difference between the two feedback groups, $F(1, 76) = 2.21, p = .14$; 95% CI = -.66, .10. There was no significant difference in cost estimates between T1 and T2 ($F = 1.10$). As would be expected, participants reported significantly greater cost for the negative scenarios relative to the positive scenarios, $F(1, 76) = 353.91, p < .05$; 95% CI = 1.67, 2.06. Cost ratings for the ambiguous scenarios were significantly greater than the positive scenarios, $F(1, 76) = 288.97, p < .05$; 95% CI = .90, 1.13, and significantly lower than the negative scenarios, $F(1, 78) = 152.41, p < .05$; 95% CI = .71, .99. None of the Scenario Type $\times$ IU Group interaction effects was significant (largest $F = 2.04$).

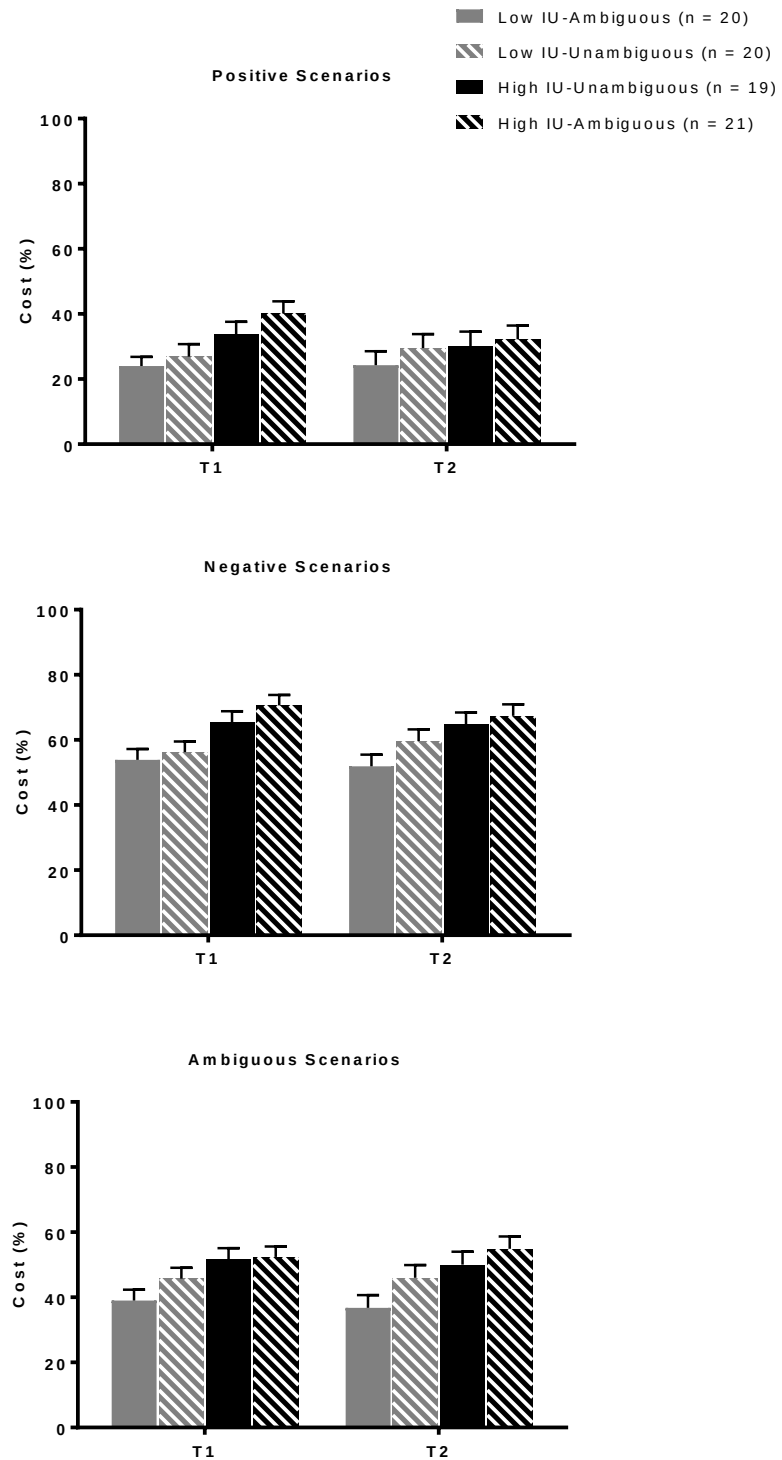


Figure 3.5. Mean negative outcome cost ratings (%) at baseline (T1) and post-manipulation (T2).

Outcome Predictability

Figure 3.6 shows the mean predictability ratings at baseline (T1) and post-manipulation (T2). Averaged across feedback groups, time, and scenario types, there was no significant difference between the IU groups in ratings of outcome predictability ($F < 1$). Averaged across IU groups, time, and scenario types, there was no significant difference between the two feedback groups ($F < 1$). Predictability ratings did not differ significantly between T1 and T2 ($F < 1$). Overall, participants reported significantly greater outcome predictability for the positive scenarios relative to the negative scenarios, $F(1, 76) = 19.20$, $p < .05$; 95% CI = .29, .76. Predictability ratings for the ambiguous scenarios were significantly lower than the positive scenarios, $F(1, 76) = 84.99$, $p < .05$; 95% CI = .67, 1.04, and greater than the negative scenarios, $F(1, 76) = 21.73$, $p < .05$; 95% CI = .19, .47. None of the Scenario Type $\times$ IU Group interaction effects was significant ($F_s < 1$).

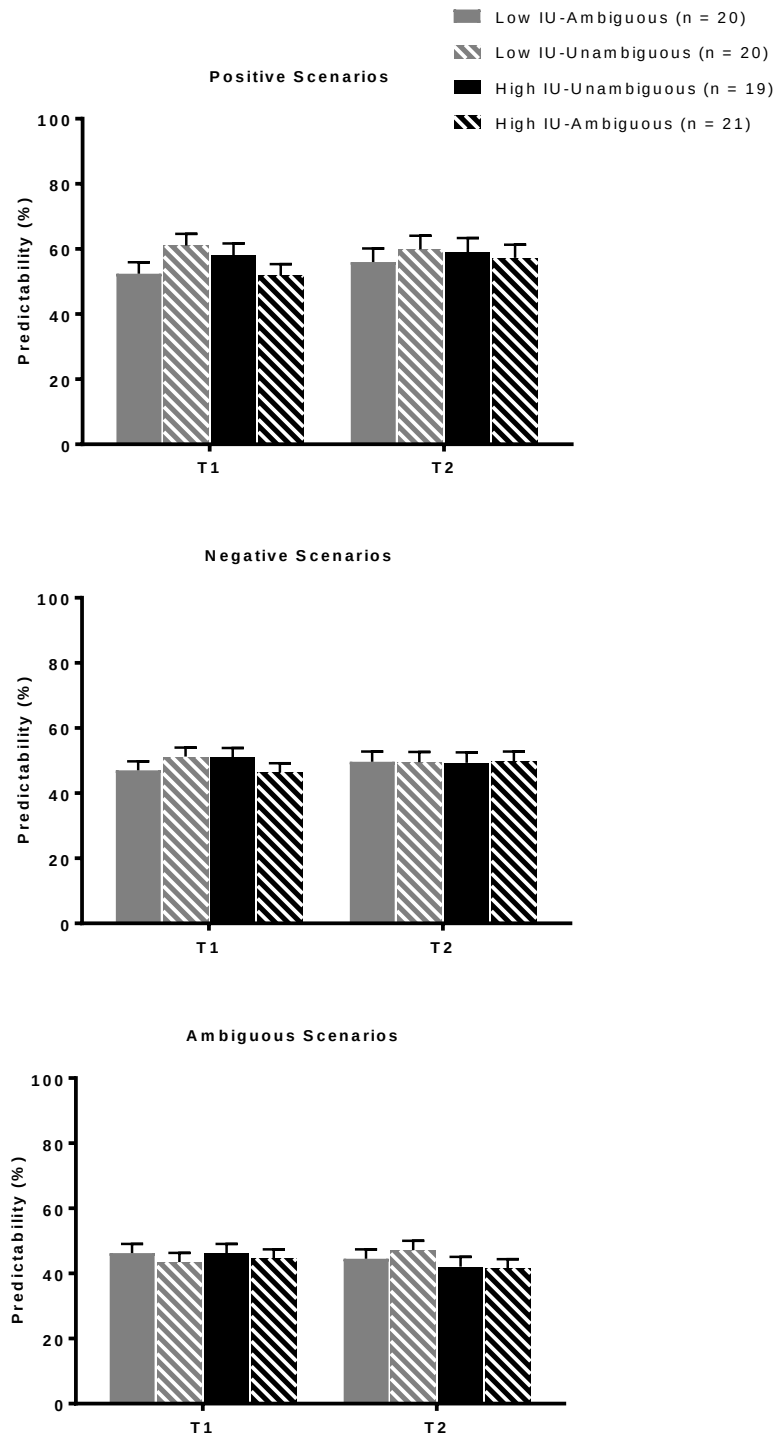


Figure 3.6. Mean predictability ratings (%) at baseline (T1) and post-manipulation (T2).

Correlation and Regression Analyses

A bivariate correlation analysis was conducted to examine the relationship between the six outcome variables (concern, controllability, confidence, probability, cost, and outcome predictability) with respect to the ambiguous scenarios, and self-report questionnaires (PSWQ, IUS-12, CAQ, NPOQ, DASS Depression, and DASS Anxiety). Correlation results were averaged across T1 and T2, as initial correlation analyses showed similar patterns of correlation coefficients across the two time points. The correlation coefficients for outcome variables and self-report questionnaires are shown in Table 3.2.

Correlations between all self-report questionnaires were significant and positive. Within the outcome measures, concern was significantly correlated with probability and cost ratings. Confidence in problem-solving abilities was significantly correlated with all of the other outcome measures. Controllability was significantly correlated with all of the outcome measures except for concern. Predictability was not correlated with any of the other outcome measures.

Of the six outcome measures, concern and probability ratings were positively and significantly correlated with all of the self-report questionnaires. Cost was positively and significantly correlated with all of the self-report questionnaires except the CAQ. Confidence in problem-solving abilities was negatively and significantly correlated with all of the self-report questionnaires. Outcome predictability was negatively and significantly correlated with NPOQ and DASS Depression, but not with the other self-report questionnaires. Controllability was significantly correlated with NPOQ, but not with the other self-report questionnaires.

Table 3.3.

Pearson bivariate zero-order correlation coefficients for self-report and outcome variables for the ambiguous scenarios.

	IUS-12 Total	CAQ	NPOQ	DASS Dep	DASS Anx	DASS Stress	Concern	Control	Confidence	Probability	Cost	Predict
PSWQ	.77**	.49**	.69**	.46**	.50**	.56**	.47**	-.16	-.37**	.41**	.25*	-.11
IUS-12 Total		.65**	.79**	.57**	.60**	.65**	.57**	-.15	-.44**	.43**	.31**	-.11
CAQ			.63**	.37**	.46**	.51**	.35**	-.04	-.29**	.28*	.16	-.07
NPOQ				.68**	.60**	.70**	.43**	-.31**	-.57**	.53**	.46**	-.25*
DASS Dep					.73**	.77**	.39**	-.19	-.31**	.36**	.42**	-.23*
DASS Anx						.77	.54**	-.19	-.40**	.37**	.35**	-.13
DASS Stress							.38**	-.25**	-.34**	.42**	.45**	-.12

Note. PSWQ = Penn State Worry Questionnaire; IUS-12 Total = Intolerance of Uncertainty Scale total score; IUS-12 Inh = Inhibitory IU subscale; IUS-12 Pro = Prospective IU subscale; CAQ = Cognitive Avoidance Questionnaire total score; NPOQ = Negative Problem Orientation Questionnaire total score; DASS Dep = Depression Anxiety Stress Scales Depression subscale; DASS Anx = Depression Anxiety Stress Scales Anxiety subscale.

** $p < .01$

* $p < .05$

Bivariate correlation analysis also showed that mean response to the manipulation check items was significantly correlated with ratings of concern ($r = .60, p < .01$), control ($r = -.28, p < .05$), confidence ($r = -.56, p < .01$), probability ($r = .55, p < .01$), and cost ($r = .37, p < .01$). The correlation between manipulation check and ratings of predictability was not significant ($r = -.08, p = .52$).

In view of the significant correlations between self-report measures and the outcome measures for the ambiguous scenarios, an exploratory analysis was conducted using linear regression to examine potential factors contributing to the variance in ratings of concern, controllability, confidence, probability, cost, and outcome predictability. IUS-12, PSWQ, NPOQ, CAQ, DASS-Depression, and DASS-Anxiety were entered as predictors. Results showed that both IUS-12 and DASS-Anxiety were significant predictors of ratings of concern for the ambiguous scenarios, $R^2 = .39, F(6, 71) = 7.71, p < .05$; IUS-12, $\beta = .51, p < .05$; DASS-Anxiety, $\beta = .34, p < .05$, but not PSWQ, NPOQ, CAQ, nor DASS-Depression. NPOQ and DASS-Depression were significant predictors of ratings of confidence in problem solving, $R^2 = .37, F(6, 71) = 6.79, p < .05$; NPOQ, $\beta = -.76, p < .05$; DASS-Depression, $\beta = .35, p < .05$. Of the six predictors, only NPOQ was a significant predictor for ratings of controllability, probability, and cost.

Discussion

The aim of Experiment 1 was to investigate the appraisal dimensions in high IU individuals, and to examine whether manipulation of ambiguity associated with task performance would affect appraisals. It was anticipated that compared to low IU

participants, high IU participants would show: 1) greater levels of concern for ambiguous situations, 2) less controllability, 3) less confidence in problem-solving abilities, 4) overestimation of threat outcome probability, 5) overestimation of cost in response to ambiguous scenarios, and 6) less outcome predictability.

Confirming the hypotheses, High IU participants reported significantly higher levels of concern with respect to the ambiguous scenarios compared to Low IU participants, averaged over feedback groups and time. Both of the IU group interactions involving the negative scenarios with respect to concern ratings appear to have been a predominant effect of the negative scenario across groups (i.e., all groups react strongly with concern to the negative scenarios), which may have restricted range and sensitivity of the measure compared to positive and ambiguous scenarios. These findings also suggest that biased appraisal of an ambiguous situation might better characterise the cognitive vulnerability in IU compared to unambiguously negative events (Dugas, Buhr, et al., 2004; Koerner & Dugas, 2008). Results from simultaneous multiple linear regression analysis showed that IU, not worry or depressed mood, predicted ratings of concern, suggesting information processing bias in IU with respect to ambiguous situations (Dugas, Hedayati, et al., 2005; Koerner & Dugas, 2008).

The pattern of IU group difference was greater for the ambiguous scenarios than positive and negative scenarios on four of the six outcomes variables (controllability, problem-solving confidence, cost, and predictability). It was somewhat surprising that the largest IU group difference in ratings of concern was observed for the positive scenarios, rather than the ambiguous ones. Koerner & Dugas (2008) found that high and low IU

individuals differed in their appraisals of ambiguous situations, but not positive or negative situations after controlling for demographics, GAD symptoms, and mood variables.

One possible explanation for the high ratings of concern by High IU participants in response to positive situations is that the relatively brief description of the positive scenarios might have prompted High IU participants to anticipate further unknown outcomes in some of the positive scenarios relative to Low IU participants. For example, one of the positive scenarios for which High IU participants endorsed high ratings of concern was *“My brother has been recovering really well from a bike accident, and he will be going back to work next week.”* As further information about this situation was not available to participants (e.g., the nature of the brother’s work, or the type of injury he sustained), it is possible that High IU participants remained concerned about unknown, and potentially negative outcomes associated with such positive situation more so than Low IU participants (e.g., the likelihood of the brother reinjuring himself when he returns to work).

Considering that many clinical worriers have a tendency to worry in the absence of realistic current stressors (Ruscio, 2002), along with evidence supporting the association between IU and worry, limited information pertaining to the positive scenarios might have prompted more intrusive negative thoughts, thus greater concern, in some of the High IU participants compared to Low IU participants. Relatedly, non-clinical high IU individuals have shown proclivity to continuously seek evidence in order to attain greater certainty compared to low IU individuals (Ladouceur et al., 1997). This parallels the reassurance-seeking behaviours that are often observed in individuals with clinical worry/GAD (Borkovec et al., 1983). In the current experiment, all participants were given a limited amount of time to complete both vignette tasks. Under such condition, High IU

participants, and indeed all participants, were precluded from seeking further information with regards to the scenarios. From this perspective, it is possible that High IU participants' perception of concern with respect to the positive scenarios remained high compared to Low IU participants. Future research may wish to further investigate the possible effect of intrusive negative thoughts on appraisal by high IU individuals.

In addition to demonstrating elevated concern, High IU participants also reported significantly less confidence in problem-solving abilities with respect to ambiguous situations compared to Low IU participants. Problem-solving confidence was also negatively associated with IU and with negative problem orientation (as measured by the NPOQ). Furthermore, IU predicted ratings of problem-solving confidence for the ambiguous scenarios after controlling for the effect of worry. These findings provide support for the role of negative problem orientation in the relationship between IU and worry (Robichaud & Dugas, 2005a).

The finding that High IU participants reported greater likelihood and cost of a negative outcome associated with the ambiguous scenarios relative to Low IU participants is consistent with previous studies showing an association between IU and overestimation of threat probability and cost (Bredemeier & Berenbaum, 2008). This finding, together with the positive correlations between perception of concern, problem-solving confidence, probability and cost ratings, indicates that interpretation bias in high IU individuals may be associated with biased threat calibration (probability and cost) and negative beliefs about their abilities to solve problems in the face of uncertain situations.

Overall, High IU participants showed similar levels of controllability and outcome predictability as Low IU participants with respect to the ambiguous scenarios. The

significant interaction between IU groups and the T1-T2 comparison with respect to controllability indicates that the manipulation might have been more effective for Low IU participants than High IU participants. In contrast with the notion that controllability may help to explain why high IU individuals would find ambiguity concerning (Koerner & Dugas, 2008), current findings suggest that high IU individuals are not necessarily biased in their perception of controllability or how much they can predict outcomes associated with ambiguous situations.

Another possible interpretation for the lack of IU group difference in perception of controllability and outcome predictability at baseline and post-manipulation is that the ambiguous scenarios might have been perceived as highly ambiguous. Ladouceur et al. (1997) found that the association between IU and reassurance-seeking behaviour was more robust on a moderately ambiguous task, but not so much on a highly ambiguous task. The researchers concluded that behavioural expressions of IU is likely influenced by the objective level of ambiguity of a given situation as well as the way in which the ambiguity is perceived. In the current study, although the ambiguous scenarios were rated as moderately ambiguous by participants in the pilot study, it is possible that participants in the main study deemed the ambiguous scenarios as highly ambiguous. If that was the case, High IU participants might not have necessarily differed from Low IU participants in their perception of how much control they would have in these scenarios. That is, highly ambiguous circumstances would evoke increased worry and decreased controllability in most individuals, irrespective of their IU levels. Given that ambiguous ratings for scenarios in the main study were not collected, this possibility remains to be investigated in future research by measuring level of ambiguity associated with the three scenario types.

The other aim of the current study was to examine the impact of experimental manipulation of ambiguity associated with task performance. It was expected that relative to participants who received unambiguous feedback on their task performance, participants who received the ambiguous feedback would demonstrate a further shift in their ratings, i.e., 1) increased levels of concern, 2) decreased controllability, 3) decreased confidence in problem-solving abilities, 4) increased negative outcome probability and cost ratings, and 5) decreased outcome predictability. Current data suggest that the effect of the manipulation was not quite as strong as predicted, as there was little significant change in levels of the outcome variables following manipulation. Given that High IU participants indicated relatively high ratings on all outcome variables at baseline, there is likely a ceiling effect in IU for the High IU group such that the ambiguous feedback did not have a strong effect (as there is no room to move), but the feedback effect had more influence on Low IU participants.

A number of limitations should be considered for the current study. Firstly, participants completed self-report questionnaires for worry, anxiety, and depression following completion of the vignette tasks. These questionnaires measured the general mood and anxiety state and worry level, and did not necessarily tap into any change in levels of worry, anxiety, or depression, that participants might have experienced during the study. These variables could have potentially influenced the current findings. Future study may wish to address this issue by measuring mood throughout the study. Secondly, participants were not asked to provide ratings with respect to level of ambiguity and valence of the vignettes during the experiment. Although level of ambiguity and valence of the vignettes were tested earlier in the pilot study, given the high ratings of concern by

High IU participants, it would have been informative to ascertain the extent to which the positive scenarios were perceived as ambiguous. Similarly, it would have been useful to examine differential valence ratings between high and low IU individuals with respect to the ambiguous scenarios. Finally, although the current experiment controlled for the total amount of time that participants spent on completing the first and the second vignette task, the amount of time spent on reading individual scenario and provide ratings was not controlled. As such, high IU participants might have spent more time deliberating on their ratings for some of the scenarios, such as the ambiguous ones, than other participants. It would therefore be useful for future research to control of the amount of time spent on individual scenarios.

One of the strengths of the current study is the use of scenarios that tap into a range of life domains (interpersonal relationships, work, finances, and family etc.) that represent common worry themes. Furthermore, the current study used participants with extreme IU levels instead of individuals with mid-range IU scores to facilitate a more stringent comparison of information processing in high and low IU individuals. In terms of future direction, the current study used an unambiguous positive feedback as comparison condition against an ambiguous feedback. It would be useful to include an unambiguous negative feedback as a reference point against which the effect of ambiguity on cognitive appraisal could be compared.

Notwithstanding the above limitations, Experiment 1 was intended as a first step towards greater clarity regarding information processing bias in IU, designed to unpack the way in which appraisal bias might affect perception of concern, controllability, confidence in problem-solving abilities, probability and cost of threatening outcomes, and

predictability in response to ambiguous situations. High IU participants showed significantly greater concerns and estimates of probability and cost of negative outcomes relative to Low IU participants in response to all three scenario types. High IU also participants showed significantly less confidence in problem-solving abilities in response to all three scenario types relative to Low IU participants. Pattern of IU group differences suggests that the ambiguous scenarios better distinguished high from low IU individuals than the negative scenarios specifically with respect to confidence in problem-solving abilities. The greatest IU group difference was observed in ratings of concern in response to the positive scenarios. These findings, along with the moderate correlations between IU (as indexed by total IUS-12) and four of the six outcome variables (concern, confidence, probability, and cost), provide partial support for the assertion that IU is associated with threat appraisal bias in response to ambiguous situations (Dugas, Hedayati, et al., 2005). Perception of controllability and outcome predictability did not appear to distinguish high and low IU individuals.

CHAPTER 4

Intolerance of Uncertainty and Appraisal of Ambiguous Situations in GAD

(Experiment 2)

In Experiment 1, High IU participants showed greater concerns and estimates of probability and cost of negative outcomes relative to Low IU participants in response to ambiguous situations. The experiment outlined in this chapter examined appraisal dimensions in individuals with GAD following the same vignette task design used in the previous experiment. In doing so, the aim was to explore whether the pattern of appraisal bias observed in high IU individuals in response to ambiguous situations also occurs in GAD.

Existing cognitive research has shown that individuals with GAD are highly sensitive to possible threats (Woody & Rachman, 1994), and that they have a tendency to interpret ambiguous information in a more negative way relative to non-anxious individuals (Butler & Mathews, 1983; Butler & Matthews, 1987). Mathews, Richards, and Eysenck (1989) showed that GAD participants selected the more threat-consistent spellings of two homophones (e.g., Die/Dye) relative to non-anxious controls, suggesting a negative interpretative bias in response to ambiguous stimuli. Eysenck, Mogg, May, Richards, and Mathews (Experiment 1; 1991) primed GAD and control participants with ambiguous sentences that could be interpreted in either a negative or neutral manner (e.g., “*They discussed the priest's convictions*”). In a subsequent recognition test, GAD participants selected sentences consistent with the threatening version of the original ambiguous sentences (e.g., “*They talked about the clergyman's criminal record*”) rather than the non-threatening version (e.g., “*They talked about the clergyman's strong beliefs*”). Furthermore,

GAD participants selected the threatening interpretation of ambiguous sentences more often than did either controls or anxious participants in remission. Eysenck et al. (Experiment 2; 1991) also showed that this interpretative bias was evident regardless whether the sentence denoted social or physical threats, suggesting a general rather than domain-specific interpretative bias amongst GAD individuals.

Previous studies with high trait anxious individuals have also provided insight into threat interpretative bias in GAD. As discussed in Chapter 2, GAD has been deemed as a relatively pure manifestation of high trait anxiety (Rapee, 1991), and GAD individuals have been reported to have higher trait anxiety than other anxiety disorders (Hirsch, Mathews, Lequertier, Perman, & Hayes, 2013). High trait anxious individuals have been shown to impose more threatening meanings on ambiguous information more rapidly than low trait anxious individuals (MacLeod & Cohen, 1993). Extending from the methodology of ambiguous words and ambiguous single sentences, Hirsch and Mathews (1997) examined response latencies for interpretative inferences regarding descriptions of ambiguously threatening events. Anxious participants responded at similar speeds to the threatening and non-threatening inferences of events that they had just read about, whereas non-anxious participants were faster to respond to non-threatening inferences. Taken together, the above studies are consistent in suggesting that individuals with GAD have a tendency to make threat-consistent appraisals of ambiguous information. Regardless whether worry is best characterised by a lack of positive interpretative bias or the presence of a negative interpretative bias, much remains to be clarified about the information-processing biases that underlie worry (Clark & Beck, 2010). One possible avenue is to examine the way in which GAD individuals calibrate threat outcome probability and cost when faced with ambiguous situations.

IU, Worry, and Rumination

There is strong evidence highlighting common features shared by worry and rumination in non-clinical samples (Muris, Roelofs, Meesters, & Boomsma, 2004; Papageorgiou & Wells, 1999; Watkins, Moulds, & Mackintosh, 2005), university students (Fresco, Frankel, Mennin, Turk, & Heimberg, 2002; Segerstrom, Tsao, Alden, & Craske, 2000), and clinical samples (Beck et al., 1987; Yook et al., 2010). Rumination, a repetitive thought process about one's own negative affect (Nolen-Hoeksema, 1991), sadness (Conway et al., 2000) and/or failure experiences (Spasojevic & Alloy, 2001), has been established as a critical component of the aetiology of depression (see Smith & Alloy, 2009 for an extensive review). Rumination has also been found to predict changes in both anxiety and depression symptoms (Nolen-Hoeksema, 2000). Worry thoughts often focus on problem-solving regarding future events; whereas ruminative thoughts are more focused on past failures and/or losses (Beck et al., 1987; Papageorgiou & Wells, 1999). It has been suggested that rumination and worry may be related types of repetitive thinking albeit differing in content and temporal orientation (Smith & Alloy, 2009).

Considering the possible overlap between rumination and worry, one area of research interest is the role of IU in rumination and worry. Previously, studies have shown an association of elevated levels of IU with severe symptoms of depression in undergraduate students (de Jong-Meyer et al., 2009; Dugas, Schwartz, et al., 2004), and individuals meeting diagnostic criteria for major depressive disorder (McEvoy & Mahoney, 2011; van der Heiden et al., 2010; Yook et al., 2010). These findings, along with existing data on the association of IU with anxiety disorders (Koerner & Dugas, 2006), underscore the possibility that IU potentially plays a role as an underlying cognitive bias in anxiety and depression psychopathology (Carleton et al., 2012; Yook et al., 2010). Despite this, there

has been limited research to date that explores how IU might contribute to worry and rumination. Yook et al. (2010) found that worry partially mediated the relationship between IU and anxiety although rumination fully mediated the relationship between IU and depression, suggesting that worry and rumination might affect the relationship between IU, anxiety, and depression differently. Extending from the IU model's assertion that IU contributes to worry by enhancing cognitive bias (Dugas, Buhr, et al., 2004), one possible experimental avenue is to examine the relationship between IU, worry and rumination in appraisal of ambiguous situations.

The Current Study

The aim of Experiment 2 was to extend the work of Koerner and Dugas (2008) on biased appraisal of ambiguous situations in individuals with high IU. Using the same vignette task as used in Experiment 1, we examined levels of concern as well as other appraisal dimensions in clinical GAD participants in response to ambiguous situations. These additional appraisal dimensions include probability and cost estimates of negative outcomes, perception of controllability, confidence in problem-solving abilities, and perception of predictability. It was predicted that in response to ambiguous situations, GAD participants would report 1) greater levels of concern (replicating Koerner & Dugas, 2008), 2) overestimation of threat outcome probability, 3) overestimation of cost in response to ambiguous scenarios, 4) less controllability, 5) less confidence in problem-solving abilities, and 6) less outcome predictability, relative to non-anxious controls.

For comparability to Experiment 1 in the non-clinical sample, the current study also examined the impact of experimental manipulation of uncertainty on clinical GAD individuals, using the same feedback methodology as used in Experiment 1. Compared to

controls, GAD participants in the current study who received the ambiguous feedback were expected show a further increase in ratings of concern, negative outcome probability and cost ratings from their baseline ratings. It was also expected that GAD participants would show a further decrease in ratings of controllability, problem-solving confidence, and outcome predictability from their baseline ratings. Finally, a subsidiary aim of the current experiment was to investigate the roles of IU and rumination in threat appraisal bias. It was predicted that rumination would mediate the relationship between IU and the outcome variables (i.e., concern, controllability, confidence in problem-solving abilities, probability and cost estimates, and outcome predictability) with respect to ambiguous situations.

Method

The Method for the present study was the same as reported in Experiment 1, except as detailed below.

Participants

Prospective participants were selected from a pool of individuals seeking treatment at the Westmead Hospital Anxiety Treatment and Research Unit, a specialist anxiety disorders treatment outpatient service in Sydney. Individuals were either self-referred or referred by general practitioners or psychiatrists. At the initial assessment, diagnosis of GAD was established using the Anxiety and Related Disorders Interview Schedule for DSM-5 Adult Version (ADIS-5; Brown & Barlow, 2014). The ADIS is a semi-structured interview for diagnosing anxiety and related disorders including mood disorders according to DSM-V criteria on a 0-8 severity rating scale where ratings of 4 and above are

considered of clinical severity and meet diagnostic status. The ADIS has demonstrated good to excellent inter-rater reliability (Brown, Campbell, Lehman, Grisham, & Mancill, 2001). In the current study, the ADIS assessments were conducted by clinical psychologists and provisional psychologists formally trained and supervised by clinical psychologists.

All clinical participants were tested prior to active treatment interventions. A recruitment advertisement was posted on an online classifieds site to recruit participants from the community to serve as controls. Individuals who volunteered for the study were administered the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) over the phone or via email to determine eligibility. A total PSWQ score greater than or equal to 62 is indicative of a clinical level of excessive and uncontrollable worry (Behar et al., 2003). As such, individuals whose total PSWQ scores were less than 62 were considered as non-clinical and were invited to participate in the main study. Participants were reimbursed for their travel expenses.

The final sample comprised of 35 GAD participants ($M_{\text{age}} = 38.74$, $SD = 13.86$, range = 20-70 years) and 40 control participants ($M_{\text{age}} = 31.89$, $SD = 10.98$, range = 18-57 years). These two participant samples were reasonably well matched on age and gender ratio (see Table 4.1). Eleven participants in the GAD group reported currently taking selective serotonin reuptake inhibitors (SSRIs) for managing mood and/or anxiety. Overall, the education level was lower for the GAD group relative to controls. The sample size for the current study was comparable to Experiment 1, with 75% power to detect a moderate effect size (Cohen's $d = 0.60$) for between-group contrasts and Group x repeat interaction contrasts.

Table 4.1
Demographic description of participants.

		Control (n = 40)		GAD (n = 35)	
		<i>n</i>	%	<i>n</i>	%
Sex	Male	20	50	18	51
	Female	20	50	17	49
Marital Status	Married/De Facto	12	30	15	43
	Never Married	25	63	16	46
	Separated/Divorced	1	3	4	11
Education	High School	8	20	2	6
	Trade Certificate/Apprenticeship	2	5	3	9
	Technician/Advanced Certificate	2	5	2	6
	Diploma	3	8	12	34
	Undergraduate/Postgraduate	23	58	10	29

Design

The study followed a 2 x 2 x (3) x (2) factorial design, where Clinical Status (Control vs. GAD) and Feedback Type (Ambiguous vs. Unambiguous) constituted the between-groups factors. The within-subjects factor referred to scenario type (positive, negative, ambiguous) and Time (baseline and post-manipulation). Participants were randomly assigned to either one of the feedback conditions.

Materials and Measures

Vignette Task. The vignette task utilised in the study was the same as that used in Experiment 1.

Self-Report Questionnaires. Participants completed the 12-item Intolerance of Uncertainty Scale (IUS-12; Carleton, Norton, et al., 2007), the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990), the Cognitive Avoidance Questionnaire (CAQ;

Gosselin et al., 2002; English translation, Sexton & Dugas, 2008), the Negative Problem Orientation Questionnaire (NPOQ; Gosselin et al., 2001; English translation, Robichaud & Dugas, 2005a, 2005b), and the 21-item Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995). The psychometric properties of these measures were described in Experiment 1. In the current sample, the Cronbach's alpha was .93 for the IUS-12, .96 for the PSWQ, .95 for the CAQ, and .95 for the NPOQ. For the DASS-21, the Cronbach's alpha was .92 for the depression subscale, .87 for the anxiety subscale, and .89 for the stress subscale.

Participants also completed the Ruminative Response Scale (RRS; Nolen-Hoeksema, 1991), which consists of 22 items that assess ruminative coping responses to depressed mood. 16 responses are given on a four-point scale, with values ranging from 1 (*almost never*) to 4 (*almost always*). The RRS has demonstrated a high internal consistency ($\alpha = .90$; Treynor, Gonzalez, & Nolen-Hoeksema, 2003). In the current sample, the Cronbach's alpha was .94.

Manipulation check measure. In order to check that the performance feedback was effective, six questions were administered following the completion of the second vignette task. These questions were the same as those used in Experiment 1. There was a positive and significant correlation between five of the six manipulation check items and the full IUS-12 scale (correlation coefficients ranged .32 to .53, all p 's < .01).

Results

The means and standard deviations for the self-report questionnaires are presented in Table 4.2. As would be expected, the mean total PSWQ score was significantly greater for the GAD group than controls, $t(71) = 9.96, p < .01$. GAD participants also reported a significantly greater mean total IUS-12 score compared to controls, $t(71) = 5.61, p < .01$, and greater mean DASS-D score compared to controls, $t(71) = 5.23, p < .01$. There was no significant mean difference between the feedback conditions on the DASS anxiety and stress subscale scores, the CAQ and the RRS scores. Furthermore, there was no significant association between participant gender and Clinical Status, $\chi^2 = .02, p > .05$.

Table 4.2.

Means (M) and standard deviations (SD) for all self-report variables by controls and GAD participants.

	Control (n = 38)		GAD (n = 35)		$t(1, 71)$
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
IUS-Inhibitory	11.61	4.75	18.97	3.87	7.23*
IUS-Prospective	21.5	7.68	28.68	7.3	4.05*
IUS-12	32.42	10.47	45.37	9.13	5.61*
PSWQ Total	44.21	12.70	68.69	7.37	9.96*
DASS Depression	8.74	9.29	20.86	10.52	5.23*
DASS Anxiety	6.47	6.00	18.51	11.27	5.76*
DASS Stress	10.63	7.22	23.71	10.21	6.36*
CAQ Total	61.76	18.58	77.57	21.13	3.40*
NPOQ Total	25.87	9.66	43.40	9.36	7.87*
RRS Total	41.72	12.09	56.03	13.47	4.78*

* $p < .01$

Manipulation Efficacy Check

Ratings on the manipulation check items were linearly transformed to a scale ranging from 0 (*Not at all characteristic of me*) to 100% (*Extremely characteristic of me*).

Responses were averaged over the six manipulation check items for each participant. The Ambiguous Feedback condition showed a greater absolute level of ratings ($M = 53.40$, $SD = 21.98$) relative to the Unambiguous Feedback condition ($M = 46.40$, $SD = 27.06$). In particular, there was a significant difference between the two feedback conditions in response to the question “*I found it was a shame that there were no guarantees that I was performing well*”, $t(73) = 2.02$, $p < .05$. Mean response to the manipulation check items was significantly greater for the GAD group ($M = 61.07$, $SD = 21.22$) relative to controls ($M = 40.21$, $SD = 23.60$), $t(73) = 4.00$, $p < .01$. However, the difference in mean scores between the two manipulation conditions did not reach statistical significance, $t(73) = 1.23$, $p = .22$. There was no significant interaction between clinical status and Feedback Condition ($F = 2.54$).

Effects of Ambiguous Feedback on Appraisal

To examine the effect of the ambiguous feedback on appraisal, each dependent measure was analysed by a set of planned orthogonal contrasts using a multivariate repeated measure model, with the decision-wise error rate set at $\alpha = .05$ (O’Brien & Kaiser, 1985). The group contrasts compared 1) the GAD to the control group, and 2) the Ambiguous Feedback condition to the Unambiguous Feedback condition. The Time contrast examined the difference between responses at baseline (T1) and post-manipulation (T2). The scenario contrasts examined the difference between 1) the negative and positive scenarios, 2) the positive and ambiguous scenarios, and 3) between the negative and ambiguous scenarios. All interactions between clinical/control group, Feedback Condition, Time, and Scenario Type contrasts were also tested. For each contrast, effect sizes are

reported using standardised 95% confidence intervals (CI; scaled in SD units). All reported analyses were conducted using the PSY Statistical Program (Bird et al., 2000).

Follow-up simple effect analyses were also conducted to clarify the pattern of results within- and between-groups for each dependent measure. Accordingly, in order to maintain statistical power, these exploratory analyses did not involve any correction for inflation of Type 1 errors. Therefore, these exploratory results should be interpreted with caution.

Concern

Figure 4.1 shows the mean concern ratings at baseline (T1) and post-manipulation (T2) for the positive scenarios (top panel), negative scenarios (middle panel), and ambiguous scenarios (bottom panel). The four participant groups represent control and GAD participants who received either unambiguous or ambiguous feedback. Averaged across Feedback Condition and Time, GAD participants showed significantly greater concern in all scenario types relative to controls, $F(1, 71) = 4.44, p < .05$; 95% CI = .02, .72. There was a significant interaction effect between this comparison and Time, $F(1, 71) = 7.93, p < .05$; 95% CI = .11, .63. This interaction effect was mainly driven by the significantly greater concern ratings reported by GAD participants at baseline relative to control, $F(1, 73) = 8.97, p < .05$; 95% CI = .19, .96.

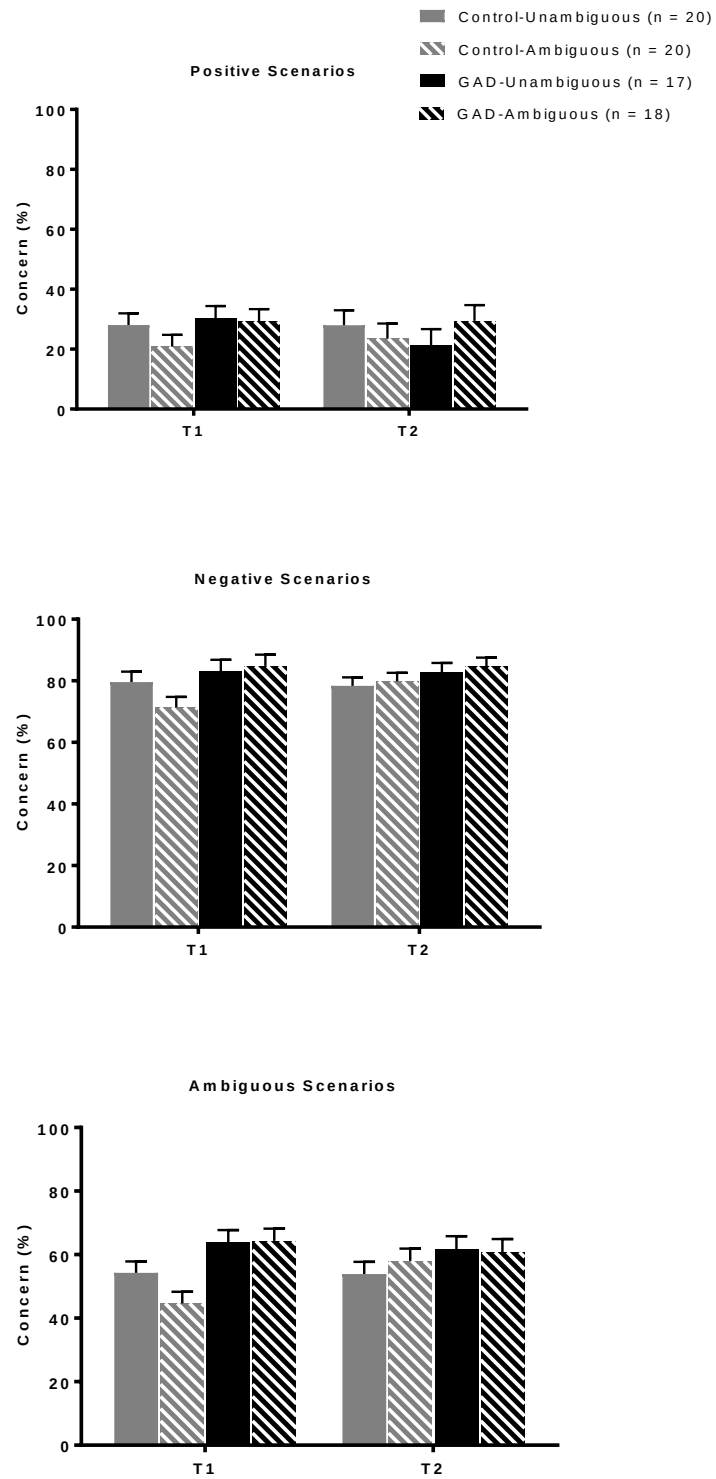


Figure 4.1. Mean concern ratings (%) at baseline (T1) and post-manipulation (T2).

There were notable individual differences in concern ratings for the ambiguous scenarios averaged over Feedback Condition and Time, with a range of 33.75% to 87.50% for GAD participants, and 20% to 85% for controls. Of the 35 GAD participants, 28 (80%) reported concern ratings greater than 50%, whereas 24 of the 40 controls (60%) reported concern ratings greater than 50%.

Although neither the comparison between the two feedback conditions or the comparison between T1 and T2 reached statistical significance (all F s < 1), there was a significant interaction between Feedback Condition and Time, $F(1, 71) = 6.40, p < .05$; 95% CI = .07, .59. This interaction effect reflected a greater increase in ratings of concern from baseline to post-manipulation for the Ambiguous Feedback condition, $F(1, 37) = 86.85, p < .05$; 95% CI = 1.03, 1.60, relative to the increase in concern ratings for the Unambiguous Feedback condition, $F(1, 36) = 75.52, p < .05$; 95% CI = .69, 1.12.

Averaged across Clinical Status, Feedback Condition and Time, participants reported significantly greater concern for the negative scenarios than positive scenarios, $F(1, 71) = 572.05, p < .05$; 95% CI = 2.91, 3.44. Averaged across Clinical Status, Feedback Condition and Time, concern ratings for the ambiguous scenarios were significantly greater than the positive scenarios, $F(1, 71) = 375.58, p < .05$; 95% CI = 1.65, 2.02, and lower than the negative scenarios, $F(1, 71) = 261.24, p < .05$; 95% CI = 1.17, 1.50.

There was a significant interaction between the positive-ambiguous scenario comparison and Clinical Status, $F(1, 71) = 5.43, p < .05$; 95% CI = .06, .82. This interaction effect reflected a greater difference in concern ratings between the positive and the ambiguous scenarios for the GAD group than controls. GAD participants reported

significantly greater concern for the ambiguous scenarios than controls, $F(1, 73) = 7.89$, $p < .05$; 95% CI = .18, 1.11. This between-group simple effect was not observed for the positive scenarios ($F < 1$). As would be expected, follow-up simple effect analysis showed that GAD participants reported significantly greater concern for the negative scenarios than controls, $F(1, 73) = 5.20$, $p < .05$; 95% CI = .07, .99.

None of the other Scenario Type $\times$ IU Group $\times$ Feedback Condition interaction effects was significant (largest $F = 2.08$).

Controllability

Figure 4.2 shows the mean controllability ratings for the four groups at baseline (T1) and post-manipulation (T2). Averaged across Feedback Condition, Time, and scenario Type, GAD participants reported significantly lower ratings of controllability relative to controls, $F(1, 71) = 22.16$, $p < .05$; 95% CI = .46, 1.14. There was no significant difference between feedback conditions averaged over Clinical Status and Time ($F < 1$). There was a significant decrease in ratings of controllability from T1 to T2, $F(1, 71) = 4.24$, $p < .05$; 95% CI = .004, .27. Furthermore, there was an interaction between this comparison and Clinical Status, $F(1, 71) = 7.19$, $p < .05$; 95% CI = .09, .63. This interaction effect reflected a significant decrease in ratings of controllability in the control group from T1 to T2, $F(1, 39) = 10.39$, $p < .05$; 95% CI = .14, .60. GAD participants, on the other hand, showed similar ratings of controllability across T1 and T2 ($F < 1$). Follow-up simple effect analysis also showed that controls who received the ambiguous feedback showed a significant decrease in ratings of controllability from T1 to T2, $F(1, 18) = 8.69$, $p < .05$; 95% CI = .17, .99. This simple effect was not observed for controls who received the unambiguous feedback ($F < 1$).

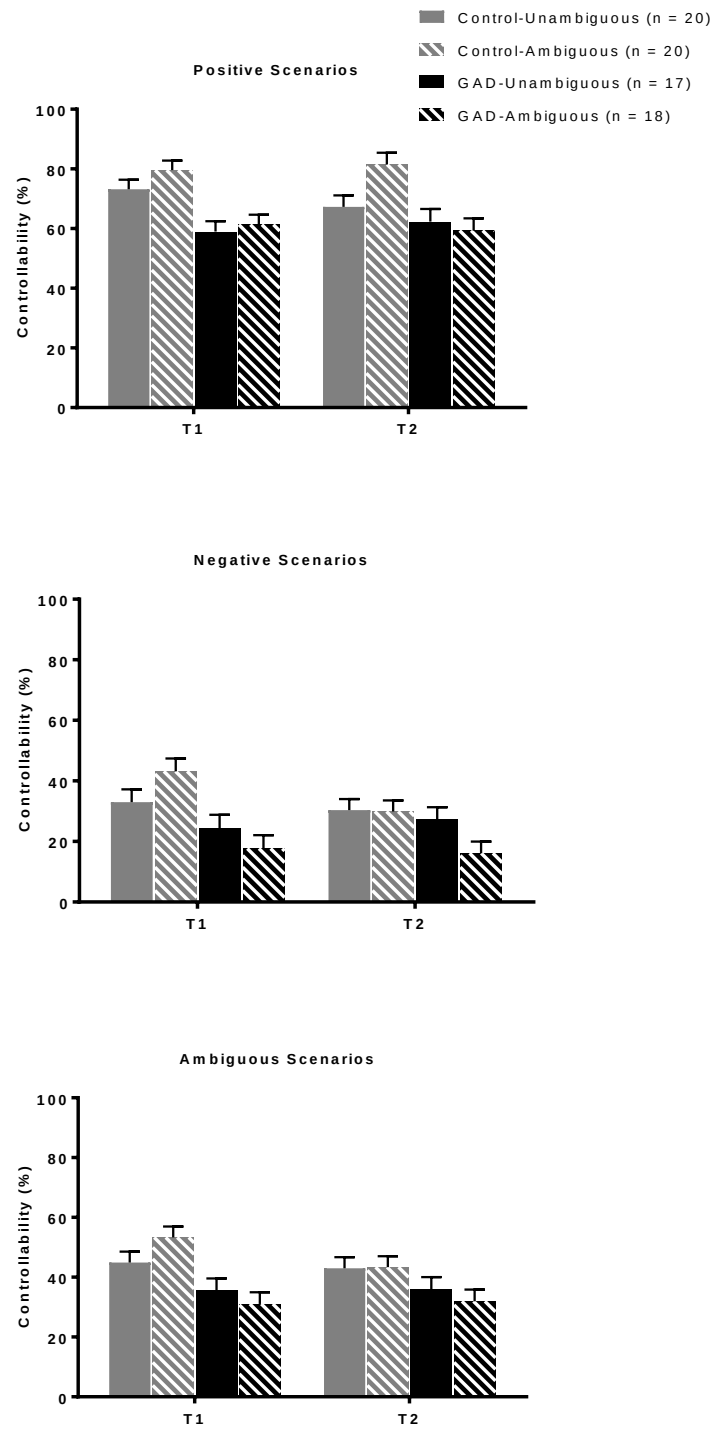


Figure 4.2. Mean controllability ratings (%) at baseline (T1) and post-manipulation.

Participants reported significantly more controllability for positive scenarios relative to the negative scenarios, $F(1, 71) = 311.52, p < .05$; 95% CI = 2.14, 2.69. Controllability ratings for the ambiguous scenarios were significantly less than the positive scenarios, $F(1, 71) = 284.40, p < .05$; 95% CI = 1.49, 1.88, and greater than the negative scenarios, $F(1, 71) = 102.53, p < .05$; 95% CI = .59, .88. None of the other Clinical Status $\times$ Feedback Condition $\times$ Scenario Type interaction effects was significant (largest $F = 2.37$).

Confidence in Problem-Solving Effectiveness

Figure 4.3 shows the mean confidence ratings for the four groups at baseline (T1) and post-manipulation (T2). Similar to the results for controllability, GAD participants reported significantly lower level of confidence in their problem-solving abilities relative to controls averaged across Feedback Condition, Scenario Type, and Time, $F(1, 71) = 56.43, p < .05$; 95% CI = .97, 1.66. Averaged across Clinical Status, Scenario Type, and Time, there was no significant difference in confidence level between the two feedback conditions ($F < 1$).

Although there was no difference in confidence ratings between T1 and T2 ($F < 1$) averaged over Clinical Status, Feedback Condition, and Scenario Type, there was an interaction between Time and Clinical Status, $F(1, 71) = 7.74, p < .05$; 95% CI = .10, .60. Follow-up simple effect analyses showed a significant decrease in confidence level in controls from T1 to T2, $F(1, 39) = 6.06, p < .05$; 95% CI = .04, .45. In particular, controls who received the ambiguous feedback showed a significant decrease in their level of confidence at T2 relative to T1, $F(1, 19) = 7.15, p < .05$; 95% CI = .10, .81.

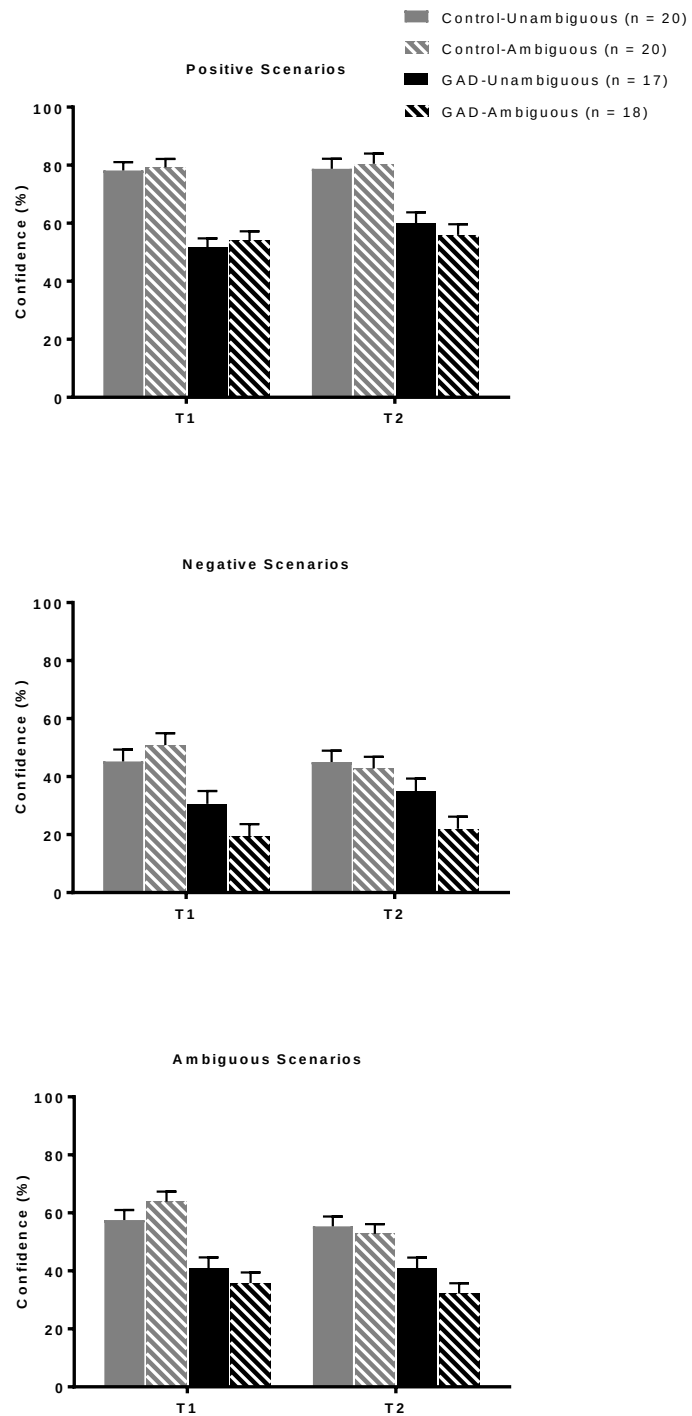


Figure 4.3. Mean confidence ratings (%) at baseline (T1) and post-manipulation (T2).

These findings were supported by the significant interaction between Feedback Condition and the comparison between T1 and T2, $F(1, 71) = 5.44, p < .05$; 95% CI = .04, .54. GAD participants, on the other hand, reported similar levels of confidence across T1 and T2 ($F = 2.01$). Interestingly, GAD participants who received the unambiguous feedback, showed a significant increase in their level of confidence from T1 to T2, $F(1, 16) = 5.74, p < .05$; 95% CI = .04, .65, averaged over Scenario Types.

Participants reported significantly greater level of confidence in their problem-solving abilities for the positive scenarios relative to the negative scenarios, $F(1, 71) = 193.75, p < .05$; 95% CI = 1.66, 2.22. Confidence ratings for the ambiguous scenarios were significantly lower than the positive scenarios, $F(1, 71) = 151.59, p < .05$; 95% CI = 1.05, 1.45, and greater than the negative scenarios, $F(1, 71) = 130.41, p < .05$; 95% CI = .57, .82. None of the Scenario Type $\times$ IU Group $\times$ Feedback Condition interaction effects was significant (all F s < 2).

Negative Outcome Probability

Figure 4.4 shows the mean negative outcome probability ratings for the four between-groups at baseline (T1) and post-manipulation (T2). Similar to the ratings of concern, GAD participants reported significantly greater negative outcome probability relative to controls averaged across Feedback Condition, Scenario Type and Time, $F(1, 71) = 28.21, p < .05$; 95% CI = .58, 1.28.

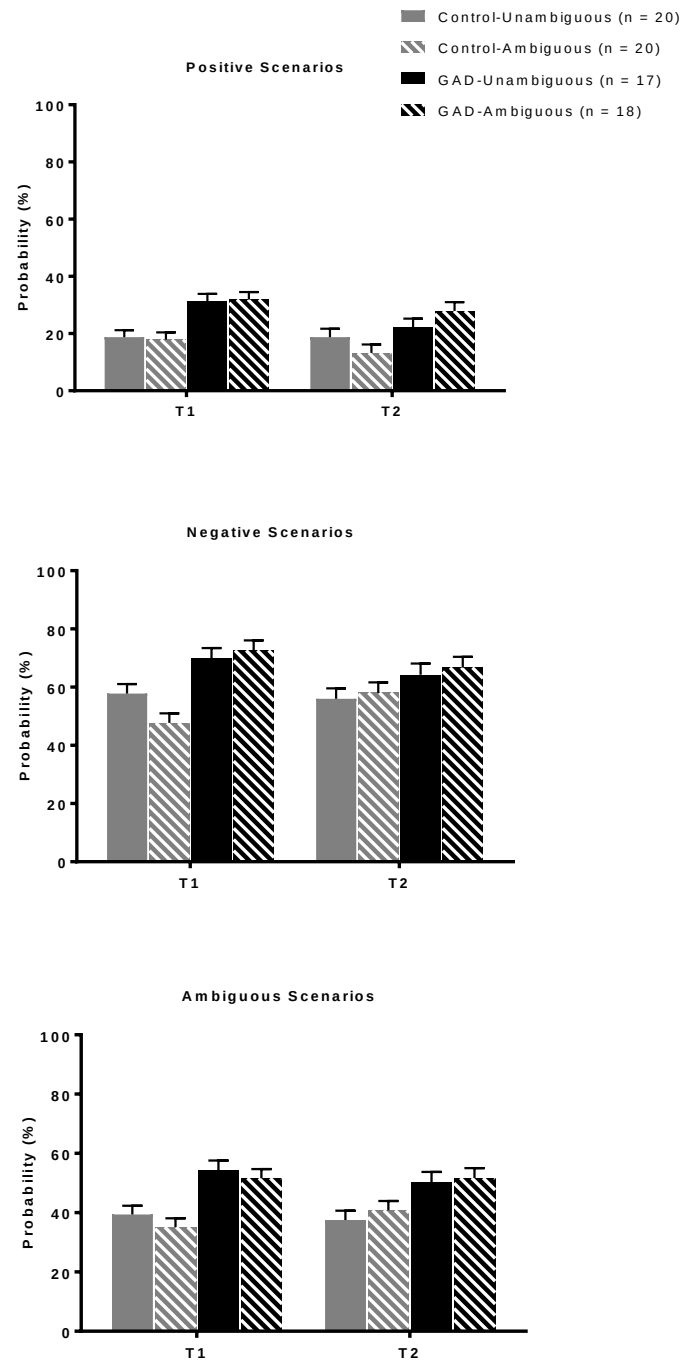


Figure 4.4. Mean negative outcome probability ratings (%) at baseline (T1) and post-manipulation (T2).

There was no significant difference in probability ratings between the two feedback conditions averaged across Clinical Status, Scenario Type and Time ($F < 1$). Although the contrast examining outcome probability ratings between T1 and T2 did not reach significance ($F = 3.30$), there was an interaction between this comparison and Clinical Status, $F(1, 71) = 9.94$, $p < .05$; 95% CI = .16, .72. Follow-up simple effect analysis showed this interaction effect was driven by a significant decrease in probability ratings from T1 to T2 for GAD participants, $F(1, 34) = 10.22$, $p < .05$; 95% CI = .15, .65. Controls, however, did not show changes in probability ratings between T1 and T2 ($F < 1$).

There was a significant interaction between Feedback Condition and the comparison between T1 and T2, $F(1, 71) = 4.28$, $p < .05$; 95% CI = .01, .57. The interaction reflected a significant decrease in probability ratings in Unambiguous Feedback condition from T1 to T2, $F(1, 36) = 8.51$, $p < .05$; 95% CI = .09, .48. This simple effect was not observed for the Ambiguous Feedback condition ($F < 1$).

As would be expected, participants indicated significantly greater probability of a negative outcome for the negative scenarios relative to the positive scenarios, $F(1, 71) = 596.73$, $p < .05$; 95% CI = 2.60, 3.06. Probability ratings for the ambiguous scenarios were significantly greater than the positive scenarios, $F(1, 71) = 349.92$, $p < .05$; 95% CI = 1.45, 1.80, and lower than the negative scenarios, $F(1, 71) = 230.35$, $p < .05$; 95% CI = 1.04, 1.36. None of the Scenario Type $\times$ IU Group $\times$ Feedback Condition interaction effects was significant (largest $F = 1.28$).

Negative Outcome Cost

Figure 4.5 shows the mean cost ratings for the four groups at baseline (T1) and post-manipulation (T2). Similar to the results for ratings of concern and probability, GAD participants reported significantly greater ratings of cost relative to controls averaged across Feedback Condition, Scenario Type and Time, $F(1, 71) = 18.65, p < .05$; 95% CI = .42, 1.15. Furthermore, there was a significant interaction between this comparison and the comparison between T1 and T2, $F(1, 71) = 8.40, p < .05$; 95% CI = .13, .68. Follow-up simple effect analysis showed this interaction was driven by the significant increase in cost ratings in controls from T1 to T2, $F(1, 39) = 6.68, p < .05$; 95% CI = .06, .46. GAD participants, on the other hand, showed similar cost ratings at T1 and T2 ($F < 2$). There was also a significant interaction between Feedback Condition and the comparison between T1 and T2, $F(1, 71) = 7.43, p < .05$; 95% CI = .10, .66, reflecting a significant increase in cost ratings in the Ambiguous Feedback condition from T1 to T2, $F(1, 37) = 6.01, p < .05$; 95% CI = .03, .41. However, this within-subject simple effect was not observed for the Unambiguous Feedback condition ($F < 2$).

As would be expected, participants indicated significantly greater cost for the negative scenarios relative to the positive scenarios, $F(1, 71) = 367.30, p < .05$; 95% CI = 2.03, 2.50. Cost ratings for the ambiguous scenarios were significantly greater for the positive scenarios, $F(1, 71) = 277.91, p < .05$; 95% CI = 1.23, 1.57, and lower than the negative scenarios, $F(1, 71) = 170.73, p < .05$; 95% CI = .73, .99. There was a significant interaction between the positive-ambiguous scenario comparison and Feedback Condition, $F(1, 71) = 5.89, p < .05$; 95% CI = .07, .74. None of the Scenario Type $\times$ IU Group $\times$ Feedback Condition interaction effects was significant (largest $F = 1.82$).

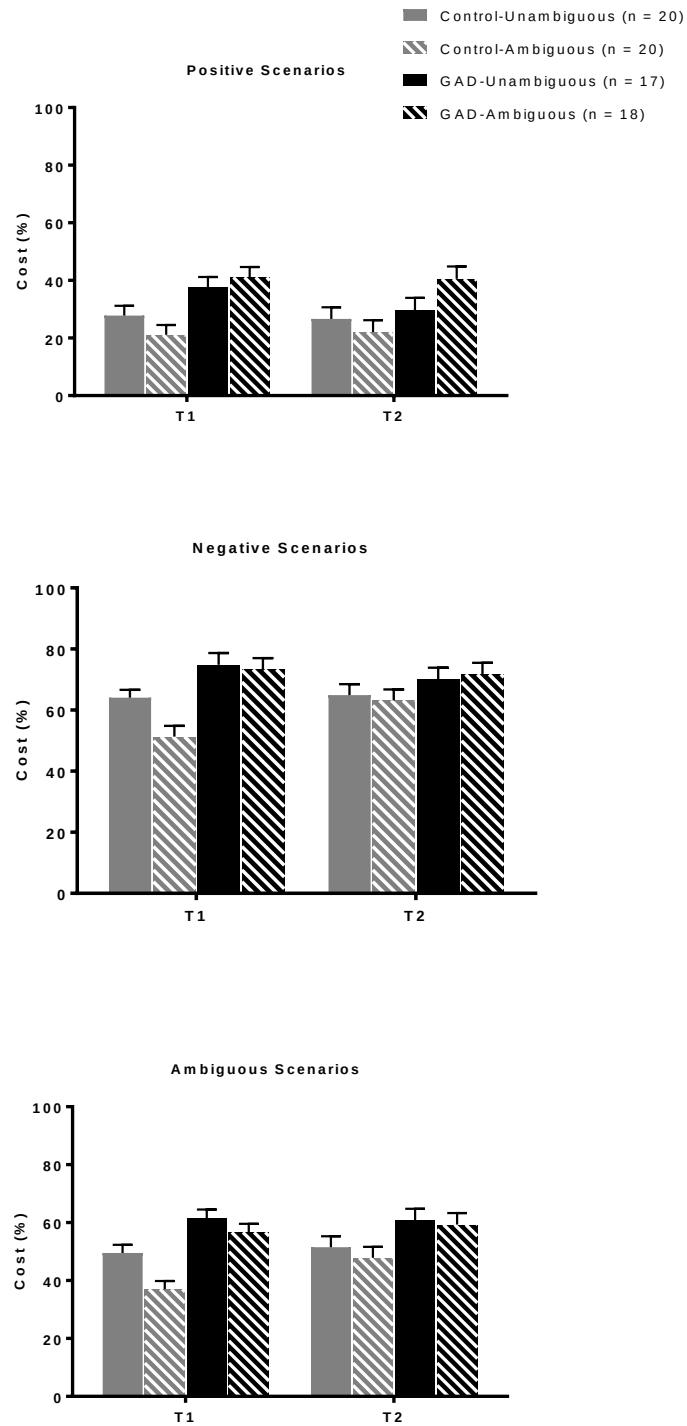


Figure 4.5. Mean negative outcome cost ratings (%) at baseline (T1) and post-manipulation (T2).

Outcome Predictability

Figure 4.6 shows the mean predictability ratings for the four between-group conditions at baseline (T1) and post-manipulation (T2). Similar to the ratings of controllability and confidence, GAD participants reported significantly lower ratings of outcome predictability than controls averaged across Feedback Condition, Time, and Scenario Type, $F(1, 71) = 13.36, p < .05$; 95% CI = .31, 1.04. Averaged across Clinical Status, Scenario Type, and Time, there was no significant difference between the two feedback conditions, $F(1, 71) = 2.22, p = .14$; 95% CI = -.64, .09. Predictability ratings did not differ significantly between T1 and T2 ($F < 1$).

Averaged across Feedback Condition, Clinical Status, and Time, participants reported significantly greater outcome predictability for the positive scenarios relative to the negative scenarios, $F(1, 71) = 15.57, p < .05$; 95% CI = .22, .65. Follow-up simple effect analysis showed that although controls deemed the outcomes of positive scenarios as significantly more predictable than the negative ones, $F(1, 39) = 41.10, p < .05$; 95% CI = .62, 1.20, GAD participants showed similar ratings of predictability for both positive and negative scenarios ($F < 1$). This pattern of predictability ratings was also supported by the significant interaction between Clinical Status and the comparison between positive and negative scenarios, $F(1, 71) = 10.68, p < .05$; 95% CI = .27, 1.15.

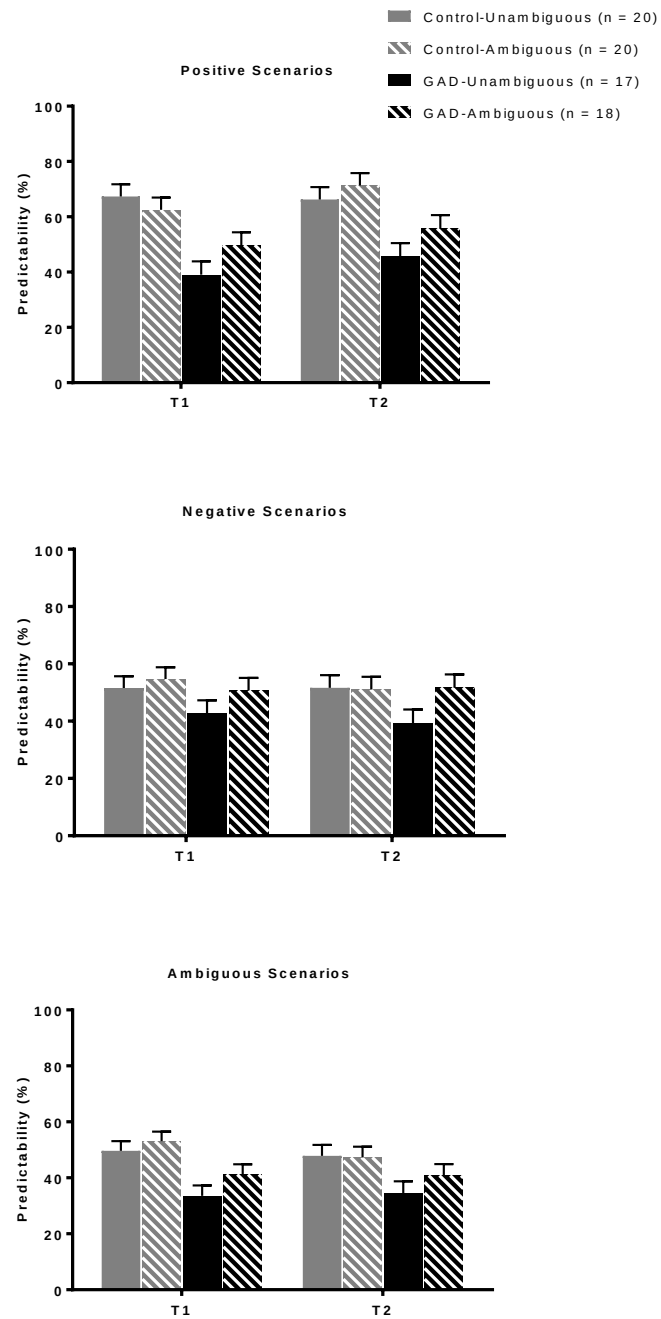


Figure 4.6. Mean predictability ratings (%) at baseline (T1) and post-manipulation (T2).

Predictability ratings for the ambiguous scenarios were significantly lower than the positive scenarios, $F(1, 71) = 62.07, p < .05$; 95% CI = .56, .92, and the negative scenarios, $F(1, 71) = 24.10, p < .05$; 95% CI = .18, .43. There was a significant interaction between Clinical Status and both the positive-ambiguous scenario comparison, $F(1, 71) = 4.61, p < .05$; 95% CI = .03, .76, and the negative-ambiguous scenario comparison, $F(1, 71) = 6.33, p < .05$; 95% CI = .07, .56. Follow-up analysis showed that although controls did not show any significant difference in outcome predictability ratings between the ambiguous and negative scenarios, $F(1,39) = 2.74, p > .05$; 95% CI = -.46, .05, GAD participants reported significantly less outcome predictability for the ambiguous scenarios relative to the negative scenarios, $F(1,34) = 31.42, p < .05$; 95% CI = .27, .58. None of the Scenario Type $\times$ IU Group $\times$ Feedback Condition interaction effects was significant (all F s < 1).

In view of the similar pattern of data for concern, probability, and cost, and between ratings of controllability, confidence, and outcome predictability, a bivariate correlation analysis was conducted to examine the relationships between the six outcome variables with respect to the ambiguous scenarios and the self-report questionnaires (PSWQ, IUS-12, CAQ, NPOQ, DASS Depression, DASS Anxiety, and RRS). Correlation results were averaged across T1 and T2, as initial correlation analyses showed similar patterns of correlation coefficients across the two time points. The correlation coefficients for self-report questionnaires and outcome variables are shown in Table 4.3.

Table 4.3

Pearson bivariate correlation coefficients for self-report questionnaires and outcome variables for the ambiguous scenarios.

	IUS-12 Total	CAQ	NPOQ	DASS Dep	DASS Anx	DASS Stress	RRS	Concern	Control	Confidence	Probability	Cost	Predict
PSWQ	.76**	.47**	.77**	.54**	.64**	.64**	.60**	.61**	-.53**	-.73**	.70**	.53**	-.31**
IUS-12 Total		.33**	.72**	.54**	.52**	.56**	.61**	.50**	-.50**	-.58**	.59**	.41**	-.26*
CAQ			.53**	.46**	.49**	.53**	.29*	.35**	-.28*	-.37**	.52**	.39**	-.22
NPOQ				.65**	.61**	.66**	.63**	.54**	-.46**	-.67**	.70**	.62**	-.21
DASS Dep					.58**	.69**	.57**	.34**	-.46**	-.48**	.51**	.46**	-.40**
DASS Anx						.79**	.50**	.50**	-.41**	-.50**	.64**	.40**	-.17
DASS Stress							.54**	.37**	-.40**	-.43**	.49**	.41**	-.26*
RRS								.45**	-.39**	-.44**	.41**	.40**	-.28*

Note. PSWQ = Penn State Worry Questionnaire; IUS-12 Total = Intolerance of Uncertainty Scale total score; IUS-12 Inh = Inhibitory IU subscale; IUS-12 Pro = Prospective IU subscale; CAQ = Cognitive Avoidance Questionnaire total score; NPOQ = Negative Problem Orientation Questionnaire total score; DASS Dep = Depression Anxiety Stress Scales Depression subscale; DASS Anx = Depression Anxiety Stress Scales Anxiety subscale; RRS = Ruminative Responses Scale.

** $p < .01$

* $p < .05$

Intolerance of Uncertainty, GAD Status, and Appraisal of Ambiguous Situations

Considering the significant correlations between IU and the six outcome variables, a question of interest is the extent to which GAD status mediated the relationship between IU and appraisal of ambiguous situations. A test of mediation was therefore conducted to test whether the conditions outlined by Baron and Kenny (1986) were met. Firstly, variations in levels of an independent variable must account for variations in the mediator. Secondly, the mediator needs to be a significant predictor of variations in the dependent variable. Thirdly, when the mediator is entered into the equation, a previously significant relationship between the independent and dependent variables is no longer significant (Baron & Kenny, 1986).

In Step 1 of the current mediation analysis, total IUS-12 was entered as the independent variable and each of the six outcome variables as the dependent variable. Step 2 examined the extent to which variations in total IUS-12 predicted GAD status (0 = Controls, 1 = GAD). Step 3 examined the extent to which GAD status accounted for variations in ratings for the six outcome variables with respect to the ambiguous scenarios. Finally, in Step 4, both total IUS-12 and GAD status were entered as the independent variables, with each of the six outcome variables as the dependent variable.

Results from Step 1 showed that total IUS-12 predicted ratings of concern ($\beta = .50$, $p < .05$), controllability ($\beta = -.50$, $p < .05$), confidence ($\beta = -.58$, $p < .05$), probability ($\beta = .59$, $p < .05$), cost ($\beta = .41$, $p < .05$), and outcome predictability ($\beta = -.26$, $p < .05$). As would be expected, results from Step 2 showed that total IUS-12 was a significant predictor of GAD status (Wald = 16.17, $p < .05$). Results from Step 3 showed that GAD status predicted ratings of concern ($\beta = .31$, $p < .05$), controllability ($\beta = -.39$, $p < .05$), confidence

($\beta = -.58, p < .05$), probability ($\beta = .50, p < .05$), cost ($\beta = .44, p < .05$), and outcome predictability ($\beta = -.37, p < .05$).

In Step 4, when both total IUS-12 and GAD status were entered as independent variables, GAD status was no longer a predictor of ratings of concern or controllability, whereas total IUS-12 remained a significant predictor of these two dependent variables (Table 4.4). Total IUS-12 was no longer a predictor of cost or outcome predictability, whereas GAD status remained a significant predictor of these two dependent variables. Total IUS-12 and GAD status as a set of predictors significantly predicted confidence in problem-solving abilities ($R^2 = .44$) and probability estimate ($R^2 = .40$).

Table 4.4

Linear regression analysis for total IUS-12 and GAD status as a set of variables predicting outcome variables for the ambiguous scenarios.

	Concern ¹			Controllability ²			Confidence ³			Probability ⁴			Cost ⁵			Predictability ⁶		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	<i>B</i>	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Total IUS-12	.64	.17	.47**	-.57	.17	.42**	-.54	.16	-.38**	.54	.13	.46**	.29	.16	.22	-.12	.19	-.09
GAD Status	1.52	3.93	.05	-4.63	3.85	-.15	-12.70	3.65	-.38**	6.92	3.07	.25*	10.14	3.74	.34**	-10.32	4.33	-.32*

¹Full model $R^2 = .25$, $F(2,72) = 11.73$, $p < .01$.

²Full model $R^2 = .27$, $F(2,72) = 12.90$, $p < .01$.

³Full model $R^2 = .44$, $F(2,72) = 27.17$, $p < .01$.

⁴Full model $R^2 = .40$, $F(2,72) = 23.01$, $p < .01$.

⁵Full model $R^2 = .25$, $F(2,72) = 11.54$, $p < .01$.

⁶Full model $R^2 = .14$, $F(2,72) = 5.69$, $p < .01$.

** $p < .01$

* $p < .05$

Intolerance of Uncertainty, Rumination, and Appraisal of Ambiguous Situations

An exploratory analysis was also conducted using linear regression to examine the relationship between IUS-12, the *Ruminative Responses Scale* (RRS), and the six outcome variables with respect to the ambiguous scenarios. When both IUS-12 and RRS were entered as predictors, RRS did not predict any of the outcome variables, whereas IUS-12 was a significant predictor of ratings of concern, $R^2 = .29$, $F(2, 70) = 14.01$, $p < .05$, $\beta = .35$, $p < .05$, controllability, $R^2 = .27$, $F(2, 70) = 12.68$, $p < .05$, $\beta = -.42$, $p < .05$, confidence, $R^2 = .35$, $F(2, 70) = 19.00$, $p < .05$, $\beta = -.50$, $p < .05$, probability, $R^2 = .36$, $F(2, 70) = 19.48$, $p < .05$, $\beta = .54$, $p < .05$, and cost, $R^2 = .21$, $F(2, 70) = 9.00$, $p < .05$, $\beta = .27$, $p < .05$. Neither IUS-12 or RRS was a significant predictor of outcome predictability with respect to the ambiguous scenarios.

Discussion

The aim of Experiment 2 was to extend the experimental design used in Experiment 1 to investigate appraisal of ambiguous situations in clinical GAD individuals who are said to be highly intolerant of uncertainty (Dugas, Gagnon, et al., 1998). In doing so, this experiment provided an opportunity to explore the extent to which the pattern of threat appraisal bias observed in high IU individuals is also reflected in clinical GAD individuals. Following the results from Experiment 1, it was predicted that in response to ambiguous situations, GAD participants in the current study would show 1) greater levels of concern (replicating Koerner & Dugas, 2008), 2) overestimation of threat outcome probability, 3) overestimation of cost in response to ambiguous scenarios, 4) less controllability, 5) less

confidence in problem-solving abilities, and 6) less predictability, relative to non-anxious controls.

Confirming the hypotheses, GAD participants reported significantly greater ratings of concern and greater probability and cost estimates of negative outcomes with respect to the negative, positive, and ambiguous scenarios relative to controls, averaged over feedback conditions and time. This pattern of results was similar to the pattern observed in High IU participants in the previous experiment. The biggest between-group differences for these three outcome variables were observed for the ambiguous scenarios. Furthermore, the between-group simple effect for concern ratings was significant for the ambiguous scenarios, but not the positive scenarios. Taken together, these findings are consistent with previous work on appraisal bias in GAD individuals in response to ambiguous situations (Eysenck et al., 1991; MacLeod & Cohen, 1993). The current findings also highlight the tendency in GAD individuals to overestimate probability and cost of negative outcomes when faced with ambiguous situations.

Similar to the high IU participants in Experiment 1, GAD participants in the current experiment were also less confident in their problem-solving abilities with respect to all three scenario types relative to controls. In addition, GAD participants perceived themselves as being less able to control or predict outcomes relative to controls regardless of whether it was a positive, negative, or ambiguous situation. It is interesting that the biggest between-group differences for controllability, confidence, and outcome predictability emerged for the positive scenarios, followed by the ambiguous scenarios. Although the interaction effects between Clinical Status and the positive-ambiguous

scenario comparison for these three outcome variables were not significant, the pattern of data is indicative of poor general confidence amongst GAD individuals in their abilities. Previous research into negative problem orientation has indicated that ineffective problem solving in GAD is more likely to be caused by maladaptive beliefs regarding one's problem-solving ability rather than a lack of problem-solving skills per se (Ladouceur et al., 1998; Robichaud & Dugas, 2005b). The current findings suggest that negative beliefs about abilities to problem-solve, control, and predict outcomes might be problematic for GAD individuals not only in response to negative or ambiguous situations across interpersonal and other life domains, but even in positive situations.

In the current study, the ambiguous feedback manipulation appears to have elicited a stronger effect on controls relative to GAD participants with respect to the ambiguous scenarios across all six outcome variables. One possible explanation for the lack of manipulation effect for the GAD group is that as GAD participants already showed considerably high ratings of concern, probability, and cost at baseline relative to controls, there might not have been much room for them to further increase their ratings following the ambiguous feedback manipulation. This pattern of response reflects a similar ceiling effect observed for the High IU participants in Experiment 1. Conversely, ratings of controllability, confidence, and outcome predictability were relatively low at baseline for the GAD group compared to controls. Following the manipulation feedback, GAD participants showed little shift in ratings for controllability, confidence, and outcome predictability with respect to the ambiguous scenarios, suggesting a possible floor effect for GAD participants. The pattern of the T1-T2 comparisons of controllability, confidence,

and predictability indicates an overall greater downward shift in ratings for controls following the feedback manipulation. Indeed, participants in the control group who received the ambiguous feedback showed a significant decrease in both ratings of controllability and confidence in problem-solving abilities relative to their baseline ratings. These significant simple effects were not observed for control participants who received the unambiguous feedback

The finding that GAD status mediated the relationship between IU and biased appraisal of cost and outcome predictability provides partial support for the potential contribution of IU to GAD by way of disrupting objective appraisal of ambiguous situations (Koerner & Dugas, 2008). Results from the regression analysis also suggest that having high levels of IU and a clinical diagnosis of GAD accounted for substantial variance in confidence and probability estimates for a negative outcome with respect to ambiguous situations.

The significant moderate correlation between rumination (as measured by the RRS) and worry (as measured by the PSWQ) replicates previous results (e.g., Fresco et al., 2002; Segerstrom et al., 2000; Watkins et al., 2005). The size of the correlation between rumination and worry in the current sample is also comparable with previous data (e.g., Yook et al., 2010). Consistent with our prediction, IU was significantly and positively associated with rumination. The finding that IU was correlated more strongly with worry than rumination also replicates previous results (de Jong-Meyer et al., 2009; Yook et al., 2010).

Considering the overlap of rumination and worry as repetitive negative thinking processes (Watkins, Moulds, & Mackintosh, 2005), it is interesting that both rumination and worry were correlated positively and significantly with ratings of concern, probability, and cost. In addition, both worry and rumination correlated negatively and significantly with ratings of controllability, confidence in problem-solving abilities, and outcome predictability. It is unsurprising that worry was correlated more strongly with the outcome variables relative to rumination, as anxiety, not depression, was the primary concern for the clinical participants in the current study. Results from linear regression analyses showed that rumination did not mediate the relationship between IU and ratings of concern, controllability, confidence, probability, cost, or outcome predictability for the ambiguous scenarios. These findings suggest that high levels of IU, rather than a tendency to engage in repetitive thinking about one's negative emotions, elicit stronger biased appraisal of ambiguous situations.

Although the strengths of the current study include the use of a treatment-seeking clinical sample, multiple dimensions of appraisal, and an experimental manipulation of uncertainty, some limitations need be considered. In addition to the limitations discussed in Experiment 1, another limitation of the current study is the relatively small sample size, which could have led to possible Type II errors. Thus, analyses will need to be replicated in future research with larger participant groups. In Experiments 1 and 2, hypothetical ambiguous scenarios were used to investigate threat appraisal in high IU and clinical GAD participants respectively. One limitation with such a design is that levels of ambiguity were not controlled, therefore some ambiguous scenarios might have been perceived as more

ambiguous compared to the others. This limitation might have at least partially contributed to the high individual variance in ratings of concerns. A more empirically established paradigm, such as the one used for studying covariation bias (Tomarken, Mineka, & Cook, 1989), may be useful for designing experimental manipulations that control for levels of ambiguity. One limitation relating to the use of the ADIS-V assessments is that inter-rater reliability was not examined for the current sample. Future research could video record, code, and recode assessment interviews for inter-rater reliability purposes.

Another aspect of the current study that warrants consideration is the use of an unambiguous positive feedback as the only comparison condition against the ambiguous feedback condition. We did consider that it would have been informative to include an unambiguous negative feedback as a second comparison condition. However, this feedback condition was omitted from the final experimental design due to the ethical consideration that the unambiguous negative feedback could have potentially caused the clinical participants undue distress. On the other hand, previous experimental studies have trained community participants to interpret ambiguous information in an explicitly negative direction, and were successful in inducing anxiety in those participants (e.g., Mathews & Mackintosh, 2000; Yiend, Mackintosh, & Mathews, 2005). One study also experimentally induced worry in clinical GAD participants without observing any long-term effect of worrying (Stapinski et al., 2010). More recently, Byrne, Hunt, and Chang (2015) examined the role of threat perception in mediating the relationship between IU and anxiety, using ambiguous scenarios, unpredictable positive scenarios (where a surprising and positive outcome was anticipated), as well as unambiguous positive and negative scenarios. The

researchers found that both ambiguous and unpredictable positive scenarios predicted the relationship between IU and worry more so than certain positive or negative scenarios. In view of the methodology used in the previous studies, it is suggested that, with an appropriate debriefing procedure, future research could examine the effect of unambiguously negative feedback on appraisal in both high IU and GAD individuals.

In summary, Experiments 1 and 2 were designed to map out the nature of appraisal biases in IU and GAD in more detail by examining different appraisal dimensions. The uncertainty manipulation did not exert a strong effect on GAD participants, possibly due to ceiling effects with respect to ratings of concern, probability, and cost. Despite this, GAD participants reported greater concern and greater estimates of probability and cost of negative outcomes in response to all three scenario types relative to controls. The biggest between-group difference in concern was observed for the ambiguous scenarios. GAD participants also reported significantly less confidence in problem-solving abilities, perceived control, and outcome predictability relative to controls. The overall pattern of current results for GAD participants is similar to, and in fact stronger than the results observed in High IU participants from Experiment 1. In particular, although the High-Low IU group difference in Experiment 1 was significant for four of the six outcome variables (concern, confidence in problem-solving abilities, probability, and cost), GAD participants differed significantly from controls on all six outcome variables. The pattern of between-group differences for confidence, controllability, and outcome predictability highlight the possibility that negative beliefs regarding problem-solving abilities and the ability to control and predict outcomes might also be problematic for GAD individuals in positive

situations. IU was found to share a robust association with rumination, though only IU predicted appraisal biases.

In the following chapter, threat appraisal bias was further examined in high IU individuals using an experimental paradigm that allowed for exploring anticipation of aversive outcomes, retrospective estimates of threat occurrence, and negative affect under the condition of ambiguity.

CHAPTER 5

Intolerance of Uncertainty under Ambiguity in Non-Clinical Individuals- Part I

(Experiment 3¹)

This chapter and following two chapters describe three experiments which further examined threat appraisal under ambiguity in high IU individuals and GAD patients.

As described in Chapter 2, IU has been broadly defined as “a cognitive bias that affects how a person perceives, interprets, and responds to uncertain situations on a cognitive, emotional, and behavioural level” (Dugas, Schwartz, et al., 2004, p. 835). This conceptualisation implies that IU contributes to worry/GAD directly by promoting threat-consistent appraisals of uncertain information (see Dugas, Buhr, et al., 2004 for summary). However, empirical evidence for this proposed mechanism has been lacking. The principal measure of IU, the Intolerance of Uncertainty Scale (IUS; Freeston, Rhéaume, et al., 1994), assesses the extent to which an individual finds uncertainty unacceptable (e.g., ‘it's unfair having no guarantees in life’), distressing (e.g., ‘unforeseen events upset me greatly’), or disruptive (e.g., ‘when it’s time to act, uncertainty paralyses me’). The IUS items do not appear to directly assess threat appraisal.

There is some evidence that IUS scores are associated with memory and interpretative biases. For example, Dugas, Hedayati, et al. (2005) found that individuals

¹ Parts of the results presented in this chapter are published in Chen, J. T.-H. & Lovibond, P. F. (2016). Intolerance of uncertainty is associated with increased threat appraisal and negative affect under ambiguity but not uncertainty. *Behavior Therapy*, 47(1), 42-53.

with high IU levels recalled a greater proportion of uncertain words (e.g., ‘unclear’), and they also reported being more concerned about ambiguous situations. Koerner and Dugas (2008) found that high IU individuals reported a greater level of concerns across positive, negative, and ambiguous scenarios, with the strongest between-group difference observed in ambiguous scenarios. Other studies have demonstrated that IU is associated with a tendency to seek more certainty cues before making decisions about moderately ambiguous tasks (e.g., Ladouceur et al., 1997). Further, individual differences in IU have been shown to predict perception of uncertainty about outcome probability as unacceptable (de Bruin et al., 2006), and task-related state worry (Ladouceur et al., 2000).

Although the above findings highlight cognitive and affective responses to uncertainty, no studies to date have directly examined the way in which high IU individuals calibrate the likelihood and cost of uncertain aversive outcomes. Fear conditioning and related paradigms provide a promising empirical framework for examining cognitive biases and affective responses in IU. Sarinopoulos et al. (2010) adapted the illusory correlation paradigm (Tomarken et al., 1989) to examine undergraduates’ responses to threat, using distressing pictures from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008) as the aversive outcome. Uncertainty was conveyed by a target cue that preceded aversive pictures 50% of the time. Responses were compared to two reference cues, one that always preceded an aversive picture and one that never did. Post-experimental estimates of the association between the uncertain cue and the aversive pictures were significantly higher than 50%, indicating evidence for covariation bias. Using a cued picture task similar to that used by Sarinopoulos et al. (2010), Grupe and

Nitschke (2011) further investigated threat appraisal under uncertainty by monitoring a priori and online expectancy ratings as well as post-experimental covariation estimates. Expectancy ratings for the uncertain cue were significantly greater than the true probability of 50%. Although they did not observe an overall covariation bias for the uncertain cue, online expectancy ratings predicted post-experiment covariation estimates.

In the research conducted on IU to date, the terms uncertainty and ambiguity have been treated somewhat synonymously. The use of ‘ambiguity’ in the IU literature may not come as a surprise given that an earlier body of literature on intolerance of ambiguity (IA) also sought to represent an individual's tendency to interpret ambiguous situations as threatening and to respond to novel and complex situations with discomfort and avoidance (Budner, 1962; Frenkel-Brunswik, 1949). Despite efforts to differentiate IA and IU (e.g., Greco & Roger, 2001; Grenier, Barrette, & Ladouceur, 2005), there has been little direct empirical research on how these two constructs are best to be distinguished.

The broader literature on cognitive bias suggests that ambiguity rather than uncertainty may provide more favourable conditions for the observation of individual differences in threat appraisal. For example, MacLeod and Mathews (2012) reviewed a wide range of interpretive tasks that embody potential threat, concluding that “selective interpretation of ambiguity can contribute to heightened anxiety vulnerability and to clinically relevant patterns of anxiety symptoms” (p. 201). Within the decision-making literature, ambiguity has generally been defined as a complete lack of knowledge regarding an outcome, whereas uncertainty refers to a situation where the outcome is not known on a

given trial but the probability of the outcome is known, such as tossing a coin (Camerer & Weber, 1992; Ellsberg, 1961; Lazarus & Folkman, 1984).

Within the IU literature, Ladouceur et al. (1997) manipulated “the ambiguity level” of their black/white marble ratio task by presenting participants with multiple possible proportions of black and white marbles. de Bruin et al. (2006) manipulated “the uncertainty level” associated with an unsolvable intelligence task by altering participants’ expected task difficulty. By providing participants with information regarding the relative probability of an outcome, both of these studies explored the effect of uncertainty on appraisal. It is well accepted in the anxiety literature that estimated probability is an important component of threat appraisal (Butler & Mathews, 1983; 1987; Reiss, 1991). However, it is rare in a clinical situation for probability of threat to be known exactly. Ambiguity therefore might be a more common and clinically relevant situation to explore (Koerner & Dugas, 2008). Accordingly, the present experiment aimed to examine threat processing in high and low IU individuals under both uncertainty and ambiguity.

This experiment was designed to extend the procedure developed by Grupe and Nitschke (2011) to compare two conditions, one of which provided information regarding outcome probability, the other was completely devoid of such information. Consistent with Grupe and Nitschke (2011), two instructed reference cues were used- the Certain Aversive cue was always followed by the aversive outcome, and the Certain Safe cue was never followed by the aversive outcome. In addition, two target cues were used, each of which was followed by the negative outcome (aversive IAPS picture) on 50% of trials. For one of these cues (Uncertain), participants were informed of the true 50% probability in the pre-

experimental instructions, whereas for the other cue (Ambiguous), participants were given no information. Importantly, participants were not informed about the existence of the Ambiguous cue. Like Grupe and Nitschke (2011), the target cues were compared to two instructed reference cues. Online expectancy of the aversive outcome and skin conductance response were recorded during the anticipatory period of each trial. In addition, post-experimental covariation estimates of the relationship between each cue and the aversive outcomes were obtained, as well as retrospective self-report ratings of mood (pleasant – unpleasant) during each cue.

Previous studies classified participants as either low or high on IU on the basis of a median split on their total IUS score (e.g., Buhr & Dugas, 2009; Dugas, Hedayati, et al., 2005; Koerner & Dugas, 2008). In the present study, participants were selected on the basis of extreme scores of the IUS for the purpose of enhancing power in statistical analyses thus improving cost-efficiency (Abrahams & Alf, 1978; Kagan, Snidman, & Arcus, 1998).

It was anticipated that, relative to low IU participants, high IU participants may show heightened threat processing and/or affective responses to the target cues relative to either normative values (e.g., 50% in the case of expectancy and covariation) or the average of the reference cues. Furthermore, if ambiguity were a more potent trigger of biased processing, then the between-group difference would be expected to be greater for the Ambiguous cue relative to the Uncertain cue.

Method

Participants

Participants were undergraduate psychology students who received either course credit or cash payment for participation. As in the previous experiments in Chapters 3 and 4, participants were selected on the basis of having either high scores (39 or above) or low scores (23 or below) on the IUS-12. Data for nine participants were excluded as a result of failure to understand instructions or failure to respond to any stimuli on the skin conductance measure. Given that existing research has examined IU as a trait variable (Buhr & Dugas, 2002), it could be expected that individual IUS-12 scores would remain relatively consistent across the initial screening phase and the main study. The IUS-12 was re-administered at the end of the experiment to confirm group membership. As a result, a further eight participants were excluded, leaving a sample size of 29 (eight men, 21 women) for the High IU group and 26 for the Low IU Group (eight men, 18 women). The final sample comprised 55 participants (16 men, 39 women, $M_{age} = 21.80$ years, $SD = 4.62$). Online expectancy and skin conductance data were missing for two participants (one from each of the IU groups) due to equipment failure. All participants were right-handed.

Materials and Measures

The study followed a $2 \times (4) \times (8)$ factorial design, where IU group (Low IU vs. High IU) constituted the between-groups factor. The within-subjects factors referred to the eight trials for each of the four warning cues. The Certain Aversive cue ('X') always preceded an aversive picture, and the Certain Safe cue ('O') always preceded a neutral

picture. Uncertain trials were signalled by a ‘ Δ ’ cue, and Ambiguous trials by a ‘?’ cue. Each cue appeared in black font against a white background.

The picture stimuli were selected from the International Affective Picture System (IAPS; Lang et al., 2008). Based on published norms and the 0-9 scale used by Lang et al. (2008) the aversive pictures (e.g., mutilated bodies, gunshots) had a mean arousal rating of 6.49 ($SD = 2.25$) and mean valence rating of 1.97 ($SD = 1.38$). Neutral pictures had a mean arousal rating of 3.19 ($SD = 1.99$) and mean valence rating of 5.15 ($SD = 1.25$). The pictures were 800 x 600 pixels, and were presented on a 30-cm computer monitor approximately 100 cm in front of the participant using MedPC software.

Skin conductance level (SCL) was measured by a Med Associates system (CANL-402) via two shielded Ag/AgCl electrodes attached to the distal phalanges of participants’ left index and middle fingers. During each trial, participants used their right hand to move a pointer mounted on the corner of the desk so as to indicate their expectancy rating of aversive pictures occurring at the end of the cue. The pointer had a continuous scale from 0 (*Expect Neutral*) to 100% (*Expect Aversive*), with 50% (*Uncertain*) in the centre.

A post-experimental covariation estimate questionnaire was administered following the last experimental trial to assess participants’ estimates of how often each cue was followed by aversive pictures. A post-experimental mood measure was also used to ascertain participants’ retrospective ratings of their affective responses during each of the cues on a nine-point scale, ranging from -4 (*Unpleasant*) to +4 (*Pleasant*), with 0 (*Neutral*) in the centre.

Participants also completed the 12-item Intolerance of Uncertainty Scale (IUS-12; Carleton, Norton, et al., 2007), the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990), and the 21-item Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995). The psychometric properties of these measures were described in Experiment 1. Cronbach's alpha for the present sample was .94 for the IUS-12; .94 for the PSWQ. For the DASS-21, Cronbach's alpha for the present sample was .88 on the depression subscale; .77 on the anxiety subscale; and .90 on the stress subscale.

Procedure

Participants were informed that the study involved viewing a series of pictures, some of which were aversive, and that each picture would be preceded by a cue. Participants were also informed that the 'X' cue always preceded an aversive picture, the 'O' cue always preceded a neutral picture, and that the '△' cue preceded aversive and neutral pictures at exactly a 50/50 ratio. Participants were not informed that a fourth cue ('?'), which also preceded aversive and neutral pictures at a 50/50 ratio, would appear as part of the trials. After signing informed consent, participants were seated in a dimly lit testing room. Participants were instructed that whenever a cue appeared on the monitor during each trial, they were to turn the dial to indicate their expectancy that an aversive picture would appear. Participants were also told that there would be waiting periods in between trials.

Skin conductance electrodes were attached to participants' left index and middle fingers prior to the experimental trials. Participants then viewed a summary of the

instructions on the monitor for 30s, followed by the 32 experimental trials. Each trial consisted of a 10-s cue presentation, during which participants indicated their expectancy ratings. The cue was immediately followed by a 3-s presentation of either a neutral or aversive picture, then a 3-s message instructing participants to return the expectancy dial to the ‘Off’ position on the pointer, which was to the left of 0 (*Expect Neutral*). This instruction was followed by a variable 15–35-s inter-trial interval (ITI). Trial order was randomised. After the last trial, participants completed the post-experimental questionnaire battery before being debriefed and thanked for their participation.

Scoring and Analysis

Online expectancy ratings in the present study were averaged over the 10-s cue presentation during each trial. Mood rating data were linearly transformed to a scale ranging from 0 (*Not unpleasant*) to 100 (*Unpleasant*), with 50 being neutral. Mean SCLs were recorded during the baseline period (i.e., final 10 s of the ITI), and during the whole 10-s cue presentation. In order to reduce variance and skew, the SCL data were log-corrected using the formula $\log(\text{mean cue period SCL} + 1) - \log(\text{mean baseline SCL} + 1)$.

For the primary analysis of the data, each dependent measure was analysed by a set of planned orthogonal contrasts using a multivariate repeated measures model, with the decision-wise error rate set at $\alpha = .05$ (O’Brien & Kaiser, 1985). The group contrast compared the High to the Low IU group. The cue contrasts examined 1) the difference between the Certain Aversive (‘X’) and Certain Safe (‘O’) reference cues; 2) responding to the target cues (‘△’ and ‘?’) relative to the normative reference point provided by the

average of the reference cues ('X' and 'O'); and 3) the difference between the Uncertain ('△') and Ambiguous ('?') cues. Finally, a linear trend contrast tested for any linear change across trials (i.e. repetitions of each trial type across the course of the test session).

All interactions between group, cue and trial contrasts were also tested. For each contrast, effect sizes are reported using the absolute value of Cohen's *d* and standardised 95% confidence intervals (CI; scaled in SD units). All reported analyses were conducted using the PSY Statistical Program (Bird et al., 2000).

Follow-up exploratory analyses were also conducted in order to further explore the pattern of results within- and between-groups for each dependent measure. In order to maintain power these exploratory analyses did not involve any correction for inflation of Type 1 errors, so they should be interpreted with caution.

Results

Initial analysis revealed a positive linear trend across trials for the expectancy measure averaged over groups and cues, $F(1, 51) = 33.91, p < .05$, which was largely due to lower expectancy ratings on the first presentation of the two target cues relative to the two reference cues, $F(1, 51) = 9.99, p < .05$. For the skin conductance measure, there was an overall negative linear trend, $F(1, 51) = 5.36, p < .05$, reflecting a general pattern of habituation across trials. There were no other interactions involving linear trend for either measure. Accordingly, subsequent analyses were based on data collapsed over trials.

The means and standard deviations for both IU groups on the self-report measures are presented in Table 5.1. As expected, the mean IUS-12 score was significantly higher for the High IU group than the Low IU group, $t(53) = 17.36$, $p < .05$. The High IU group also reported a higher mean PSWQ score, $t(53) = 5.49$, $p < .05$, and a higher mean DASS-Depression score, $t(42) = 5.13$, $p < .05$, relative to the Low IU group. There was no significant difference in the proportion of males and females in the two groups ($\chi^2(1) = .07$, $p > .05$).

Table 5.1

Means (M) and standard deviations (SD) for all self-report variables by IU group.

	Low IU (n = 26)		High IU (n = 29)		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i> (53)
IUS-12	19.71	5.19	41.98	4.31	17.36*
PSWQ	38.65	13.41	57.03	11.43	5.49*
DASS Depression	3.15	4.70	13.44	9.59	4.96*
DASS Anxiety	2.38	3.20	11.10	7.66	5.39*
DASS Stress	5.00	5.13	18.21	10.45	5.84*

* $p < .05$

Online Expectancy Ratings

Figure 5.1 shows the mean expectancy ratings during presentation of the four cue types, averaged over trials. Error bars depict 95% confidence intervals around the mean. There was a trend for the High IU group to show higher overall expectancy ratings than the Low IU group, averaged over cues, $F(1, 51) = 3.81$, $p = .06$, $d = .33$; 95% CI = -.67, .01. Averaged over groups, participants showed high levels of expectancy that the Certain Aversive cue ('X'), $M = 77.70$, $SD = 6.75$, would be followed by aversive pictures, and low

levels of expectancy that the Certain Safe cue ('O'), $M = 1.75$, $SD = 6.42$, would be followed by aversive pictures, with a highly significant difference between these reference cues, $F(1, 51) = 2592.04$, $p < .05$, $d = 8.32$; 95% CI = 7.99, 8.65.

The average expectancy ratings for the target cues (' Δ ' and '?') were significantly lower than the average of the reference cues ('X' and 'O'), $F(1, 51) = 13.12$, $p < .05$, $d = .48$; 95% CI = .21, .74. This result indicates that, overall, participants underestimated threat to the target cues (' Δ ' and '?') relative to the reference point provided by the average of the maximum ('X') and the minimum ('O') ratings. Further, expectancy ratings for the Ambiguous cue ('?'), $M = 33.38$, $SD = 13.64$, were significantly lower than those for the Uncertain cue (' Δ '), $M = 37.34$, $SD = 7.76$; $F(1, 51) = 5.86$, $p < .05$, $d = .43$; 95% CI = -.79, -.07.

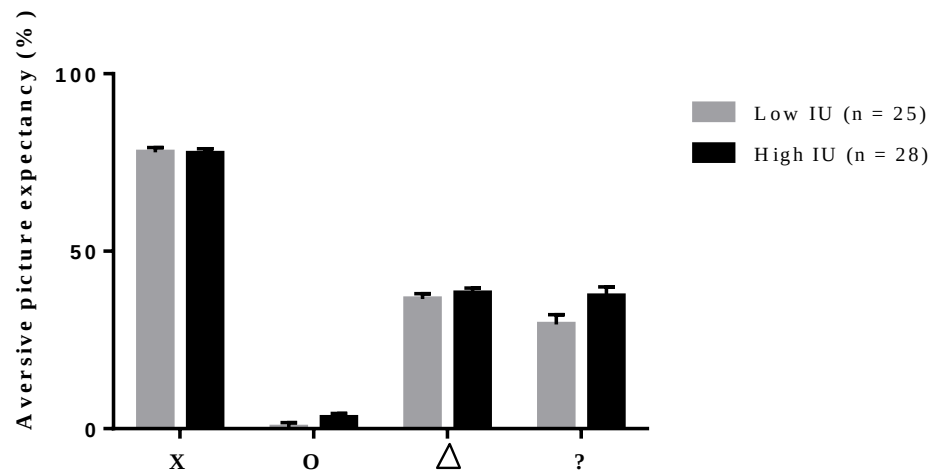


Figure 5.1. Mean aversive picture expectancy ratings.

Follow-up analyses indicated that the High IU group reported significantly greater threat expectancy ratings for the Ambiguous cue ('?'), $M = 37.39$, $SD = 12.41$, than did the Low IU group, $M = 29.37$, $SD = 14.91$; $F(1, 51) = 4.58$, $p < .05$, $d = .59$; 95% CI = .04, 1.14. The two groups did not differ in their expectancy ratings for the Uncertain cue ('△'), $F(1, 51) = .61$, $p = .44$, $d = .22$; 95% CI = -.77, .34. There was a trend for the interaction between IU Group and the contrast comparing the Ambiguous cue ('?') with the Uncertain cue ('△'), indicating that the differences between the two target cues were greater for the Low IU group compared to the High IU group) did not quite reach significance, $F(1, 51) = 3.78$, $p = .06$, $d = .70$; 95% CI = -.02, 1.42. None of the other Cue Type $\times$ IU Group interaction effects were significant (all F s < 3).

Post-Experiment Covariation Estimates

Mean post-experiment covariation estimates of the relationship between the cues and aversive pictures are shown in Figure 5.2. There was no overall difference between the IU groups, averaged over cues, $F(1, 53) = 1.04$, $p = .31$, $d = .16$; 95% CI = -.47, .15. Averaged over groups, participants reliably estimated the degree of covariation between the Certain Aversive cue ('X') and aversive pictures, $M = 97.70$, $SD = 6.90$, and that between the Certain Safe cue ('O') and aversive pictures, $M = 1.76$, $SD = 5.43$. Covariation estimates for the target cues ('△' and '?') averaged were significantly greater than the reference cues ('X' and 'O') averaged, $F(1, 53) = 15.23$, $p < .05$, $d = .64$; 95% CI = .31, .97, suggesting an overall covariation bias for both target cues. This conclusion was also supported by the results of follow-up single sample t tests against a fixed value of 50%, as conducted by Grupe and Nitschke (2011). Covariation estimates for the Uncertain cue

(‘ Δ ’) were significantly greater than 50%, $M = 55.85$, $SD = 13.37$; $t(54) = 3.25$, $p < .05$, $d = .88$, as were covariation estimates for the Ambiguous cue (‘?’), $M = 59.00$, $SD = 17.68$; $t(54) = 3.78$, $p < .05$, $d = 1.03$.

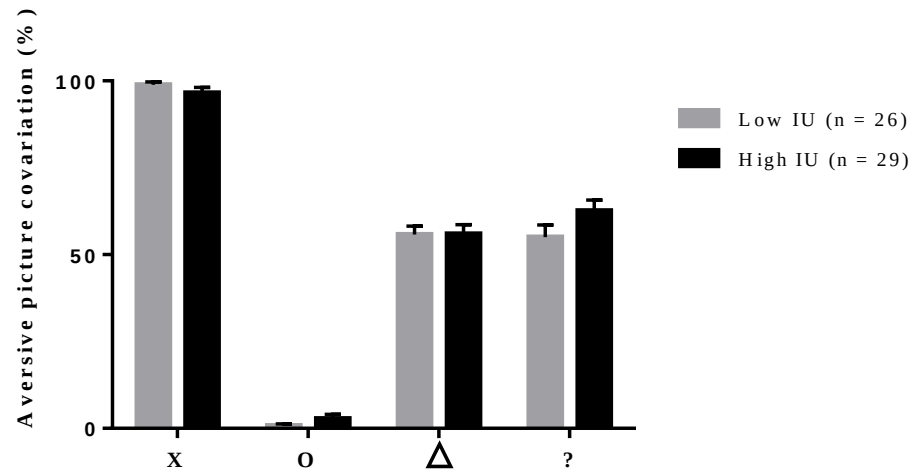


Figure 5.2. Mean post-experiment cue-aversion covariation estimates for each cue.

Averaged over groups, covariation estimates for the Ambiguous cue (‘?’), $M = 58.79$, $SD = 17.42$ were not significantly higher than for the Uncertain cue (‘ Δ ’), $M = 55.85$, $SD = 13.49$; $F(1, 53) = 2.06$, $p = .16$, $d = .25$; 95% CI = $-.60, .10$. However, from Figure 5.2 it appears that the High IU group showed selectively higher covariation estimates for the Ambiguous cue (‘?’). This pattern was partially supported by the statistical analysis, which showed a trend towards an interaction between IU Group and the contrast comparing the Uncertain (‘ Δ ’) vs. Ambiguous (‘?’) cues, $F(1, 53) = 3.28$, $p = .08$, $d = .63$; 95% CI = $-.07, 1.32$. Follow-up simple effect analyses indicated that covariation

estimates for the Ambiguous cue ('?') were significantly greater than for the Uncertain cue ('△') within the High IU group, $F(1, 28) = 8.13, p < .05, d = .43$; 95% CI = .12, .73. For the Low IU group, however, the covariation estimates between the Uncertain ('△') and Ambiguous ('?') cues did not differ significantly, $F(1, 25) = .05, p = .83, d = .05$; 95% CI = -.41, .51. However, these analyses should be interpreted with caution due to the non-significance of the interaction. None of the other Cue Type $\times$ IU Group interaction effects were significant (largest $F = 2.19$).

Post-Experiment Mood Ratings

Mean mood rating data for each cue are shown in Figure 5.3. There was a trend for the High IU group to show higher (more unpleasant) mood ratings than the Low IU group, averaged over cues, $F(1, 53) = 3.29, p = .08, d = .28$; 95% CI = -.58, .03. Averaged across groups, the Certain Aversive cue ('X') was rated as most unpleasant, $M = 85.27, SD = 16.99$, and the Certain Safe cue ('O') was rated as least unpleasant, $M = 21.95, SD = 19.79$. Mood ratings for the two target cues ('△' and '?') averaged were significantly more unpleasant than the two reference cues ('X' and 'O') averaged, $F(1, 53) = 39.64, p < .05, d = .74$; 95% CI = .5, .97. Mood ratings for the Ambiguous cue ('?') were significantly more unpleasant than the ratings for the Uncertain cue ('△'), $F(1, 53) = 20.60, p < .05, d = .51$; 95% CI = .28, .73.

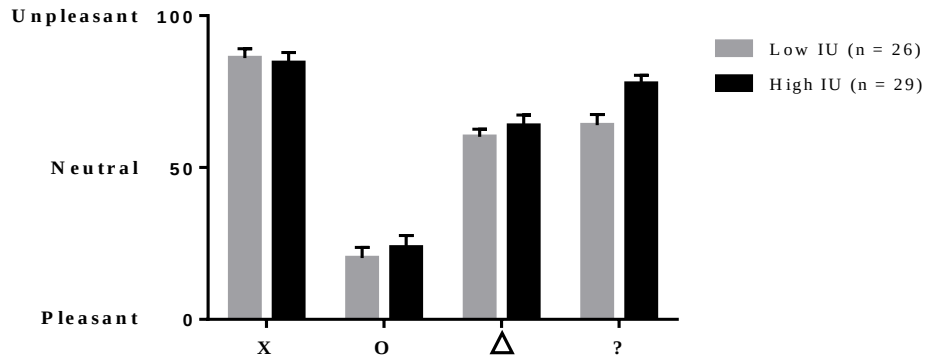


Figure 5.3. Mean post-experiment mood ratings for each cue.

Follow up analyses suggested that whereas both IU groups demonstrated similar mood ratings for the Uncertain cue (' Δ '), $F(1, 53) = .72, p = .40, d = .23$; 95% CI = -.77, .31, the High IU group found the Ambiguous cue ('?'), $M = 78.02, SD = 14.43$, significantly more unpleasant relative to the Low IU group, $M = 63.94, SD = 17.79$; $F(1, 53) = 10.47, p < .05, d = .88$; 95% CI = .33, 1.42. Consistent with this effect, there was a significant interaction between IU Group and the comparison of Uncertain (' Δ ') vs. Ambiguous ('?') cues, $F(1, 53) = 6.55, p < .05, d = .57$; 95% CI = .12, 1.02. None of the other Cue Type $\times$ IU Group interaction effects were significant (largest $F = 3.62$).

Skin Conductance

Figure 5.4 shows the skin conductance data for the cues. There was no overall difference between the IU groups, averaged over cues, $F(1, 51) = .70, p = .41, d = .16$; 95% CI = -.54, .22.

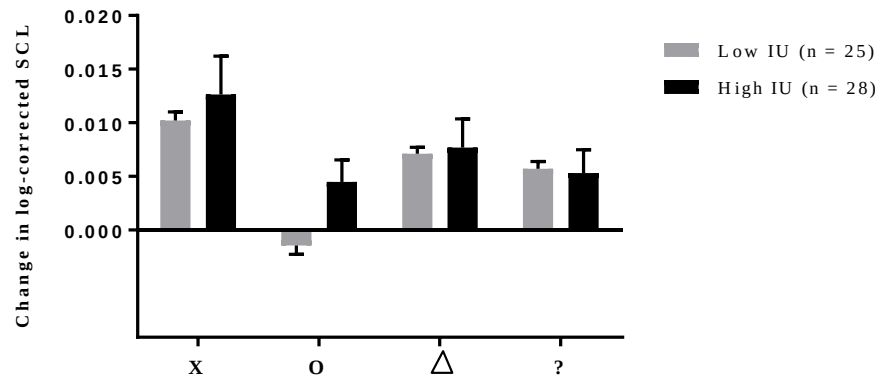


Figure 5.4. Mean change in log-corrected skin conductance level for each cue.

Consistent with previous findings (Dunsmoor, Bandettini, & Knight, 2007; Grupe & Nitschke, 2011), skin conductance responding to the Certain Aversive cue ('X') was significantly greater than that to the Certain Safe cue ('O'), $F(1, 51) = 8.32$, $p < .05$, $d = .62$; 95% CI = .19, 1.04. There was no significant difference between skin conductance responding to the reference cues ('X' and 'O') averaged versus that to the target cues ('Δ' and '?') averaged ($F < 1$), and there was no significant difference between skin conductance responding to the Ambiguous cue ('?') versus that to the Uncertain cue ('Δ'), $F = 1.09$. None of the Cue Type $\times$ IU Group interaction effects were significant (all F s < 1).

Correlations

A bivariate correlation analysis was conducted to examine the relationship between the outcome variables for the target cues ('Δ' and '?'), including online expectancy

ratings, post-experiment covariation estimates, post-experiment mood ratings, and skin conductance responses. Initial analysis revealed that the Uncertain (' Δ ') and Ambiguous ('?') cues shared similar patterns of correlations between the outcome variables. Therefore, results were averaged across the target cues (' Δ ' and '?') in the final correlation analysis. The correlation coefficients for the four variables are shown in Table 5.2. All correlations were positive. In particular, online expectancy ratings were significantly correlated with post-experiment covariation estimates and mood ratings. Post-experiment covariation estimates were also significantly correlated moderately with post-experiment mood ratings. There was a significant correlation between covariation estimates and skin conductance response. Skin conductance was also correlated significantly with mood ratings. The correlation between online expectancy ratings and skin conductance responses was not significant.

Table 5.2

Pearson bivariate correlation coefficients for outcome (target cues) and self-report variables.

	Covariation Estimates	Mood Ratings	SCR	PSWQ	IUS-12	DASS Depression	DASS Anxiety	DASS Stress
Online expectancy	.51**	.50**	.21	.20	.28*	.27	.15	.12
Covariation estimates		.64**	.32*	.26	.22	.33*	.28*	.19
Mood Ratings			.35**	.22	.29*	.36**	.38**	.32*
SCR				.09	.12	.10	.04	-.01
PSWQ					.66**	.59**	.58**	.67**
IUS-12						.63**	.61**	.69**
DASS Depression							.63**	.74**
DASS Anxiety								.84**

* $p < .05$

** $p < .01$

Discussion

Extending the experimental design of Grupe and Nitschke (2011), this experiment found preliminary evidence that individuals with high IU responded more strongly to cues with an inconsistent relationship to threat, both in terms of threat appraisal and affective reaction. High IU participants showed increased online threat expectancy ratings, covariation bias and negative affect to the target cues compared to low IU participants, particularly for the Ambiguous cue.

The primary online measure of threat appraisal, expectancy ratings, showed the expected difference between the Certain Aversive and Certain Safe reference cues. However, the absolute level of mean ratings to the Certain Aversive cue ('X') was only 77.7%, lower than in Grupe and Nitschke (2011). The reason for this pattern is likely to be that expectancy ratings were averaged across the full 10s of the cue presentation, whereas Grupe and Nitschke (2011) recorded ratings during the last 500ms of the cue. Therefore any delay in making a rating would have reduced the recorded value. This procedure may also explain the lower mean ratings to the Ambiguous cue ('?') compared to the known Uncertain cue ('△'), as the Ambiguous cue was novel and likely caused participants to take longer before committing to a rating. Response latencies were not recorded in the present data set, and therefore this interpretation cannot be directly confirmed. Nonetheless, a direct comparison between groups was still possible, as the measurement technique was the same for all participants.

The finding that high IU participants reported significantly higher expectancy ratings for the Ambiguous cue than low IU participants is consistent with previous studies showing that anxious individuals tend to show a bias in favour of threatening

interpretations of ambiguous stimuli, relative to non-anxious individuals (Butler & Mathews, 1983; Butler & Matthews, 1987; MacLeod & Cohen, 1993; Mathews & Mackintosh, 1998). This group difference is particularly striking given that the High IU group may have been expected to have longer decision latencies when faced with an ambiguous task (Dugas et al., 1997; Ladouceur et al., 1997), which would have worked against the higher mean expectancy observed in this group. The between-group simple effect was only significant for the Ambiguous cue, not the Uncertain cue, providing some support for the idea that high IU individuals are prone to over-predicting aversive outcomes under the condition of ambiguity.

As expected, the post-experimental covariation data indicated biased estimates of the association between the target cues (' Δ ' and '?') and aversive pictures. This finding is consistent with Sarinopoulos et al. (2010), who demonstrated a posteriori covariation bias for uncertain cues signalling 50% probability of aversive outcomes. Although overall high IU participants did not show stronger covariation bias to the target cues relative to low IU participants, only high IU participants showed a significant difference in covariation estimates between the Uncertain and Ambiguous cues. That is, high IU participants, but not low IU participants, perceived a significantly higher contingency between the Ambiguous cue and aversive pictures relative to that between the Uncertain cue and aversive pictures. This finding is again consistent with the idea that IU participants overestimate threat under conditions of ambiguity (Dugas, Buhr, et al., 2004; Dugas, Hedayati, et al., 2005).

In addition to examining threat appraisal, negative affective response to cues signalling possible aversive outcomes were also examined. The mood ratings provided evidence for heightened negative affect to the target cues compared to the reference cues, consistent with the item content of the IUS (Freeston, Rhéaume, et al., 1994). Furthermore, although high and low IU participants showed similar negative affective ratings to the Uncertain cue, high IU participants found the Ambiguous cue significantly more unpleasant than low IU participants, confirming that ambiguity elicits a more negative affective response than uncertainty in high IU individuals.

By contrast, the psychophysiological measure, skin conductance, did not appear to be sensitive to this difference. Participants clearly demonstrated differential skin conductance responding to the two reference cues, but both High and Low IU groups showed similar skin conductance responding to the two target cues. Nonetheless, skin conductance was positively correlated with post-experiment covariation estimates and mood ratings. Skin conductance is known to show high individual variability (e.g., Borkovec, 1985; Borkovec & Hu, 1990), and it appears that a larger sample size may be necessary to detect differences between ambiguity and uncertainty on this measure.

Overall, the similarity in the pattern of means for expectancy, covariation estimates and mood ratings provides converging evidence for the reliability of this pattern. There was no evidence for any substantial dissociation between the measures. Further, the moderate and positive correlations between all four outcome variables for the target cues are consistent with the idea that IU drives both threat appraisal and negative affect in response to cues that signal possible aversive outcomes. Perceived contingency is

presumed to be an interplay of a priori expectancies and situational information (Alloy & Tabachnik, 1984). From this perspective, participants who were unable to calibrate outcome probabilities during the target cues might have based their threat appraisal on their cognitive schema, which are presumably biased toward a higher threat appraisal of negative outcomes in those with high IU levels (Dugas, Hedayati, et al., 2005; Koerner & Dugas, 2008).

With the exception of the skin conductance data, the primary feature that was common across the outcome measures was the tendency for high IU participants to respond more strongly to the Ambiguous cue compared to low IU participants, suggesting that ambiguity may be the critical trigger stimulus for high IU individuals and clinical patients. Note that Sarinopoulos et al. (2010) Grupe and Nitschke (2011) informed participants that the target cue would sometimes be followed by the negative outcome and sometimes would not, without giving the exact ratio. In this experiment, two cues were used to distinguish between ambiguity ('?') and pure uncertainty (' Δ '). The Ambiguous cue essentially represented a complete lack of information about the degree of uncertainty regarding outcome probabilities, as participants did not have any basis for predicting the percentage of trials that would be followed by aversive pictures. The Uncertain cue also did not allow prediction of the outcome on any trial, but due to the pre-experimental instructions it did communicate exactly the probability of the aversive outcome. It was under the condition of ambiguity rather than uncertainty that high IU participants showed the greatest threat responding in the present experiment.

Results from this experiment are consistent with previous studies which have shown that uncertainty does not necessarily generate greater threat appraisal in anxious individuals if the situational information explicitly specifies the degree of uncertainty (Alloy & Tabachnik, 1984; Chan & Lovibond, 1996). This perspective is consistent with a view of ambiguity as higher-order uncertainty- that is, uncertainty about uncertainty (Camerer & Weber, 1992; Einhorn & Hogarth, 1985; Ellsberg, 1961). Findings from the present experiment indicate that uncertainty alone (i.e., clear calibration of uncertain threat probability) is unlikely to elicit a difference in information processing bias and negative affect between the low and high IU individuals. Rather, high IU individuals may differ maximally from low IU individuals when they do not have information about the probabilities of aversive outcomes and hence their judgment of threat is relatively unconstrained. A useful direction for future experimental and clinical studies on IU may therefore be to include an ambiguous condition similar to that in the present experiment, where there is a complete lack of information regarding probabilities of aversive outcomes.

A number of limitations of this experiment should be considered. Firstly, assessment of affective responding was conducted retrospectively, as to minimise overloading participants who were already rating threat expectancy online. It would be important to confirm the present finding that ambiguity is subjectively more distressing than uncertainty using a real-time measure. Secondly, the difference between expectancy results from the present experiment and Grupe and Nitschke (2011) also suggest that it would be valuable to separately record response latency and final expectancy ratings in this paradigm. Finally, the present study sought to maximise ambiguity by combining novelty,

a lack of information regarding outcome probability, and the intrinsic meaning of the target cue (a question mark symbol). Future research could disentangle these components by using a more neutral symbol to determine which one(s) are critical to the differences observed between the ambiguity and uncertain conditions in the present study.

This experiment measured state worry as IU has been shown to be closely associated with GAD, for which the dominant symptom is worry (e.g., Dugas et al., 1997; Freeston, Rhéaume, et al., 1994; Ladouceur et al., 1997). Further, biased threat appraisal has previously been shown to be more strongly related to IU than to worry, anxiety or depression (Dugas, Hedayati, et al., 2005). In this experiment, online expectancy rating was a significant predictor of post-experiment covariation estimates, whereas IU, worry, depression, and anxiety were not. Considering recent findings have underscored the association between IU and change in depressive symptoms (Boswell et al., 2013; Yook et al., 2010), it would be informative to further explore the extent to which factors such as depression, anxiety and worry account for present findings compared to the role of IU with a larger sample. Finally, the current study used an extreme groups approach (EGA) for increasing statistical power. It should be noted that conclusions based on analyses using EGA can be limited relative to those based on analysis of full-range and continuous data (Preacher, Rucker, MacCallum, & Nicewander, 2005), and it would be useful to include mid-range values of these variables and IU in future research to check for non-linear effects.

In summary, the present study provided preliminary evidence that high IU individuals show both biased threat appraisal and enhanced affective responses in situations

where a potential threat may or may not occur. Furthermore, the greatest differences between high and low IU individuals were observed under conditions of ambiguity, rather than uncertainty. These findings indicate that further exploration of the distinction between ambiguity and uncertainty is warranted.

CHAPTER 6

Intolerance of Uncertainty under Ambiguity in Non-Clinical Individuals- Part II

(Experiment 4)

The experiment described in this chapter is a follow-up experiment to Experiment 3. In Experiment 3, participants reported significantly lower expectancies of aversive pictures after the target cues compared to the average of the 100% and 0% reference cues. Furthermore, high IU participants reported significantly higher expectancy ratings for the Ambiguous cue than low IU participants. This between-group simple effect was only significant for the Ambiguous cue, not the Uncertain cue, providing partial support for the idea that high IU individuals are prone to over-predicting aversive outcomes under the condition of ambiguity. This result is consistent with previous findings that anxious individuals tend to show a bias in favour of threatening interpretations of ambiguous stimuli, relative to non-anxious individuals (Butler & Mathews, 1983; MacLeod & Cohen, 1993; Mathews & Mackintosh, 1998). Differences in expectancy ratings from Experiment 3 and Grupe and Nitschke (2011) suggest that it would be valuable to separately record response latency and final expectancy ratings in this paradigm.

In Experiment 3, online expectancy ratings were averaged across the 10-second cue presentation. As discussed in Experiment 3, it would be informative to see if the effect of ambiguity is even greater on the final expectancy rating. Recording terminal expectancy ratings would also allow for a more direct replication of the online results of Grupe and

Nitschke (2011). As such, this experiment sought to examine terminal expectancy of aversive pictures after uncertain/ambiguous cues in high and low IU individuals.

Method

The Method for this experiment was the same as reported in the previous experiment, except as detailed below.

Participants

Participants were students attending the University of New South Wales who received either course credit or cash payment for participation. Prospective participants were selected from a pool of 41 subjects who met selection criteria from an initial screening survey using the IUS-12 (Carleton, Norton, et al., 2007). Data for seven participants were excluded as a result of failure to understand instructions or failure to respond to any stimuli on the skin conductance measure. As in the previous study, the IUS-12 was re-administered at the end of the experiment to confirm group membership. As a result, one participant was excluded, leaving a sample size of 16 (eight men, eight women) for the High IU group and 17 (10 men, seven women) for the Low IU Group. The final sample comprised 33 participants (15 females, 18 males, $M_{\text{age}} = 23.29$ years, $SD = 6.98$). Online expectancy and skin conductance data were missing for one participant due to equipment failure.

Materials and Measures

Cronbach's alpha for the present sample was .96 on the IUS-12 (Carleton, Norton, et al., 2007) total score and .86 on the PSWQ (Meyer et al., 1990) total score. For the DASS-21 (Lovibond & Lovibond, 1995), Cronbach's alpha for the present sample was .87 on the depression subscale; .79 on the anxiety subscale; and .89 on the stress subscale.

Scoring and Analysis

Unlike the previous study in which online expectancy ratings were averaged over the 10-s cue presentation, expectancy ratings in the present study were recorded in the final second of the 10-s cue presentation during each trial.

Results

As in the previous experiment, initial analysis revealed an overall positive linear trend for the expectancy measure averaged across groups and cues, $F(1, 30) = 13.50$, $p < .05$, which was largely due to the lower expectancy ratings on the first presentation of the two target cues relative to the reference cues, $F(1, 30) = 8.54$, $p < .05$. Also consistent with the previous experiment was the overall negative linear trend for the skin conductance measure, $F(1, 30) = 4.54$, $p < .05$, reflecting a general pattern of habituation across trials. There were no other interactions involving linear trend for either measure. As such, the data presented hereafter are averaged over trials. The means and standard deviations for both IU groups on the self-report measures are presented in Table 6.1.

Table 6.1

Means (M) and standard deviations (SD) for all self-report variables by IU group.

	Low IU (n = 17)		High IU (n = 16)		<i>t</i> (31)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
IUS-12	17.65	3.48	43.00	5.89	15.16*
PSWQ	35.41	9.91	60.00	11.52	6.58*
DASS Depression	2.82	3.24	16.25	8.00	6.39*
DASS Anxiety	2.24	4.41	11.75	7.90	4.31*
DASS Stress	3.41	3.99	21.00	8.03	8.04*

**p* < .05

As expected, the mean IUS-12 total score was significantly higher for the High IU group than for the Low IU group, $t(31) = 15.16$, $p < .05$. The High IU group also scored higher than participants in the low IU group on the PSWQ, $t(31) = 6.58$, $p < .05$; the depression subscale of the DASS, $t(31) = 6.39$, $p < .05$; the anxiety subscale of the DASS, $t(31) = 4.31$, $p < .05$; and the stress subscale of the DASS, $t(31) = 8.04$, $p < .05$. There was no significant difference in any of the self-report measures between men and women (largest $t = .96$), nor was there any significant difference in the proportion of males and females in the two groups, $\chi^2(1) = .26$, $p > .05$.

Online Expectancy Ratings

Figure 6.1 shows the mean expectancy ratings during the presentation of the four cue types, averaged over trials. Error bars depict 95% confidence intervals around the mean. Consistent with the previous experiment, participants showed high levels of

expectancy that the Certain Aversive cue ('X') would be followed by aversive pictures, and low levels of expectancy that the Certain Safe cue ('O') would be followed by aversive pictures, with a highly significant difference between these reference cues, $F(1, 30) = 6054.47$, $p < .05$, $d = 19.63$; 95% CI = 19.11, 20.14. Although in the previous experiment, participants underestimated threat to the target cues (' Δ ' and '?') relative to the reference point provided by the average of the maximum ('X') and the minimum ('O') ratings, average expectancy ratings for the target cues in this experiment did not differ from the average of the reference cues ('X' and 'O') averaged over groups, $F(1, 30) = .62$, $p = .44$, $d = .15$; 95% CI = -.24, .54.

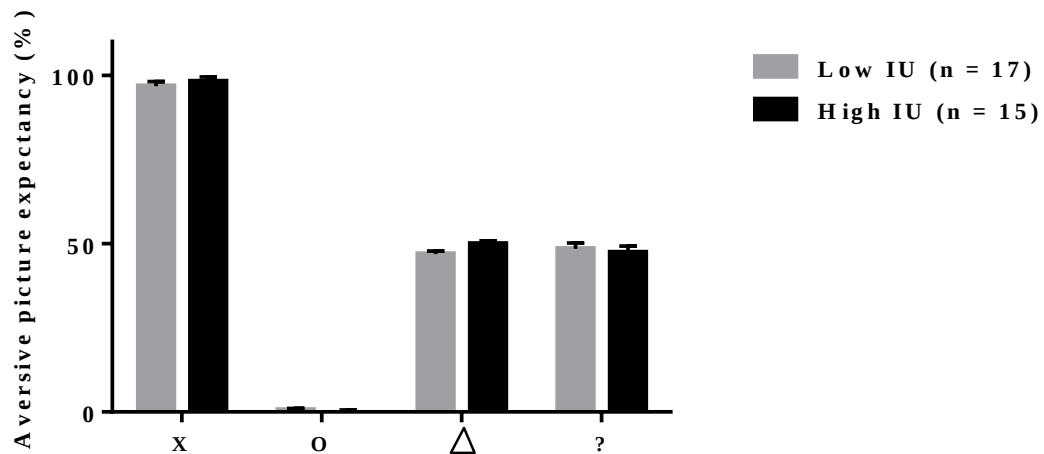


Figure 6.1. Mean aversive picture expectancy ratings for each cue.

In follow-up single sample *t*-tests, online expectancy ratings were tested against a fixed value of 50%, as conducted by Grupe & Nitschke (2011). Expectancy ratings for aversive pictures following the Ambiguous cue did not differ significantly from the true 50% probability, $M = 47.93$, $SD = 7.23$; $t(31) = 1.62$, $p = .12$, $d = .58$. Interestingly, expectancy ratings for the Uncertain cue were slightly but significantly lower than 50%, $M = 48.31$, $SD = 3.78$; $t(31) = 2.53$, $p < .05$, $d = .91$.

Compared to Experiment 3 in which expectancy ratings for the Ambiguous cue ('?') were significantly lower than the Uncertain cue ('△'), there was no difference in expectancy ratings between the two target cues in this experiment, $F(1, 30) = .20$, $p = .66$, $d = .10$; 95% CI = -.37, .57. Similar to the expectancy data in Experiment 3, the interaction between IU Group and the contrast comparing the Ambiguous cue ('?') with the Uncertain cue ('△') did not reach significance, $F(1, 30) = 3.17$, $p = .09$, $d = .82$; 95% CI = -1.76, .12. None of the other Cue Type × IU Group interaction effects were significant (all F s < 1).

Post-Experiment Covariation Estimates

Mean post-experiment covariation estimates of the relationship between the cues and aversive pictures are presented in Figure 6.2. Overall, participants reliably estimated the degree of covariation between the Certain Aversive cue ('X') and aversive pictures, $M = 99.39$, $SD = 2.46$, and that between the Certain Safe cue ('O') and aversive pictures, $M = .61$, $SD = 2.46$.

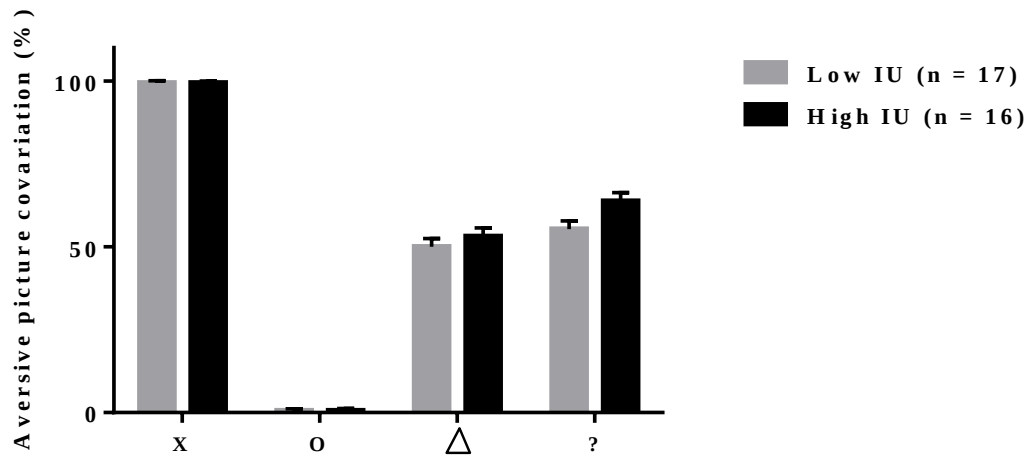


Figure 6.2. Mean post-experiment cue-aversion covariation estimates for each cue.

As in the previous experiment, covariation estimates for the target cues ('Δ' and '?') averaged were significantly greater than the reference cues ('X' and 'O') averaged, $F(1, 31) = 23.40, p < .05, d = .76$; 95% CI = .44, 1.07, suggesting an overall covariation bias for the target cues. Although in Experiment 3 the interaction between this comparison and IU group did not reach significance, this interaction effect was significant in the present experiment, $F(1, 31) = 6.39, p < .05, d = .79$; 95% CI = .15, 1.42, suggesting a greater covariation bias for the target cues in the High IU group compared to the Low IU group largely due to the Ambiguous cue ('?').

Contrary to the previous experiment in which there was no significant difference in covariation estimates between the two target cues, covariation estimates for the Ambiguous cue ('?') in this experiment were significantly greater than those for the Uncertain cue

(‘ $\triangle$ ’) averaged over group, $F(1, 31) = 9.94$, $p < .05$, $d = 1.08$; 95% CI = .38, 1.78. This difference was largely driven by the High IU group who reported higher covariation estimates for the Ambiguous cue (‘?’) relative to the Uncertain cue (‘ $\triangle$ ’).

The difference in covariations estimates between the Ambiguous cue (‘?’) and the Uncertain cue (‘ $\triangle$ ’) was greater for the High IU group than for the Low IU group, in which the difference between the two target cues were smaller but in the same direction as for the High IU group. However, the interaction between IU Group and the comparison between the Ambiguous cue (‘?’) with the Uncertain cue (‘ $\triangle$ ’) did not reach significance, $F(1, 31) = 1.11$, $p = .30$, $d = .72$; 95% CI = -.68, 2.12. Nonetheless, follow-up analyses revealed that although there was no significant IU group difference in covariation estimates for the Uncertain cue (‘ $\triangle$ ’), $F(1, 31) = .79$, $p = .40$, $d = .31$; 95% CI = -1.02, .40, the High IU group reported significantly greater threat covariation estimates for the Ambiguous cue (‘?’) relative to the Low IU group, $F(1, 31) = 5.71$, $p < .05$, $d = .83$; 95% CI = .12, 1.54.

Post-experiment covariation estimates for the two target cues were also tested against 50% using a single-sample t -test, in order to facilitate comparison with the results of Grupe & Nitschke (2011). Participants’ overall post-experiment estimates of the relationship between the Ambiguous cue (‘?’) and aversive pictures were significantly greater than 50%, $M = 59.39$, $SD = 10.88$; $t(32) = 4.96$, $p < .05$, $d = 1.75$, indicating covariation bias for the Ambiguous cue. Although in Experiment 3 covariation estimates for both target cues were significantly greater than 50%, covariation estimates of the relationship between the Uncertain cue (‘ $\triangle$ ’) and aversive pictures in this experiment did not differ from the true ratio of 50%, $M = 51.52$, $SD = 10.04$; $t(32) = .87$, $p = .39$, $d = .31$.

Post-Experiment Mood Ratings

Mean mood rating data for each cue are presented in Figure 6.3. Averaged across IU groups, the Certain Aversive cue ('X') was rated as most unpleasant, $M = 82.20$, $SD = 13.29$, and the Certain Safe cue ('O') least unpleasant, $M = 23.74$, $SD = 21.42$. There was an unexpected significant interaction between IU group and the comparison between the Certain Aversive and Certain Safe cues, $F(1, 31) = 4.80$, $p < .05$, $d = 1.25$; 95% CI = .09, 2.40. Follow-up simple effect analyses revealed that although there was no group difference in mood ratings for the Certain Safe cue ($F = 1.27$), the High IU group found the Certain Aversive cue significantly more unpleasant relative to the Low IU group, $F(1, 31) = 7.81$, $p < .05$, $d = .97$; 95% CI = .26, 1.68.

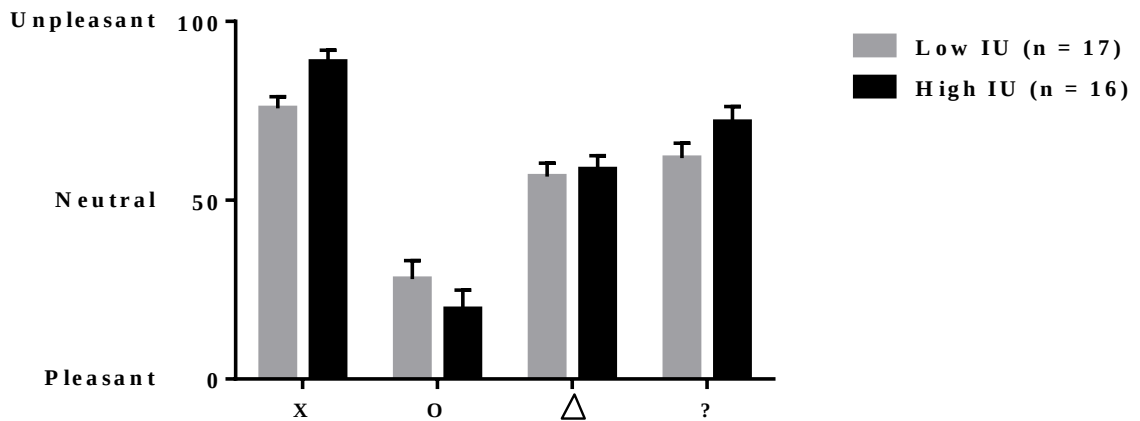


Figure 6.3. Mean post-experiment mood ratings for each cue.

Consistent with the previous experiment, mood ratings for the two target cues ('Δ' and '?') averaged were significantly more unpleasant than the two reference cues ('X' and 'O') averaged, $F(1, 31) = 13.39$, $p < .05$, $d = .54$; 95% CI = .24, .84, averaged over groups.

There was no significant IU group difference in the mood rating comparison between the target and reference cues ($F < 1$).

As in the previous experiment, mood ratings for the Ambiguous cue ('?') were significantly more unpleasant than the ratings for the Uncertain cue (' Δ '), $F(1, 31) = 13.53$, $p < .05$, $d = .54$; 95% CI = .24, .84. Although the interaction between IU Group and the comparison of Uncertain (' Δ ') vs. Ambiguous ('?') cues followed the same pattern as in the previous experiment, it did not reach significance, $F(1, 31) = 2.64$, $p = .12$, $d = .48$; 95% CI = -.12, 1.07.

Follow-up analyses did not reveal any significant IU group differences for the Uncertain cue, $F(1, 31) = .13$, $p = .72$, $d = .13$; 95% CI = -.84, .58, nor the for the Ambiguous cue, $F(1, 31) = 2.79$, $p = .11$, $d = .58$; 95% CI = -1.29, .13. However, although the Low IU group showed similar mood ratings for the two target cues ('?' and ' Δ '), $F = 2.09$, $p = .17$, $d = .29$; 95% CI = -.70, .13, the High IU group found the Ambiguous cue ('?') significantly more unpleasant than the Uncertain cue (' Δ '), $F(1, 15) = 14.31$, $p < .05$, $d = .92$; 95% CI = .40, 1.43.

Skin Conductance

Figure 6.4 shows the skin conductance data for the cues. Consistent with the previous experiment, skin conductance responding to the Certain Aversive cue ('X') was significantly greater than that to the Certain Safe cue ('O'), $F(1, 30) = 10.55$, $p < .05$, $d = .68$; 95% CI = .25, 1.11. There was a similar group trend for the Certain Aversive cue ('X') in the present experiment, where the High IU group showed a stronger skin

conductance response relative to the Low IU group. However, the interaction effect did not quite reach significance, $F(1, 30) = 3.74$, $p = .06$, $d = .81$; 95% CI = -1.67, .05. As in the previous experiment, there was no significant difference between skin conductance responding to the reference cues ('X' and 'O') averaged versus that to the target cues (' Δ ' and '?') averaged ($F < 1$).

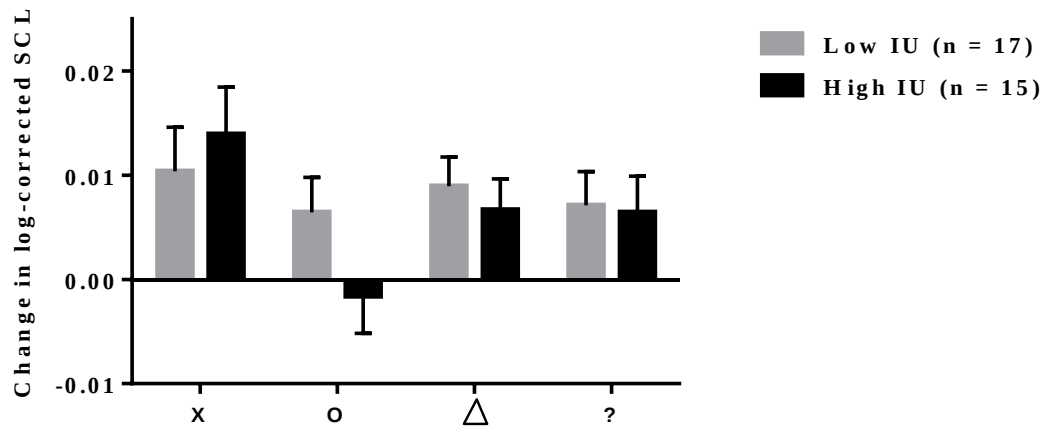


Figure 6.4. Mean change in log-corrected skin conductance level for each

Furthermore, there was no significant difference between skin conductance responding to the Ambiguous cue ('?') versus that to the Uncertain cue (' Δ '), $F(1, 30) = .22$, $p = .64$, $d = .08$; 95% CI = -.24, .39. None of the other Cue Type $\times$ IU Group interaction effects were significant (largest $F = .14$). A follow-up analysis revealed that contrary to Grupe and Nitschke (2011), skin conductance response to the Certain Aversive cue ('X') was not greater than the mean skin conductance response to the target cues, $t(1, 31) = 1.69$, $p = .10$, $d = .61$. However, mean skin conductance response to the target cues was significantly greater than that to the Certain Safe cue, $t(1, 31) = 2.43$, $p < .05$, $d = .87$,

providing partial support for the idea that a cue stimulus representing uncertainty about potential aversive outcomes can increase arousal response.

Correlations

A bivariate correlation analysis was conducted to examine the relationship between the outcome variables for the target cues (' Δ ' and '?'), including online expectancy ratings, post-experiment covariation estimates, post-experiment mood ratings, and skin conductance responses. Initial analysis revealed that the Uncertain (' Δ ') and Ambiguous ('?') cues shared similar patterns of correlations between the outcome variables. Therefore, as in the previous experiment, results were averaged across the target cues (' Δ ' and '?') in the subsequent correlation analyses. The correlation coefficients for the four variables are shown in Table 6.2.

Table 6.2

Pearson bivariate correlation coefficients for outcome (target cues) and self-report variables.

	Covariation Estimates	Mood Ratings	SCR	PSWQ	IUS-12	DASS Depression	DASS Anxiety	DASS Stress
Online Expectancy	.48**	.51**	.07	.17	.18	.16	.13	.15
Covariation estimates		.48**	-.20	.39*	.43*	.45**	.22	.39*
Mood Ratings			-.19	.15	.30	.07	-.04	.05
SCR				.09	-.03	-.02	-.21	-.04
PSWQ					.78**	.69**	.71**	.81**
IUS-12						.76**	.60**	.77**
DASS Depression							.66**	.78**
DASS Anxiety								.79**

* $p < .05$

** $p < .01$

Online expectancy ratings were significantly and positively correlated with post-experiment covariation estimates and mood ratings. Post-experiment covariation estimates were also significantly correlated moderately with post-experiment mood ratings. None of the correlations between skin conductance responses and the other three variables were significant. Follow-up analyses revealed that although the correlation between online expectancy and post-experiment covariation estimates was not significant for the Low IU group, $r = .39$, $p = .13$, online expectancy ratings correlated significantly with covariation estimates for the High IU group, $r = .62$, $p < .05$.

Discussion

In this chapter, the nature of threat appraisal and affective reaction in individuals with high levels of IU was further explored. This experiment replicated and extended the design of the preceding experiment by examining terminal online expectancy ratings. Post-experiment covariation estimates, affective and skin conductance responses to the cues were also examined.

In Experiment 3, expectancy ratings for the Ambiguous cue ('?') were significantly lower than those for the Uncertain ('△'). In this experiment, however, there was no difference in mean expectancy ratings between the target ('△' and '?') and reference ('X' and 'O') cues, nor was there any difference between the Uncertain ('△') and Ambiguous ('?') cues. This finding is at odds with previous findings that higher IU is associated with inflated threat appraisal of ambiguous information (Dugas, Buhr, et al., 2004; Koerner & Dugas, 2008). One possible explanation for the null group difference in expectancy ratings

for the target cues is that when making decisions about stimuli that signal uncertain aversive outcomes, high IU participants showed similar intellectual reasoning as Low IU participants. Although it is possible that High IU participants changed expectancy ratings during the 10-second cue presentation, they eventually reached the same final decision as the Low IU participants.

It is also worth to consider the role of process characteristics (e.g., response speed and required information) in high IU individuals' appraisal. Relative to non-anxious individuals, anxious individuals have been shown to take more time to make categorization decisions when the ambiguity of the category membership is increased (Metzger, Miller, Cohen, Sofka, & Borkovec, 1990). Within the IU literature, individuals who are high in IU have reported requiring more information (and consequently a longer decision time) before feeling adequately confident to make a decision (Carleton, Sharpe, et al., 2007; Ladouceur et al., 1997). It is perhaps not surprising that there appears to be a considerable association between IU and indecisiveness (Rassin & Muris, 2005). When facing uncertain or ambiguous situations, process characteristics such as response latency may better distinguish high IU individuals from those with low IU levels than expectancy ratings. The present experiment had intended to record expectancy ratings at each one-second interval. However, due to a programming error, these data were not obtained in the final dataset. Future research could directly examine response latencies across trial types as a way to provide further insight into the process characteristics of decision making in high IU individuals.

Another possible interpretation for the correct online expectancy ratings in the present experiment is that the aversive pictures were not perceived as being particularly unpleasant by the present cohort of participants, following anecdotal report by some participants during post-experiment debriefings. The role of “affective match” between warning cues and subsequent aversive outcomes in cognitive bias (Tomarken, Sutton, & Mineka, 1995) was also raised by Grupe and Nitschke (2011), who found that their participants’ average valence ratings of aversive pictures were a full point less unpleasant than the valence ratings reported in Sarinopoulos et al. (2010) on a nine-point scale. Although the aversive pictures selected for the present experiment and Experiment 3 were based on the published norms for mean arousal and valence ratings (Lang et al., 2008), it is possible that these pictures elicited an overall milder affective response in the present cohort of participants relative to the norms. From this perspective, the normative expectancy ratings reported by the High IU group may have reflected non-affectively based cognitive reasoning.

Consistent with the results of the previous experiment, mean covariation estimates for the target cues were significantly greater than those for the reference cues, suggesting an overall covariation bias for the target cues. Unlike in Experiment 3 where the interaction effect between comparison of the target cues with the reference cues and IU group did not reach significance, high IU participants in the present study showed a significantly greater covariation bias for the target cues than low IU participants. This interaction was driven by the considerably higher covariation estimates for the Ambiguous cue by high IU participants. Furthermore, the group difference was only observed for the

Ambiguous cue, not the Uncertain cue. Covariation bias has been thought of as a continuation of expectancy bias (Tomarken et al., 1995). Given the lack of evidence of expectancy bias in the present experiment, bias in covariation estimates immediately following the last experimental trial would not have been expected. Yet, a significant covariation bias was observed for the Ambiguous cue, but not the Uncertain cue. What else could have been driving this covariation bias? One possibility that has been discussed in the literature is that covariation bias could be a memory-based effect.

Although the cognitive bias literature has generally provided consistent support for attentional bias favouring threatening information across anxiety disorders (Butler & Matthews, 1987), evidence for enhanced explicit/implicit memory bias has been less compelling (Coles & Heimberg, 2002). Inconsistent findings on memory bias across GAD studies have mostly been attributed to methodological inconsistencies (i.e., variance in the nature of the tasks) and the role of physiological arousal in influencing recall (Becker, Roth, Andrich, & Margraf, 1999). Nonetheless, some studies have demonstrated that prolonged, rather than brief exposure, to stimuli during encoding may elicit a subsequent recall bias for threatening information in patients with GAD (e.g., Friedman, Thayer, & Borkovec, 2000). Within the IU literature, preliminary data have highlighted the association of IU with enhanced recall of uncertain words (e.g., Dugas, Hedayati, et al., 2005), suggesting that the use of stimuli denoting uncertainty may allow for a better understanding of the memory bias involved in IU and worry/GAD. In the previous experiment, no group difference was observed for either target cue. However, high IU participants from the present experiment showed significant covariation bias for the

Ambiguous cue compared to low IU participants. Given that this between-group simple effect was not observed for the Uncertain cue, the possibility that memory bias in IU may be more likely to emerge under the condition of ambiguity relative to uncertainty should not be ruled out.

The overall similarity in the pattern of means for mood ratings in the present experiment replicated the data pattern in Experiment 3. Although the interaction effect between IU group and the comparison between the two target cues (Ambiguous and Uncertain) did not reach significance, high IU participants rated the Ambiguous cue as significantly more unpleasant relative to the Uncertain cue. This within-subject simple effect was not observed in low IU participants. Taken together, the overall similarity in the pattern of means for mood ratings across both experiments consistently suggests that high IU individuals find ambiguity more aversive than low IU individuals.

In view of the finding that affective responses to the Ambiguous cue were significantly more negative than that to the Uncertain cue, another possible interpretation for the covariation bias observed in the present experiment is that the negative affect bestowed upon the Ambiguous cue during the online measure may have persisted following the completion of the experiment. Previously, the role of affective response has been implicated in the development of covariation bias (Tomarken et al., 1995). That is, the more aversive the outcome in the stimuli-outcome pairing, the greater the tendency to overestimate the outcome's covariation with the fear-relevant stimuli. It has also been suggested that reaction to fear-relevant stimuli can play a role in mediating judgment about the pairing contingency (Amin & Lovibond, 1997). As in Experiment 3, participants in the

present experiment were able to use the pre-experimental instructions to calibrate their threat appraisal on the 50% probability trials signaled by the Uncertain cue. On the other hand, no information was available regarding aversive outcome probability on the Ambiguous cue trials. Under this condition, participants may have experienced a stronger negative affect in response to a cue denoting unknown outcome possibilities and probabilities. This negative affective response could have played a role in influencing the participants' retrospective recall of the association between the Ambiguous cue and aversive outcomes, despite the absence of online expectancy bias. Alternatively, the pairings of the aversive cue with aversive pictures may have been better encoded in memory.

In line with the physiological measure results in Experiment 3, skin conductance did not appear to be sensitive to any differences between the target and reference cues, nor to the difference between the Ambiguous and Uncertain cues. Although participants clearly demonstrated differential skin conductance responding to the two reference cues, both IU groups showed similar skin conductance responding to the two target cues. In Experiment 3, participants' skin conductance response correlated significantly with post-experiment covariation estimates and affective response. In the present experiment, however, skin conductance response did not correlate with any of the self-report measures. Nonetheless, this finding is not necessarily indicative of a strong dissociation between the physiological and self-report measures. As highlighted in Experiment 3, skin conductance is known to show high individual variability (Borkovec, 1985; Borkovec & Hu, 1990). Given the sample size in this experiment was relatively smaller than that in the preceding experiment,

the skin conductance measure might not have been sensitive enough to detect any difference between the Ambiguous and Uncertain cues.

The moderate and positive correlations between the online expectancy, post-experiment covariation estimates, and affective measures in this experiment replicated the correlational results in Experiment 3, supporting the idea that IU is associated with both threat appraisal and negative affect in response to cues that signal possible negative outcomes. In particular, the pattern of post-experiment self-report data confirmed the tendency observed in the present experiment for high IU participants to respond more strongly to the Ambiguous cue compared to low IU individuals, suggesting that ambiguity may be a more potent trigger stimulus for high IU individuals and clinical patients.

Some of the limitations of this experiment have been discussed in Experiment 3. In addition, the absence of expectancy bias observed in this experiment may be in part due to the aversive pictures not being perceived as particularly unpleasant. Future studies could therefore use more potent aversive stimuli to examine the relationship between perceived stimuli aversiveness and cognitive appraisal.

Previously, Dugas, Buhr, et al. (2004) observed that some GAD patients preferred a problem to have a known negative outcome than an uncertain one. Findings from the present experiment suggest that individuals who are intolerant of uncertainty might be more prone to unconstrained threat appraisal when they are facing situations for which no information is available regarding the probability of aversive outcomes. It would be premature to draw conclusions about individuals with GAD, who have demonstrated high levels of IU, based on the results from the present experiment. As suggested in Experiment

3, it would be useful for future studies to replicate the current findings using a clinical sample.

In summary, this chapter further investigated the dual characteristic of IU, threat appraisal bias and heightened negative affect, in response to uncertainty/ambiguity. Although interpretations of present findings are limited by relatively small sample sizes, the pattern of retrospective covariation estimates and affective responses to the target cues (Uncertain and Ambiguous cues) is consistent with findings from Experiment 3 that ambiguity appears to be a more potent precipitant for threat appraisal bias. Results from this experiment provided further evidence that high IU individuals show both biased threat appraisal and enhanced affective responses in situations where a potential threat may or may not occur. Furthermore, the greatest differences between high and low IU individuals were observed under conditions of ambiguity, rather than uncertainty. Results from both Experiments 3 and 4 suggest that high IU patients may benefit from explicitly quantifying threat probability in novel situations where there is an ambiguous threat of an aversive consequence, as well as targeting retrospective evaluation of their prior negative experiences. In consideration of the current results, a follow-up question is whether similar effects would be observed in individuals with GAD. This question will be addressed in the next chapter.

CHAPTER 7

Threat Appraisal under Ambiguity in GAD

(Experiment 5)

Experiment 3 and 4 examined threat appraisal under ambiguity in undergraduates with high levels of IU. In this chapter, the same experimental design used in the preceding experiment was extended to a sample of treatment-seeking GAD patients.

The pattern of expectancy ratings, covariation estimates, and affective responses from the previous two experiments suggests that relative to low IU individuals, individuals who are intolerant of uncertainty respond more strongly to ambiguity. Considering existing evidence demonstrating the robust association of IU with pathological worry in GAD (Dugas et al., 1997; Dugas, Gagnon, et al., 1998; Dugas et al., 1996; Dugas, Schwartz, et al., 2004; Ruggiero et al., 2012; van der Heiden et al., 2010), individuals with GAD would be expected to show similar patterns of cognitive biases as high IU individuals in response to ambiguity.

As discussed in Chapter 4, there is strong evidence supporting the hypothesis that GAD individuals have a tendency to make threat-consistent appraisals and interpretations of ambiguous information (MacLeod & Rutherford, 2004). One way to understand the processes involved in appraisal bias amongst worriers is to examine subjective judgement of outcome probability. In such studies, participants are asked to rate the probability of self-referential worries (Berenbaum, Thompson, & Pomerantz, 2007) or hypothetical

negative scenarios (e.g., "Your health deteriorating"; Berenbaum, Thompson, & Bredemeier, 2007). Support for biased probability judgement in GAD has been provided by studies that observed an association of worry severity with overestimation of undesirable outcomes occurring (Berenbaum, Thompson, & Bredemeier, 2007; Berenbaum, Thompson, & Pomerantz, 2007; MacLeod et al., 1991). Indeed, overestimation of threat is one of the key cognitive processing errors that has been identified across anxiety disorders, such as social anxiety disorder, (Foa, Franklin, Perry, & Herbert, 1996; Lucock & Salkovskis, 1988), panic disorder (Clark, 1986), agoraphobia (McNally & Foa, 1987), OCD (Clark, 2004, p. 112), and PTSD (Ehlers & Clark, 2000). Interestingly, although conditioning paradigms can be used to assess information processing biases in clinical contexts, few studies have explored this avenue in the case of GAD. In particular, there is little data from the GAD or IU literature that directly speak to probability estimates of threatening outcomes in ambiguous situations.

Everyday situations are often intrinsically ambiguous. In order to optimally respond, decision-making processes are at least in part guided by an individual's judgement of contingencies between events, their own/others' actions, and resulting outcomes (Volz, Schubotz, & von Cramon, 2003). Given that GAD worriers typically hold negative expectations about the future (Beck & Clark, 1997; MacLeod et al., 1991; Roemer et al., 1997; Stöber, 2000), conditioning paradigms provide a valuable opportunity to investigate how threat-related associations are learned, as well as evaluating the factors that modulate worriers' probabilistic judgement in response to uncertain situations.

In Experiments 1 and 2, hypothetical ambiguous scenarios were used to investigate estimation of threats in high IU individuals and clinical GAD participants. One limitation with such design is that levels of ambiguity are not controlled, such that some scenarios might be perceived as more ambiguous than others. This limitation might have at least partially contributed to the high individual variance in ratings of concerns and the other dependent measures. A more empirically established paradigm, such as the one used for studying covariation bias (Tomarken et al., 1989), is useful for designing experimental manipulations that control for levels of ambiguity. Using a modified covariation bias paradigm, as in Experiments 3 and 4, a cue that explicitly signals 50% of occurrence of aversive outcomes allows for testing hypotheses regarding appraisal biases in GAD.

In Experiment 3, although high and low IU participants showed similar negative affective ratings to the cue signalling uncertainty, high IU participants found the Ambiguous cue significantly more unpleasant than low IU participants. However, skin conductance recording did not appear to be sensitive to this difference. This finding is in line with some of the physiological research demonstrating that GAD individuals often fail to show expected changes in physiological arousal in response to laboratory stressors, despite reporting significant subjective arousal (Fisher, Granger, & Newman, 2010; Hoehn-Saric, McLeod, Funderburk, & Kowalski, 2004; Hoehn-Saric et al., 1989). Given that participants showed similar skin conductance responses to both the Uncertainty and Ambiguous cues across both Experiments 3 and 4, any differential physiological reactivity to ambiguity between high and low IU individuals would have possibly required a more sensitive measure than the skin conductance response. As such, the present experiment did

not include skin conductance response as one of the dependent measures. This also made it possible to conduct the study in a clinical rather than a laboratory environment.

Method

The Method for the present study was the same as reported in Experiment 3, except as detailed below.

Participants

Prospective clinical participants were recruited from a group of adults seeking treatment at the Westmead Hospital Anxiety Treatment and Research Unit, a specialist anxiety disorders treatment outpatient service in Sydney. Individuals were either self-referred or referred by general practitioners or psychiatrists. At the initial assessment, diagnosis of GAD was established using the Anxiety and Related Disorders Interview Schedule for DSM-5 Adult Version (ADIS-5; Brown & Barlow, 2014). All clinical participants were tested prior to active treatment interventions.

A recruitment advertisement was posted on an online classifieds to recruit participants from the community to serve as controls. Individuals who volunteered for the study were administered the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) over the phone or via email to determine eligibility. A total PSWQ score greater than or equal to 62 is indicative of a clinical level of excessive and uncontrollable worry (Behar et al., 2003). As such, individuals whose total PSWQ scores were less than 62 were

considered as non-clinical and were invited to participate in the main study. Participants were reimbursed for their travel expenses.

The final sample comprised 34 GAD participants ($M_{\text{age}} = 38.79$ years, $SD = 14.17$, range = 20-70 years) and 34 control participants ($M_{\text{age}} = 31.47$ years, $SD = 10.45$, range = 18-57 years). Data for both participant samples were reasonably well matched on age and gender ratio (see Table 7.1). However, overall education level was considerably higher for the control sample compared to the clinical GAD group. 6% ($n = 2$) of clinical participants left school before completing Year 10 and 9% ($n = 3$) completed School Certificates only.

Table 7.1
Demographic description of participants.

		Control ($n = 34$)		GAD ($n = 34$)	
		n	%	n	%
Sex	Male	18	53	18	53
	Female	16	47	16	47
Marital Status	Married/De Facto	10	29	15	44
	Never Married	23	68	15	44
	Separated/Divorced	1	3	4	12
Education	High School	7	21	2	6
	Trade Certificate/Apprenticeship	2	6	3	9
	Technician/Advanced Certificate	2	6	2	6
	Diploma	2	6	12	35
	Undergraduate/Postgraduate	21	62	10	29

Materials and Measures

The picture stimuli in the current study were presented on a 30-cm laptop monitor approximately 100 cm in front of the participant using LiveCode software. During each trial, participants used their right hand to click on one of the 10 radio buttons on the screen so as to indicate their expectancy rating of aversive pictures occurring at the end of the cue. The radio buttons represented a continuous scale from 0 (*Expect Neutral*) to 100% (*Expect Aversive*), with 50% (*Uncertain*) at the centre.

Self-report measures. In addition to the post-experimental covariation estimate and mood rating questionnaires, participants also completed a battery of self-report questionnaires that included the 12-item Intolerance of Uncertainty Scale (IUS-12; Carleton, Norton, et al., 2007), the PSWQ (Meyer et al., 1990), the 21-item Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995), the Cognitive Avoidance Questionnaire (CAQ; Gosselin et al., 2002), and the Negative Problem Orientation Questionnaire (NPOQ; Gosselin et al., 2001; English translation, Robichaud & Dugas, 2005a, 2005b). The psychometric properties of these scales were described in Experiment 1.

Cronbach's alpha for the present sample was .93 for the IUS-12 and .96 for the PSWQ. For the DASS-21, Cronbach's alpha was .91 for the depression subscale; .88 for the anxiety subscale; and .90 for the stress subscale. For the CAQ, Cronbach's alpha was .74 for the Thought Substitution subscale, .84 for the Transformation of Images into Thoughts subscale, .87 for the Distraction subscale, .91 for the Avoidance of Threatening Stimuli subscale, and .86 for the Thought Suppression subscale.

Scoring and Analysis

This experiment followed the same scoring and analysis approaches as described in Experiment 4. In particular, expectancy ratings in the present study were recorded in the final second of the 10-s cue presentation during each trial.

Results

Preliminary contrast analyses revealed no interpretable main or interaction effects for linear trend over trials averaged across the four cues (largest $F = 3.94$). Accordingly, all the data and analyses referred to hereafter were based on ratings averaged over trials.

The means and standard deviations for control and GAD participants on the self-report measures are presented in Table 7.2. As expected, the mean PSWQ total score was significantly higher for the GAD group than for the control group, $t(66) = 9.83$, $p < .05$. GAD participants also scored higher than controls on the IUS-12, $t(66) = 5.94$, $p < .05$; DASS-Depression, $t(66) = 5.67$, $p < .05$; DASS-Anxiety, $t(66) = 5.63$, $p < .05$; and DASS-Stress, $t(66) = 6.23$, $p < .05$. There was no significant difference in any of the self-report measures between men and women (largest $t = 1.31$).

Table 7.2

Means (M) and standard deviations (SD) for all self-report variables for the Control and GAD groups.

	Control (n = 34)		GAD (n = 34)		<i>t</i> (66)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
IUS-12	31.38	9.9	45.06	9.08	5.94*
PSWQ	43.65	12.77	68.56	7.44	9.83*
DASS Depression	7.65	8.11	20.35	10.24	5.67*
DASS Anxiety	6.06	5.86	18.47	11.43	5.63*
DASS Stress	10.24	6.94	23.47	10.26	6.23*
CAQ Thought Substitution	10.29	3.34	13.09	4.63	2.85*
CAQ Transformation	10.47	4.39	12.97	4.78	2.25*
CAQ Distraction	12.82	3.99	17.15	5.23	3.83*
CAQ Avoidance	13.53	5.58	16.15	5.86	1.89
CAQ Suppression	14.29	4.35	18.24	5.00	3.47*
CAQ Total	61.41	18.33	77.59	21.45	3.34*
NPOQ Total	25.74	9.61	43.09	9.31	7.56*

* $p < .05$

Online Expectancy Ratings

Figure 7.1 shows the mean expectancy ratings during the presentation of the four cue types, averaged over trials. Error bars depict 95% confidence intervals around the mean. As expected, participants showed high levels of expectancy that the Certain Aversive cue ('X') would be followed by aversive pictures, and low levels of expectancy that the Certain Safe cue ('O') would be followed by aversive pictures, with a highly significant difference between these two reference cues, $F(1, 66) = 2481.04$, $p < .05$, $d = 8.99$; 95% CI = 8.63, 9.35.

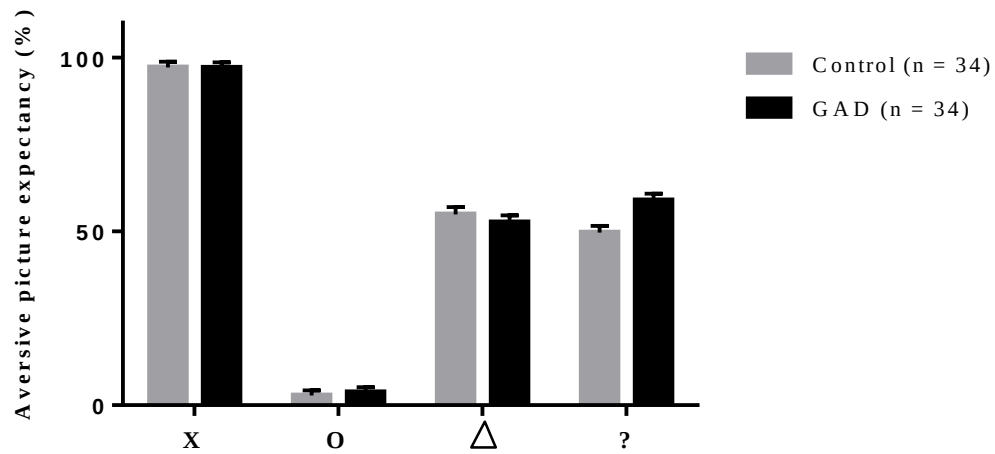


Figure 7.1. Mean aversive picture expectancy ratings for each cue.

For the target cues, a pattern of expectancy bias emerged from three sets of results. Firstly, average expectancy ratings for the two target cues (‘ Δ ’ and ‘?’) were somewhat significantly greater than the reference point provided by the average of the maximum (‘X’) and the minimum (‘O’) ratings, $F(1, 66) = 12.95$, $p < .05$, $d = .37$; 95% CI = .16, .57. Secondly, consistent with findings from Grupe & Nitschke (2011), follow-up t test results in the current study showed that expectancy ratings for aversive pictures following the Uncertain cue (‘ Δ ’), $M = 53.72$, $SD = 11.89$, were greater than the true 50% probability, $t(67) = 2.59$, $p < .05$, $d = .44$. Expectancy ratings for the Ambiguous cue (‘?’), $M = 54.27$, $SD = 11.29$, were also significantly greater than 50%, $t(67) = 2.90$, $p < .05$, $d = .50$, suggesting an expectancy bias. Thirdly, there was a significant interaction between Group and the comparison between expectancy ratings for the two target cues (‘?’ and ‘ Δ ’), $F(1, 66) = 15.05$, $p < .05$, $d = 1.11$; 95% CI = .54, 1.68. Follow-up analyses revealed that this interaction was driven by high expectancy ratings for the Ambiguous cue (‘?’) as endorsed by GAD participants. Although there was no group difference for the Uncertain cue (‘ Δ ’),

$F(1, 66) = .67, p = .42; d = .20; 95\% \text{ CI} = -.29, .68$, GAD participants demonstrated significantly greater expectancy ratings for the Ambiguous cue ('?') relative to control participants, $F(1, 66) = 11.29, p < .05; d = .82; 95\% \text{ CI} = .33, 1.3$. However, the comparison between the two target cues averaged over groups did not reach significance, $F(1, 66) = .14, p = .72, d = .06; 95\% \text{ CI} = -.34, .23$. None of the other Cue Type $\times$ Group interaction effects were significant (largest $F = 2.02$).

Post-Experiment Covariation Estimates

Mean post-experiment covariation estimates of the relationship between the cues and aversive pictures are shown in Figure 7.2. Overall, participants reliably estimated the degree of covariation between the Certain Aversive cue ('X') and aversive pictures, $M = 98.09, SD = 8.71$, and that between the Certain Safe cue ('O') and aversive pictures, $M = 1.54, SD = 5.96; F(1, 66) = 3730.80, p < .05, d = 9.52; 95\% \text{ CI} = 9.21, 9.83$. Consistent with the pattern of the expectancy data, average covariation estimates for the target cues (' $\triangle$ ' and '?') were significantly greater than the reference cues ('X' and 'O') averaged, $F(1, 66) = 26.11, p < .05, d = .59; 95\% \text{ CI} = .36, .83$, suggesting an overall covariation bias for the target cues. This conclusion was also supported by the results of follow-up single t tests against a fixed value of 50%, as conducted by Grupe and Nitschke (2011). Participants' overall post-experiment estimates for the Uncertain cue (' $\triangle$ '), $M = 52.21, SD = 8.95$, were significantly greater than 50%, $t(67) = 2.03, p = .046, d = .35$, as were covariation estimates for the Ambiguous cue ('?'), $M = 59.49, SD = 14.92; t(67) = 5.24, p < .05, d = .91$.

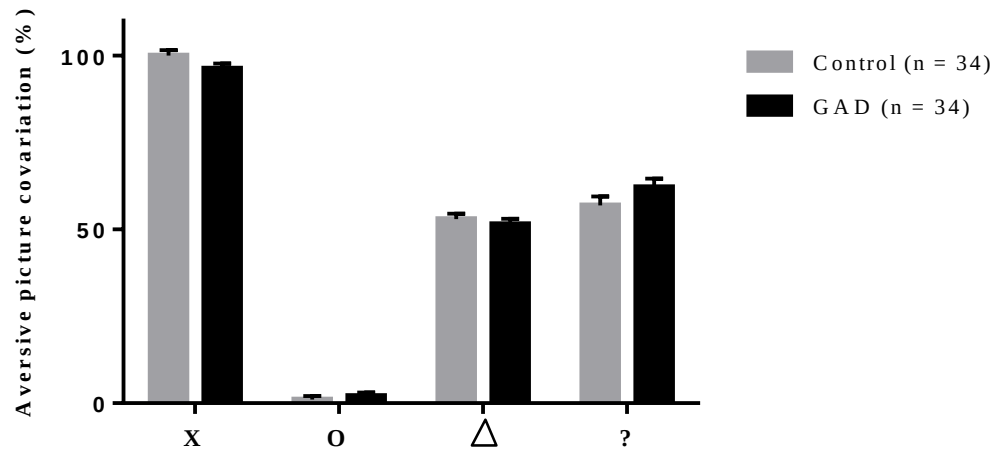


Figure 7.2. Mean post-experiment cue-aversion covariation estimates for each cue.

Averaged over groups, participants showed a covariation bias towards the Ambiguous cue ('?') more so than the Uncertain cue ('Δ'), $F(1, 66) = 13.69$, $p < .05$, $d = .72$; 95% CI = .33, 1.11. Follow-up analyses revealed that GAD participants reported significantly greater threat covariation estimates for the Ambiguous cue ('?'), $M = 62.06$, $SD = 14.73$, relative to the Uncertain cue ('Δ'), $M = 56.91$, $SD = 14.87$; $F(1, 33) = 15.36$, $p < .05$, $d = .88$; 95% CI = .42, 1.34. Control participants, however, did not show this within-subject simple difference ($F = 1.93$), suggesting preliminary evidence for a stronger covariation bias amongst GAD participants towards ambiguity relative to uncertainty. However, the interaction between Group and the comparison between the two target cues did not reach significance, $F(1, 66) = 2.83$, $p = .10$, $d = .72$; 95% CI = -.12, 1.43. None of the other Cue Type $\times$ Group interaction effects were significant (largest $F = 2.36$).

Post-Experiment Mood Ratings

Mean mood rating data for each cue are shown in Figure 7.3. Overall, GAD participants rated all four cues as significantly more unpleasant relative to control participants, $F(1, 66) = 8.37, p < .05, d = .42$; 95% CI = .13, .70.

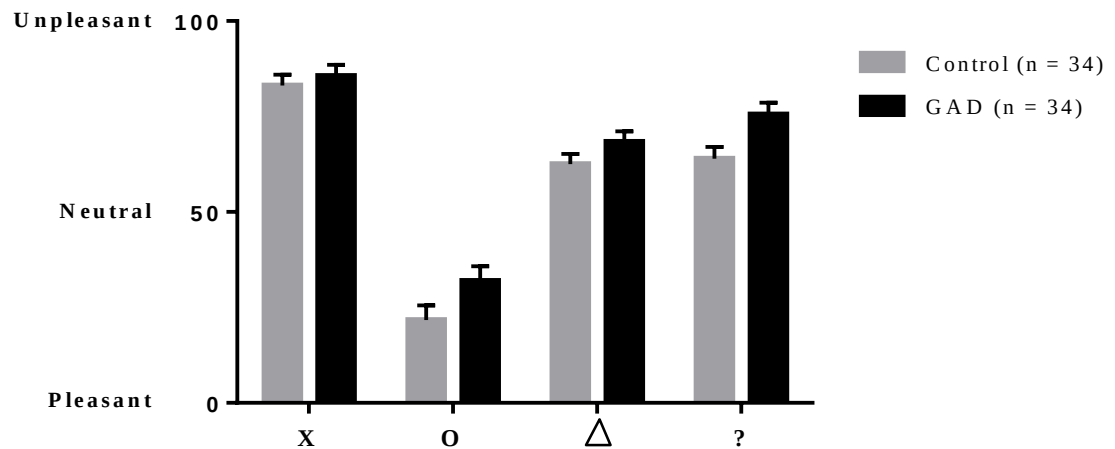


Figure 7.3. Mean post-experiment mood ratings for each cue

Averaged across participant groups, the Certain Aversive cue ('X') was rated as most unpleasant, $M = 84.38, SD = 16.57$, and the Certain Safe cue ('O') least unpleasant, $M = 26.84, SD = 22.24$. Congruent with the pattern of expectancy and covariation data, average mood ratings for the two target cues ('Δ' and '?') were significantly more unpleasant than the two reference cues ('X' and 'O') averaged, $F(1, 66) = 44.86, p < .05, d = .66$; 95% CI = .46, .85. Furthermore, mood ratings for the Ambiguous cue ('?') were significantly more unpleasant than ratings for the Uncertain cue ('Δ'), $F(1, 66) = 5.49, p < .05, d = .24$; 95% CI = .04, .44, suggesting an enhanced negative affect for the Ambiguous cue relative to the Uncertain cue. Follow-up analyses confirmed that the GAD

group rated the Ambiguous cue ('?') as significantly more unpleasant relative to the Uncertain cue ('△'), $F(1, 33) = 7.37, p < .05, d = .37$; 95% CI = .09, .64. Interestingly, this within-subject simple effect was not observed for controls ($F = .33$). However, the interaction between Group and the comparison of Uncertain ('△') vs. Ambiguous ('?') cues did not reach significance, $F(1, 66) = 2.39, p = .13, d = .40$; 95% CI = -.09, .71. None of the other Cue Type X Group interaction effects were significant (largest $F = 2.39$).

Correlations between Outcome Variables and Self-Report Measures

A bivariate correlation analysis was conducted to examine the relationship between the three outcome variables for the target cues ('△' and '?'), including online expectancy ratings, post-experiment covariation estimates, and post-experiment mood ratings across all participants. Initial analysis revealed that the Uncertain ('△') and Ambiguous ('?') cues shared similar patterns of correlations between the outcome variables. Therefore, results were averaged across the target cues ('△' and '?') in the subsequent correlation analyses. Scores for the IUS-12, PSWQ, CAQ, NPOQ, and the DASS-21 were also entered into the final correlation analysis. Correlation coefficients for outcome variables and self-report measures are shown in Table 7.3.

Overall, all the dependent measures were positively correlated. The correlation between expectancy ratings and post-experiment covariation estimates were positive and significant, $r = .35, p < .01$, as was the correlation between expectancy ratings and mood ratings, $r = .27, p < .05$, suggesting an association between the three outcome variables.

Table 7.3

Pearson bivariate correlation coefficients for outcome and self-report variables.

	Covariation Estimates	Mood Ratings	PSWQ	IUS-12	CAQ	NPOQ	DASS Dep	DASS Anx	DASS Stress
Online Expectancy	.35**	.27*	.34**	.27*	.31**	.28*	.28*	.24	.31*
Covariation Estimates		.23	.04	-.06	.19	-.02	.18	.10	.16
Mood Ratings			.40**	.19	.03	.22	.00	.16	.05
PSWQ				.77**	.45**	.75**	.54**	.65**	.63**
IUS-12					.32**	.70**	.50**	.52**	.56**
CAQ						.52**	.47**	.48**	.52**
NPOQ							.62**	.61**	.67**
DASS Dep								.59**	.71**
DASS Anx									.80**

Note. PSWQ = Penn State Worry Questionnaire; IUS-12 = Intolerance of Uncertainty Scale total score; CAQ = Cognitive Avoidance Questionnaire total score; NPOQ = Negative Problem Orientation Questionnaire total score; DASS Dep = Depression Anxiety Stress Scales Depression subscale; DASS Anx = Depression Anxiety Stress Scales Anxiety subscale; DASS Stress = Depression Anxiety Stress Scales Stress subscale.

** $p < .01$

* $p < .05$

The correlation between these covariation estimates and mood ratings did not quite reach significance ($p = .06$). It is worth noting that of the three outcome variables, the expectancy measure was correlated with virtually all of the self-report measures. This, however, was not the case for the covariation and mood measures.

Although the target cues were combined for the primary correlation analyses shown in Table 7.3, follow-up analyses showed that for the Uncertain cue (' Δ '), there was no significant association between the IUS and any of the outcome measures (expectancy ratings, post-experiment covariation estimates, and post-experiment mood ratings). For the Ambiguous cue ('?'), however, higher IUS scores were significantly associated with online expectancy ratings, $r = .40$, $p < .01$.

All the self-report variables were highly inter-correlated. In particular, the IUS-12 was correlated significantly and positively with all the other self-report measures, including the PSWQ, CAQ and NPOQ.

The Role of Intolerance of Uncertainty in Threat Appraisal Bias and Negative Affect

In view of the high correlation between the IUS-12 and PSWQ scores in this experiment, along with the close association between IU and GAD reported in the literature, one question of interest concerns the role of IU in threat appraisal bias and negative affect in response to ambiguity. As noted earlier, GAD participants in the current experiment showed high levels of IU. This pattern was also seen when participants were classified as either high ($n = 36$) or low ($n = 32$) on IU using a cut-off score of 40 on the IUS-12. This cut-off score was chosen based on the mean IUS-12 score of 40.38 reported

by a sample of clinical GAD individuals in a study by Carleton et al. (2012). As shown in Table 7.4, 79% ($n = 27$) of the GAD participants were identified as having high levels of IU, whereas 74% ($n = 25$) of controls were identified as having low IU levels. There was a significant difference in the proportion of high and low IU individuals in both participants groups ($\chi^2(1) = 19.13, p < .05$).

Table 7.4

Crosstab analysis for the number of High and Low IU individuals in each of the two participant groups.

	Low IU	High IU	Total
Control	25	9	34
GAD	7	27	34
Total	32	36	

To further investigate the relationship between IU and GAD, contrast analyses and follow-up simple t tests described earlier in the Results section were repeated using participant classification based on IU levels. Results from this analysis of high and low IU participants shared a similar pattern to the analysis of participants classified by clinical status (i.e., GAD vs. Control). In particular, consistent with the expectancy data based on clinical status, there was a significant interaction between IU groups and the comparison between the Ambiguous ('?') and the Uncertain cues (' Δ ') for expectancy ratings. That is, the High IU group showed significantly greater differential expectancy ratings between the two target cues (a bias towards the Ambiguous cue) relative to the Low IU group, $F(1, 66) = 11.84, p < .05, d = 1.00$; 95% CI = .42, 1.58.

Furthermore, much like the covariation estimate data based on clinical status, results from follow-up analyses showed that High IU participants reported significantly greater threat covariation estimates for the Ambiguous cue ('?'), $M = 60.28$, $SD = 15.02$, relative to the Uncertain cue (' Δ '), $M = 50.56$, $SD = 8.26$; $F(1, 35) = 14.35$, $p < .05$, $d = .80$; 95% CI = .37, 1.23. Low IU participants, on the other hand, did not show this within-subject simple difference ($F = 2.17$). However, the interaction between Group and the comparison between the two target cues did not reach significance, $F(1, 66) = 1.71$, $p = .20$, $d = .51$; 95% CI = -.27, 1.29.

Finally, the High IU group rated the Ambiguous cue ('?') as significantly more unpleasant relative to the Uncertain cue (' Δ '), $F(1, 35) = 6.60$, $p < .05$, $d = .38$; 95% CI = .08, .67. Consistent with the mood rating data where this within-subject simple effect was not significant for controls, Low IU participants did not show significant differential mood ratings for the two target cues either ($F = .31$). However, the interaction between Group and the comparison of Uncertain (' Δ ') with Ambiguous ('?') cues also did not reach significance, $F(1, 66) = 2.28$, $p = .14$, $d = .30$; 95% CI = -.10, .70.

Mediation Analyses

In view of the similarity in data pattern between the two sets of analyses (one based on participant clinical status, the other based on participant IU levels), along with the hypothesised role of IU as a vulnerability factor in the development of GAD (Dugas, Buhr, et al., 2004), one possibility is that IU predicted threat appraisal bias in the current study, with GAD status as a mediating factor.

According to Baron and Kenny (1986), a number of conditions must be met for a variable to be considered as a mediator. Firstly, variations in levels of an independent variable significantly account for variations in the mediator. Secondly, the mediator needs to be a significant predictor of variations in the dependent variable. Finally, when the mediator is entered into the equation, a previously significant relationship between the independent and dependent variables is no longer significant.

To examine the extent to which IU accounted for threat appraisal biases and negative affect, a test of mediation was carried out following the conditions outlined by Baron and Kenny (1986). In view of the results from primary contrasts analyses, nine possible dependent variables were considered for the full mediation analysis. These include averaged ratings across the two target cues for each of the three target measures (expectancy, covariation, and affect), differences between the two target cues for the three target measure, and expectancy ratings, covariation estimates, and mood ratings for the Ambiguous cue.

Results from simultaneous multiple linear regression analyses showed that GAD status as a binary independent variable (0 = control; 1 = GAD) predicted differential expectancy ratings between the two target cues ('△' and '?'; $\beta = .43, p < .05$), mood ratings for the Ambiguous cue ('?'; $\beta = .32, p < .05$), and mood ratings averaged across the two target cues ($\beta = .28, p < .05$). GAD status did not predict any other outcome variables.

In Step 1 of the full mediation analysis, mean IU level was entered as the independent variable and differential expectancy ratings as the dependent variable. In two other separate models, mean IU level was entered as the independent variable. Dependent

variables were mood ratings for the Ambiguous cue and mood ratings averaged across the two target cues.

Results showed that IU did not predict mood ratings for the Ambiguous cue (“?”) or mood ratings averaged across the two target cues, thus failing to meet the criteria outlined by Baron and Kenny (1986). Further analyses were therefore not carried out for these two dependent variables. Step 2 examined the extent to which variations in IU levels predicted GAD status. Step 3 examined the extent to which GAD status accounted for variations in differential expectancy ratings. Finally, in Step 4, both IU levels and GAD status were entered as the independent variables, with differential expectancy ratings as the dependent variable. Results showed that IU was a significant predictor of differential expectancy ratings directly and independently of GAD (path *c* in Figure 7.4).

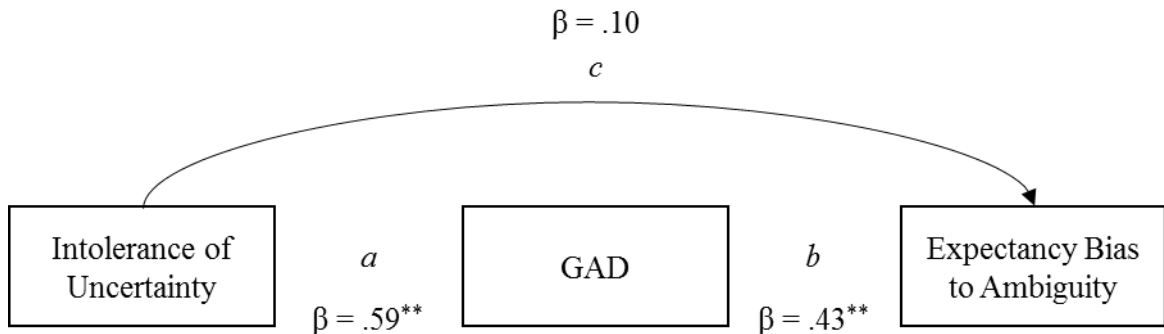


Figure 7.4. Mediation analysis suggests that Intolerance of Uncertainty is associated with biased appraisal of ambiguous threat (difference in expectancy ratings to the ambiguous and uncertain cues) indirectly via GAD status.

^{**} $p < .01$.

As expected, IU was a significant predictor of GAD status (path *a*). GAD status was also a significant predictor of differential expectancy ratings between the Uncertain and Ambiguous cues (path *b*). When both GAD status and IU were entered as independent

variables, IU was no longer a significant predictor ($\beta = .10, p = .49$), whereas GAD remained a significant predictor ($\beta = .38, p < .01$). Taken together, these results indicate that GAD status substantially mediated the relationship between IU levels and differential expectancy ratings for the target cues.

Discussion

One aim of Experiment 5 was to extend the experimental design used for Experiments 3 and 4 to investigate threat appraisal and affective responses to ambiguity in clinical GAD individuals who are said to be highly intolerant of uncertainty (Dugas, Gagnon, et al., 1998). In particular, this experiment provided an opportunity to directly examine the way in which clinical GAD individuals calibrate the probability of threatening outcomes in ambiguous situations. Following results from the previous two experiments, it was predicted that individuals with clinical GAD would demonstrate enhanced expectancy and covariation biases, as well as negative affect, in response to cues denoting ambiguous information about subsequent occurrence of aversive outcomes.

Overall, all three dependent measures in the present study (expectancy ratings, covariation estimates and negative affect) shared a similar pattern. In particular, the key statistically significant finding is that GAD participants demonstrated expectancy bias towards the Ambiguous cue relative to controls. When surprised with a cue for which no information was available regarding the likelihood of aversive pictures occurring, GAD participants overestimated the likelihood that this Ambiguous cue would be followed by

aversive pictures, relative to the Uncertain cue. This finding is consistent with previous studies which have demonstrated an interpretive bias in anxious individuals under an ambiguous threat (e.g., Chan & Lovibond, 1996). An extensive body of information processing bias studies has generally shown that anxious individuals are biased towards threatening interpretations of ambiguous stimuli compared to non-anxious individuals (Butler & Mathews, 1983; Butler & Matthews, 1987; MacLeod & Cohen, 1993; Mathews & Mackintosh, 1998). The present study extends existing findings on interpretative bias by providing evidence for biased probability judgment in GAD individuals under the condition of ambiguity relative to uncertainty.

Given that expectancy ratings and self-report measures involve two very different methodologies, it is interesting that online expectancy ratings in this experiment were correlated significantly and positively with six of the seven self-report variables. The expectancy measure referred participants to consider future threats, and expectancy ratings were collected continuously over a specified period of time. On the other hand, the self-report measures used in the present study comprised linguistic items which participants either endorsed or denied, and they were only required to make these decisions once at the end of the experiment. These correlations highlight the important role of expectancy of future threats in negative affect. In particular, the correlation between expectancy ratings and anxiety-related measures, such as the PSWQ and the IUS-12, is consistent with the cognitive bias account of worry that anxious individuals typically hold more negative expectations about the future compared to non-anxious controls (e.g., Beck & Clark, 1988; MacLeod, Tata, Kentish, & Jacobsen, 1997; Miranda, Fontes, & Marroquín, 2008).

The correlation between expectancy ratings and depression scores in the current experiment is also in line with previous findings that symptoms of depression are associated with greater certainty in anticipating negative future outcomes (Miranda & Mennin, 2007), and reduced anticipation of potential future positive events (e.g., Andersen & Limpert, 2001; MacLeod & Salaminiou, 2001). Taken together, results from the current study, along with the existing literature, suggest that expectancy bias concerning future threats could be a possible underlying mechanism driving IU. Although this hypothesis remains speculative at this stage, it presents a potential avenue for future research to further examine the role of expectancy bias in IU.

Much like the covariation estimation data from Experiments 3 and 4, participants in the current study followed a similar pattern of over-associating the target cues with aversive pictures relative to the reference cues. In particular, congruent with the finding from Experiment 3, there was a non-significant trend in the current study that is consistent with a covariation bias towards the Ambiguous cue relative to the Uncertain cue. Furthermore, the finding that a within-subject simple effect was observed for GAD participants, but not controls, suggests a tendency amongst GAD individuals to over-associate ambiguity with aversive outcomes, more so than with uncertainty.

In the current study, participants were asked to indicate their covariation estimates almost immediately following the final experimental trial. In the real world, however, GAD worriers might not be prompted to recall probabilities of specific threatening outcomes until after some time has passed and when they are facing prospective ambiguous threats. One possible direction in future research could focus on investigating what

happens to enhanced appraisal bias and negative affect in the longer term. The review of existing literature on memory biases in GAD in Chapter 1 suggests little evidence for an explicit memory bias towards threat-relevant information (e.g., recalling a previously viewed threat word), although support for an implicit memory bias (e.g., recognising a threat word from earlier presentation) has been inconsistent (Coles & Heimberg, 2002).

Studies on memory biases in GAD have typically relied on word or phrase recognition/recall methodology typically tapping social threat and physical threats (Bradley, Mogg, & Williams, 1995; Coles, Turk, & Heimberg, 2007; Mogg & Mathews, 1990; Mogg, Mathews, & Weinman, 1987; Otto, McNally, Pollack, Chen, & Rosenbaum, 1994). The IU literature has also used a similar methodology to study the association of appraisal bias with IU (Dugas, Hedayati, et al., 2005). As domains of worry can vary considerably from one individual to another, it can be difficult to develop one set of threat stimuli that is relevant for all GAD individuals. Retrospective estimates of the extent to which a cue preceded negative outcomes is intrinsically an exercise of recall. Therefore, the present methodology offers interesting possible lines of investigation for future research to examine memory bias in GAD.

As discussed above, clinical GAD participants in this experiment responded more negatively to the Ambiguous cue relative to controls, despite some of the interaction effects not reaching statistical significance. The same patterns of expectancy and covariation biases, as well as elevated negative affect were observed when participants were classified as either high or low on IU. For example, High IU participants reported significantly greater threat covariation estimates for the Ambiguous cue relative to the Uncertain cue.

Low IU participants, on the other hand, did not show this within-subject simple difference, suggesting preliminary evidence for a stronger covariation bias amongst High IU participants towards ambiguity relative to uncertainty.

The similarity between findings from the present experiment and the previous two experiments (Experiments 3 and 4) with High/Low IU non-clinical participants provides support for the notion that high IU individuals tend to overestimate the probability of negative outcomes occurring (Carleton, Sharpe, et al., 2007), and in particular, under ambiguous threat. In the present study, the finding that differential expectancy ratings for aversive outcomes between the two target cues were predicted by IU is also consistent with the IU model's hypothesis regarding appraisal bias in high IU individuals (Koerner & Dugas, 2008).

The IU model posits that high IU individuals consider the possibility of a negative event occurring as threatening and unacceptable, irrespective of the actual probability of it occurring (Carleton, Sharpe, et al., 2007; Freeston, Rhéaume, et al., 1994). Following this prediction, GAD participants in this experiment would have been expected to show stronger negative affect to the Uncertain cue relative to controls. However, both participant groups demonstrated similar negative affective responses to the Uncertain cue, as indexed by a non-significant between-group simple effect, suggesting that uncertainty about occurrence of negative outcomes does not necessarily elicit negative affect in high IU individuals. Rather, high IU individuals are likely to perceive uncertainty as more threatening and distressing if they are precluded from accessing information to calibrate relative outcome probability. This possibility is partially supported by the between-group

simple effect that GAD participants rated the Ambiguous cue as significantly more unpleasant than controls.

The finding that GAD status partly mediated the relationship between IU and expectancy bias is congruent with the result of a mediation test in Koerner and Dugas (2008), in which the researchers found worry mediated the relationship between IU and appraisal of ambiguous information in a sample of undergraduates. Furthermore, when tests of mediation were carried out with the mediator (GAD status) and outcome (expectancy bias) in reversed roles, expectancy bias partially mediated the relationship between IU and GAD. As the current study did not involve a longitudinal design or manipulation of IU, it would be premature to draw any strong conclusions regarding the causal role of IU in the development of GAD. Nonetheless, findings from the current study do speak to the potential indirect relationship of IU to GAD by way of disrupting objective appraisal of ambiguous information. It is also worth considering that other than elevated IU levels, there are perhaps other constructs, presumably worry, that lead to the biased expectancy ratings for the Ambiguous cue.

Several limitations should be kept in mind when considering results from the current study. Firstly, as discussed in relation to Experiments 3 and 4, the Ambiguous cue used in the present study combined novelty, a lack of information regarding outcome probability, and the intrinsic meaning of a question mark symbol. It would be informative for future research to use a more neutral symbol, such as a square, to begin to disentangle which of these components is critical to the differences observed between ambiguity and uncertain conditions. Secondly, the present study did not include diagnostic data on

comorbid anxiety and mood disorders for the clinical group, due to insufficient sample size. Given a larger sample size, it would have been valuable to examine any effect of comorbid anxiety and mood disorders on the current findings. More generally, considering the heterogeneity of clinical participants with respect to age and education levels, the current study would have benefited from a larger sample size to improve the statistical power of results, particularly the interaction effects.

Notwithstanding these limitations, the present study extends the existing IU literature by examining appraisal bias and negative affect response in a treatment-seeking clinical sample of GAD individuals. A majority of the previous experimental studies have used young university students (e.g., de Bruin et al., 2006; Dugas, Hedayati, et al., 2005; Koerner & Dugas, 2008; Ladouceur et al., 2000). The current cohort of participants presented with a wide age range of 18 to 70 years, with a mean age of 39 years, which enhances generalisability of the findings to clinical populations. Furthermore, semi-structured diagnostic interviews were used to confirm these patients did meet diagnostic criteria of GAD. Results from the current study showed a similar overall pattern to Experiments 3 and 4, supporting the idea that enhanced appraisal bias and negative affect are implicated in both IU and GAD, particularly in response to ambiguous threats. When contrast analyses were repeated with participant classification based on IU levels, results shared a similar pattern with results from analysis based on participants' clinical status. In addition, a test of mediation suggested that IU indirectly contributed to expectancy bias via GAD. Chapter 8 will further examine the role of IU in anxiety psychopathology beyond GAD.

CHAPTER 8

Intolerance of Uncertainty across Anxiety and Related Disorders

(Experiment 6)

Since its conception, IU has predominantly been examined in the context of GAD and pathological worry (Buhr & Dugas, 2006; Dugas, Gagnon, et al., 1998; Dugas et al., 2007). This line of research follows the argument that IU is more closely related to GAD than to other anxiety disorders (Buhr & Dugas, 2006; Dugas, Gosselin, et al., 2001; Dugas, Marchand, & Ladouceur, 2005; Ladouceur et al., 1999). Emerging evidence, however, suggests that GAD may not be the only anxiety disorder associated with IU. For example, Holaway et al. (2006) found that undergraduates with traits of GAD (e.g., worrying and nervous tension) and OCD (e.g., washing, checking, ordering, hoarding, and neutralising) reported higher levels of IU than controls, but did not differ significantly from each other in terms of IU levels. More recently, a meta-analysis review of 57 studies on the cross-sectional association of IU with symptoms of GAD and OCD showed that IU was significantly related to symptoms of both disorders, but relative to OCD, GAD was no more strongly associated with IU (Gentes & Ruscio, 2011).

A number of studies have also indicated that some subtypes of OCD, such as compulsive checking, can be partially accounted for by beliefs about tolerance of uncertainty (e.g., Steketee et al., 1998). It is perhaps unsurprising to observe a strong relationship between IU and OCD, as many OCD patients report difficulties tolerating feelings of doubt associated with completion of their compulsions (e.g., turning on/off a

light switch, ritualised hand-washing, and ordering). These feelings of uncertainty may inherently compel OCD patients to repeat actions until they feel “right” (Tolin et al., 2003).

Data from non-clinical (Boelen & Reijntjes, 2009; Carleton, Collimore, & Asmundson, 2010) and clinical samples (Teale Sapach et al., 2015) also suggest an association of IU with social anxiety disorder (SAD). It has been established that overestimation of negative evaluation and biased perception of oneself are the core cognitive features of SAD (Beck et al., 1985; Beck, Emery, & Greenberg, 2005). Arguably, many interpersonal and performance situations can be uncertain and ambiguous. For example, an acquaintance who looks out the window during a conversation could be bored or merely distracted. A colleague who starts checking their phone in the middle of your presentation might have lost interest, or they might have just received a message about cancellation of an important flight. It has been suggested that individuals who find it difficult to tolerate possible social scrutiny could be vulnerable to experiencing excessive fear and avoidance of social interactions and performances (Boelen & Reijntjes, 2009; Teale Sapach et al., 2015).

High levels of IU have also been observed in panic disorder, a condition characterised by catastrophic interpretations of unexpected (i.e., not necessarily objective) intense bodily sensations, including heart palpitations and shortness of breath (American Psychiatric Association, 2013). Previously, constructs such as anxiety sensitivity, which relates to the fear of anxiety-related somatic sensations arising from beliefs that these sensations have harmful consequences (Reiss & McNally, 1985), have been shown to predict panic disorder symptoms (e.g., Maller & Reiss, 1992; Schmidt, Lerew, & Jackson,

1997). Another possible explanation for the fear of bodily sensations concerns the uncertain nature of panic attacks. For example, one cannot know for sure when and where the next attack is going to occur, or how long the attack would last. Having difficulty tolerating uncertainty regarding the circumstances under which the next attack is going to occur may play a role in facilitating panic disorder symptoms (Carleton, 2012). Data from analogue community and clinical samples have shown that IU accounts for unique variance in panic symptoms after controlling for anxiety sensitivity (Carleton et al., 2014; Carleton, Fetzner, Hackl, & McEvoy, 2013; Dugas, Gosselin, et al., 2001; Gorka, Lieberman, Nelson, Sarapas, & Shankman, 2014).

More recently, a small but growing number of studies have begun examining the role of IU in adult separation anxiety (Boelen et al., 2014) and health anxiety (Fergus & Bardeen, 2013). IU also appears to be associated with symptoms of posttraumatic disorder (PTSD) above and beyond anxiety sensitivity, negative affect (Oglesby, Gibby, Mathes, Short, & Schmidt, 2016), and neuroticism (Boelen, Reijntjes, & Smid, 2016). In particular, one study found that IU accounted for unique variance in PTSD symptoms such as avoidance, numbing, and hyperarousal (Fetzner et al., 2013). Given the preliminary nature of these findings, it would be premature to draw strong conclusions regarding the contribution of IU to these disorders at this stage. Nonetheless, the above findings highlight the possibility of IU being a potential risk factor for not only GAD, but also other anxiety disorders (Norr et al., 2013). This idea is congruent with theoretical frameworks for a unified approach to conceptualising emotional disorders (Barlow, 2000; Barlow, Allen, & Choate, 2004). Such a theory proposes to draw attention to common components

across emotional disorders that might supersede between-disorder differences (Barlow et al., 2004). These components include antecedent cognitive appraisals (e.g., excessive and uncontrollable worries in GAD, misinterpretations of bodily sensations in panic disorder, and fear of negative evaluation in SAD) and behavioural avoidance (e.g., avoidance of contamination in OCD, avoidance of physical exertion in panic disorder, and avoidance of performances in SAD).

Longitudinal studies have shown that individuals who meet diagnostic criteria for one anxiety disorder also have an increased likelihood of having other anxiety disorders in their lifetime (Andrews, Slade, & Issakidis, 2002). It is possible there are common vulnerability factors that account for the high degree of comorbidity in anxiety disorders, beyond the influence of trait anxiety. That IU is present in various anxiety disorders, as discussed earlier in this chapter, suggests this construct could potentially explain the high degree of comorbidity observed across anxiety disorders (Boswell et al., 2013; Shihata, McEvoy, & Mullan, 2017).

Across previous studies investigating the role of IU in anxiety disorders other than GAD, one noticeable feature is that comparisons tend to be limited to one other anxiety diagnostic category. For example, differential IU levels have been compared between GAD and panic disorder with agoraphobia (Dugas, Marchand, et al., 2005), or between GAD and OCD (Fergus & Wu, 2010; Holaway et al., 2006). If IU indeed plays an integral role in the development and maintenance of broader anxiety psychopathology, there is value in comparing the presence of IU between different types of anxiety disorders

Ladouceur et al. (1999) compared IU levels in four groups of participants: patients with a primary diagnosis of GAD, patients with a primary diagnosis of other anxiety disorder as well as secondary GAD ($n = 24$; 42% participants had primary panic disorder, 42% OCD, 16% social phobia), patients with a primary diagnosis of other anxiety disorder without secondary diagnosis of GAD ($n = 38$; 73% of participants had OCD, 13% social phobia, 8% panic disorder, 3% specific phobia, and 3% PTSD), and non-clinical controls. Results from univariate orthogonal contrast tests showed that GAD patients, regardless of primary or secondary status, reported significantly higher IU levels relative to patients with other anxiety disorders without GAD. However, primary GAD patients did not differ significantly from secondary GAD patient in their IU levels.

Carleton et al. (2012) examined patterns of IU levels across undergraduate and community participants, as well as clinical individuals with a primary diagnosis of panic disorder with or without agoraphobia (PD/A; $n = 89$), GAD ($n = 63$), SAD ($n = 120$), and OCD ($n = 60$). Results from the present study replicated the findings by Ladouceur et al. (1999), where no differences were found between primary GAD and secondary GAD participant groups. Contrary to Ladouceur et al. (1999), however, GAD participants (regardless of primary or secondary status) did not differ from participants with other anxiety disorders in their IU levels. Tukey post hoc comparisons also showed there were no statistically significant differences between any of the diagnostic groups, with the exception of the SAD group reporting significantly higher IU relative to the panic disorder group.

McEvoy and Mahoney (2011) observed significant and positive correlations between IUS total score and symptoms of PD/A, GAD, SAD, and OCD in a treatment-seeking sample. Further, IU accounted for unique variance in symptoms of these anxiety disorders after controlling for neuroticism, distress (as measured by the Kessler Psychological Distress Scale; Kessler et al., 2002), and disability (as measured by the World Health Organization Disability Assessment Schedule 2.0; Rehm et al., 1999). In particular, the prospective IU subscale of the IUS, which measures fear of uncertainty regarding future events, uniquely predicted GAD and OCD symptoms. The other aspect of IU, inhibitory IU, was a significant predictor of panic and social anxiety symptoms, suggesting a role of beliefs relating to uncertainty inhibiting action or experience in these phobic disorders. McEvoy and Mahoney (2012) further reported that in a single treatment-seeking sample, prospective IU partially mediated the relationship between neuroticism and symptoms of GAD and OCD. Inhibitory IU also mediated the relationship between neuroticism and panic and social anxiety symptoms.

In sum, emerging evidence indicates that IU may be associated with a broader range of anxiety psychopathology than was initially hypothesised (Boswell et al., 2013; Carleton et al., 2012; Holaway et al., 2006; Sexton & Dugas, 2009a). A number of limitations, however, remain to be addressed in this line of investigation. Firstly, few studies, apart from investigation by McEvoy and Mahoney (2011, 2012) and Shihata et al. (2017), have examined the relationship between IU and disorder-specific symptoms in a single cohort with broad diagnostic categories of anxiety and related disorders. It would be useful to

further understand the way in which IU contributes to symptoms of GAD, SAD, PD/A, and OCD after controlling for trait anxiety.

Secondly, few studies to date have examined the relative contribution of other proposed maintaining factors in the IU model, namely negative problem orientation and cognitive avoidance, across diagnostic groups. As mentioned in Chapter 2, negative problem orientation has been implicated in the development and maintenance of excessive worry (Borkovec, 1985; Ladouceur et al., 1998; Robichaud & Dugas, 2005a). IU has been also been shown to correlate negatively with negative problem orientation (Dugas et al., 1997). Beyond GAD, a small number of studies have shown that negative problem orientation shares an association with SAD and panic disorder (Fergus, Valentiner, Wu, & McGrath, 2015), as well as predicting SAD severity (Hearn, Donovan, Spence, & March, 2017).

Evidence supporting the role of cognitive avoidance with anxiety disorders other than GAD is limited. There are some findings indicating an association of cognitive avoidance with social anxiety in child and adolescents (Hearn et al., 2017) and undergraduates (Wong & Moulds, 2011). However, apart from one study by McNally, Otto, Yap, Pollack, and Hornig (1999), which found no evidence of cognitive avoidance in patients with panic disorder, there are few data on the relationship between cognitive avoidance and panic disorder.

It is likely that IU represents one of the many key factors in anxiety psychopathology (McEvoy & Mahoney, 2012). As such, the relative contribution of other

components within the IU model, namely negative problem orientation and cognitive avoidance, to symptoms of anxiety disorders warrants further investigation.

The aim of the present study was to replicate and extend previous studies on comparisons of IU levels across anxiety and related disorders in a treatment-seeking sample with 1) a broad range of anxiety diagnoses and 2) similar demographic profiles. In particular, differential IU levels between clinical patients with GAD and those with a primary diagnosis of other anxiety disorders were examined. Following previous findings (Ladouceur et al., 1999), it could be expected that GAD patients would endorse higher levels of IU relative to patients without any diagnosis of GAD. On the other hand, following the transdiagnostic account of IU's role in anxiety disorders (Carleton et al., 2012), there might not be substantial differences in IU between anxiety diagnostic groups.

Further to examining the relationship between IU and anxiety disorders in the context of binary diagnostic groups (i.e., comparison between a primary diagnosis of GAD and a primary diagnosis of other anxiety disorder), the present study used dimensional disorder-specific measures which would provide a more sensitive test of the relative contribution of IU to anxiety disorders. Following previous findings (McEvoy & Mahoney, 2012; McEvoy & Mahoney, 2011), it was expected that IU would be associated with symptoms of various anxiety disorders above and beyond the contribution of trait anxiety.

In addition to examining the role of IU in broader anxiety psychopathology, the present study also investigated the relations between IU and depression. Previously, high levels of IU have been associated with severe symptoms of depression in undergraduate

students (de Jong-Meyer et al., 2009; Dugas, Schwartz, et al., 2004), and patients meeting diagnostic criteria for an anxiety disorder (McEvoy & Mahoney, 2011; van der Heiden et al., 2010; Yook et al., 2010). Evidence supporting the idea that IU may be more strongly associated with depression than with anxiety/worry has been mixed. Non-clinical data have shown that correlations between IU and symptoms of depression are higher than those with anxiety (de Jong-Meyer et al., 2009). On the other hand, some studies have reported that IU appears to be more strongly associated with worry than with depression symptoms (Dugas, Schwartz, et al., 2004; McEvoy & Mahoney, 2011). Findings by Buhr and Dugas (2002) suggest the correlation between IU and worry in a undergraduate sample is no greater than the correlation between IU and depression nor the correlation between IU and anxiety.

Considering anxiety and depression share a high co-morbidity rate (Brown et al., 2001; Mineka, Watson, & Clark, 1998), IU potentially plays a role as an underlying cognitive bias in anxiety and depression psychopathology. The present study therefore sought to investigate the relationship of IU to depression in a treatment-seeking sample of mixed anxiety diagnoses.

Additionally, as mentioned in Chapter 1, IU has been associated with symptoms of hoarding disorder (HD), a condition characterised by excessive acquisition and difficulties discarding possessions resulting in large quantities of clutter (American Psychiatric Association, 2013). The uncertainty associated with discarding a possession that might be needed later, or a missed opportunity to acquire items, potentially accounts for anxiety during decision-making processes in hoarding (Mathes et al., 2017). Data from

undergraduate samples have demonstrated strong associations between IU and difficulty discarding, excessive acquisition and clutter severity after controlling for depression and non-hoarding obsessive-compulsive symptoms (Oglesby et al., 2013; Wheaton et al., 2016). Similar findings were also reported by one study using subjects who met diagnostic criteria for HD (Mathes et al., 2017). In view of the recent interest in the role of IU in hoarding, data for participants with HD were also examined in the present study.

Finally, as mentioned earlier, the present study sought to investigate the relationship between other subsidiary mechanisms via which IU is said to worry, namely cognitive avoidance and negative problem orientation, and symptoms of GAD, OCD, SAD, PD/A, HD, and depression after controlling for trait anxiety.

Method

Participants

Participants were recruited from a group of adults seeking treatment at the Westmead Hospital Anxiety Treatment and Research Unit, a specialist anxiety disorders treatment outpatient service in Sydney. Individuals were either self-referred or referred by general practitioners or psychiatrists. As in Ladouceur et al. (1999), participants' primary diagnosis was established at the time of assessment using the *Anxiety and Related Disorders Interview Schedule for DSM-5 Adult Version* (ADIS-5; Brown & Barlow, 2014). A primary diagnosis of hoarding disorder was established using the Structured Interview for Hoarding Disorder (SIHD; Nordsletten et al., 2013).

Primary diagnoses included GAD ($n = 39$; 35%), SAD ($n = 21$; 19%), panic disorder with/without agoraphobia ($n = 19$; 17%), OCD ($n = 14$; 12%), and HD ($n = 20$; 18%). Comorbid conditions were diagnosed in 72% of the sample, with 43% having one comorbid condition, 20% having two comorbid conditions, 6% having three comorbid conditions, and 1% having four comorbid conditions. The sample comprised 113 participants (62 men, 51 women, $M_{\text{age}} = 42.27$ years, $SD = 14.08$).

In the current sample, 27% of the participants were married or in de facto relationships, 41% were never married, 19% were separated or divorced. 5% of the sample left school before completing Year 10, 13% completed School Certificate, 12% completed Higher School Certificate, 35% completed a trade certificate/diploma, and 21% completed undergraduate/postgraduate degrees.

Materials and Measures

The 12-item Intolerance of Uncertainty Scale (IUS-12; Carleton, Norton, et al., 2007) was the target measure. The psychometric properties of the IUS-12 were described in Experiment 1. The present sample demonstrated excellent internal reliability for the IUS-12 ($\alpha = .91$).

The other proposed trait-like subsidiary factors in the IU model, cognitive avoidance and negative problem orientation, were also examined. Cognitive Avoidance Questionnaire (CAQ; Gosselin et al., 2002) was used to assess cognitive avoidance strategies. These strategies include thought suppression (e.g., “*I avoid certain situations that lead me to pay attention to things I don't want to think about*”), the substitution of

distressing thoughts (e.g., “*I think about trivial details so as not to think about important subjects that worry me*”), distraction (e.g., “*I distract myself to avoid thinking about certain disturbing subjects*”), avoidance of threatening stimuli (e.g., “*I sometimes avoid objects that can trigger upsetting thoughts*”), and the transformation of mental images into verbal thoughts (e.g., “*I replace threatening mental images with things I say to myself in my mind*”). The psychometric properties of the CAQ were described in Experiment 1. The present sample demonstrated excellent internal reliability for the CAQ ($\alpha = .95$).

Negative Problem Orientation Questionnaire (NPOQ; Gosselin et al., 2001; English translation, Robichaud & Dugas, 2005a, 2005b) were used to assess the tendency to see problems as a threat, to doubt one’s own problem-solving ability, and to be pessimistic about the outcome. The psychometric properties of the NPOQ were described in Experiment 1. In this sample, the internal reliability for the NPOQ was excellent ($\alpha = .95$).

The trait version of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) was used to evaluate aspects of anxiety propensity, with positively and negatively scored items that assess general states of calmness, confidence, and security (e.g., positively scored item: “*I feel nervous and restless*”; negatively scored item: “*I am content*”). The scale consists of 20 items, and has shown good internal reliability, where alpha coefficients range from .86 to .95 (Spielberger et al., 1983). Internal reliability for the present sample was $\alpha = .91$.

Several self-report measures with established reliability and validity were used to assess diagnosis-specific symptoms. GAD symptoms were assessed using the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990), a measure of worry. Psychometric

properties of the PSWQ were described in Experiment 1. In this sample, internal reliability was $\alpha = .90$.

Symptoms of SAD were assessed by the Fear of Negative Evaluation scale (FNE; Watson & Friend, 1969). The 30-item FNE measures apprehension about receiving negative evaluation, avoidance of being evaluated, and the expectation of being negatively evaluated (e.g., “*I am usually worried about what kind of impression I make*”). Watson and Friend (1969) reported that internal consistency for the FNE ranged from $\alpha = .94$ to $.96$, and that test-retest reliability over a one-month period ranged from $.78$ to $.94$. Cronbach’s alpha for the present sample was $.85$.

The Agoraphobic Cognitions Questionnaire and Body Sensations Questionnaire (ACQ & BSQ; Chambless, Caputo, Bright, & Gallagher, 1984) were used to assess symptoms of PD/A. Both the ACQ and the BSQ are self-report instruments. The ACQ consists of 14 items designed to measure fear cognitions that occur when an individual is feeling nervous or frightened (e.g., “*I will have a heart attack*”). The BSQ consists of 17 items that measure the intensity of fear associated with particular physical symptoms of arousal (e.g., heart palpitations, dizziness, and nausea). The ACQ and BSQ have demonstrated good internal consistency ($\alpha = .80$ for the ACQ and $\alpha = .87$ for the BSQ). Both questionnaires are reliable over a one-month interval (test-retest $r = 0.86$ for the ACQ and $r = 0.67$ for the BSQ). Cronbach’s alpha for the present sample was $.85$ for the ACQ, and $.90$ for the BSQ.

OCD symptoms were assessed by the Padua Inventory (PI; Sanavio, 1988), a 60-item self-report questionnaire that comprises four subscales: Contamination (e.g., “*I feel my*

hands are dirty when I touch money”), Checking (e.g., *“I return home to check doors, windows, drawers, etc. to make sure they are properly shut”*), Mental Control (e.g., *“When I start thinking of certain things, I become obsessed with them”*), and Impulses (e.g., *“While driving I sometimes feel an impulse to drive the car into someone or something”*). Internal consistency for the PI is high ($\alpha = .90$ in males and $\alpha = .94$ in females), and it has shown good reliability over a one-month interval, with test-retest $r = .78$ for males and $.83$ for females (Sanavio, 1988). A recent meta-analysis study by (Sánchez-Meca et al., 2017) found an excellent average alpha coefficient for the PI total score ($M = .94$; 95% CI = $.92-.95$), although this may have been due in part to the large number of items in the PI (Cortina, 1993). Moderator analyses showed larger alpha coefficients for those studies with larger standard deviation of PI total scores ($p = .0005$; $R^2 = .46$). The PI has also demonstrated considerable ecological validity for a four-factor structure (impaired control over mental activities/doubting, contamination, checking, and worries about losing control over motor behaviour) with respect to obsessive-compulsive symptoms (Macdonald & de Silva, 1999). Internal consistency for the current sample was high ($\alpha = .97$).

The Saving Inventory-Revised (SIR; Frost, Steketee, & Grisham, 2004) was used to assess hoarding disorder symptoms. The SIR is a 23-item measure that assesses severity of difficulty discarding (e.g., *“How distressing do you find the task of throwing things away?”*), acquisition (e.g., *“How upset or distressed do you feel about your acquiring habits?”*), and clutter (e.g., *“To what extent do you feel unable to control the clutter in your home?”*). Participants are asked to respond to each item using a five-point scale, with higher scores indicating greater severity of hoarding symptoms. The SIR total score has

demonstrated excellent internal consistency ($\alpha = .94$; Frost et al., 2004). Internal reliability for the present sample was excellent ($\alpha = .94$).

Depression symptoms were assessed by the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996). The BDI-II consists of 21 items that assess severity of depression symptoms experienced during the preceding fortnight. Internal consistency ($\alpha = .92$) and test re-test reliability ($r = .93$ over one week) are good (Beck et al., 1996). The present sample demonstrated excellent internal reliability for the BDI-II ($\alpha = .93$).

Procedure

Participants first underwent a face-to-face initial assessment using the ADIS at the Westmead Hospital Anxiety Treatment and Research Unit to confirm clinical diagnoses. Disorder-specific measures were then administered only for diagnoses for which participants met criteria. All participants completed a battery of self-report questionnaires as part of initial assessment prior to commencing treatment, including the IUS-12, CAQ, NPOQ, STAI-T, and BDI-II. In total, disorder-specific and self-report questionnaires generally took between 45 to 50 minutes to complete. Signed informed consent was provided by participants for the use of their questionnaire data.

Scoring and Analysis

Descriptive statistics were calculated for summed total and subscale scores for each of the diagnostic groups (a primary diagnosis of GAD, SAD, PD/A, OCD, and HD), including IU, trait measures (CAQ, NPOQ, STAI), and disorder-specific symptom measures (PSWQ, FNE, ACQ, BSQ, PI, SIR, BDI-II).

Replicating and extending the comparison analyses conducted by Ladouceur et al. (1999) and Carleton et al. (2012), planned orthogonal contrast analyses were conducted to compare total and subscale (Inhibitory IU and Prospective IU) score means of the IUS-12, CAQ, and NPOQ between three groups of participants. Group 1 consisted of participants with a primary diagnosis of GAD. Group 2 consisted of participants with a primary diagnosis of any other anxiety disorder without an additional diagnosis of GAD. Group 3 consisted of participants with a primary diagnosis of other anxiety disorder as well as an additional diagnosis of GAD.

The first planned contrast compared GAD participants (Groups 1 and 3) to participants without any diagnosis of GAD (Group 2). The second contrast compared primary GAD participants (Group 1) to participants with an additional diagnosis of GAD (Group 3). For each contrast, effect sizes are reported using standardised 95% confidence intervals (CI; scaled in SD units). All reported contrast analyses were conducted using the PSY Statistical Program (Bird et al., 2000). Exploratory analyses were conducted in order to further explore the pattern of results for each dependent measure. In order to maintain power, these exploratory analyses did not involve any correction for inflation of Type 1 errors, so they should be interpreted with caution.

Results

For each measure, total scale score was first examined to check for any issue with respect to distribution, skewness and kurtosis. Most measures demonstrated acceptable

levels or skewness (i.e., a skewness value less than the absolute value of 1), except for PSWQ and FNE (a skew of -1.28 and -1.74 respectively). Data for the PSWQ and FNE were not transformed despite the negative skewness of scores, as data transformation did not significantly change subsequent regression analyses results. No issue of kurtosis was identified for any of the self-report measures.

As shown in Table 8.1, all diagnostic groups reported high IU levels. Participants with a primary diagnosis of GAD reported slightly higher total and subscale mean scores for the IUS-12 relative to participants with a primary diagnosis of other anxiety disorders. Participants with a primary diagnosis of panic disorder with or without agoraphobia (PD/A) showed the lowest total IUS-12.

The PD/A group reported greater use of cognitive avoidance strategies (CAQ, $M = 80.53$, $SD = 12.66$) relative to other primary diagnosis groups. Participants with a primary diagnosis of OCD reported greater negative problem orientation (NPOQ, $M = 41.09$, $SD = 11.20$) compared to participants with a primary diagnosis of any other anxiety disorder. There was no significant difference in the proportion of males and females in either the GAD group or the no-GAD group, $\chi^2(1) = .59$, $p = .44$.

Table 8.1

Sample characteristics for diagnostic groups based on primary diagnosis.

	GAD (n = 39)	SAD (n = 21)	PD/A (n = 19)	OCD (n = 14)	HD (n = 20)	Total (n = 113)
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
IUS-12 Inh	17.67 (5.79)	16.38 (4.94)	16.32 (5.24)	16.93 (5.21)	15.10 (4.95)	16.65 (5.32)
IUS-12 Pro	24.38 (6.83)	23.90 (6.65)	20.63 (7.67)	22.00 (7.15)	22.25 (5.31)	22.99 (6.78)
IUS-12 Total	41.92 (10.85)	40.29 (10.74)	36.95 (11.44)	38.93 (11.74)	37.35 (8.71)	39.48 (10.71)
CAQ	69.96 (21.45)	67.26 (10.45)	80.53 (12.66)	75.21 (25.99)	68.02 (24.87)	71.54 (21.78)
NPOQ	37.66 (12.53)	33.91 (11.42)	37.37 (11.06)	41.09 (11.20)	31.11 (12.37)	36.26 (12.06)
STAI-T	60.91 (8.07)	57.10 (11.15)	59.63 (7.98)	60.50 (10.83)	53.89 (13.48)	58.57 (10.33)

Note. IUS-12 Inh = Inhibitory IU subscale; IUS-12 Pro = Prospective IU subscale; IUS-12 Total = Intolerance of Uncertainty Scale total score; CAQ = Cognitive Avoidance Questionnaire total score; NPOQ = Negative Problem Orientation Questionnaire total score; STAI-T = State-Trait Anxiety Inventory trait version.

Figure 8.1 shows the mean total IUS-12 for the three participants groups: participants with a primary diagnosis of GAD (Group 1), participants with a primary diagnosis of any other anxiety disorder without an additional diagnosis of GAD (Group 2), and participants with a primary diagnosis of other anxiety disorder as well as an additional diagnosis of GAD (Group 3). Error bars depict 95% confidence intervals around the mean.

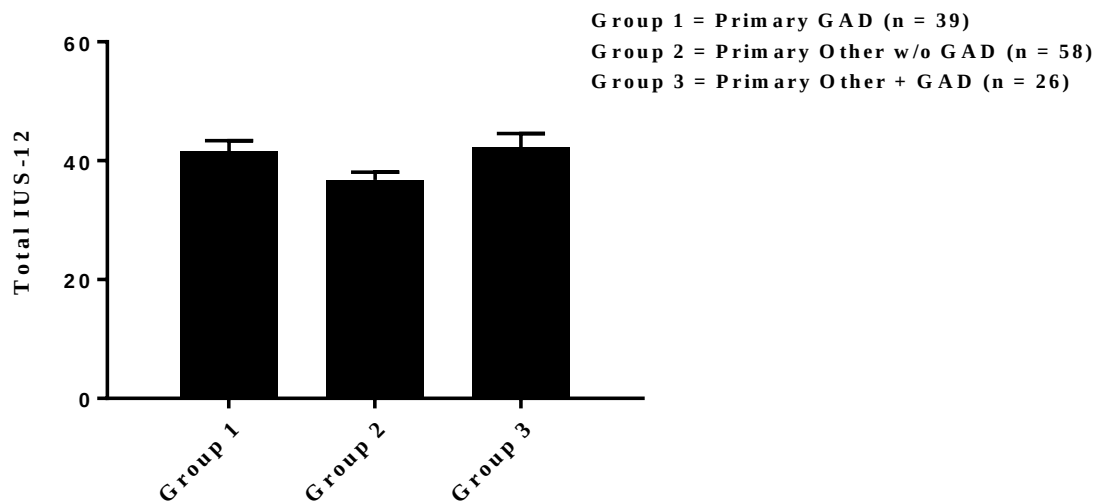


Figure 8.1. Mean total IUS-12 for the three participant groups.

The means and standard deviations on self-report questionnaires for GAD participants (Group 1 + Group 3) and participants without any diagnosis of GAD (Group 2) are presented in Table 8.2. GAD participants (Groups 1 and 3) showed significantly higher total IUS-12 relative to participants without any diagnosis of GAD, $F(1, 120) = 7.10$, $p < .05$, $d = .49$; 95% CI = .13, .85. A follow-up comparison analysis confirmed that IU was significantly greater for primary GAD participants (Group 1) compared to participants with

a primary diagnosis of any other anxiety disorder but no additional GAD (Group 2), $F(1, 95) = 5.27, p < .05; d = .48; 95\% \text{ CI} = .06, .89$.

Table 8.2

Means (M) and standard deviations (SD) for self-report variables by diagnostic group.

	GAD (n = 65)	No GAD (n = 58)	$F(1, 120)$
	<i>M (SD)</i>	<i>M (SD)</i>	
IUS-12 Inh	17.28 (5.33)	15.57 (4.87)	3.31
IUS-12 Pro	24.60 (6.88)	21.22 (6.34)	8.02*
IUS-12 Total	41.88 (11.21)	36.79 (9.74)	7.10*
CAQ	73.54 (23.26)	70.46 (21.91)	0.94
NPOQ	39.37 (12.74)	32.78 (10.37)	10.52*

Note. GAD = Group 1 (Primary GAD) + Group 3 (Primary Other + GAD); No GAD = Group 2 (Primary Other w/o GAD); IUS-12 Inh = Inhibitory IU subscale; IUS-12 Pro = Prospective IU subscale; IUS-12 Total = Intolerance of Uncertainty Scale total score; CAQ = Cognitive Avoidance Questionnaire total score; NPOQ = Negative Problem Orientation Questionnaire total score.

* $p < .05$

GAD participants (Groups 1 and 3) also reported significantly greater Prospective IU than participants without any diagnosis of GAD, $F(1, 120) = 8.02, p < .05, d = .52; 95\% \text{ CI} = .16, .88$. There was no difference in scores of Inhibitory IU between GAD participants and participants without any diagnosis of GAD ($F < 1$). There was no significant difference between primary GAD participants and participants with an additional diagnosis of GAD in either subscales of IUS-12 or total IUS-12 (all F s < 1).

GAD participants (Groups 1 and 3) had significantly greater total NPOQ scores relative to participants without any diagnosis of GAD, $F(1, 117) = 10.52, p < .05, d = .60; 95\% \text{ CI} = .23, .96$. There was no significant difference between the two GAD participant groups, $F = 2.06$. None of the contrasts for CAQ was significant (largest $F = 2.48$).

Correlations between IU and Trait Measures

Bivariate correlations between IU and trait measures are shown in Table 8.2. Both subscales of the IUS-12 (Inhibitory IU and Prospective IU) and total IUS-12 were positively correlated with CAQ, NPOQ, and STAI-T. All three of the trait measures were correlated more strongly with Inhibitory IU relative to Prospective IU.

Table 8.3

Correlations between IU and trait measures.

	IUS-12 Inh	IUS-12 Pro	IUS-12 Total	CAQ	NPOQ
IUS-12 Pro	.62**				
IUS-12 Total	.87**	.93**			
CAQ	.47**	.28**	.40**		
NPOQ	.66**	.52**	.64**	.54**	
STAI-T	.50**	.37**	.47**	.41**	.64**

Note. IUS-12 Inh = Inhibitory IU subscale; IUS-12 Pro = Prospective IU subscale; IUS-12 Total = Intolerance of Uncertainty Scale total score; CAQ = Cognitive Avoidance Questionnaire total score; NPOQ = Negative Problem Orientation Questionnaire total score; STAI-T = State-Trait Anxiety Inventory trait version.

**
* $p < .01$

* $p < .05$

In view of the earlier finding that GAD participants (regardless of primary or secondary status) reported greater IU than participants without any diagnosis of GAD, and the strong correlation between IU and STAI-T reported above, one question of interest is whether IU has a specific relationship to a diagnosis of GAD when controlling for severity of trait anxiety.

A logistic regression analysis was therefore conducted to predict the probability of a primary diagnosis of GAD, using total IUS-12 and the trait version of the STAI entered as

predictors. Primary diagnosis was entered as a binary dependent variable (0 = primary diagnosis of GAD; 1 = primary diagnosis of any other anxiety disorder). The full regression model did not reach statistical significance, indicating that IU and STAI-T as a set did not distinguish between a primary diagnosis of GAD and a primary diagnosis of other anxiety disorder, $\chi^2(8) = 5.16, p = .74$. In a separate regression analysis, IU did not distinguish participants with a diagnosis of GAD (primary or secondary) from those without any diagnosis of GAD, $\chi^2(8) = 5.15, p = .74$.

A logistic regression model with negative problem orientation and STAI-T entered as simultaneous predictors also did not predict a diagnosis of GAD, $\chi^2(8) = 4.26, p = .83$. Similarly, a logistic regression model with cognitive avoidance and STAI-T entered as simultaneous predictors did not distinguish between a primary diagnosis of GAD and a primary diagnosis of other anxiety disorder, $\chi^2(8) = 5.60, p = .69$.

Intolerance of Uncertainty and Anxiety Symptom Measures

The analyses reported thus far examined the relationship between IU and anxiety disorders in the context of binary diagnostic groups (i.e., primary GAD compared with a primary diagnosis of other anxiety disorder). As mentioned in the introduction of this study, comparison of dimensional symptom measures (PSWQ, FNE, ACQ, BSQ, PI, and SIR) may provide a more sensitive test of the relative contribution of IU to anxiety disorders. Means and standard deviations for each symptom measure are shown in Table 8.3.

For each symptom measure, three linear regression analyses were conducted with Inhibitory IU, Prospective IU, and total IUS-12 separately as a predictor in each model. STAI-T was entered into all three regression models as a simultaneous predictor. Results showed that Inhibitory IU, Prospective IU and total IUS-12 each predicted PSWQ when entered as individual predictors, Inhibitory IU, $R^2 = .28$, $F(1, 46) = 18.26$, $p < .05$, $\beta = .53$, $p < .05$; Prospective IU, $R^2 = .12$, $F(1, 46) = 6.35$, $p < .05$, $\beta = .35$, $p < .05$; total IUS-12, $R^2 = .23$, $F(1, 46) = 14.02$, $p < .05$, $\beta = .48$, $p < .05$. When STAI-T was entered as a simultaneous predictor of PSWQ, Inhibitory IU remained a significant predictor of PSWQ, $R^2 = .42$, $F(2, 38) = 13.86$, $p < .05$, $\beta = .31$, $p < .05$. However, Prospective IU and total IUS-12 no longer predicted PSWQ, Prospective IU, $\beta = .19$, $p = .15$; total IUS-12, $\beta = .24$, $p = .08$). STAI-T remained a significant predictor of PSWQ in both regression models.

Total IUS-12 and STAI-T as simultaneous predictors significantly predicted PI, $R^2 = .64$, $F(2, 12) = 10.60$, $p < .05$, with both measures contributing significantly, total IUS-12, $\beta = .48$, $p < .05$; STAI-T, $\beta = .44$, $p < .05$. A linear regression model with Prospective IU and STAI-T as simultaneous predictors showed that Prospective IU was a significant predictor of PI, $R^2 = .62$, $F(2, 12) = 9.74$, $p < .05$, $\beta = .46$, $p < .05$, whereas STAI-T was not, $\beta = .44$, $p = .06$. When Inhibitory IU and STAI-T were entered into a linear regression model as simultaneous predictors, only STAI-T was a significant predictor of PI, $R^2 = .46$, $F(2, 12) = 5.20$, $p < .05$; STAI-T, $\beta = .69$, $p < .05$; Inhibitory IU, $\beta = -.02$, $p = .94$. Neither total IUS-12 nor the two subscales of the IUS-12 predicted FNE. STAI-T remained a significant predictor of FNE in all three regression models. Similarly, neither total IUS-12, the two subscales of the IUS-12, nor STAI-T predicted ACQ, BSQ, and SIR.

Intolerance of Uncertainty and Depression

As shown in Table 8.3, BDI-II was significantly associated with both subscales of the IUS-12, as well as with total IUS-12. Interestingly, the correlation between total IUS-12 and BDI-II was stronger than the correlation between total IUS-12 and PSWQ. However, the difference between these correlations did not reach statistical significance, $z = -.61, p = .54$. Given that depression was not a primary diagnosis in the current sample, it would normally be considered as secondary to anxiety. A linear regression analysis was conducted with total IUS-12 and STAI-T entered as simultaneous predictors and BDI-II as the dependent variable. Both total IUS-12 and STAI-T were significant predictors of BDI-II, $R^2 = .41, F(2, 92) = 32.34, p < .05$; total IUS-12, $\beta = .35, p < .05$; STAI-T, $\beta = .40, p < .05$.

Furthermore, both Prospective IU and STAI-T predicted BDI-II when entered as simultaneous predictors, $R^2 = .37, F(2, 92) = 26.78, p < .05$; Prospective IU, $\beta = .25, p < .05$; STAI-T, $\beta = .47, p < .05$. Similarly, both Inhibitory IU and STAI-II predicted BDI-II when entered as simultaneous predictors, $R^2 = .43, F(2, 92) = 35.11, p < .05$; Inhibitory IU, $\beta = .40, p < .05$; STAI-T, $\beta = .36, p < .05$.

To further examine the relationship between IU, worry, and depression, a linear regression predicting total IUS-12 was carried out with PSWQ and BDI-II entered as simultaneous predictors. Results showed that BDI-II was a significant predictor of IU, $R^2 = .33, F(2, 38) = 9.55, p < .05$; BDI-II, $\beta = .43, p < .05$, but PSWQ was not a predictor, $\beta = .24, p = .11$.

Correlations between Trait and Symptom Measures

Results from bivariate Pearson correlation analyses showed that of all the anxiety symptom measures, only PSWQ and PI were significantly correlated with total IUS-12 (Table 8.3). Although the correlation between total IUS-12 and PI appeared stronger compared to the correlation between total IUS-12 and PSWQ, comparison between the two correlation coefficients using the Fisher transformation showed the difference was not significant, $z = -.81$, $p = .42$. Prospective IU was correlated more strongly with PI than with PSWQ. Only the PSWQ showed significant correlations with both subscales of the IUS-12. CAQ was positively correlated with the PSWQ and FNE, but not ACQ, BSQ, PI, nor SIR. NPOQ was positively and significantly correlated with the PSWQ, FNE, PI, and SIR, but not ACQ nor BSQ. Of the three subscales of the SIR, difficulties with discarding and acquisition were positively and significantly associated with negative problem orientation, Discarding, $r = .63$, $p < .05$; Acquisition, $r = .50$, $p < .05$.

Table 8.4

Means and standard deviations for symptom measures and bivariate correlations between IU, trait and symptom measures.

	<i>M (SD)</i>	IUS-12 Inh	IUS-12 Pro	IUS-12 Total	CAQ	NPOQ	STAI-T
PSWQ	65.17 (11.37)	.53**	.35*	.48**	.41**	.55**	.59**
FNE	25.10 (4.76)	.35	.34	.38	.52*	.61**	.59**
ACQ	35.83 (9.49)	.08	.20	.16	.02	-.15	.22
BSQ	50.04 (13.14)	.25	.08	.16	.03	.06	.32
PI	94.74 (51.84)	.19	.58**	.64**	.23	.76**	.75*
SIR	66.50 (14.61)	.42	.36	.46	.32	.61**	.59*
BDI-II	25.44 (12.97)	.58**	.43**	.57**	.50**	.62**	.56**

Note. PSWQ = Penn State Worry Questionnaire; FNE = Fear of Negative Evaluation; ACQ = Agoraphobia Cognitions Questionnaire; BSQ = Bodily Sensation Questionnaire; PI = Padua Inventory; SIR = Saving Inventory-Revised; BDI-II = Beck Depression Inventory-II; IUS-12 Inh = Inhibitory IU subscale; IUS-12 Pro = Prospective IU subscale; IUS-12 Total = Intolerance of Uncertainty Scale total score; CAQ = Cognitive Avoidance Questionnaire total score; NPOQ = Negative Problem Orientation Questionnaire total score; STAI-T = State-Trait Anxiety Inventory trait version.

** $p < .01$

* $p < .05$

Cognitive Avoidance and Symptom Measures

Linear regression analyses were conducted to examine the relationship between cognitive avoidance (CAQ) and symptom measures (PSWQ, FNE, PI, ACQ, BSQ, SIR, BDI-II). CAQ predicted PSWQ when entered as an individual predictor, $R^2 = .17$, $F(1, 46) = 9.28$, $p < .05$, $\beta = .41$, $p < .05$. When both CAQ and STAI-T were entered as simultaneous predictors, STAI-T predicted PSWQ, $R^2 = .36$, $F(2, 38) = 10.85$, $p < .05$, $\beta = .54$, $p < .05$, but CAQ did not, $\beta = .14$, $p = .34$.

CAQ predicted FNE when it was entered into regression analysis as an individual predictor, $R^2 = .27$, $F(1, 18) = 6.64$, $p < .05$, $\beta = .52$, $p < .05$. When STAI-T was entered into the regression model as a simultaneous predictor, neither CAQ nor STAI-T were significant predictors of FNE, CAQ, $R^2 = .38$, $F(2, 16) = 4.92$, $p < .05$, $\beta = .24$, $p = .36$; STAI-T, $\beta = .44$, $p = .10$.

A linear regression model with both STAI-T and CAQ entered as predictors showed both trait measures predicted BDI-II, $R^2 = .42$, $F(2, 92) = 33.28$, $p < .05$; CAQ, $\beta = .36$, $p < .05$; STAI-T, $\beta = .40$, $p < .05$. CAQ did not predict any of the other symptoms measures.

Negative Problem Orientation and Symptom Measures

Linear regression analyses were also conducted to examine the relationship between negative problem orientation (NPOQ) and symptom measures (PSWQ, FNE, PI, ACQ, BSQ, SIR, BDI-II). STAI-T was entered as a simultaneous predictor in all regression models. NPOQ predicted PI, $R^2 = .66$, $F(2, 11) = 10.90$, $p < .05$; NPOQ, $\beta = .74$, $p < .05$; STAI-T, $\beta = .09$, $p = .75$, and BDI-II, $R^2 = .47$, $F(2, 89) = 38.61$, $p < .05$; NPOQ, $\beta = .42$, p

$< .05$; STAI-T, $\beta = .35$, $p < .05$. NPOQ was not a predictor for any other symptom measures.

Discussion

The primary aim of the present study was to examine the relationship of IU with a broad range of anxiety disorders (GAD, SAD, PD/A) and obsessive-compulsive and related disorders (OCD, HD) controlling for the effect of trait anxiety. GAD participants, regardless of primary or secondary status, reported greater IU compared to participants without any diagnosis of GAD, indicating that IU is more elevated in GAD than other anxiety disorders (Buhr & Dugas, 2006; Dugas, Gosselin, et al., 2001; Dugas, Marchand, et al., 2005; Ladouceur et al., 1999). However, the size of this effect was relatively small, as all diagnostic groups showed elevated IU. This pattern of IU response is perhaps not surprising, as Carleton et al. (2012) previously found that clinical patients with heterogeneous primary anxiety disorder diagnoses (GAD, SAD, OCD, PD/A) all had elevated IU (mean total IUS-12 ranged from 37.01 to 41.65) relative to undergraduate and community participants who reported a mean total IUS-12 score of 27.52 ($SD = 9.28$) and 29.53 ($SD = 10.96$) respectively. Furthermore, the pattern of IU response from the present study is consistent with previous clinical data. For example, OCD patients in the present study reported a mean total IUS-12 score of 38.93 ($SD = 11.71$), which is similar to a previous study in which clinical OCD patients reported a mean total IUS-12 score of 39.06, $SD = 12.43$ (Jacoby, Fabricant, Leonard, Riemann, & Abramowitz, 2013).

Consistent with the result reported by Ladouceur et al. (1999), participants with a primary diagnosis of GAD in the present study showed similar levels of IU as participants with secondary GAD. Interestingly, logistic regression analyses showed that IU did not distinguish between a primary diagnosis of GAD and that of other anxiety disorder after controlling for trait anxiety. One possible interpretation of this finding, along with the pattern of IU response across anxiety and related disorders, is that IU may not be specific to GAD (Carleton et al., 2012; Holaway et al., 2006; McEvoy & Mahoney, 2011; Norr et al., 2013).

Previously, Dugas, Gagnon, et al. (1998) observed that IU distinguished GAD patients from non-clinical controls. IU has also been shown to distinguish GAD patients with moderate or severe GAD symptoms from GAD patients whose GAD symptoms are relatively mild, after controlling for age, gender, and depressive symptoms (Dugas et al., 2007). Considering the evidence supporting the relationship of IU with symptoms of other anxiety disorders, such as OCD (Holaway et al., 2006) and SAD (Boelen & Reijntjes, 2009; Teale Sapach et al., 2015), it was important to examine the ability of IU to predict a diagnosis of GAD compared to a diagnosis of other anxiety above and beyond the contributions of trait anxiety. The current finding appears to be more in line with the account that IU is elevated in GAD but may not demonstrate narrow specificity to GAD compared to other anxiety disorders (Gentes & Ruscio, 2011). Alternatively, considering that GAD has been regarded as the “basic” component of other anxiety disorders (Barlow, 1988; Barlow, Chorpita, & Turovsky, 1996), the lack of differences in IU between participants with a primary diagnosis of GAD and those with a primary diagnosis of

another anxiety disorder possibly reflected worry as being an underlying feature of many other anxiety disorders.

If IU does not appear to bear specificity to GAD, it raises the question as to whether or not IU is better conceptualised as one of the many markers of a general negative emotional construct. However, in the present study, regressions models in which IU was a significant predictor after controlling for trait anxiety would argue for at least some specificity for IU.

As discussed in the Introduction to this chapter, the high rates of current and lifetime comorbid anxiety disorders have seen a trend towards a unified or transdiagnostic approach to identifying common underlying constructs across emotional disorders (Barlow, 2000; Barlow et al., 2004; Harvey, Watkins, Mansell, & Shafran, 2004). The association of IU with a number of anxiety disorders reported in studies underscores the possibility that IU may be a shared factor in anxiety psychopathology (Boswell et al., 2013; Gillett, Bilek, Hanna, & Fitzgerald, 2018). However, contrary to previous studies that have shown the association of IU with GAD, OCD, SAD and PD/A, IU was correlated with symptoms of GAD and OCD, but not SAD, PD/A, or HD in the present study. At the subscale level, GAD participants reported significantly greater prospective IU, but not inhibitory IU, relative to participants without any diagnosis of GAD. Furthermore, prospective IU was associated with symptoms of GAD and OCD but not symptoms of SAD, PD/A, or HD. These findings provide some support for the suggestion that non-phobic anxiety disorders, such as GAD and OCD might be most strongly associated with anxiety in response to anticipation of uncertainty (Carleton et al., 2012; McEvoy & Mahoney, 2011). From this

perspective, prospective IU would have been expected to be a significant predictor of the PSWQ. However, inhibitory IU, but not prospective IU, significantly predicted PSWQ after controlling for trait anxiety.

The non-significant correlations between IU and symptoms of PD/A and SAD are at odds with previous clinical data which have supported the relationship between IU and PD/A (McEvoy & Mahoney 2011; 2012), and between IU and SAD (Teale Sapach et al., 2015). The small sample sizes for symptom measures (BSQ and ACQ, $n = 23$; FNE, $n = 20$) could have accounted for the difference in correlation results between the present study and previous findings. On the other hand, it is also possible that the items of the IUS-12, which were originally designed to tap into symptoms of GAD (Freeston, Rhéaume, et al., 1994), do not necessarily tap into the characteristics of disorders such as SAD and PD/A in the same way (Gentes & Ruscio, 2011). One possible avenue for future research is to examine the relationship of IU with SAD and PD/A using the situation-specific version of the IUS-12 (IUS-SS) developed by Mahoney and McEvoy (2012). Items of the IUS-SS are worded to reference an individual's primary concern (e.g., social interaction). Recent data showed that situation-specific IU predict social anxiety concerns above and beyond trait IU (Jensen & Heimberg, 2015).

If IU represents a potential key underlying factor in emotional disorders, it would have been expected to show a robust association with depression. Indeed, IU was positively correlated with symptoms of secondary depression in the present study. Furthermore, prospective IU, inhibitory IU, and total IUS-12 IU each predicted depression symptoms after controlling for trait anxiety, indicating that the contribution of IU

potentially extends to depression psychopathology (McEvoy & Mahoney, 2011; van der Heiden et al., 2010; Yook et al., 2010). Although IU was correlated more strongly with depression symptoms (BDI-II) relative to GAD symptoms (PSWQ), the difference between the two correlation coefficients did not reach statistical significance, suggesting that IU is no more strongly associated with worry than with depression symptoms (Buhr & Dugas, 2002).

Considering depression was not a primary diagnosis for participants in the present study, it is not clear as to why or how IU might have contributed to depression symptoms. One possible mechanism via which IU can contribute to anxiety and depression is repetitive thought (Gentes & Ruscio, 2011). In the case of GAD, worry typically involves repetitive thought about future potential threat and uncertainties, whereas rumination in depression typically involves repetitive thought about past failures (Watkins, 2008). Indeed, clinical data have shown that rumination mediates the relationship between IU and depression (Yook et al., 2010). The extent to which repetitive thought mediates the relationship between IU and worry remains to be further investigated in future research. Furthermore, in view of the regression model where depression, but not worry, predicted IU after controlling for trait anxiety, the possibility that depression contributes to IU should not be ruled out.

Another aim of the present study was to examine negative problem orientation and cognitive avoidance in a clinical sample with mixed primary anxiety diagnoses. Although negative problem orientation did not predict worry severity after controlling for trait anxiety, GAD patients, regardless of primary or secondary status, showed poorer negative

problem orientation relative to participants without any diagnosis of GAD. This finding lends some support to the account that having a negative disposition to one's problem-solving ability and problem-solving outcome may be an underlying vulnerability factor in GAD (Davey, 1994; Dugas, Gagnon, et al., 1998; Ladouceur et al., 1998). Furthermore, the pattern of positive and significant correlations between negative problem orientation and symptoms of GAD, SAD, OCD, HD, and depression indicates that negative problem orientation may be broadly applicable to emotional disorders (Fergus, Valentiner, et al., 2015).

Contrary to the finding by Fergus, Valentiner, et al. (2015), not only did negative problem orientation correlate with symptoms of OCD in the present study, negative problem orientation also predicted severity of OCD symptoms after controlling for trait anxiety. Negative problem orientation was also positively associated with hoarding difficulties, particularly with respect to discarding relative to excessive acquisition. Considering that OCD and HD are part of the obsessive-compulsive spectrum disorders (American Psychiatric Association, 2013), the tendency to doubt one's problem-solving ability might contribute to behaviours such as repetitive checking, or avoidance of making decisions about discarding unneeded items. This possibility needs to be further investigated in future research.

Whereas negative problem orientation was positively and significantly correlated with symptoms of GAD, SAD, OCD, HD, and depression, cognitive avoidance was only correlated with symptoms of GAD, SAD, and depression. The finding that cognitive avoidance was significantly correlated with worry but not symptoms of PD/A is consistent

with a previous study comparing cognitive avoidance between non-comorbid GAD patients and non-comorbid PD/A patients (Dugas, Marchand, et al., 2005).

The present findings should be interpreted in the context of several limitations that provide directions for future research. Firstly, symptom measures were only administered to participants who met the diagnostic criteria for an anxiety disorder. For example, patients who did not meet the diagnostic criteria for GAD (primary or secondary status), did not complete the PSWQ. This methodology might have introduced systematic missing data from participants who did not complete certain symptom measures as they did not meet the relevant diagnostic criteria, thus limiting the ability to capture the full variance of each measure in the analyses. However, because patients were already asked to complete several assessment questionnaires, completing additional symptom measures which were not directly related to their clinical diagnoses could have resulted in respondent fatigue. Future research could address this issue of systematic missing data by asking all participants to complete symptom measure regardless of diagnosis over multiple sessions. A related issue is that the range of questionnaire scores in the present study is restricted to clinical participants. Future research could consider comparing clinical data with data from non-clinical controls.

Secondly, the present study used cross-sectional designs which preclude strong conclusions about the degree to which IU is causally related to the development and maintenance of anxiety and related disorders, and indeed, depression. However, a recent intervention study has shown that pretreatment IU was related to reduced anxiety and depressive symptom levels following treatment across diagnostic groups (Boswell et al.,

2013). Such finding lends support for the potential causal role of IU in emotional disorders. Experimental manipulation could also be useful for examining cognitive bias and negative affect in response to uncertainty across diagnostic groups. Thirdly, the current study used the Padua Inventory (PI; Sanavio, 1988) for assessing obsessive-compulsive symptoms, as this was the existing measure used at the clinic where current data were collected. One limitation of the PI is that the obsessional subscales of this measure also appear to measure worry in addition to the obsessional aspects of OCD (Freeston, Ladouceur, et al., 1994). Given that IU is a construct that emerged primarily from the GAD literature, future research should consider using an alternative measure when examining the relationship of IU, GAD, and obsessive-compulsive related disorders. For example, the revision of the PI, Padua Inventory – Washington State University Revision (Burns, Keortge, Formea, & Sternberger, 1996), has demonstrated more independence of worry, as measured by the PSWQ, compared to the original PI (Burns et al., 1996). Finally, the present study had relatively small sample sizes for each diagnostic group and the current findings will need to be replicated in studies with larger clinical samples.

Notwithstanding these limitations, one of the strengths of the present study is the use of a structured diagnostic interview to confirm participant' diagnoses. The overall patterns of data appear to be in line with the notion that IU is not specific to GAD, though it is more elevated in disorders such as GAD and OCD, relative to SAD, PD/A, and HD. Prospective IU was more elevated in participants with a diagnosis of GAD relative to those without GAD, though Inhibitory IU was a better predictor of worry compared to

Prospective IU. Data also indicate that negative problem orientation may be applicable to a broad range of anxiety and related disorders, including hoarding difficulties.

CHAPTER 9

General Discussion

The construct of Intolerance of Uncertainty (IU) has gained increasing interest in contemporary anxiety disorder literature as a cognitive vulnerability factor for GAD and other anxiety disorders. Treatment trials targeting IU-related beliefs and behaviours have also shown promising results (e.g., Dugas & Ladouceur, 2000; van der Heiden, Muris, & van der Molen, 2012). However, the phenomenology of IU and mechanisms underlying the contribution of IU to worry remain to be further clarified. While research in this area has mostly focused on investigating difficulty of accepting/tolerating uncertainty (e.g., de Bruin et al., 2006; Dugas, Hedayati, et al., 2005; Grenier & Ladouceur, 2004; Ladouceur et al., 2000), the nature of appraisal bias in IU warrants further empirical investigation. Theoretically, IU is said to lead to increased appraisals of risk for ambiguous information (Dugas & Robichaud, 2007; Koerner & Dugas, 2006). Although the principal measure of IU, the IUS (Freeston, Rhéaume, et al., 1994), has demonstrated reliable psychometric properties for assessing distress associated with uncertainty, the IUS items do not appear to directly assess threat appraisal bias. As such, the role of appraisal bias in mediating the relationship between IU and worry/GAD represents a gap in the current understanding of the mechanism of IU.

The research presented in this thesis aimed to shed light on the mechanisms underlying the construct of IU, in terms of cognitive bias, negative affect, and physiological arousal. The starting point in the current investigation was an exploration of the relevant

parameters in threat appraisal of ambiguous information. Given the existing body of research on the relationship between IU and GAD, high IU and GAD individuals would be expected to demonstrate a similar pattern of cognitive bias in response to ambiguity. Yet this hypothesis has not been tested extensively in empirical studies. To this end, various appraisal tasks were employed in the experimental component of this research project to unpack the way in which high IU and GAD individuals appraise ambiguous situations. The experiments conducted for this research project used participants with extreme IU levels instead of individuals with mid-range IU scores to facilitate a more stringent comparison of information processing in high and low IU individuals.

The vignette tasks in Experiments 1 and 2 examined perception of concern, controllability, confidence in problem-solving abilities, probability and cost of threatening outcomes, and predictability in response to a range of positive, negative and ambiguous situations (e.g., work, interpersonal relationships, health, and finances). Furthermore, experimental manipulation of uncertainty was used to examine the impact of uncertainty on threat appraisal.

Experiments 3-4 manipulated uncertainty regarding the probability of aversive outcomes using a modified version of the covariation bias paradigm. Differences in threat appraisal, affective responses, and skin conductance response were compared between individuals with low versus high levels of IU. Two instructed reference cues were used—the Certain Aversive cue always preceded negative outcomes (aversive IAPS pictures), and the Certain Safe cue never preceded negative outcomes. Additionally, two target cues were used, both of which were followed by aversive IAPS pictures on 50% of trials. In the pre-

experimental instructions, participants were informed about one of the target cues (Uncertain) only and its relationship to the aversive pictures. Participants were unaware of the other target cue (Ambiguous) until they were surprised with this cue during the trials. No information was given to participants about its relationship to the aversive pictures. Both Experiments 3 and 4 used undergraduate samples with high and low levels of IU. In Experiment 3, online expectancy ratings were averaged across the 10-second cue presentation, whereas in Experiment 4 online expectancy ratings were recorded in the final second of cue presentation period.

Experiment 5 replicated Experiment 4 with a sample of treatment-seeking GAD patients. Finally, Experiment 6 conducted a cross-sectional examination of IU in a clinical sample with heterogeneous anxiety disorder diagnoses (GAD, social anxiety disorder, panic disorder, OCD, and hoarding disorder).

This chapter will first provide a summary of the empirical findings from Experiments 1-6, followed by a discussion of how the collective findings reported in the present work contribute to the IU literature. Next, clinical implications of the current findings will be discussed. Finally, methodological limitations of the studies conducted and suggestions for future research directions will be outlined.

Summary of the Empirical Findings

In Experiment 1, High IU participants showed significantly greater concerns as well as greater probability and cost estimates of negative outcomes relative to Low IU participants for all three scenario types. High IU participants also showed significantly less

confidence in problem-solving abilities averaged over all three scenario types relative to Low IU participants. Both High and Low IU groups reported similar overall ratings of controllability and outcome predictability. Overall comparison between T1 and T2 did not reveal any significant difference in ratings of concern, controllability, confidence, probability, cost and predictability. However, a significant interaction between IU groups and the T1-T2 comparison was observed with respect to ratings of controllability. This interaction reflected a significant decrease in controllability ratings by the Low IU group at T2 relative to T1. The pattern of means for the Low IU group indicated a slightly greater decrease in perceived controllability in Low-IU participants who received the ambiguous feedback relative to those who received the unambiguous feedback. Moderate correlations were observed between the 12-item IUS and four of the six outcome variables (concern, confidence, probability, and cost) for the ambiguous scenarios.

GAD participants in Experiment 2 showed a similar pattern of appraisal as high IU individuals in Experiment 1 in that they reported greater ratings of concern and greater estimates of probability and cost of negative outcomes relative to control participants averaged over scenario types and feedback conditions. The biggest between-group difference in concern ratings was observed for the ambiguous scenarios. There was also a significant interaction between IU group and scenario type, in which a significant between-group difference was observed for the ambiguous scenarios, but not the positive scenarios. Furthermore, GAD participants reported less confidence in problem-solving abilities, perceived control, and outcome predictability relative to controls. The biggest between-group differences for confidence in problem-solving effectiveness, controllability, and

outcome predictability emerged for the positive scenarios. GAD status fully mediated the relationship between IU and biased appraisal of cost and outcome predictability. IU levels and GAD status as a set of predictors accounted for the variance in confidence in problem-solving effectiveness and probability estimates for a negative outcome with respect to ambiguous situations. GAD status did not mediate the relationship between IU and ratings of concerns or the relationship between IU and perception of controllability for the ambiguous scenarios.

Considering that the uncertainty manipulation in Experiments 1 and 2 did not exert a strong effect on High IU or GAD participants, possibly due to ceiling effects for ratings of concern, probability, and cost, it was important to map out the circumstances under which threat appraisal bias and negative affect are more likely to emerge in response to ambiguous threats. Furthermore, Experiments 1 and 2 also highlighted the need for further investigation of possible dual character of IU- appraisal bias and negative affect. Experiment 3 was designed to address these questions. Results from Experiment 3 showed both biased threat appraisal and enhanced affective responses in High IU participants in situations where a potential threat may or may not occur. Additionally, the greatest difference between High and Low IU participants were observed under conditions of ambiguity, rather than uncertainty. Contrary to predictions, however, there was no difference in mean skin conductance response for the target cues (Ambiguous and Uncertain cues) and the reference cues (Certain Aversive and Certain Safe cues). Skin conductance response did not differ between the Ambiguous and the Uncertain cues.

A similar pattern in cognitive bias was observed in Experiment 4. A simple between-group effect in post-experiment covariate estimates was observed for the Ambiguous cue, but not for the Uncertain cue, despite the interaction effect between the comparison of target cues and IU group did not reach significance. High IU participants did not differ from their Low IU counterparts in their online expectancy ratings for the target cues. High IU participants rated the Ambiguous cue as significantly more unpleasant than the Uncertain cue, whereas Low IU participants reported similar post-experiment mood ratings for the target cues, despite the interaction involving group and the Ambiguous-Uncertain cue comparison did not reach significance. There was no difference in mean skin conductance response for the target cues and the reference cues. Skin conductance response did not differ between the Ambiguous and the Uncertain cues.

GAD participants in Experiment 5 demonstrated expectancy bias towards the Ambiguous cue relative to controls. When surprised with a cue for which no information was available regarding the probability of aversive pictures occurring, GAD participants overestimated the probability that this Ambiguous cue would be followed by aversive pictures, relative to the Uncertain cue. Consistent with the pattern of post-experiment mood rating data from Experiments 3 and 4, GAD participants in Experiment 5 also reported strong negative affective responses to the Ambiguous cue more so than the Uncertain cue. The interaction between group comparison and the Ambiguous-Uncertain cue comparison did not reach significance. However, much like the mood rating data from Experiments 3 and 4, GAD participants, not controls, reported significantly stronger

negative affect towards the Ambiguous cue than the Uncertain cue. GAD status partly mediated the relationship between IU and expectancy bias.

Experiment 6 showed high levels of IU across GAD, social anxiety disorder, OCD, panic disorder with/without agoraphobia, and hoarding disorder. The highest level of IU was observed in the GAD group. GAD participants, regardless of primary/secondary diagnostic status, showed significantly greater IU levels relative to participants without any diagnosis of GAD. Follow-up comparison analysis found that IU was significantly greater for primary GAD participants compared to participants with a primary diagnosis of any other anxiety disorder but no additional GAD. Prospective IU was more elevated in participants with a diagnosis of GAD relative to those without GAD, though Inhibitory IU was a better predictor of worry compared to Prospective IU. Negative problem orientation was positively and significantly correlated with symptoms of GAD, social anxiety disorder, OCD, hoarding disorder, and depression. Results of linear regression analyses showed that when trait anxiety was entered a simultaneous predictor, negative problem orientation predicted symptoms of OCD and depression, but not the other anxiety disorders. Cognitive avoidance was correlated with symptoms of GAD, social anxiety disorder, and depression. Results of linear regression analyses showed that when trait anxiety was entered a simultaneous predictor, cognitive avoidance did not predict any of the anxiety disorders nor depression.

Interpretations of the Empirical Findings

The data obtained from Experiments 1-5 provided an empirical description of the dimension and extent of appraisal bias and concomitant affective responses in high IU

individuals when faced with uncertain situations. The results also reflect a considerable overlap in information-processing characteristics for high IU and GAD individuals in their appraisal of ambiguous information.

Appraisal Bias in Intolerance of Uncertainty

Across Experiments 1-5, non-clinical high IU individuals and clinical GAD individuals demonstrated a tendency to overestimate the probability of negative outcomes occurring in response to ambiguity. This overall finding is in line with the IU model's assertion that being intolerant of uncertainty may cause GAD patients to overestimate both the likelihood and cost of potential negative events (Dugas, Buhr, et al., 2004, p. 152; Dugas & Robichaud, 2007). Results from Experiments 3-5 also suggest that overestimation of threat probability can occur during anticipation of threat for high IU individuals as well as during post-experiment recall. In Experiment 5, the same patterns of expectancy and covariation biases were observed in GAD participants with high IU levels. Furthermore, GAD status partially mediated the relationship between IU and expectancy bias. Collectively, these findings extend current IU research and shed further insight on the potential contribution of IU to GAD by way of disrupting objective appraisal of threat probability in ambiguous situations (Dugas, Hedayati, et al., 2005; Koerner & Dugas, 2008).

The results of Experiments 1-2 showed that in addition to overestimation of probability of potential negative outcomes, non-clinical High IU participants and clinical GAD participants also overestimated the cost of potential negative outcomes in ambiguous situations. Furthermore, Experiment 2 found that GAD status mediated the relationship

between IU and biased appraisal of costs associated with negative outcomes in ambiguous situations. In previous studies, individuals with GAD and non-clinical high worriers have shown a tendency to overestimate the cost of unambiguously negative outcomes, such as failing an exam (Berenbaum, Thompson, & Bredemeier, 2007; Berenbaum, Thompson, & Pomerantz, 2007; Butler & Mathews, 1983). The data collected from Experiments 1-2 suggest that biased appraisal of personal costs associated with negative outcomes in ambiguous situations may be a contributing factor to heightened distress in high IU individuals.

Although the current research primarily focused on threat appraisal of ambiguous situations in high IU and GAD individuals, the way in which High IU and GAD participants responded to the positive scenarios in Experiments 1-2 also provided further insight into threat appraisal in IU/GAD. One of the earlier conceptualisations of IU had argued that individuals who are highly intolerant of uncertainty would find the mere possibility of a negative event occurring as unacceptable, irrespective of the probability of its occurrence (Carleton, Sharpe, et al., 2007; Dugas, Gosselin, et al., 2001). In considering positive situations where the probability of negative outcomes occurring is relatively low, how might high IU individuals calibrate threats? In Experiment 1, although participants rated the positive scenarios as overall less likely to engender negative outcomes relative to the ambiguous negative scenarios, High IU participants rated the mean probability of negative outcomes in the positive scenarios as more probable compared to Low IU participants. Additionally, High IU participants rated the cost of these negative outcomes as greater compared to Low IU participants. This tendency to overestimate threat

probability and cost even in positive scenarios was also observed in the GAD/control sample from Experiment 2. Additionally, the biggest between-group differences for ratings of controllability, confidence, and outcome predictability emerged for the positive scenarios in Experiment 2.

Taken together, the pattern in these data underscores the possibility that negative beliefs about uncertainty potentially influence interpretation of positive situations (Deschenes, Dugas, Radomsky, & Buhr, 2010). In particular, when facing a situation in which negative outcomes are unlikely to occur, one possible factor that contributes to the perpetuation of distress in high IU individuals could be excessive perceived personal cost associated with these outcomes.

It has been suggested that low perceptions of controllability and effectiveness may explain why high IU individuals appraise uncertain events as aversive (Koerner & Dugas, 2008). The results of Experiment 1 suggest that high IU individuals do not necessarily differ from their low IU counterparts in their perceived control and perceived ability to predict outcomes in ambiguous situations. On the other hand, GAD participants from Experiment 2 showed an overall poorer sense of control and confidence in their ability to problem-solve and predict outcomes in ambiguous situations relative to controls. Overall, poorer confidence in problem-solving abilities emerged from Experiments 1-2 as a potential factor that distinguishes between high and low IU individuals.

Impact of Different Levels of Uncertainty

As discussed in the Introduction to Chapter 5, the terms uncertainty and ambiguity have been treated somewhat synonymously in the IU literature. The broader literature on cognitive bias suggests that ambiguity rather than uncertainty may provide a more favourable condition for the observation of individual differences in threat appraisal (MacLeod & Mathews, 2012). Within the decision-making literature, ambiguity has generally been defined as a complete lack of knowledge regarding an outcome, whereas uncertainty refers to a situation where the outcome is not known on a given trial but the probability of the outcome is known, such as tossing a coin (Camerer & Weber, 1992; Ellsberg, 1961; Lazarus & Folkman, 1984). The overall pattern in expectancy and covariation biases from Experiments 3-5 suggests that when faced with unknown contingency between signals and aversive outcomes, appraisal under such a condition is likely to reflect a stronger bias in individuals who are intolerant of uncertainty relative to when they are made aware of the contingency between the signal and aversive outcomes.

Dual Character of Intolerance of Uncertainty

As noted in the review of IU research in Chapter 2, the operational definition of IU has undergone several revisions throughout the IU research. The primary focus of the original and revised definitions varies, with some defining IU as a cognitive bias (Buhr & Dugas, 2002) and others defining IU as an excessive tendency to consider the possibility of a negative event occurring as distressing irrespective of the probability of its occurrence (Carleton, Sharpe, et al., 2007). Some items of the IUS-12 also describe IU as an excessive

tendency to consider negative events as unacceptable. Collectively, these definitions underscore possible dual character of IU- cognitive bias and negative affect.

The overall pattern of affective response data from Experiments 3-4 showed that High IU participants responded more negatively to the Ambiguous cue (unknown uncertainty) relative to the Uncertain cue (known uncertainty). A similar pattern of affective response data was also observed in GAD participants in Experiment 5, in that controls showed similar mood ratings for the Ambiguous and the Uncertain cues, whereas GAD participants found the Ambiguous cue significantly more unpleasant than the Uncertain cue. The overall pattern in online expectancy ratings and covariation estimates from Experiments 3-5 also reflected cognitive bias towards the Ambiguous cue in high IU and GAD individuals.

Collectively, the results of Experiments 3-5 indicate that IU is not only associated with inflated threat appraisal of ambiguous situations, but also enhanced negative affect. This conclusion is also supported by the correlations between mood ratings and the cognitive measures (expectancy ratings and covariation estimates) observed across Experiments 3-5, despite the mediation analysis in Experiment 5 finding IU levels did not predict mood ratings for the Ambiguous cue nor mood ratings averaged across the two target cues.

Information processing accounts of threat appraisal in GAD (Beck & Clark, 1997; Clark & Beck, 2010) may help to explain the interaction of cognitive bias and negative affect when faced with a stimulus for which there is no reference point regarding threat probability. The information processing accounts predict that anxiety arises from three

phases of information processing sequence. First, the evocative phase involves threat-relevant intrusive thoughts. Second, schemas are activated in the automatic processing phase. Third, an elaborative processing phases where one evaluates the availability and effectiveness of their coping resources to deal with the perceived threat (Beck et al., 1985). The information processing accounts would argue that intrusive negative thoughts about uncertainty occur in the first phase as well as the second phase. When surprised with a stimulus for which there is no reference point regarding the probability of a threatening outcome occurring, beliefs such as the ones outlined in the IUS-12- “*Unforeseen events upset me greatly*”, “*If frustrates me not having all the information I need*”, “*I can’t stand being taken by surprise*”- are likely to be activated in high IU individuals, thus evoking negative affect. Taken together, the results of Experiments 3-5 provided preliminary support for the dual character of IU, and are in line with the notion that IU reflects an individual’s response to uncertain information with a set of negative cognitive, emotional, and behavioural reactions (Freeston, Rhéaume, et al., 1994; Ladouceur et al., 1998).

Specificity of Intolerance of Uncertainty

In Experiment 6, participants with a diagnosis of GAD, regardless of primary or secondary status, reported greater IU levels compared to participants without any diagnosis of GAD. Additionally, IU was correlated with symptoms of GAD and OCD, but not social anxiety, panic disorder with/without agoraphobia, or hoarding disorder. Although the results of logistic regression analyses showed that IU did not distinguish between a primary diagnosis of GAD from a primary diagnosis of other anxiety disorder after controlling for trait anxiety, the overall pattern of results nonetheless pointed to a somewhat more elevated

level of IU in GAD compared to other anxiety disorders (Buhr & Dugas, 2006; Dugas, Gosselin, et al., 2001; Dugas, Marchand, et al., 2005; Ladouceur et al., 1999).

Given that the items of IUS were designed to tap into worry/GAD (Freeston, Rhéaume, et al., 1994), one would not have necessarily expected to observe high levels of IU in other anxiety disorders. Yet, Experiment 6 found high levels of IU across heterogeneous anxiety disorders, a finding that is in line with the emerging view that IU is not specific to GAD but may be a transdiagnostic factor in broader anxiety psychopathology (Ladouceur et al., 1999; McEvoy & Mahoney, 2012; McEvoy & Mahoney, 2011; Norton et al., 2005).

When non-specificity is observed, it is generally assumed that the construct in question is not a cause of the disorder, but is instead a non-specific consequence of general psychopathology (Garber & Hollon, 1991). The results of Experiment 6 suggest that IU may have particular relevance to GAD despite a lack of narrow specificity. Boswell et al. (2013) argued that IU potentially represents one aspect of a broader construct, such as perceived control. In Experiment 1, perceived controllability did not distinguish between High and Low IU participants; whereas GAD participants in Experiment 2 reported significantly less perceived control in ambiguous situations. If perceived controllability is one of the mechanisms by which IU exerts its influence on worry, the construct of IU potentially bears a broader specificity to anxiety disorders. However, even if IU is a common factor in anxiety disorders, the IUS alone provides a narrow scope for conceptualising the mechanism of IU, as the IUS items mostly assess the perceived consequences of uncertainty, rather than cognitive processing of uncertainty situations.

Future research would need to extend beyond reliance on the IUS to examine the mechanisms of IU underlying broader anxiety psychopathology.

The Role of Repetitive Thinking in Intolerance of Uncertainty

Although the construct of IU has mostly been examined within the context of worry/GAD, emerging studies have also begun to examine the role of IU in depression (e.g., McEvoy & Mahoney, 2012; McEvoy & Mahoney, 2011). Considering that both anxious worry and depressive rumination are inherently repetitive processes albeit differing in content and temporal orientation (Papageorgiou & Wells, 1999; Smith & Alloy, 2009), IU potentially represents a common factor in worry and rumination (Dugas, Schwartz, et al., 2004; Miranda et al., 2008). Despite this, data on the relationship between IU, worry, and rumination have been scarce, with one study finding that worry partially mediated the relationship between IU and anxiety symptoms whereas rumination completely mediated the relationship between IU and depressive symptoms (Yook et al., 2010). Consistent with previous findings, Experiment 2 found that both rumination (as measured by the Ruminative Response Scale) and worry were moderately correlated with both subscales of the IUS-12 as well as the total IUS-12.

Further understanding of how IU contributes to worry and rumination would require clarifying the mechanism by which IU exerts its influence on worry. Results from Experiments 1-5 suggest biased appraisal of probability and cost of possible negative events occurring, biased appraisal of one's problem-solving effectiveness, and increased negative affect, might be some of the possible mechanisms underlying the IU-worry relationship. Experiment 2 also showed that both rumination and worry were correlated

with ratings of concern, probability, cost, controllability, confidence in problem-solving abilities, and outcome predictability. If IU contributes to worry by way of disrupting objective appraisal of future ambiguous information, bias in calibration of threat probability and cost estimates may be a common mechanism that mediates the relationship between IU and repetitive negative thinking processes.

Although rumination typically involves repetitive thinking about past negative events, rumination about uncertainty could involve expecting a lack of future positive outcomes (Anderson et al., 2012), leading to depressive symptoms such as feelings of hopelessness. In Experiment 2, results of mediation analysis showed that when worry and IU were entered as a set of predictors, worry, but not IU, predicted changes in the appraisal outcome variables. On the other hand, rumination only partially mediated the variance in probability and cost estimates. Given that Experiment 2 used a sample of clinical participants whose primary concerns were related to anxiety, future research could further investigate the relationship between IU, rumination and appraisal bias in individuals with a primary diagnosis of depressive disorder.

Intolerance of Uncertainty, Negative Problem Orientation, and Cognitive Avoidance

The IU model proposes that negative problem orientation and cognitive avoidance represent process variables via which IU indirectly exerts its influence on worry (Dugas, Buhr, et al., 2004). Negative problem orientation reflects negative beliefs regarding the process and outcome of problem-solving and one's problem-solving skills (e.g., 'I often have the impression that my problems cannot be solved'; Robichaud & Dugas, 2005a). Explicit cognitive avoidance strategies, such as thought suppression and distraction, are

said to reduce distress associated with mental images of feared outcomes (Sexton & Dugas, 2008). Findings from Experiments 1, 2 and 5 are in line with the hypothesis that high levels of IU are associated with cognitive avoidance and negative problem orientation (Dugas et al., 1997; Dugas & Robichaud, 2007).

Although both negative problem orientation and cognitive avoidance have been conceptualised on the same level subsidiary to IU (Dugas & Robichaud, 2007), results from Experiments 1, 2, and 5 suggest that these two processing variables might contribute to biased appraisal of ambiguous situations in different ways. Firstly, the overall sizes of correlation coefficients across Experiments 1, 2, and 5 showed that IU was correlated more strongly with negative problem orientation than cognitive avoidance. Secondly, the size of correlations between negative problem orientation and the outcome variables for ambiguous situations across Experiments 1-2 was overall greater than the correlations between cognitive avoidance and the outcome variables. Thirdly, regression analysis results from Experiment 1 indicated that negative beliefs pertaining to problem-solving abilities and outcome was a stronger predictor for appraisal bias in ambiguous situations compared to cognitive avoidance. Collectively, the overall pattern in correlation and regression results across Experiments 1, 2, and 5 suggest that negative beliefs about one's problem-solving effectiveness and the outcome of their problem-solving appear to be closely associated with appraisal biases in ambiguous situations more so than cognitive avoidance. It is possible that having a tendency to focus on uncertain aspects of a problem is likely to activate biased appraisal in high IU individuals regarding their problem-solving

effectiveness, which in turn would render it difficult to implement appropriate problem solving strategies (Dugas et al., 1997).

Motivation to avoid thinking about uncertain situations in everyday life might provide high IU individuals with considerable practice in cognitive avoidance. Cognitive avoidance strategies such as thought suppression and distraction may interfere with elaborative processing of threat cues (Mogg et al., 1987). Evidence of enhanced explicit memory bias for threat following suppression of threat words (Kircanski, Craske, & Bjork, 2008) raises the possibility that habitual disengagement of further processing of threat cues in high IU individuals may lead to memory biases for previously suppressed thoughts. In Experiments 3-5 of the current research, participants were required to recall the association between the Ambiguous cue and aversive outcomes. The pattern in retrospective covariate estimates across Experiments 3-5 appears to suggest an explicit memory bias in High IU participants and GAD. Dugas, Hedayati, et al. (2005) found that high IU individuals recalled a significantly higher proportion of uncertain words compared to low IU individuals. The researchers concluded that the semantic task instruction designed to foster encoding without using memorisation strategies (i.e., rating the familiarity of neutral/uncertainty words) appeared to lead to explicit memory bias in IU. In light of the association of IU with cognitive avoidance observed in the current research, whether explicit memory bias would be observed in high IU individuals when instructed to suppress uncertain words is an issue for future research to address. Empirical investigation of uncertainty-related thought suppression represents an important step in understanding the way in which IU contributes to appraisal bias and worry.

Clinical Implications

An overarching goal of the work presented in this thesis was to improve the current understanding of mechanisms underlying pathological worry, with the view of informing psychological treatments. Although it is premature to advocate for any particular intervention strategies on the basis of the preliminary evidence obtained, the findings are indicative of a number of potential clinical implications. Firstly, results from Experiments 3-5 indicate that ambiguity may be a more potent trigger of heightened threat appraisal than uncertainty. One possible clinical implication is that GAD patients with high levels of IU (or the related construct of (in)tolerance of ambiguity; Frenkel-Brunswik, 1949) might benefit from explicit training in threat appraisal of novel situations. IU has been shown to be highly related to worry (Ladouceur et al., 1997), which typically involves thinking repetitively about potential future threats across various life domains (Borkovec, 1985). These threats may be real-life problems where there is an objective degree of threat, or ambiguous hypothetical situations.

Quite often, GAD patients present for treatment when they struggle to deal with difficult stressors which in turn exacerbate their tendency to worry about hypothetical situations. Although it can be difficult to reliably estimate future events in some situations because of the complexity of daily experience, high IU GAD patients may nonetheless benefit from treatment approaches that encourage them to explicitly quantify threat probability in upcoming situations where there is an ambiguous threat of an aversive consequence. This approach is in line with traditional cognitive interventions that address the catastrophic aspects of worry by encouraging patients to consider the realistic evidence

in order to re-evaluate the likelihood of feared outcomes occurring. The cost appraisal data from Experiments 1-2 indicate that encouraging GAD patients who are highly intolerant of uncertainty to re-evaluate the realistic cost of negative outcomes, particularly those which are highly unlikely to occur, may be adaptive. Of specific interest may be one's evaluation of their ability to cope with undesirable consequences of uncertainty situations. The results from Experiments 1-2 regarding poor problem orientation highlight effective problem-solving as a potential target in intervention for high IU individuals and GAD patients. Re-evaluation of maladaptive beliefs regarding problem-solving as well as enhancing effective problem-solving skills may help to increase tolerance of uncertainty (Robichaud, 2013a, 2013b). An example is developing a more flexible approach to decision-making instead of a rigid tendency to spend excessive amount of time on deliberating decisions in uncertain situations.

The covariation biases observed across Experiments 3-5 suggest it would be beneficial to target retrospective evaluation of prior negative experiences. Although it is not necessarily possible (or desirable) to turn ambiguous situations into certain safe situations for these high IU patients, a more realistic clinical treatment goal might be to recalibrate ambiguous situations into uncertain ones with a constrained degree of threat. A caveat about such an approach is that the process of cognitive challenging may sometimes become an endless cycle, particularly for feared situations that are not necessarily of primary concern and for which realistic evidence is unavailable. Given the dynamic and ever-shifting nature of worry topics in GAD, reducing heightened threat appraisal of circumscribed ambiguous situations may only be fruitful to an extent. It would be

informative for future research to investigate the extent to which high IU patients benefit from additional treatment following the cognitive intervention of threat reappraisal. Such treatment may include strategies identifying and challenging underlying negative beliefs about uncertainty as proposed by the IU model (Dugas & Ladouceur, 2000). Another useful implication for treatment would perhaps be to teach patients an approach to their worry in which they check they are not assuming excessive ambiguity in threat, and make a more realistic assessment of the probability of the potential threat.

Beliefs that support overestimation of threat in uncertain situations could also be addressed by behavioural strategies. The emotional processing account (Foa & Kozak, 1986) argues that pathological fear is characterised by associations between a stimulus, biased meaning representations and excessive response elements (e.g., avoidance of safe situations). Pathological fear is said to persist due to behavioural avoidance that interferes with the acquisition of relevant information needed to contrast with the meaning representations (Foa, Huppert, & Cahill, 2006). Well-supported therapeutic strategies such as behavioural experiments involve graded exposure to feared situations without employing avoidant behaviours to allow for the opportunity of obtaining corrective information regarding the realistic outcomes in anxiety-provoking situations. Indeed, behavioural experiments have been used to test inaccurate appraisals of probability and cost of negative evaluation in social anxiety disorder (Clark & Wells, 1995), recurrence of trauma in PTSD (Ehlers & Clark, 2000) and physical harm in panic disorder (Salkovskis, 1991).

In the case of GAD, individuals with a tendency to overestimate probability and cost of negative outcomes in uncertain situations would be expected to adhere to rigid

approach behaviours and/or avoidant strategies (Robichaud, 2013b). Empirically, IU has been associated with excessive information-seeking behaviours (Ladouceur et al., 1997; Rosen & Knäuper, 2009). High IU individuals may also engage in avoidance strategies such as forgoing opportunities to apply for a job promotion due to concerns about managing unfamiliar tasks, travelling to new places, or deferring decision-making to others due to doubts about one's own decisions. These avoidant behaviours are likely to interfere with processing of evidence regarding the realistic probability and cost of negative outcomes in uncertain situations.

Behavioural expressions of IU in everyday situations, such as doing everything oneself instead of delegating tasks to others, or excessive researching before committing to engaging in an activity, may not appear problematic at face value to GAD patients with high IU levels. Expectancy data from Experiments 1-3 and 5 highlight potential benefits of helping GAD patients with high levels of IU to recognise how their tendency to overestimate the probability of negative outcomes occurring and the cost of these negative outcomes may contribute to maladaptive avoidant/approach behaviours.

Affective response data from Experiments 3-5 raise the possibility that biased covariation estimates of threatening outcomes occurring in uncertain situations is likely to be influenced by enhanced negative affect. Therapeutic approaches that encourage high IU individuals to identify and describe their negative affect responses during exposure to uncertain situations may help to augment reappraisal of threats. Indeed, linguistic processing of emotional responses to aversive stimuli has been shown to effectively reduce self-reported distress (Lieberman et al., 2007; Lieberman, Inagaki, Tabibnia, & Crockett,

2011). Such approach has also been recognised by contemporary anxiety treatment literature as one of the key strategies that optimise the effect of exposure therapy (Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014; Kircanski et al., 2012).

Limitations and Future Research

Several limitations of the present work have already been raised in Chapters 3-8. Another limitation relates to the absence of strong skin conductance responding to the target cues in Experiments 3-4. As a measure of physiological arousal, skin conductance is known to show a high degree of individual variability (Borkovec, 1985; Borkovec & Hu, 1990), which likely reduced the power of the skin conductance comparisons. As such, a larger sample size may be necessary to detect any difference between ambiguous and uncertain stimuli, given the evidence for this effect on the other dependent measures (expectancy, covariation estimates, and negative affect) and the congruence between these measures that is typically observed in human learning experiments (e.g., Mitchell, De Houwer, & Lovibond, 2009).

Considering the parallel between the design for Experiments 3-5 and fear conditioning paradigm, IAPS aversive pictures used in the current research might have been weaker unconditioned stimuli relative to other conventional aversive stimuli such as electric shock and loud noise. Future research examining the effect of different levels of uncertainty (i.e., known uncertainty, unknown uncertainty) could use a stronger unconditioned stimulus to determine which, if any, elicits greatest physiological arousal responses.

With respect to sample size and statistical power, overall the studies included in the current research work had adequate sample sizes, and thus were sufficiently powered to detect moderate sized effects of interest. Experiments 3, 4 and 5 included between 16 and 34 participants per cell. These samples tended to be smaller than those in previous studies that compared appraisal biases between low and high IU individuals (Dugas, Hedayati, et al., 2005; Koerner & Dugas, 2008). Despite this, significant differences in expectancy, covariation estimates and negative affect were observed between low and high IU individuals. Future investigation might seek to replicate the current findings with a larger sample size to provide greater statistical power and confidence in the pattern of appraisal biases observed.

Autonomic Arousal in Intolerance of Uncertainty

Considering that arousal is implicit in the IU model, and that it has been recognised as an integral process in the avoidance model of worry and GAD (Borkovec, 1994; Borkovec et al., 2004), alternative measures of autonomic arousal could be considered in future research to further understand the mechanisms of IU. In view of the proposition that IU reflects a bias towards perceiving uncertain stimuli as threatening (Carleton, 2012), and evidence of a positive correlation between IU and rapid responding to uncertainty stimuli (Fergus, Bardeen, & Wu, 2013), one possible avenue for future research concerns the role of arousal via stimulation of noradrenaline (NA) in enhancing attentional bias in high IU individuals.

NA has been implicated in neuronal modulation of autonomic arousal and higher cognitive cognition functioning such as learning and attention (Posner & Petersen, 1990; Usher, Cohen, Servan-Schreiber, Rajkowski, & Aston-Jones, 1999). Specifically, the locus coeruleus (LC), the major noradrenergic cell body in the brain, contains ascending excitatory NA afferents that activate diffuse cortical and subcortical regions which are associated with mediating autonomic arousal (Aston-Jones, Ennis, Pieribone, Nickell, & Shipley, 1986). These ascending excitatory NA afferents are also associated with the cortical and subcortical regions which are implicated in selective attention to threatening stimuli (Aston-Jones, Rajkowski, & Cohen., 1999).

NA modulation may be a key mechanism for the LC's role in attention towards threat, particularly in the parietal cortex, superior colliculus, and prefrontal cortex (Posner & Petersen, 1990). Further, single cell recording showed that an increase in LC cell activity activated the prefrontal neurons involved in selective attention (Ramos & Arnsten, 2007).

Increased arousal level (via noradrenergic activation) may be associated with threat appraisal of ambiguous situations, and modulation in the noradrenergic activity could potentially explain individual differences in IU. Preliminary evidence has indicated that decision-making in response to uncertainty may be directly related to NA and acetylcholine, a neuromodulator in the central nervous system and peripheral nervous system (Yu & Dayan, 2005). Investigating changes in NA to ambiguous situations in addition to cognitive and affective responses could provide further insight into the patterns of maladaptive behavioural and cognitive responses in IU. For example, salivary alpha-

amylase (sAA) is a digestive enzyme that has been proposed as an indicator of changes in NA levels (Bosch, Veerman, de Geus, & Proctor, 2011; Rohleder & Nater, 2009). In light of recent research measuring changes in sAA activity from baseline to fear acquisition in posttraumatic stress disorder (e.g., Zuj, Palmer, Malhi, Bryant, & Felmingham, 2018), the role of arousal in response to uncertain situations may be further examined using sAA as an indicator of NA.

Personality Diatheses in Intolerance of Uncertainty

The work presented in this thesis primarily focused on the experimental investigation of cognitive biases and negative affect as possible mechanisms underlying the relationship between IU and worry/GAD. The roles of personality diatheses in these mechanisms would also help to further inform the conceptualisation of IU. For example, obsessive-compulsive and avoidance personality traits, which are common in GAD (Dyck et al., 2001), may be implicated in the mechanism of IU. The IU model has argued that individuals who are highly intolerant of uncertainty would find the mere possibility of a negative event occurring as “unacceptable”, irrespective of the probability of its occurrence (Carleton, Sharpe, et al., 2007; Dugas, Gosselin, et al., 2001). This definition highlights a degree of cognitive rigidity that has been observed in patients with GAD and OCD (Dyck et al., 2001). Clinically, GAD patients typically engage in time-consuming reassurance-seeking behaviours as a way to cope with worry, such as spending excessive amount of time researching before committing to an unfamiliar activity. Considering the high levels of IU observed in GAD and OCD patients in Experiment 6, one possible commonality with these two disorders is an obsessive-compulsive personality style characterised by a

persistent and pervasive maladaptive perfectionism and rigid control (American Psychiatric Association, 2013).

To date, one study has found that undergraduate students with strong obsessive-compulsive personality traits engaged in information-seeking behaviour for a longer period of time in comparison to both normal controls and participants with avoidant personality traits (Gallagher, South, & Oltmanns, 2003). Given previous studies have also reported a similar pattern of information-seeking behaviours in high IU individuals (Ladouceur et al., 1997), obsessive-compulsive personality traits represent a potential mechanism by which IU exerts its influence on worry. Individuals with high IU levels and strong obsessive-compulsive personality traits are likely to be more resistant to traditional cognitive therapy which aims to shift cognitive bias, relative to those without the personality traits. This hypothesis warrants further investigation.

Intolerance of Uncertainty in Hierarchical Structure of Psychopathology

The results of Experiment 6 are in line with the notion that IU may not be specific to GAD and that it potentially represents a transdiagnostic factor for broader anxiety psychopathology. From the perspective of hierarchical structure of general and specific factors for anxiety, further understanding of the mechanisms underlying IU in relation to higher-order constructs could inform a more systematic approach to diagnosis and treatment planning. This could be helpful for reducing the interference of IU with information processing and worry. For example, it has been suggested that some dimensions of IU (e.g., desire for predictability) may be related to trait-like constructs such as neuroticism (Berenbaum et al., 2008). Neuroticism has generally been conceptualised as

a universal construct underlying anxiety disorders that by itself provides little explanatory value (Claridge & Davis, 2001), but may be integral in moderating individual responses to uncertainty (Greco & Rogers, 2001). Findings on the extent to which neuroticism exerts its influence on IU have been mixed. Sexton et al. (2003) reported a significant effect of neuroticism on IU, accounting for 28.6% of the variability on the IUS amongst non-clinical undergraduates. IU and negative metacognitive beliefs about worry have also been shown to mediate the relationship between neuroticism and worry in a clinical sample (van der Heiden et al., 2010).

On the other hand, McEvoy and Mahoney (2012) found that the relationship between neuroticism and all symptom measures of anxiety was significantly reduced in a treatment-seeking sample once IU was accounted for. Furthermore, IU accounted for modest but unique variance in measures of worry, agoraphobia, panic disorder, social phobia, OCD, and depression, after controlling for neuroticism. Collectively, these findings suggest that the IUS contains items that appear to partly reflect neuroticism (Berenbaum et al., 2008; Fergus & Rowatt, 2014). Delineating the role of neuroticism in mediating the relationship between IU and worry may provide further insight into the mechanisms of IU.

Another higher-order construct of interest is negative affectivity, as preliminary evidence has indicated the role of IU in mediating the association of negative affectivity with symptoms of worry, depression, and OCD (Norton et al., 2005; Sexton et al., 2003). Negative affectivity, a trait variable conceptualised as a broad predisposition to experiencing negative emotions (e.g., anxiety, fear, and sadness), has long been recognised

as a common vulnerability factor linking emotional disorders (Brown, Chorpita, & Barlow, 1998; Clark & Watson, 1991; Kotov, Watson, P., & Schmidt, 2007; Watson, Clark, & Tellegen, 1988). Meta-analysis studies have found that negative affectivity is differentially related to specific diagnostic subgroups of emotional disorders (e.g., Kotov, Gamez, Schmidt, & Watson, 2010). The results of Experiments 3-5 in this research project highlight the role of state negative affect in influencing expectancy of possible negative outcomes in ambiguous situations. Future research may wish to further investigate the relationship between negative affectivity, IU and threat appraisal.

Two other dispositional constructs that potentially operate at a similar level in the hierarchical model of anxiety as IU are anxiety sensitivity and distress tolerance. Carleton (2012) speculated that anxiety sensitivity and IU share a basis in anxiety related to unknown and potentially harmful consequences. Anxiety sensitivity refers to catastrophic fear of anxiety-related physiological sensations (e.g., heart palpitations, shortness of breath) (Reiss & McNally, 1985; Taylor, Koch, McNally, & Crockett, 1992). Previous research has shown that individuals with high anxiety sensitivity tend to endorse greater fear of strong arousal sensations compared to those with low anxiety sensitivity who experience the same sensations as unpleasant but non-threatening (Reiss, 1991). Anxiety sensitivity has been hypothesised as a risk factor in the development of worry (Floyd, Garfield, & LaSota, 2005; Rodriguez, Bruce, Pagano, Spencer, & Keller, 2004; Taylor et al., 1992). Confirmatory factor analysis studies have suggested that anxiety sensitivity and IU are independent constructs that share a moderate correlation (Carleton, Sharpe, et al., 2007; Dugas, Gosselin, et al., 2001). Hierarchical regression analysis has also shown that IU

accounts for a significant amount of variance in worry scores in undergraduate samples over and above that accounted for by anxiety sensitivity (Dugas, Gosselin, et al., 2001).

It may be that IU in combination with high anxiety sensitivity is more likely to increase worry than either one in isolation. Previous research has shown that experimentally increasing fear of anxiety led to increased worry in individuals with high IU (Buhr & Dugas, 2009). Fear of anxiety, or “fear and avoidance of internal experiences” as defined by Buhr and Dugas (2009), may be related to the perceived negative consequences of anxiety and that a common aetiology in IU and anxiety sensitivity may operate transdiagnostically. Individuals with high anxiety sensitivity have been shown to be more fearful of strong arousal sensations compared to those with low anxiety sensitivity who experience the same sensations as unpleasant but nonthreatening (Reiss, 1991; Reiss & McNally, 1985). Considering findings that individuals with GAD are generally avoidant of arousal experiences (Buhr & Dugas, 2009; Lee, Orsillo, Roemer, & Allen, 2010; Roemer et al., 2005), and that anxiety sensitivity is dependent on IU (Carleton, Norton, et al., 2007), examining the role of broad personality dimensions and clinical traits may further delineate the conceptual boundaries of IU.

Relatedly, a small number of emerging non-clinical studies have identified a negative association of IU with distress tolerance (Macdonald, Pawluck, Koerner, & Goodwill, 2015; Norr et al., 2013). Distress tolerance refers to a person’s capacity to experience and withstand negative psychological states (Simons & Gaher, 2005). This emotion regulation construct has been linked to several clinical disorders, notably borderline personality disorder (Anestis, Gratz, Bagge, & Tull, 2012) and eating disorders

(Anestis, Selby, Fink, & Joiner, 2007). More recently, distress tolerance has been investigated in the context of anxiety, such as health anxiety (Fergus, Bardeen, & Orcutt, 2015). Distress tolerance has been shown to have a negative association with anxiety sensitivity and IU in a treatment-seeking sample consisted of OCD, GAD, social anxiety, and panic disorder/agoraphobia (Laposa, Collimore, Hawley, & Rector, 2015). Interestingly, distress tolerance was no longer a significant predictor of OCD or anxiety disorder symptom severity when AS and IU were considered. It should be noted that due to the relatively recent emergence of research interest in this construct, the theories offered to explicate multiple clinical disorders are still at early stages of development and require further investigation.

Furthering the experimental lines of investigation into the mechanisms underlying the relationship between IU and personality dimensions or the higher order constructs discussed above, and the degree to which these constructs might overlap, will contribute to a more sophisticated understanding of the scope of dysfunctions in GAD. The emotion dysregulation framework argues that GAD, especially when it co-occurs with depression, is characterised by emotional distress reflecting heightened temperamental negative affect. The mechanisms underlying the motivation for individuals with GAD to obtain safety from perceived threats more so than seeking rewards (Mennin et al., 2002, 2005) may be in part influenced by a heterogeneous cluster of personality traits and higher order vulnerabilities. From this perspective, a move towards bolstering abilities to regulate emotion by promoting attentional flexibility as well as addressing information-processing biases in individuals with high IU may lead to greater treatment efficacy in GAD.

Conclusions

The IU model provides a promising theoretical framework for furthering the current understanding of the development and maintenance of worry/GAD, and potentially broader anxiety psychopathology. The work presented in this thesis has extended the IU literature by examining threat appraisal and negative affect processing in response to ambiguity. The findings emerged from the series of experiments reported here point to the roles of overestimation of threat probability and cost, as well as negative beliefs pertaining to problem-solving effectiveness and biased recall as potential underlying mechanisms of IU. Current findings also clearly point to the duality of IU, namely heightened threat appraisal and negative affective response in a state of uncertainty.

The current research suggests that the threshold of IU-related appraisal bias and negative affect is likely to be triggered when information regarding the relative probability of potential negative events occurring is unavailable. While it would be difficult to advocate for any particular intervention strategies on the basis of the current preliminary evidence, reappraisal may be an effective strategy for responding to ambiguous threat particularly when the relative probability of threatening outcomes occurring is available for calibration.

Collectively, results from this project provide useful practical messages with regards to the information-processing characteristics in high IU/GAD individuals when facing ambiguity. Interpretation of these findings in the context of the broader cognitive bias literature underscores the need for reconciling the dual character of IU, appraisal bias and negative affect, with the roles of autonomic arousal and personality diathesis. This will

not only be important from a theoretical perspective, but it will also benefit ongoing clinical efforts to address the tendency to find uncertainty inherently distressing.

References

- Abrahams, N. M., & Alf, E. F. J. (1978). Relative costs and statistical power in the extreme groups approach. *Psychometrika*, 43, 11-17. doi:10.1007/BF02294085
- Alloy, L. B., & Tabachnik, N. (1984). Assessment of covariation by humans and animals: The joint influence of prior expectations and current situational information. *Psychological Review*, 91(1), 112-149. doi:10.1037/0033-295X.91.1.112
- American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (3rd Ed.). Washington, DC: Author.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Amin, J. M., & Lovibond, P. F. (1997). Dissociations between covariation bias and expectancy bias for fear-relevant stimuli. *Cognition and Emotion*, 11(3), 273-289. doi:10.1080/026999397379926
- Amir, N., Elias, J., Klumpp, H., & Przeworski, A. (2003). Attentional bias to threat in social phobia: facilitated processing of threat or difficulty disengaging attention from threat? . *Behaviour Research and Therapy*, 41(11), 1325-1335. doi:10.1016/S0005-7967(03)00039-1
- Andersen, S. M., & Limpert, C. (2001). Future-event schemas: automaticity and rumination in major depression. *Cognitive Therapy and Research*, 25(3), 311-333. doi:10.1023/A:1026447600924

- Anderson, K. G., Dugas, M. J., Koerner, N., Radomsky, A. S., Savard, P., & Turcotte, J. (2012). Interpretive style and intolerance of uncertainty in individuals with anxiety disorders: A focus on generalized anxiety disorder. *Journal of Anxiety Disorders*, 26(8), 823-832. doi:10.1016/j.janxdis.2012.08.003
- Andor, T., Gerlach, A. L., & Rist, F. (2008). Superior perception of phasic physiological arousal and the detrimental consequences of the conviction to be aroused on worrying and metacognitions in GAD. *Journal of Abnormal Psychology*, 117(1), 193-205. doi:10.1037/0021-843X.117.1.193
- Andrews, G., Slade, T., & Issakidis, C. (2002). Deconstructing current comorbidity: data from the Australian National Survey of Mental Health and Well-Being. *The British Journal of Psychiatry*, 181(4), 306-314. doi:10.1192/bjp.181.4.306
- Anestis, M. D., Gratz, K. L., Bagge, C. L., & Tull, M. T. (2012). The interactive role of distress tolerance and borderline personality disorder in suicide attempts among substance users in residential treatment. *Comprehensive Psychiatry*, 53(8), 1208-1216. doi:10.1016/j.comppsy.2012.04.004
- Anestis, M. D., Selby, E. A., Fink, E. L., & Joiner, T. E. (2007). The multifaceted role of distress tolerance in dysregulated eating behaviors. *International Journal of Eating Disorders*, 40(8), 718-726. doi:10.1002/eat.20471
- 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(2), 176-181. doi:10.1037/1040-3590.10.2.176

- Aston-Jones, G., Ennis, M., Pieribone, V. A., Nickell, W. T., & Shipley, M. T. (1986). The brain nucleus locus coeruleus: restricted afferent control of a broad efferent network. *Science*, 234(4777), 734-737. doi:10.1126/science.3775363
- Aston-Jones, G., Rajkowski, J., & Cohen., J. (1999). Role of locus coeruleus in attention and behavioral flexibility. *Biological Psychiatry*, 46(9), 1309-1320. doi:10.1016/S0006-3223(99)00140-7
- Avdagic, E., Morrissey, S. A., & Boschen, M. J. (2014). A randomised controlled trial of acceptance and commitment therapy and cognitive behaviour therapy for generalised anxiety disorder. *Behaviour Change*, 31(2), 110–130. doi:10.1017/bec.2014.5
- Baldwin, P. A., Whitford, T. J., & Grisham, J. R. (2017). The relationship between hoarding symptoms, intolerance of uncertainty, and error-related negativity. *Journal of Psychopathology and Behavioral Assessment*, 39, 313-321. doi:10.1007/s10862-016-9577-3
- Barlow, D. H. (1988). *Anxiety and its disorders: The nature and treatment of anxiety and panic*. New York: Guilford Press.
- Barlow, D. H. (2000). Unravelling the mysteries of anxiety and its disorders from the perspective of emotion theory. *American Psychologist*, 55(11), 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: Guilford Press.

- Barlow, D. H., Allen, L. B., & Choate, M. L. (2004). Toward a unified treatment for emotional disorders. *Behavior Therapy*, 35(2), 205-230. doi:10.1016/S0005-7894(04)80036-4
- Barlow, D. H., Blanchard, E. B., Vermilyea, J. A., Vermilyea, D. B., & DiNardo, P. A. (1986). Generalized anxiety and generalized anxiety disorder: Description and reconceptualization. *American Journal of Psychiatry*, 143(1), 40–44. doi:10.1176/ajp.143.1.40
- Barlow, D. H., Chorpita, B. F., & Turovsky, J. (1996). Fear, panic, anxiety, and disorders of emotion. In D. A. Hope (Ed.), *Perspectives on anxiety, panic, and fear* (Vol. 43, pp. 251-328). Lincoln: University of Nebraska Press.
- Baron, R. M., & Kenny, D. A. (1986). The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology*, 51(6), 1173-1182.
- Beck, A. T. (1976). *Cognitive therapy and the emotional disorder*. New York: International Universities Press.
- Beck, A. T., Brown, G., Steer, R. A., Eidelson, J. I., & Riskind, J. H. (1987). Differentiating anxiety and depression: A test of the cognitive content-specificity hypothesis. *Journal of Abnormal Psychology*, 96(3), 179-183. doi:10.1037/0021-843X.96.3.179
- Beck, A. T., & Clark, D. A. (1988). Anxiety and depression: An information processing perspective. *Anxiety Research*, 1(1), 23-36. doi:10.1080/10615808808248218

- Beck, A. T., & Clark, D. A. (1997). An information processing model of anxiety: automatic and strategic processes. *Behaviour Research and Therapy*, 35(1), 49-58. doi:10.1016/S0005-7967(96)00069-1
- Beck, A. T., Emery, G., & Greenberg, R. (1985). *Anxiety disorders and phobias: A cognitive perspective*. New York: Basic Books.
- Beck, A. T., Emery, G., & Greenberg, R. (2005). *Anxiety Disorders and Phobias: A Cognitive Perspective*. New York: Basic Books.
- Beck, A. T., Rush, A., Shaw, B., & Emery, G. (1979). *Cognitive therapy of depression*. New York: Guilford Press.
- Beck, A. T., Steer, R. A., & Brown, T. A. (1996). *Manual for the Beck Depression Inventory-II* (2nd ed.). San Antonio, TX: Psychological Corporation.
- Becker, E. S., Roth, W. T., Andrich, M., & Margraf, J. (1999). Explicit memory bias in anxiety disorders. *Journal of Abnormal Psychology*, 108(1), 153-163. doi:10.1037/0021-843X.108.1.153
- Behar, E., Alcaine, O., Zuellig, A. R., & Borkovec, T. D. (2003). Screening for generalized anxiety disorder using the Penn State Worry Questionnaire: a receiver operating characteristic analysis. *Journal of Behavior Therapy and Experimental Psychiatry*, 34(1), 25-43. doi:10.1016/S0005-7916(03)00004-1
- Behar, E., DiMarco, I. D., Hekler, E. B., Mohlman, J., & Staples, A. M. (2009). Current theoretical models of generalized anxiety disorder (GAD): Conceptual review and treatment implications. *Journal of Anxiety Disorders*, 23(8), 1011-1023. doi:10.1016/j.janxdis.2009.07.006

- Berenbaum, H. (2010). An initiation–termination two-phase model of worrying. *Clinical Psychology Review*, 30(8), 962-975. doi:10.1016/j.cpr.2010.06.011
- Berenbaum, H., Bredemeier, K., & Thompson, R. J. (2008). Intolerance of uncertainty: Exploring its dimensionality and associations with need for cognitive closure, psychopathology, and personality. *Journal of Anxiety Disorders*, 22(1), 117-125. doi:10.1016/j.janxdis.2007.01.004
- Berenbaum, H., Thompson, R. J., & Bredemeier, K. (2007). Perceived threat: Exploring its association with worry and its hypothesized antecedents. *Behaviour Research and Therapy*, 45(10), 2473–2482. doi:10.1016/j.brat.2007.03.015
- Berenbaum, H., Thompson, R. J., & Pomerantz, E. M. (2007). The relation between worrying and concerns: The importance of perceived probability and cost. *Behaviour Research and Therapy*, 45 (2), 301–311. doi:10.1016/j.brat.2006.03.009
- Bernstein, A., Zvolensky, M. J., Marshall, E. C., & Schmidt, N. B. (2009). Laboratory test of a novel structural model of anxiety sensitivity and panic vulnerability. *Behavior Therapy*, 40(2), 171–180. doi:10.1016/j.beth.2008.05.001
- Bird, K. D., Hadzi-Pavlovic, D., & Isaac, A. P. (2000). PSYC. Retrieved from <http://www.psy.unsw.edu.au/research/psy.htm>
- Birrell, J., Meares, K., Wilkinson, A., & Freeston, M. (2011). Toward a definition of intolerance of uncertainty: A review of factor analytical studies of the Intolerance of Uncertainty Scale. *Clinical Psychology Review*, 31(7), 1198-1208. doi:10.1016/j.cpr.2011.07.009

- Boelen, P. A., & Reijntjes, A. (2009). Intolerance of uncertainty and social anxiety. *Journal of Anxiety Disorders*, 23(1), 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(2), 133-144. 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
- Borkovec, T. D. (1985). Worry: A potentially valuable concept. *Behaviour Research and Therapy*, 23(4), 481-482. doi:10.1016/0005-7967(85)90178-0
- Borkovec, T. D. (1994). The nature, functions, and origins of worry. In G. D. F. Tallis (Ed.), *Worrying: perspectives on theory assessment and treatment* (pp. 5-33). Sussex, England: Wiley & Sons.
- Borkovec, T. D., Alcaine, O., & Behar, E. (2004). Avoidance theory of worry and generalised anxiety disorder. In C. L. T. R. G. Heimberg, & D. S. Mennin (Eds.), *Generalised Anxiety Disorder: Advances in research and practice* (pp. 77-108). New York: The Guildford Press.

- Borkovec, T. D., & Hu, S. (1990). The effect of worry on cardiovascular response to phobic imagery. *Behaviour Research and Therapy*, 28(1), 69-73. doi:10.1016/0005-7967(90)90056-O
- Borkovec, T. D., & Inz, J. (1990). The nature of worry in generalized anxiety disorder: A predominance of thought activity. *Behaviour Research and Therapy*, 28(2), 153-158. doi:10.1016/0005-7967(90)90027-G
- Borkovec, T. D., Lyonfields, J. D., Wiser, S. L., & Diehl, L. (1993). The role of worrisome thinking in the suppression of cardiovascular response to phobic imagery. *Behaviour Research and Therapy*, 31(3), 321-324. doi:10.1016/0005-7967(93)90031-O
- Borkovec, T. D., Ray, W. J., & Stöber, J. (1998). Worry: A cognitive phenomenon intimately linked to affective, physiological, and interpersonal behavioral processes. *Cognitive Therapy and Research*, 22(6), 561-576. doi:10.1023/A:1018790003416
- Borkovec, T. D., Robinson, E., Pruzinsky, T., & DePree, J. A. (1983). Preliminary exploration of worry: Some characteristics and processes. *Behaviour Research and Therapy*, 21(1), 9-16. doi:10.1016/0005-7967(83)90121-3
- Borkovec, T. D., & Roemer, L. (1995). Perceived functions of worry among generalized anxiety subjects: distraction from more emotionally distressing topics? *Journal of Behavior Therapy and Experimental Psychiatry*, 26(1), 25-30. doi:10.1016/0005-7916(94)00064-S
- Bosch, J. A., Veerman, E. C., de Geus, E. J., & Proctor, G. B. (2011). α -Amylase as a reliable and convenient measure of sympathetic activity: don't start salivating just

yet! *Psychoneuroendocrinology*, 36(4), 449-453.

doi:10.1016/j.psyneuen.2010.12.019

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(6), 630-645. doi:10.1002/jclp.21965

Bradley, B. P., Mogg, K., Millar, N., & White, J. (1995). Selective processing of negative information: Effects of clinical anxiety, concurrent depression, and awareness.

Journal of Abnormal Psychology, 104(3), 532-536. doi:10.1037/0021-843X.104.3.532

Bradley, B. P., Mogg, K., & Williams, R. (1995). Implicit and explicit memory for emotion-congruent information in clinical depression and anxiety. *Behaviour Research and Therapy*, 33(7), 755-770. doi:10.1016/0005-7967(95)00029-W

doi:10.1016/0005-7967(95)00029-W

Bredemeier, K., & Berenbaum, H. (2008). Intolerance of uncertainty and perceived threat.

Behaviour Research and Therapy, 46(1), 28-38. doi:10.1016/j.brat.2007.09.006

Brosschot, J. F., Van Dijk, E., & Thayer, J. F. (2007). Daily worry is related to low heart rate variability during waking and the subsequent nocturnal sleep period.

International Journal of Psychophysiology, 63(1), 39-47. doi:10.1016/j.ijpsycho.2006.07.016

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(1), 33-37. doi:10.1016/0005-7967(92)90093-V

- Brown, T. A., & Barlow, D. H. (2014). *Anxiety and Related Disorders Interview Schedule for DSM-5 (ADIS-5) - Adult Version*. New York, NY: Oxford University Press.
- 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*(4), 585-599. doi:10.1037/0021-843X.110.4.585
- Brown, T. A., Chorpita, B. F., & Barlow, D. H. (1998). Structural relationships among dimensions of the DSM-IV anxiety and mood disorders and dimensions of negative affect, positive affect, and autonomic arousal. *Journal of Abnormal Psychology, 107*(2), 179-192. doi:10.1037/0021-843X.107.2.179
- Budner, S. (1962). Intolerance of ambiguity as a personality variable. *Journal of Personality, 30*(1), 29-50. doi:10.1111/j.1467-6494.1962.tb02303.x
- Buhr, K., & Dugas, M. J. (2002). The intolerance of uncertainty Scale: Psychometric properties of the English version. *Behaviour Research and Therapy, 40*(8), 931-945. doi: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*(2), 222-236. doi:10.1016/j.janxdis.2004.12.004
- Buhr, K., & Dugas, M. J. (2009). The role of fear of anxiety and intolerance of uncertainty in worry: An experimental manipulation. *Behaviour Research and Therapy, 47*(3), 215-223. doi:10.1016/j.brat.2008.12.004

- Burns, G. L., Keortge, S. G., Formea, G. M., & Sternberger, L. G. (1996). Revision of the Padua Inventory of obsessive compulsive disorder symptoms: Distinctions between worry, obsessions, and compulsions. *Behaviour Research and Therapy*, 34(2), 163-173. doi:10.1016/0005-7967(95)00035-6
- Butler, G., & Mathews, A. (1983). Cognitive processes in anxiety. *Advances in Behaviour Research and Therapy*, 5(1), 51-62. doi:10.1016/0146-6402(83)90015-2
- Butler, G., & Matthews, A. (1987). Anticipatory anxiety and risk perception. *Cognitive Therapy and Research*, 11(5), 551-565. doi:10.1016/0146-6402(83)90015-2
- Byrne, S. P., Hunt, C. J., & Chang, B. P. I. (2015). Comparing the Roles of Ambiguity and Unpredictability in Intolerance of Uncertainty. *Behaviour Change*, 32(1), 26-34. doi:10.1017/bec.2014.27
- Camerer, C., & Weber, M. (1992). Recent developments in modeling preferences: Uncertainty and ambiguity. *Journal of Risk and Uncertainty*, 5(4), 325-370. doi:10.1007/BF00122575
- Carleton, R. N. (2012). The intolerance of uncertainty construct in the context of anxiety disorders: Theoretical and practical perspectives. *Expert Review of Neurotherapeutics*, 12(8), 937 - 947. doi:10.1586/ern.12.82
- 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(2), 189-195. doi: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(5), 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(4), 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(2), 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(3), 468-479. doi:10.1016/j.janxdis.2012.01.011
- Carleton, R. N., Norton, P. J., & Asmundson, G. J. G. (2007). Fearing the unknown: A short version of the Intolerance of Uncertainty Scale. *Journal of Anxiety Disorders*, 21(1), 105-117. doi:10.1016/j.janxdis.2006.03.014
- Carleton, R. N., Sharpe, D., & Asmundson, G. J. G. (2007). Anxiety sensitivity and intolerance of uncertainty: Requisites of the fundamental fears? *Behaviour Research and Therapy*, 45(10), 2307-2316. doi:10.1016/j.brat.2007.04.006

- Cartwright-Hatton, S., & Wells, A. (1997). Beliefs about worry and intrusions: the metacognitions questionnaire and its correlates. *Journal of Anxiety Disorders*, 11(3), 279-296. doi: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. doi:10.1037/0022-006X.52.6.1090
- Chan, C. K. Y., & Lovibond, P. F. (1996). Expectancy bias in trait anxiety. *Journal of Abnormal Psychology*, 105(4), 637-647. doi:10.1037/0021-843X.105.4.637
- Claridge, G., & Davis, C. (2001). What's the use of neuroticism. *Personality and Individual Differences*, 31(3), 383-400. doi:10.1016/S0191-8869(00)00144-6
- Clark, D. A. (2004). *Cognitive behavior therapy for OCD*. New York: Guilford.
- Clark, D. A., & Beck, A. T. (2010). *Cognitive Therapy of Anxiety Disorders: Science and Practice*. New York, NY: Guilford Press.
- Clark, D. M. (1986). A cognitive approach to panic. *Behaviour Research and Therapy*, 24(4), 461-470. doi:10.1016/0005-7967(86)90011-2
- Clark, D. M., & Wells, A. (1995). A cognitive model of social phobia. In R. G. Heimberg, M. R. Liebowitz, D. A. Hope, & I. Schneier (Eds.), *Social phobia: diagnosis, assessment, and treatment*. New York: Guilford Press.
- Clark, L. A., & Watson, D. (1991). Tripartite model of anxiety and depression: Psychometric evidence and taxonomic implications. *Journal of Abnormal Psychology*, 100(3), 316-336. doi:10.1037/0021-843X.100.3.316

- Coles, M. E., & Heimberg, R. G. (2002). Memory biases in the anxiety disorders: Current status. *Clinical Psychology Review*, 22(4), 587–627. doi:10.1016/S0272-7358(01)00113-1
- Coles, M. E., Turk, C. L., & Heimberg, R. G. (2007). Memory bias for threat in generalized anxiety disorder: The potential importance of stimulus relevance. *Cognitive Behaviour Therapy*, 36(2), 65-73. doi:10.1080/16506070601070459
- Conway, M., Csank, P. A. R., Holm, S., & Blake, C. K. (2000). On assessing individual differences in rumination on sadness. *Journal of Personality Assessment*, 75(3), 404-425. doi:10.1207/S15327752JPA7503_04
- Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology*, 78(1), 98-104. doi:10.1037/0021-9010.78.1.98
- Cowie, J., Clementi, M. A., & Alfano, C. A. (2016). Examination of the Intolerance of Uncertainty Construct in Youth With Generalized Anxiety Disorder. *Journal of Clinical Child & Adolescent Psychology*, 47(6), 1014-1022. doi:10.1080/15374416.2016.1212358
- Craske, M. G., Rapee, R. M., Jackel, L., & Barlow, D. H. (1989). Qualitative dimensions of worry in DSM-III-R generalized anxiety disorder subjects and nonanxious controls. *Behaviour Research and Therapy*, 27(4), 397-402. doi:10.1016/0005-7967(89)90010-7

- Craske, M. G., Treanor, M., Conway, 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
- Crawford, J. R., & Henry, J. D. (2003). The Depression Anxiety Stress Scales (DASS): Normative data and latent structure in a large non-clinical sample. *British Journal of Clinical Psychology*, 42, 111-131. doi:10.1348/014466503321903544
- Cuijpers, P., Sijbrandij, M., Koole, S., Huibers, M., Berking, M., & Andersson, G. (2014). Psychological treatment of generalized anxiety disorder: A meta-analysis. *Clinical Psychology Review*, 34(2), 130-140. doi:10.1016/j.cpr.2014.01.002
- D'Zurilla, T. J., & Goldfried, M. R. (1971). Problem solving and behavior modification. *Journal of Abnormal Psychology*, 78(1), 107-126. doi:10.1037/h0031360
- D'Zurilla, T. J., & Nezu, A. M. (1990). Development and preliminary evaluation of the Social Problem-Solving Inventory. *Psychological Assessment*, 2(2), 156-163. doi:10.1037/1040-3590.2.2.156
- Davey, G. C. L. (1994). Worrying, social problem solving, and problem solving confidence. *Behaviour Research and Therapy*, 32(3), 327-330. doi:10.1016/0005-7967(94)90130-9
- Davey, G. C. L., Hampton, J., Farrell, J., & Davidson, S. (1992). Some characteristics of worry: evidence for worry and anxiety as separate constructs. *Personality and Individual Differences*, 13(2), 133-147. doi:10.1016/0191-8869(92)90036-O

- Davey, G. C. L., Jubb, M., & Cameron, C. (1996). Catastrophic worrying as a function of changes in problem-solving confidence. *Cognitive Therapy and Research*, 20(4), 333-344. doi:10.1007/BF02228037
- Davis, R. N., & Valentiner, D. P. (2000). Does meta-cognitive theory enhance our understanding of pathological worry and anxiety? *Personality and Individual Differences*, 29(3), 513-526. doi:10.1016/S0191-8869(99)00211-1
- de Bruin, G. O., Rassin, E., & Muris, P. (2006). Worrying in the lab: Does intolerance of uncertainty have predictive value? *Behaviour Change*, 23(2), 138-147. doi:10.1375/behc.23.2.138
- 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
- Deschenes, S. S., Dugas, M. J., Radomsky, A. S., & Buhr, K. (2010). Experimental manipulation of beliefs about uncertainty: Effects on interpretive processing and access to threat schemata. *Journal of Experimental Psychopathology*, 1(1), 52-70. doi:10.5127/jep.008510
- Dugas, M. J. (2000). Generalized anxiety disorder publications: So where do we stand? . *Journal of Anxiety Disorders*, 14(1), 31-40. doi:10.1016/S0887-6185(99)00034-1
- Dugas, M. J., Anderson, K. G., Deschenes, S. S., & Donegan, E. (2010). Generalized anxiety disorder publications: Where do we stand a decade later? *Journal of Anxiety Disorders*, 24(7), 780-784. doi:10.1016/j.janxdis.2010.05.012

- 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(1), 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* (pp. 143-163). New York: Guilford Press.
- Dugas, M. J., Freeston, M. H., & Ladouceur, R. (1997). Intolerance of uncertainty and problem orientation in worry. *Cognitive Therapy and Research*, 21(6), 593 -606. doi:10.1023/A:1021890322153
- Dugas, M. J., Freeston, M. H., Ladouceur, R., Rhéaume, J., Provencher, M., & Boisvert, J.-M. (1998). Worry themes in primary GAD, secondary GAD, and other anxiety disorders. *Journal of Anxiety Disorders*, 12(3), 253-261. doi:10.1016/S0887-6185(98)00013-9
- Dugas, M. J., Freeston, M. H., Provencher, M. D., Lachance, S., Ladouceur, R., & Gosselin, P. (2001). The Worry and Anxiety Questionnaire: validation in non-clinical and clinical samples. *Journal de Therapie Comportementale et Cognitive*, 11, 31-36.
- Dugas, M. J., Gagnon, F., Ladouceur, R., & Freeston, H. (1998). Generalized anxiety disorder: A preliminary test of a conceptual model. *Behaviour Research and Therapy*, 36(2), 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(5), 551- 558. doi:10.1023/A:1005553414688
- Dugas, M. J., Hedayati, M., Karavidas, A., Buhr, K., Francis, K., & Phillips, N. A. (2005). Intolerance of uncertainty and information processing: Evidence of biased recall and interpretations. *Cognitive Therapy and Research*, 29(1), 57-70. doi:10.1007/s10608-005-1648-9
- Dugas, M. J., & Koerner, N. (2005). Cognitive-behavioral treatment for generalized anxiety disorder: Current status and future directions. *Journal of Cognitive Psychotherapy: An International Quarterly*, 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. *Behavior Modification*, 24(5), 635-657. doi:10.1177/0145445500245002
- Dugas, M. J., Ladouceur, R., Boisvert, J.-M., & Freeston, M. H. (1996). Generalized anxiety disorder: Fundamental elements and psychological interventions. *Canadian Psychology*, 37(1), 40-53. doi:10.1037/0708-5591.37.1.40
- Dugas, M. J., Ladouceur, R., Léger, E., Freeston, M. H., Langolis, 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(4), 821-825. doi:10.1037/0022-006x.71.4.821

- Dugas, M. J., Letarte, H., Rhéaume, J., Freeston, M. H., & Ladouceur, R. (1995). Worry and problem solving: evidence of a specific relationship *Cognitive Therapy and Research*, 19(1), 109–120. doi:10.1007/BF02229679
- 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(3), 329-343. doi: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: Routledge.
- Dugas, M. J., Savard, P., Gaudet, A., Turcotte, J., Laugesen, N., Robichaud, M., . . . Koerner, N. (2007). Can the components of a cognitive model predict the severity of Generalized Anxiety Disorder? *Behavior Therapy*, 38(2), 169-178. doi:10.1016/j.beth.2006.07.002
- Dugas, M. J., Schwartz, A., & Francis, K. (2004). Intolerance of uncertainty, worry, and depression. *Cognitive Therapy and Research*, 28(6), 835-842. doi:10.1007/s10608-004-0669-0
- Dunsmoor, J. E., Bandettini, P. A., & Knight, D. C. (2007). Impact of continuous versus intermittent CS-UCS pairing on human brain activation during Pavlovian fear conditioning. *Behavioral Neuroscience*, 121(4), 635-642. doi:10.1037/0735-7044.121.4.635
- Durham, R. C., Chambers, J. A., McDonald, R. R., Power, K. G., & Major, K. (2003). Does cognitive-behavioural therapy influence the long-term outcome of generalized

- anxiety disorder? An 8-14 year follow-up of two clinical trials. *Psychological Medicine*, 33(3), 499-509. doi:10.1017/S0033291702007079
- Dyck, I. R., Phillips, K. A., Warshaw, M. G., Dolan, R. T., Shea, M. T., Stout, R. L., . . . Keller, M. B. (2001). Patterns of personality pathology in patients with generalized anxiety disorder, panic disorder with and without agoraphobia, and social phobia. *Journal of Personality Disorders*, 15(1), 60-71. doi:10.1521/pedi.15.1.60.18643
- Ehlers, A., & Clark, D. M. (2000). A cognitive model of posttraumatic stress disorder. *Behaviour Research and Therapy*, 38(4), 319-345. doi:10.1016/S0005-7967(99)00123-0
- Einhorn, H. J., & Hogarth, R. M. (1985). Ambiguity and uncertainty in probabilistic inference. *Psychological Review*, 92(4), 433-461. doi:10.1037/0033-295X.92.4.433
- Ellsberg, D. (1961). Risk, Ambiguity, and the Savage axioms. *Quarterly Journal of Economics*, 75(4), 643-669. doi:10.2307/1884324
- England, S. L., & Dickerson, M. (1988). Intrusive thoughts; unpleasantness not the major cause of uncontrollability. *Behaviour Research and Therapy*, 26(3), 279-282. doi:10.1016/0005-7967(88)90012-5
- Eysenck, M. W., Mogg, K., May, J., Richards, A., & Mathews, A. (1991). Bias in interpretation of ambiguous sentences related to threat in anxiety. *Journal of Abnormal Psychology*, 100(2), 144-150. doi:10.1037/0021-843X.100.2.144
- Fergus, T. A., & Bardeen, J. R. (2013). Anxiety sensitivity and intolerance of uncertainty: Evidence of incremental specificity in relation to health anxiety. *Personality and Individual Differences Jun*, 55(6), 640–644. doi:10.1016/j.paid.2013.05.016

- Fergus, T. A., Bardeen, J. R., & Orcutt, H. K. (2015). Examining the specific facets of distress tolerance that are relevant to health anxiety. *Journal of Cognitive Psychotherapy*, 29(1), 32-44. doi:10.1891/0889-8391.29.1.32
- Fergus, T. A., Bardeen, J. R., & Wu, K. D. (2013). Intolerance of uncertainty and uncertainty-related attentional biases: Evidence of facilitated engagement or disengagement difficulty? *Cognitive Therapy and Research*, 37(4), 735-741. doi:10.1007/s10608-012-9509-9
- Fergus, T. A., & Rowatt, W. C. (2014). Intolerance of uncertainty and personality: Experiential permeability is associated with difficulties tolerating uncertainty. *Personality and Individual Differences*, 58, 128-131. doi:10.1016/j.paid.2013.10.017
- Fergus, T. A., Valentiner, D. P., Wu, K. D., & McGrath, P. B. (2015). Examining the symptom-level specificity of negative problem orientation in a clinical sample. *Cognitive Behaviour Therapy*, 44(2), 153-161. doi:10.1080/16506073.2014.987314
- Fergus, T. A., & Wu, K. D. (2010). Do symptoms of generalized anxiety and obsessive-compulsive disorder share cognitive processes? . *Cognitive Therapy and Research*, 34(2), 168-176. doi:10.1007/s10608-009-9239-9
- Fetzner, M. G., Horswill, S. C., Boelen, P. A., & Carleton, R. N. (2013). Intolerance of uncertainty and PTSD: Exploring the construct relationship in a community sample with a heterogeneous trauma history. *Cognitive Therapy and Research*, 37(4), 725-734. doi:10.1007/s10608-013-9531-6

- Fisher, A. J., Granger, D. A., & Newman, M. G. (2010). Sympathetic arousal moderates self-reported physiological arousal symptoms at baseline and physiological flexibility in response to a stressor in generalized anxiety disorder. *Biological Psychology*, 83(3), 191–200. doi:10.1016/j.biopsycho.2009.12.007
- Fisher, P. L., & Wells, A. (2011). Conceptual models of generalized anxiety disorder. *Psychiatric Annals*, 41(2), 127-132. doi:10.3928/00485713-20110203-11
- Floyd, M., Garfield, A., & LaSota, M. T. (2005). Anxiety sensitivity and worry. *Personality and Individual Differences*, 38(5), 1223-1229. doi:10.1016/j.paid.2004.08.005
- Foa, E. B., Franklin, M. E., Perry, K. J., & Herbert, J. D. (1996). Cognitive biases in generalized social phobia. *Journal of Abnormal Psychology*, 105(3), 433–439. doi:10.1037/0021-843X.105.3.433
- Foa, E. B., Huppert, J. D., & Cahill, S. P. (2006). Emotional processing theory: an update. In B. O. Rothbaum (Ed.), *Pathological anxiety: Emotional processing in etiology and treatment* (pp. 3-24). New York: Guilford Press.
- Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin*, 99, 22-35. doi:10.1037/0033-2909.99.1.20
- Freeston, M. H., Dugas, M. J., & Ladouceur, R. (1996). Thoughts, images, worry, and anxiety. *Cognitive Therapy and Research*, 20(3), 265-273. doi:10.1007/BF02229237

- Freeston, M. H., Ladouceur, R., Rhéaume, J., Letarte, H., Gagnon, F., & Thibodeau, N. (1994). Self-Report of Obsessions and Worry. *Behaviour Research and Therapy*, 32(1), 29-36. doi:10.1016/0005-7967(94)90081-7
- Freeston, M. H., Rhéaume, J., Letarte, H., Dugas, M. J., & Ladouceur, R. (1994). Why do people worry? . *Personality and Individual Differences*, 17(6), 791-802. doi:10.1016/0191-8869(94)90048-5
- Frenkel-Brunswik, E. (1949). Intolerance of ambiguity as an emotional and perceptual personality variable. *Journal of Personality*, 18(1), 108-143. doi:10.1111/j.1467-6494.1949.tb01236.x
- Fresco, D. M., Frankel, A. N., Mennin, D. S., Turk, C. L., & Heimberg, R. G. (2002). Distinct and overlapping features of rumination and worry: The relationship of cognitive production to negative affective states. *Cognitive Therapy and Research*, 26(2), 179-188. doi:10.1023/A:1014517718949
- Fricchione, G. (2004). Generalized Anxiety Disorder. *New England Journal of Medicine*, 351(7), 675-682. doi:10.1056/NEJMc022342
- Friedman, B. H., Thayer, J. F., & Borkovec, T. D. E. (2000). Explicit memory bias for threat words in generalized anxiety disorder. *Behavior Therapy*, 31(4), 745–756. doi:10.1016/S0005-7894(00)80042-8
- Frost, R. O., Steketee, G., & Grisham, J. (2004). Measurement of compulsive hoarding: saving inventory-revised. *Behaviour Research and Therapy*, 42(10), 1163-1182. doi:10.1016/j.brat.2003.07.006

- Furnham, A., & Marks, J. (2013). Tolerance of Ambiguity: A Review of the Recent Literature *Psychology*, 4(9), 717-728. doi:10.4236/psych.2013.49102
- Gallagher, N. G., South, S. C., & Oltmanns, T. F. (2003). Attentional coping style in obsessive-compulsive personality disorder: a test of the intolerance of uncertainty hypothesis. *Journal of Personality and Individual Differences*, 34, 41-57. doi:10.1016/S0191-8869(02)00025-9
- Garber, J., & Hollon, S. D. (1991). What can specificity designs say about causality in psychopathology research? . *Psychological Bulletin*, 110(1), 129-136. doi:10.1037/0033-2909.110.1.129
- Garner, M., Mogg, K., & Bradley, B. P. (2006). Orienting and maintenance of gaze to facial expressions in social anxiety. *Journal of Abnormal Psychology*, 115(4), 760-770. doi:10.1037/0021-843X.115.4.760
- 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(6), 923-933. doi:10.1016/j.cpr.2011.05.001
- Gillett, C. B., Bilek, E. L., Hanna, G. L., & Fitzgerald, K. D. (2018). Intolerance of uncertainty in youth with obsessive-compulsive disorder and generalized anxiety disorder: A transdiagnostic construct with implications for phenomenology and treatment. *Clinical Psychology Review*, 60, 100-108. doi:10.1016/j.cpr.2018.01.00
- Gorka, S. M., Lieberman, L., Nelson, B. D., Sarapas, C., & Shankman, S. A. (2014). Aversive responding to safety signals in panic disorder: The moderating role of

- intolerance of uncertainty. *Journal of Anxiety Disorders*, 28(7), 731-736.
doi:10.1016/j.janxdis.2014.06.004
- Gosselin, P., Ladouceur, R., Evers, A., Laverdiere, 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(8), 1427-1439.
doi:10.1016/j.janxdis.2008.02.005
- Gosselin, P., Langlois, F., Fresston, M. H., Ladouceur, R., Dugas, M. J., & Pelletier, O. (2002). Le Questionnaire d'évitement cognitif (QEC): Développement et validation auprès d'adultes et d'adolescents [The Cognitive Avoidance Questionnaire (CAQ): Development and validation among adults and adolescent samples]. *Journal de Thérapie Comportementale et Cognitive*, 12, 24 - 37.
- Gosselin, P., Pelletier, O., & Ladouceur, R. (2001). *The Negative Problem Orientation Questionnaire (NPOQ): Development and validation among a non-clinical sample*. Poster session presented at the annual meeting of the World Congress of Behavioral and Cognitive Therapies. Vancouver, BC, July.
- Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and validation of the Difficulties with Emotion Regulation Scale. *Journal of Psychopathology and Behavioral Assessment*, 26(1), 41-54. doi:10.1023/B:JOBA.00000007455.08539.94
- Greco, V., & Roger, D. (2001). Coping with uncertainty: The construction and validation of a new measure. *Personality and Individual Differences*, 31(4), 519-534.
doi:10.1016/S0191-8869-(00)00156-2

- Greco, V., & Roger, D. (2003). Uncertainty, stress, and health *Personality and Individual Differences*, 34(6), 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(3), 593-600. doi:10.1016/j.paid.2005.02.014
- Grenier, S., & Ladouceur, R. (2004). Manipulation de l'intolérance à l'incertitude et inquiétudes. *Canadian Journal of Behavioural Science*, 36(1), 56-65. doi:10.1037/h0087216
- Grupe, D. W., & Nitschke, J. B. (2011). Uncertainty is associated with biased expectancies and heightened responses to aversion. *Emotion*, 11(2), 413-424. doi:10.1037/a0022583
- Harvey, A. E., Watkins, E., Mansell, W., & Shafran, R. (2004). *Cognitive behavioural processes across psychological disorders: A transdiagnostic approach to research and treatment*. New York: Oxford.
- Hayes, S., Hirsch, C. R., & Mathews, A. (2010). Facilitating a benign attentional bias reduces negative thought intrusions. *Journal of Abnormal Psychology*, 119(1), 235-240. doi:10.1037/a0018264
- Hearn, C. S., Donovan, C. L., Spence, S. H., & March, S. (2017). A worrying trend in social anxiety: To what degree are worry and its cognitive factors associated with youth social anxiety disorder? . *Journal of Affective Disorders* 208, 33-40. doi:10.1016/j.jad.2016.09.052

- Hebert, E. A., Dugas, M. J., Tulloch, T. G., & Holowka, D. W. (2014). Positive beliefs about worry: A psychometric evaluation of the Why Worry-II. *Personality and Individual Differences*, 56, 3-8. doi:10.1016/j.paid.2013.08.009
- Helsen, K., Van den Bussche, E., Vlaeyen, J. W., & Goubert, L. (2013). Confirmatory factor analysis of the Dutch Intolerance of Uncertainty Scale: Comparison of the full and short version. *Journal of Behavior Therapy and Experimental Psychiatry*, 44(1), 21-29. doi:10.1016/j.jbtep.2012.07.004
- 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(2), 227-239. doi:10.1348/014466505X29657
- Hirsch, C. R., MacLeod, C., Mathews, A., Sandher, O., Siyani, A., & Hayes, S. (2011). The contribution of attentional bias to worry: distinguishing the roles of selective engagement and disengagement. *Journal of Anxiety Disorders*, 25(2), 272-277. doi:10.1016/j.janxdis.2010.09.013
- Hirsch, C. R., & Mathews, A. (2012). A cognitive model of pathological worry. *Behaviour Research and Therapy*, 50(10), 636-646. doi:10.1016/j.brat.2012.06.007
- Hirsch, C. R., Mathews, A., Lequertier, B., Perman, G., & Hayes, S. (2013). Characteristics of worry in Generalized Anxiety Disorder. *Journal of Behavior Therapy and Experimental Psychiatry*, 44(4), 388-395. doi:10.1016/j.jbtep.2013.03.004
- Hoehn-Saric, R., & McLeod, D. R. (1988). The peripheral sympathetic nervous system: Its role in pathological anxiety. *Psychiatric Clinics of North America*, 11(2), 375-386.

- Hoehn-Saric, R., McLeod, D. R., Funderburk, F., & Kowalski, P. (2004). Somatic symptoms and physiologic responses in generalized anxiety disorder and panic disorder: An ambulatory monitor study. *Archives of General Psychiatry*, 61(9), 913-921. doi:10.1001/archpsyc.61.9.913
- Hoehn-Saric, R., McLeod, D. R., & Zimmerli, W. D. (1989). Somatic manifestations in women with generalized anxiety disorder. *Archives of General Psychiatry*, 46(12), 1113-1119. doi:10.1001/archpsyc.1989.01810120055009
- Hofmann, S. G., Moscovitch, D. A., Litz, B. T., Kim, H. J., Davis, L. L., & Pizzagalli, D. A. (2005). The worried mind: autonomic and prefrontal activation during worrying. *Emotion*, 5(4), 464-475. doi:10.1037/1528-3542.5.4.464
- 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(2), 157-174. doi:10.1016/j.janxdis.2005.01.002
- Hunot, V., Churchill, R., Teixeira, V., & Silva de Lima, M. (2007). Psychological therapies for generalised anxiety disorder. *Cochrane Database of Systematic Reviews*, Issue 1. Art. No.: CD001848. doi:10.1002/14651858.CD001848.pub4.
- 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(5), 535– 542. doi:10.1016/j.janxdis.2013.07.008

- 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), 54-62. doi:10.1080/16506073.2014.959039
- Kagan, J., Snidman, N., & Arcus, D. (1998). The value of extreme groups. In R. B. Cairns, L. R. Bergman, & J. Kagan (Eds.), *Methods and models for studying the individual: Essays in honor of Marian Radke-Yarrow* (pp. 65–82). Thousand Oaks: CA: Sage.
- Kertz, S. J., & Woodruff-Borden, J. (2011). The developmental psychopathology of worry. *Clinical Child and Family Psychology Review*, 14(2), 174-197. doi:10.1007/s10567-011-0086-3
- Kessler, R. C., Andrews, G., Colpe, L. J., Hiripi, E., Mroczek, D. K., Normand, S.-L. T., . . . Zaslavsky, A. M. (2002). Short screening scales to monitor population prevalence and trends in non-specific psychological distress. *Psychological Medicine*, 32(6), 959–976. doi:10.1017/S0033291702006074
- Kircanski, K., Craske, M. G., & Bjork, R. A. (2008). Thought suppression enhances memory bias for threat material. *Behaviour Research and Therapy*, 46, 462–476. doi:10.1016/j.brat.2008.01.009
- Kircanski, K., Mortazavi, A., Castriotta, N., Baker, A. S., Mystkowski, J. L., Yi, R., & Craske, M. G. (2012). Challenges to the traditional exposure paradigm: Variability in exposure therapy for contamination fears. *Journal of Behavior Therapy and Experimental Psychiatry*, 43(2), 745-751. doi:10.1016/j.jbtep.2011.10.010
- Koerner, N., & Dugas, M. J. (2006). A cognitive model of generalized anxiety disorder: The role of intolerance of uncertainty. In G. C. L. D. A. W. (Eds) (Ed.), *Worry and*

its psychological disorders: Theory, assessment and treatment (pp. 201-216).

Chichester, England: Wiley.

- 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(5), 619-638. doi:10.1007/s10608-007-9125-2
- Konstantellou, A., & Reynolds, M. (2010). Intolerance of uncertainty and metacognitions in a non-clinical sample with problematic and normal eating attitudes. *Eating Behaviors*, 11(3), 193-196. doi:10.1016/j.eatbeh.2010.01.003
- Koster, E. H. W., Crombez, G., Verschuere, B., & De Houwer, J. (2004). Selective attention to threat in the dot probe paradigm: differentiating vigilance and difficulty to disengage. *Behaviour Research and Therapy*, 42(10), 1183–1192. doi:10.1016/j.brat.2003.08.001
- 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(5), 768-821. doi:10.1037/a0020327
- Kotov, R., Watson, D., P., R. J., & Schmidt, N. B. (2007). Personality traits and anxiety symptoms: the multilevel trait predictor model. *Behaviour Research and Therapy*, 45(7), 1485-1503. doi:10.1016/j.brat.2006.11.011
- Krebs, G., Hirsch, C. R., & Mathews, A. (2010). The effect of attention modification with explicit vs. minimal instructions on worry. *Behaviour Research and Therapy*, 48(3), 251-256. doi:10.1016/j.brat.2009.10.009

- Krohne, H. W. (1989). The concept of coping modes: Relating cognitive person variables to actual coping behaviour. *Advances in Behaviour Research and Therapy*, 11(4), 235-248. doi:10.1016/0146-6402(89)90027-1
- Krohne, H. W. (1993). *Vigilance and cognitive avoidance as concepts in coping research*. Toronto: Hogrefe & Huber.
- 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(2), 139-152. doi:10.1016/S0887-6185(98)00002-4
- Ladouceur, R., Dugas, M. J., Freeston, M. H., Rhéaume, J., Blais, F., Boisvert, J., . . . Thibodeau, N. (1999). Specificity of generalized anxiety disorder symptoms and processes. *Behavior Therapy*, 30(2), 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 theoretical model of worry. *Behaviour Research and Therapy*, 38(9), 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(3), 355-371. doi:10.1177/01454455970213006
- Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2008). *International affective picture system (IAPS): Affective ratings of pictures and instruction manual. Technical Report A-8*. Retrieved from Gainesville, FL: University of Florida:
- Laposa, J. M., Collimore, K. C., Hawley, L. L., & Rector, N. A. (2015). Distress tolerance in OCD and anxiety disorders, and its relationship with anxiety sensitivity and

- intolerance of uncertainty. *Journal of Anxiety Disorders*, 33, 8-14.
doi:10.1016/j.janxdis.2015.04.003
- Laugesen, N., Dugas, M. J., & Bukowski, W. M. (2003). Understanding adolescent worry: the application of a cognitive model. *Journal of Abnormal Child Psychology*, 31(1), 55-64. doi:10.1023/A:1021721332181
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal and coping*. New York: Springer.
- Lee, J. K., Orsillo, S. M., Roemer, L., & Allen, L. B. (2010). Distress and Avoidance in Generalized Anxiety Disorder: Exploring the Relationships with Intolerance of Uncertainty and Worry. *Cognitive Behaviour Therapy*, 39(2), 126-136.
doi:10.1080/16506070902966918
- Levy, M. N. (1984). Cardiac sympathetic-parasympathetic interactions. *Federation proceedings*, 43(11), 2598-2602.
- Levy, M. N. (1990). Autonomic interactions in cardiac control. *Annals of the New York Academy of Sciences*, 601(1 Electrocardio), 209-221. doi:10.1111/j.1749-6632.1990.tb37302.x
- Lieberman, M. D., Eisenberger, N. I., Crockett, M. J., Tom, S. M., Pfeifer, J. H., & Way, B. M. (2007). Putting feelings into words: affective labelling disrupts amygdala activity in response to affective stimuli. *Psychological Science*, 18, 421-428.
doi:10.1111/j.1467-9280.2007.01916.x
- Lieberman, M. D., Inagaki, T. K., Tabibnia, G., & Crockett, D. J. (2011). Subjective responses to emotional stimuli during labeling, reappraisal, and distraction. *Emotion*, 11, 468-480. doi:10.1037/a0023503

- Lind, C., & Boschen, M. J. (2009). Intolerance of uncertainty mediates the relationship between responsibility beliefs and compulsive checking. *Journal of Anxiety Disorders, 23*(8), 1047-1052. doi:10.1016/j.janxdis.2009.07.005
- Llera, S. J., & Newman, M. G. (2010). Effects of worry on physiological and subjective reactivity to emotional stimuli in generalized anxiety disorder and nonanxious control participants. *Emotion, 10*(5), 640-650. doi:10.1037/a0019351
- Llera, S. J., & Newman, M. G. (2014). Rethinking the role of worry in generalized anxiety disorder: Evidence supporting a model of emotional contrast avoidance. *Behavior Therapy, 45*(3), 283-299. doi:10.1016/j.beth.2013.12.011
- Lovibond, P. F., & Rapee, R. M. (1993). The representation of feared outcomes. *Behaviour Research and Therapy, 31*(6), 595-608. doi:10.1016/0005-7967(93)90111-7
- Lovibond, S. H., & Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales* (2 ed.). Sydney: Psychology Foundation.
- Lucock, M. P., & Salkovskis, P. M. (1988). Cognitive factors in social anxiety and its treatment. *Behaviour Research and Therapy, 26*(4), 297-302. doi:10.1016/0005-7967(88)90081-2
- Luhmann, C. C., Ishida, K., & Hajcak, G. (2011). Intolerance of uncertainty and decisions about delayed, probabilistic rewards. *Behavior Therapy, 42*(3), 378-386. doi:10.1016/j.beth.2010.09.002
- Lyonfields, J. D., Borkovec, T. D., & Thayer, J. F. (1995). Vagal tone in generalized anxiety disorder and the effects of aversive imagery and worrisome thinking. *Behavior Therapy, 26*(3), 457-466. doi:10.1016/S0005-7894(05)80094-2

- Macdonald, A. M., & de Silva, P. (1999). The assessment of obsessionality using the Padua inventory: its validity in a British non-clinical sample. *Personality and Individual Differences*, 27(6), 1027-1046. doi:10.1016/S0191-8869(99)00036-7
- Macdonald, E. M., Pawluck, E. J., Koerner, N., & Goodwill, A. M. (2015). An Examination of Distress Intolerance in Undergraduate Students High in Symptoms of Generalized Anxiety Disorder. *Cognitive Behaviour Therapy*, 44(1), 74-84. doi:10.1080/16506073.2014.964303
- MacLeod, A. K., & Salaminiou, E. (2001). Reduced positive future-thinking in depression: cognitive and affective factors. *Cognition and Emotion*, 15(1), 99-107. doi:10.1080/0269993004200006
- MacLeod, A. K., Tata, P., Kentish, J., & Jacobsen, H. (1997). Retrospective and prospective cognitions in anxiety and depression. *Cognition and Emotion*, 11(4), 467-479. doi:10.1080/026999397379881
- MacLeod, A. K., Williams, J. M. G., & Bekerian, D. A. (1991). Worry is reasonable: The role of explanations in pessimism about future personal events. *Journal of Abnormal Psychology*, 100(4), 478-486. doi:10.1037/0021-843X.100.4.478
- MacLeod, C., & Cohen, I. (1993). Anxiety and the interpretation of ambiguity: a text comprehension study. *Journal of Abnormal Psychology*, 102(2), 238-247. doi:10.1037/0021-843X.102.2.238
- MacLeod, C., & Mathews, A. (1988). Anxiety and the allocation of attention to threat. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology*, 40(4), 653-670. doi:10.1080/14640748808402292

- MacLeod, C., & Mathews, A. (2012). Cognitive bias modification approaches to anxiety. *Annual Review of Clinical Psychology*, 8(1), 189-217. doi:10.1146/annurev-clinpsy-032511-143052
- MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in the emotional disorders. *Journal of Abnormal Psychology*, 95(1), 15-20. doi:10.1037/0021-843X.95.1.15
- MacLeod, C., & Rutherford, E. (2004). Information processing approaches: Assessing the selective functioning of attention, interpretation, and retrieval. In C. L. T. R. G. Heimberg, and D. S. Mennin (Ed.), *Generalised Anxiety Disorder: Advances in research and practice* (pp. 109-142). New York: Guilford.
- MacLeod, C. M. (1991). Half a century of research on the Stroop effect: an integrative review. *Psychological Bulletin*, 109(2), 163-203. doi:10.1037/0033-2909.109.2.163
- MacLeod, C. M., & Dunbar, K. (1988). Training and Stroop-like interference: Evidence for a continuum of automaticity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 14(1), 126-135. doi:10.1037/0278-7393.14.1.126
- Mahoney, A. E. J., & McEvoy, P. M. (2012). Trait versus situation-specific intolerance of uncertainty in a clinical sample with anxiety and depressive disorders. *Cognitive Behaviour Therapy*, 41(1), 26-39. doi:10.1080/16506073.2011.622131
- Maller, R. G., & Reiss, S. (1992). Anxiety sensitivity in 1984 and panic attacks in 1987. *Journal of Anxiety Disorders*, 6(241-247). doi:10.1016/0887-6185(92)90036-7
- 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.comppsy.2016.10.007
- Mathews, A., & Mackintosh, B. (1998). A cognitive model of selective processing in anxiety. *Cognitive Therapy and Research*, 22(6), 539-560.
doi:10.1023/A:1018738019346
- Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology*, 109(4), 602-615.
- Mathews, A., & MacLeod, C. (1985). Selective processing of threat cues in anxiety states. *Behaviour Research and Therapy*, 23(5), 563-570. doi:10.1016/0005-7967(85)90104-4
- Mathews, A., & MacLeod, C. (1986). Discrimination of threat cues without awareness in anxiety states. *Journal of Abnormal Psychology*, 95(2), 131-138. doi:10.1037/0021-843X.95.2.131
- Mathews, A., Mogg, K., Kentish, J., & Eysenck, M. (1995). Effect of psychological treatment on cognitive bias in generalized anxiety disorder. *Behaviour Research and Therapy*, 33(3), 293-303. doi:10.1016/0005-7967(94)E0022-B
- Mathews, A., Richards, A., & Eysenck, M. (1989). Interpretation of homophones related to threat in anxiety states. *Journal of Abnormal Psychology*, 98(1), 31-34.
doi:10.1037/0021-843X.98.1.31
- 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(3), 533-545. doi:10.1016/j.beth.2011.02.007

- McEvoy, P. M., & Mahoney, A. E. J. (2011). Achieving certainty about the structure of intolerance of uncertainty in a treatment-seeking sample with anxiety and depression. *Journal of Anxiety Disorders*, 25(1), 112-122. doi:10.1016/j.janxdis.2010.08.010
- McLaughlin, K. A., Mennin, D. S., & Farach, F. J. (2007). The contributory role of worry in emotion generation and dysregulation in generalized anxiety disorder. *Behaviour Research and Therapy*, 45(8), 1735-1752. doi:10.1016/j.brat.2006.12.004
- McNally, R. J., & Foa, E. B. (1987). Cognition and agoraphobia: Bias in the interpretation of threat. *Cognitive Therapy and Research*, 11(5), 567-588. doi:10.1007/BF01183859
- McNally, R. J., Otto, M. W., Yap, L., Pollack, M. H., & Hornig, C. D. (1999). Is panic disorder linked to cognitive avoidance of threatening information? *Journal of Anxiety Disorders*, 13(4). doi:10.1016/S0887-6185(99)00008-0
- 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(11), 690-698. doi:10.1016/j.brat.2012.08.003
- Mennin, D. S. (2004). Emotion regulation therapy for generalized anxiety disorder. *Clinical Psychology and Psychotherapy*, 11(1), 17-29. doi:10.1002/cpp.389
- Mennin, D. S., Fresco, D. M., Ritter, M., & Heimberg, R. G. (2015). An open trial of emotion regulation therapy for generalized anxiety disorder and cooccurring depression. *Depression and Anxiety*, 32(8), 614-623. doi:10.1002/da.22377

- Mennin, D. S., Heimberg, R. G., Turk, C. L., & Fresco, D. M. (2002). Applying an Emotion Regulation Framework to Integrative Approaches to Generalized Anxiety Disorder. *Clinical Psychology: Science and Practice*, 9(1), 85-90. doi:10.1093/clipsy.9.1.85
- Mennin, D. S., Heimberg, R. G., Turk, C. L., & Fresco, D. M. (2005). Preliminary evidence for an emotion dysregulation model of generalised anxiety disorder. *Behaviour Research and Therapy*, 43(10), 1281-1310. doi:10.1016/j.brat.2004.08.008
- Mennin, D. S., Turk, C. L., Heimberg, R. G., & Carmin, C. N. (2004). Focusing on the regulation of emotion: a new direction for conceptualising and treating generalized anxiety disorder. In D. A. C. E. M. A. Reinecke (Ed.), *Cognitive therapy over the lifespan: evidence and practice* (pp. 60-89). New York: Cambridge University Press.
- Metzger, R. L., Miller, M. L., Cohen, M., Sofka, M., & Borkovec, T. D. (1990). Worry changes decision making: The effect of negative thoughts on cognitive processing. *Journal of Clinical Psychology*, 46(1), 78-88. doi:10.1002/1097-4679(199001)
- Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the Penn State Worry Questionnaire. *Behaviour Research and Therapy*, 28(6), 487-495. doi:10.1016/0005-7967(90)90135-6
- Mineka, S., Watson, D., & Clark, L. A. (1998). Comorbidity of anxiety and unipolar mood disorders. *Annual Review of Psychology*, 49(1), 377-412. doi:10.1146/annurev.psych.49.1.377

- Miranda, R., Fontes, M., & Marroquín, B. (2008). Cognitive content-specificity in future expectancies: Role of hopelessness and intolerance of uncertainty in depression and GAD symptoms. *Behaviour Research and Therapy*, 46(10), 1151-1159. doi:10.1016/j.brat.2008.05.009
- Miranda, R., & Mennin, D. S. (2007). Depression, generalized anxiety disorder, and certainty in pessimistic predictions about the future. *Cognitive Therapy and Research*, 31(1), 71-82. doi:10.1007/s10608-006-9063-4
- Mitchell, C. J., De Houwer, J., & Lovibond, P. F. (2009). The propositional nature of human associative learning. *Behavioral and Brain Sciences*, 32(2), 183-198. doi:10.1017/S0140525X09000855
- Mogg, K., & Bradley, B. P. (2005). Attentional bias in generalized anxiety disorder versus depressive disorder. *Cognitive Therapy and Research*, 29(1), 29-45. doi:10.1007/s10608-005-1646-y
- Mogg, K., Bradley, B. P., Millar, N., & White, J. (1995). A follow-up study of cognitive bias in generalized anxiety disorder. *Behaviour Research and Therapy*, 33(8), 927-935. doi:10.1016/0005-7967(95)00031-R
- Mogg, K., & Mathews, A. (1990). Is there a self-referent mood-congruent recall bias in anxiety? *Behaviour Research and Therapy*, 28(1), 91-92. doi:10.1016/0005-7967(90)90060-V
- Mogg, K., Mathews, A., & Eysenck, M. (1992). Attentional bias to threat in clinical anxiety states. *Cognition and Emotion*, 6(2), 149-159. doi:10.1080/02699939208411064

- Mogg, K., Mathews, A., & Weinman, J. (1987). Memory bias in clinical anxiety. *Journal of Abnormal Psychology*, 96(2), 94-98. doi:10.1037/0021-843X.96.2.94
- Mogg, K., Mathews, A., & Weinman, J. (1989). Selective processing of threat cues in anxiety states: A replication. *Behaviour Research and Therapy*, 27(4), 317-323. doi:10.1016/0005-7967(89)90001-6
- Molina, S., & Borkovec, T. D. (1994). The Penn State Worry Questionnaire: psychometric properties and associated characteristics. In G. C. L. Davey & F. Tallis (Eds.), *Worrying: perspectives on theory, assessment, and treatment* (pp. 265–283). New York: Wiley.
- Muris, P., Roelofs, J., Meesters, C., & Boomsma, P. (2004). Rumination and worry in nonclinical adolescents. *Cognitive Therapy and Research*, 28(4), 539-554. doi:10.1023/B:COTR.0000045563.66060.3e
- Nassif, Y. (1999). *Predictors of Pathological Worry*. (Unpublished M.Phil. Thesis), University of Manchester, UK.
- Newman, M. G., Castonguay, L. G., Borkovec, T. D., Fisher, A. J., Boswell, J., Szkodny, L., & Nordberg, S. S. (2011). A randomized controlled trial of cognitive-behavioral therapy for generalized anxiety disorder with integrated techniques from emotion-focused and interpersonal therapies. *Journal of Consulting and Clinical Psychology*, 79(2), 171-181. doi:10.1037/a0022489
- Newman, M. G., & Llera, S. J. (2011). A novel theory of experiential avoidance in generalized anxiety disorder: A review and synthesis of research supporting a

- contrast avoidance model of worry. *Clinical Psychology Review*, 31(3), 371-382.
doi:10.1016/j.cpr.2011.01.008
- Nolen-Hoeksema, S. (1991). Response to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology*, 100(4), 569-582.
doi:10.1037/0021-843X.100.4.569
- Nolen-Hoeksema, S. (2000). The role of rumination in depressive disorders and mixed anxiety/depressive symptoms. *Journal of Abnormal Psychology*, 109(3), 504-511.
doi:10.1037/0021-843X.109.3.504
- Nordsletten, A. E., Fernández de la Cruz, L., Pertusa, A., Reichenberg, A., Hatch, S. L., & Mataix-Cols, D. (2013). The Structured Interview for Hoarding Disorder (SIHD): Development, usage and further validation. *Journal of Obsessive Compulsive and Related Disorders*, 2(3), 346-350. doi:10.1016/j.jocrd.2013.06.003
- 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(1), 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(6), 699-707.
doi:10.1016/j.janxdis.2004.08.002
- 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(1), 50-63. doi:10.1080/16506070410005401

- Norton, R. (1975). Measurement of ambiguity tolerance. *Journal of Personality Assessment*, 39(6), 607-619. doi:10.1207/s15327752jpa3906_11
- O'Brien, R. G., & Kaiser, M. K. (1985). MANOVA method for analyzing repeated measures designs: An extensive primer. *Psychological Bulletin*, 97(2), 316-333. doi:10.1037/0033-2909.97.2.316
- Oglesby, M. E., Gibby, B. A., Mathes, B. M., Short, N. A., & Schmidt, N. B. (2016). Intolerance of uncertainty and post-traumatic stress symptoms: An investigation within a treatment seeking trauma-exposed sample. *Comprehensive Psychiatry*, 72, 34-40. doi:10.1016/j.comppsy.2016.08.011
- 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(2), 227-231. doi:10.1016/j.jad.2012.08.003
- Otto, M. W., McNally, R. J., Pollack, M. H., Chen, E., & Rosenbaum, J. F. (1994). Hemispheric laterality and memory bias for threat in anxiety disorders. *Journal of Abnormal Psychology*, 103(4), 828-831. doi:10.1037/0021-843X.103.4.828
- Papageorgiou, C., & Wells, A. (1999). Process and meta cognitive dimensions of depressive and anxious thoughts and relationship with emotional intensity. *Clinical Psychology and Psychotherapy*, 6(2), 152-162. doi:/10.1002/(SICI)1099-0879(199905)6:2%3C156::AID-CPP196%3E3.0.CO;2-A
- Parkinson, L., & Rachman, S. (1981). The nature of intrusive thoughts. *Part II. The nature of intrusive thoughts*, 3(3), 101-110. doi:10.1016/0146-6402(81)90008-4

- Peasley-Miklus, C., & Vrana, S. R. (2000). Effect of worrisome and relaxing thinking on fearful emotional processing. *Behaviour Research and Therapy*, 38(2), 129-144. doi:10.1016/S0005-7967(99)00025-X
- Penney, A. M., Mazmanian, D., & Rudanycz, C. (2013). Comparing Positive and Negative Beliefs About Worry in Predicting Generalized Anxiety Disorder Symptoms. *Canadian Journal of Behavioural Science*, 45(1), 34–41. doi:10.1037/a0027623
- Posner, M. I., & Petersen, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience*, 13(1), 25-42. doi:10.1146/annurev.ne.13.030190.000325
- Preacher, K. J., Rucker, D. D., MacCallum, R. C., & Nicewander, W. A. (2005). Use of the Extreme Groups Approach: A Critical Reexamination and New Recommendations. *Psychological Methods*, 10(2), 178-192. doi:10.1037/1082-989X.10.2.178
- Ramos, B. P., & Arnsten, A. F. (2007). Adrenergic pharmacology and cognition: focus on the prefrontal cortex. *Pharmacology & Therapeutics*, 113(3), 523-536. doi:10.1016/j.pharmthera.2006.11.006
- Rapee, R. M. (1991). Generalized anxiety disorder: A review of clinical features and theoretical concepts. *Clinical Psychology Review*, 11(4), 419-440. doi:10.1016/0272-7358(91)90116-C
- Rassin, E., & Muris, P. (2005). Indecisiveness and the interpretation of ambiguous situations. *Personality and Individual Differences*, 39(7), 1285-1291. doi:10.1016/j.paid.2005.06.006
- Rehm, J., Ustun, T. B., Saxena, S., Nelson, C. B., Chatterji, S., Ivis, F., & Adlaf, E. D. (1999). On the development and psychometric testing of the WHO screening

- instrument to assess disablement in the general population. *International Journal of Methods in Psychiatric Research*, 8(2), 110–122. doi:10.1002/mpr.61
- Reiss, S. (1991). The expectancy model of fear, anxiety, and panic. *Clinical Psychology Review*, 11(2), 141-153. doi:10.1016/0272-7358(91)90092-9
- Reiss, S., & McNally, R. J. (1985). Expectancy model of fear. In S. R. R. B. (Eds) (Ed.), *Theoretical Issues in Behavior Therapy*. Orlando: Academic Press Inc.
- Robichaud, M. (2013a). Cognitive Behavior Therapy Targeting Intolerance of Uncertainty: Application to a Clinical Case of Generalized Anxiety Disorder. *Cognitive and Behavioral Practice*, 20(3), 251-263. doi:10.1016/j.cbpra.2012.09.001
- Robichaud, M. (2013b). Generalized Anxiety Disorder: Targeting Intolerance of Uncertainty. In G. Simos & S. G. Hofmann (Eds.), *CBT for Anxiety Disorders: A Practitioner Book* (pp. 57 -85). Oxford: Wiley-Blackwell.
- Robichaud, M., & Dugas, M. J. (2005a). Negative problem orientation (Part I): psychometric properties of a new measure. *Behaviour Research and Therapy*, 43(3), 391-401. doi:10.1016/j.brat.2004.02.007
- Robichaud, M., & Dugas, M. J. (2005b). Negative problem orientation (Part II): Construct validity and specificity to worry. *Behaviour Research and Therapy*, 43(3), 403-412. doi:10.1016/j.brat.2004.02.008
- Rodriguez, B. F., Bruce, S. E., Pagano, M. E., Spencer, M. A., & Keller, M. B. (2004). Factor structure and stability of the Anxiety Sensitivity Index in a longitudinal study of anxiety disorder patients. *Behaviour Research and Therapy*, 42(1), 79-91. doi:10.1016/S0005-7967(03)00074-3

- Roemer, L., Molina, S., & Borkovec, T. D. (1997). An Investigation of Worry Content among Generally Anxious Individuals. *The Journal of Nervous & Mental Disease*, 185(5), 314-319. doi:10.1097/00005053-199705000-00005
- Roemer, L., & Orsillo, S. M. (2002). Expanding our conceptualization of and treatment for generalized anxiety disorder: integrating mindfulness/acceptancebased approaches with existing cognitive-behavioral models. *Clinical Psychology: Science and Practice*, 9(1), 54-68. doi:10.1093/clipsy.9.1.54
- Roemer, L., & Orsillo, S. M. (2007). An open trial of an acceptance-based behavior therapy for generalized anxiety disorder. *Behavior Therapy*, 38(1), 72-85. doi:10.1016/j.beth.2006.04.004
- Roemer, L., Salters, K., Raffa, S., & Orsillo, S. M. (2005). Fear and avoidance of internal experiences in GAD: preliminary tests of a conceptual model. *Cognitive Therapy and Research*, 29(1), 71-88. doi:10.1007/s10608-005-1650-2
- Rohleder, N., & Nater, U. M. (2009). Determinants of salivary alpha-amylase in humans and methodological considerations. *Psychoneuroendocrinology*, 34(4), 469-485. doi:10.1016/j.psyneuen.2008.12.004
- 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(3), 228-238. doi:10.1080/10410230902804125
- Ruggiero, G. M., Stapinski, L., Caselli, G., Fiore, F., Gallucci, M., Sassaroli, S., & Rapee, R. M. (2012). Beliefs over control and meta-worry interact with the effect of

- intolerance of uncertainty on worry. *Personality and Individual Differences*, 53(3), 224–230. doi:10.1016/j.paid.2012.03.016
- Ruscio, A. M. (2002). Delimiting the boundaries of generalized anxiety disorder: differentiating high worriers with and without GAD. *Anxiety Disorders*, 16(4), 377–400. doi:10.1016/S0887-6185(02)00130-5
- Ruscio, A. M., & Borkovec, T. D. (2004). Experience and appraisal of worry among high worriers with and without generalized anxiety disorder. *Behaviour Research and Therapy*, 42(12), 1469–1482. doi:10.1016/j.brat.2003.10.007
- Russell, M., & Davey, G. C. L. (1993). The relationship between life events measures and anxiety and its cognitive correlates. *Personality and Individual Differences*, 14(2), 317–322. doi:10.1016/0191-8869(93)90129-Q
- Salkovskis, P. M. (1989). Cognitive-behavioural factors and the persistence of intrusive thoughts in obsessional problems. *Behaviour Research and Therapy*, 27(6), 677–682. doi:10.1016/0005-7967(89)90152-6
- Salkovskis, P. M. (1991). The importance of behaviour in the maintenance of anxiety and panic: a cognitive account. *Behavioural Psychotherapy*, 19, 6–19. doi:10.1017/S0141347300011472
- Sanavio, E. (1988). Obsessions and Compulsions: The Padua Inventory. *Behaviour Research and Therapy*, 26(2), 169–177. doi:10.1016/0005-7967(88)90116-7
- Sánchez-Meca, J., Rubio-Aparicio, M., Núñez-Núñez, R. M., López-Pina, J., Marín-Martínez, F., & López-López, J. A. (2017). A Reliability Generalization Meta-

- Analysis of the Padua Inventory of Obsessions and Compulsions. *The Spanish Journal of Psychology*, 20, 1-15. doi:10.1017/sjp.2017.65
- Sanderson, W. C., & Barlow, D. H. (1990). A Description of Patients Diagnosed with DSM-III-R Generalized Anxiety Disorder. *The Journal of Nervous and Mental Disease*, 178(9), 588–591. doi:10.1097/00005053-199009000-00006
- 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(4), 929-940. doi:10.1093/cercor/bhp155
- Schmidt, N. B., Lerew, D. R., & Jackson, R. J. (1997). The role of anxiety sensitivity in the pathogenesis of panic: Prospective evaluation of spontaneous panic attacks during acute stress. *Journal of Abnormal Psychology*, 106, 355-364. doi:10.1037/0021-843X.106.3.355
- Segerstrom, S. C., Tsao, J. C. I., Alden, L. E., & Craske, M. G. (2000). Worry and rumination: Repetitive thought as a concomitant and predictor of negative mood. *Cognitive Therapy and Research*, 24(6), 671-688. doi:10.1023/A:1005587311498
- Sexton, K. A., & Dugas, M. J. (2008). The Cognitive Avoidance Questionnaire: Validation of the English translation. *Journal of Anxiety Disorders*, 22(3), 355-370. doi:10.1016/j.janxdis.2007.04.005
- Sexton, K. A., & Dugas, M. J. (2009a). Defining distinct negative beliefs about uncertainty: Validating the factor structure of the IU Scale. *Psychological Assessment*, 21(2), 176-186. doi:10.1037/a0015827

- Sexton, K. A., & Dugas, M. J. (2009b). An Investigation of Factors Associated with Cognitive Avoidance in Worry. *Cognitive Therapy and Research*, 33(2), 150–162. doi:10.1007/s10608-007-9177-3
- 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(2), 82-94. doi:10.1080/16506070302321
- Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). Pathways from uncertainty to anxiety: An evaluation of a hierarchical model of trait disorder-specific intolerance of uncertainty on anxiety disorder symptoms. *Journal of Anxiety Disorders*, 45, 72-79. doi:10.1016/j.janxdis.2016.12.001
- Sica, C., Steketee, G., Ghisi, M., Chiri, L. R., & Franceschini, S. (2007). Metacognitive beliefs and strategies predict worry, obsessive-compulsive symptoms and coping styles: A preliminary prospective study on an Italian non-clinical sample. *Clinical Psychology and Psychotherapy*, 14(4), 258–268. doi:10.1002/cpp.520
- Simons, J. S., & Gaher, R. M. (2005). The distress tolerance scale: development and validation of a self-report measure. *Motivation and Emotion*, 29(2), 83-102. doi:10.1007/s11031-005-7955-3
- Smith, J. M., & Alloy, L. B. (2009). A roadmap to rumination: A review of the definition, assessment, and conceptualization of this multifaced construct. *Clinical Psychology Review*, 29(2), 116-128. doi:10.1016/j.cpr.2008.10.003

- Spasojevic, J., & Alloy, L. B. (2001). Rumination as a common mechanism relating depressive risk factors to depression. *Emotion*, 1(1), 25-37. doi:10.1037/1528-3542.1.1.25
- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory STAI (Form Y)*. Palo Alto, CA: Mind Garden.
- Stapinski, L. A., Abbott, M. J., & Rapee, R. M. (2010). Evaluating the cognitive avoidance model of generalised anxiety disorder: Impact of worry on threat appraisal, perceived control and anxious arousal. *Behaviour Research and Therapy*, 48(10), 1032-1040. doi:10.1016/j.brat.2010.07.005
- Starcevic, V. (1995). Pathological worry in major depression: A preliminary report. *Behaviour Research and Therapy*, 33(1), 55-56. doi:10.1016/0005-7967(93)E0028-4
- Starcevic, V., & Berle, D. (2006). Cognitive specificity of anxiety disorders: A review of selected key constructs. *Depression and Anxiety*, 23(2), 51-61. doi:10.1002/da.20145
- Steketee, G., Frost, R. O., & Cohen, I. (1998). Beliefs in obsessive-compulsive disorder. *Journal of Anxiety Disorders*, 12(6), 525-537. doi:10.1016/S0887-6185(98)00030-9
- Stöber, J. (2000). Prospective cognitions in anxiety and depression: Replication and methodological extension. *Cognition and Emotion*, 14, 725-729.

- Stöber, J., Tepperwien, S., & Staak, M. (2000). Worry leads to reduced concreteness of problem elaborations: evidence for the avoidance theory of worry. *Anxiety, Stress & Coping*, 13, 217-227. doi:10.1080/10615800008549263
- Stopa, L., & Clark, D. M. (1993). Cognitive processes in social phobia. *Behaviour Research and Therapy*, 31(3), 255-267. doi:10.1016/0005-7967(93)90024-O
- Stroop, J. R. (1938). Factors affecting speed in serial verbal reactions. *Psychological Monographs*, 50(5), 38-48. doi:10.1037/h0093516
- Tallis, F., Eysenck, M., & Mathews, A. (1991). Elevated evidence requirements and worry. *Personality and Individual Differences*, 12(1), 21-27. doi:10.1016/0191-8869(91)90128-X
- Tallis, F., & Eysenck, M. W. (1994). Worry: Mechanisms and modulating influences. *Behavioural and Cognitive Psychotherapy*, 22(1), 37-56. doi:10.1017/S1352465800011796
- Tan, S., Moulding, R., Nedeljkovic, M., & Kyrios, M. (2010). Metacognitive, cognitive and developmental predictors of generalised anxiety disorder symptoms. *Clinical Psychologist*, 14(3), 84-89. doi:10.1080/13284207.2010.521521
- Taylor, S., Koch, W. J., McNally, R. J., & Crockett, D. J. (1992). Conceptualizations of anxiety sensitivity. *Psychological Assessment*, 4(2), 245-250. doi:10.1037/1040-3590.4.2.245
- Teale Sapach, M. J. N., Carleton, R. N., Mulvogue, M. K., Weeks, J. W., & Heimberg, R. G. (2015). Cognitive Constructs and Social Anxiety Disorder: Beyond Fearing

- Negative Evaluation. *Cognitive Behaviour Therapy*, 44(1), 63-73.
doi:10.1080/16506073.2014.961539
- Thayer, J. F., Friedman, B. H., & Borkovec, T. D. (1996). Autonomic characteristics of generalized anxiety disorder and worry. *Biological Psychiatry*, 39(4), 255-266.
doi:10.1016/0006-3223(95)00136-0
- 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(4), 532–543.
doi:10.1016/j.beth.2015.05.001
- Tolin, D. F., Abramowitz, J. S., Brigidi, D. B., & Foa, E. B. (2003). Intolerance of uncertainty in obsessive-compulsive disorder. *Anxiety Disorders*, 17(2), 233-242.
doi:10.1016/S0887-6185(02)00182-2
- Tomarken, A. J., Mineka, S., & Cook, M. (1989). Fear-relevant selective associations and covariation bias. *Journal of Abnormal Psychology*, 98(4), 381-394.
doi:10.1037/0021-843X.98.4.381
- Tomarken, A. J., Sutton, S. K., & Mineka, S. (1995). Fear-relevant illusory correlations: What types of associations promote judgmental bias? *Journal of Abnormal Psychology*, 104(2), 312–326. doi:10.1037/0021-843X.104.2.312
- Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination Reconsidered: A Psychometric Analysis. *Cognitive Therapy and Research*, 27(3), 247-259.
doi:10.1023/A:1023910315561

- Turk, C. L., Heimberg, R. G., Luterek, J. A., Mennin, D. S., & Fresco, D. M. (2005). Delineating emotion regulation deficits in generalized anxiety disorder: A comparison with social anxiety disorder. *Cognitive Therapy and Research*, 29(1), 89-106. doi:10.1007/s10608-005-1651-1
- Uijtdehaage, S. H. J., & Thayer, J. F. (1989). Sympathetic-parasympathetic interactions in heart rate response to laboratory stressors. *Psychophysiology*, 26, S63.
- Usher, M., Cohen, J. D., Servan-Schreiber, D., Rajkowski, J., & Aston-Jones, G. (1999). The Role of Locus Coeruleus in the Regulation of Cognitive Performance. *Science*, 283(5401), 549-554. doi:10.1126/science.283.5401.549
- van den Hout, M., & Kindt, M. (2003). Repeated checking causes memory distrust. *Behaviour Research and Therapy*, 41(3), 301–316. doi:10.1016/S0005-7967(02)00012-8
- van der Heiden, C., Melchior, K., Peter, M., 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(2), 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, 100-109. doi:10.1016/j.brat.2011.12.005
- Vasey, M. W., & Borkovec, T. D. (1992). A catastrophizing assessment of worrisome thoughts. *Cognitive Therapy and Research*, 16, 505-520. doi:10.1007/BF01175138

- Volz, K. G., Schubotz, R. I., & von Cramon, D. Y. (2003). Predicting events of varying probability: Uncertainty investigated by fMRI. *NeuroImage*, 19(2), 271–280. doi:10.1016/S1053-8119(03)00122-8
- Vrana, S. R., Cuthbert, B. N., & Lang, P. J. (1989). Processing fearful and neutral sentences: memory and heart rate change. *Cognition and Emotion*, 3(3), 179-195. doi:10.1080/02699938908415240
- Vrana, S. R., & Lang, P. J. (1990). Fear imagery and the startle-probe reflex. *Journal of Abnormal Psychology*, 99(2), 189-197. doi:10.1037/0021-843X.99.2.189
- Warwick, H. M. C., & Salkovskis, P. M. (1990). Hypochondriasis. *Behaviour Research and Therapy*, 28(2), 105–117. doi:10.1016/0005-7967(90)90023-C
- Watkins, E., Moulds, M., & Mackintosh, B. (2005). Comparisons between rumination and worry in a non-clinical population. *Behaviour Research and Therapy*, 43(12), 1577-1585. doi:10.1016/j.brat.2004.11.008
- Watkins, E. R. (2008). Constructive and Unconstructive Repetitive Thought. *Psychological Bulletin*, 134(2), 163–206. doi:10.1037/0033-2909.134.2.163
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54, 1063-1070. doi:10.1037/0022-3514.54.6.1063
- Watson, D., & Friend, R. (1969). Measurement of social-evaluative anxiety. *Journal of Consulting and Clinical Psychology*, 33, 448–457. doi:10.1037/h0027806

- Wells, A. (1994). A multidimensional measure of worry: development and preliminary validation of the Anxious Thoughts Inventory. *Anxiety, Stress & Coping*, 6(4), 289-299. doi:10.1080/10615809408248803
- Wells, A. (1995). Meta-cognition and worry: A cognitive model of generalised anxiety disorder. *Behavioural and Cognitive Psychopathology*, 23(3), 301-320. doi:10.1017/S1352465800015897
- Wells, A. (1997). *Cognitive therapy of anxiety disorders: A practice manual and conceptual guide*. Chichester, UK: Wiley.
- Wells, A. (2004). A cognitive model of GAD: metacognitions and pathological worry. In R. G. Heimberg, C. L. Turk, & D. S. Mennin (Eds.), *Generalized anxiety disorder: Advances in research and practice* (pp. 143-163). New York: Guilford Press.
- Wells, A. (2010). Metacognitive Theory and Therapy for Worry and Generalized Anxiety Disorder: Review and Status. *Journal of Experimental Psychopathology*, 1(1), 133-145. doi:10.5127/jep.007910
- Wells, A., & Carter, K. (1999). Preliminary tests of a cognitive model of generalized anxiety disorder. *Behavior Research and Therapy*, 37(6), 585-594. doi:10.1016/S0005-7967(98)00156-9
- Wells, A., & Carter, K. (2001). Further tests of a cognitive model of generalized anxiety disorder: metacognitions and worry in GAD, panic disorder, social phobia, depression, and nonpatients. *Behavior Therapy*, 32(1), 85-102. doi:10.1016/S0005-7894(01)80045-9

- Wells, A., & Cartwright-Hatton, S. (2004). A short form of the metacognitions questionnaire: properties of the MCQ-30. *Behaviour Research and Therapy*, 42(4), 385-396. doi:10.1016/S0005-7967(03)00147-5
- Wells, A., & Papageorgiou, C. (1998). Relationships between worry, obsessive-compulsive symptoms and meta-cognitive beliefs. *Behaviour Research and Therapy*, 36(9), 899-913. doi:10.1016/S0005-7967(98)00070-9
- Wells, A., Welford, M., King, P., Papageorgiou, C., Wisely, J., & Mendel, E. (2010). A pilot randomized trial of metacognitive therapy vs applied relaxation in the treatment of adults with generalized anxiety disorder. *Behaviour Research and Therapy*, 48(5), 429-434. doi:10.1016/j.brat.2009.11.013
- 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
- Wong, Q. J. J., & Moulds, M. L. (2011). The relationship between the maladaptive self-beliefs characteristic of social anxiety and avoidance. *Journal of Behavior Therapy and Experimental Psychiatry*, 42(2), 171-178. doi:10.1016/j.jbtep.2010.11.004
- Woody, S., & Rachman, S. (1994). Generalized anxiety disorder (GAD) as an unsuccessful search for safety. *Clinical Psychology Review*, 14(8), 743-753. doi:10.1016/0272-7358(94)90040-X

- Yiend, J., Mackintosh, B., & Mathews, A. (2005). Enduring consequences of experimentally induced biases in interpretation. *Behaviour Research and Therapy*, 43(6), 779-797. doi:10.1016/j.brat.2004.06.007
- Yonkers, K. A., Massion, A. O., Warshaw, M. G., & Keller, M. B. (1996). Phenomenology and course of generalised anxiety disorder. *British Journal of Psychiatry*, 168(3), 308-313. doi:10.1192/bjp.168.3.308
- 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(6), 623-628. doi:10.1016/j.janxdis.2010.04.003
- York, D., Borkovec, T. D., Vasey, M., & Stern, R. (1987). Effects of worry and somatic anxiety induction on thoughts, emotion and physiological activity. *Behaviour Research and Therapy*, 25(6), 523-526. doi:10.1016/0005-7967(87)90060-X
- Yu, A. J., & Dayan, P. (2005). Uncertainty, neuromodulation, and attention. *Neuron*, 46(4), 681-692. doi:10.1016/j.neuron.2005.04.026
- Zuj, D. V., Palmer, M. A., Malhi, G. S., Bryant, R. A., & Felmingham, K. L. (2018). Endogenous salivary α -amylase does not interact with skin conductance response during fear extinction in posttraumatic stress disorder. *Psychiatry Research*, 262, 316-322. doi:10.1016/j.psychres.2018.02.016

Appendices

Appendix A: Manipulation of feedback 328

Appendix A: Manipulation of Feedback (Experiments 1 and 2)

Unambiguous Feedback

“Based on your scores at this stage, you have demonstrated an excellent understanding of the appropriate level of concerns required in interpersonal situations. You have excellent sensitivity to interpersonal situations as well as outstanding appraisal skills.”

Ambiguous Feedback

“Your performance is unclear at this stage. Although you have shown appropriate level of concerns in some situations, for other situations your level of concerns is not consistent with most other people’s ratings. Your sensitivity to interpersonal situations varies and it is not clear what level of appraisal skills you have.”