

**Investigating the Role of Intolerance of Uncertainty in GAD Using a Probe Discrimination
Task**

BY

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THESIS

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
ANCOVA	Analysis of Covariance
BDI-II	Beck Depression Inventory II
DSM-IV	Diagnostic and Statistical Manual for Mental Disorders 4 th edition
GAD-Q-IV	Generalized Anxiety Disorder Questionnaire for DSM-IV
IUM	Intolerance of Uncertainty Model
IUS	Intolerance of Uncertainty Scale
IU	Intolerance of Uncertainty
IUM	Intolerance of Uncertainty Model
MANOVA	Multivariate Analysis of Variance
PSWQ	Penn State Worry Questionnaire
SCID	Structured Clinical Interview for DSM-IV
WHODAS 2.0	World Health Organization Disability Schedule Assessment 2.0

SUMMARY

Generalized anxiety disorder (GAD), a mental disorder characterized by chronic and uncontrollable worry, has received increasing attention over the years. Researchers have proposed multiple theoretical models aiming to explain how the disorder develops and how it is maintained. One model in particular, the Intolerance of Uncertainty Model (IUM; Dugas et al., 1998), posits that individuals with GAD have an intolerance of uncertainty (IU) in which they respond negatively to uncertainty on an emotional, cognitive, and behavioral level. Moreover, IU may be conceptualized as a cognitive bias through which individuals with GAD experience and interpret information in their environments. To further examine the role of IU in GAD, participants with and without GAD completed a probe discrimination task (MacLeod et al., 1986) using both general threat- and uncertainty-related stimuli. Stimuli were presented using subliminal presentation time, allowing for the examination of an attentional bias at the pre-attentive level. We hypothesized that relative to NonGAD participants, GAD participants would demonstrate an attentional bias toward both threat-related and uncertainty-related words. Although our results replicated findings regarding a pre-attentive attentional bias toward general threat-related stimuli, we did not find evidence of an attentional bias toward uncertainty-related stimuli. Implications of these findings are discussed.

1. INTRODUCTION

1.1 **The Intolerance of Uncertainty Model**

Researchers have proposed multiple theoretical models (e.g., avoidance model of worry, intolerance of uncertainty model, emotion dysregulation model; for a review, see Behar et al., 2009) for understanding the development and maintenance of generalized anxiety disorder (GAD). One model in particular, the intolerance of uncertainty model (IUM), consists of four components: positive beliefs about worry, problem orientation, cognitive avoidance, and intolerance of uncertainty (Dugas et al., 2004). According to this model, the first component (positive beliefs about worry) proposes that individuals hold positive beliefs about worry and its effects (e.g., individuals believe that worrying allows them to better prepare for the future and/or avoid negative outcomes; Freeston et al., 1994; Ladouceur et al., 1998). The second component (problem orientation) suggests that individuals intolerant of uncertainty perceive themselves as having poor problem-solving abilities (Dugas et al., 1997; Ladouceur et al., 1998). The third component (cognitive avoidance) stipulates that individuals engage in cognitive avoidance, ultimately diverting attention away from processing threatening mental images related to worries (Borkovec and Inz, 1990; Dugas et al., 2004). Lastly, the fourth component (intolerance of uncertainty [IU]) is the central component of the IUM and is the hypothesized factor that elicits and maintains the excessive worry characterizing GAD (Dugas et al., 1997; Dugas et al., 1998; Freeston et al., 1994).

This cognitive vulnerability factor may be defined as a dispositional characteristic or tendency to negatively respond to uncertain situations on an emotional, cognitive, and behavioral

level (Dugas et al., 2004; Koerner and Dugas, 2008). Individuals intolerant of uncertainty find uncertain or ambiguous situations stressful and upsetting, and they believe that uncertainty should be avoided. Finally, those high in IU have difficulty functioning when faced with uncertain situations; they are immobilized by uncertainty and experience difficulty in executing a course of action (Buhr and Dugas, 2002; Carleton et al., 2007).

1.2 **Intolerance of Uncertainty and Worry**

Research demonstrates a robust relationship between IU and worry. For example, worry and IU are strongly correlated (e.g., $r = .63$; Buhr and Dugas, 2006), and IU differentiates between individuals with and without GAD (Dugas et al., 1998). Additionally, the IU-worry relationship remains significant after controlling for several anxiety-relevant variables. Specifically, IU predicts worry even after controlling for relevant variables such as gender and somatic anxiety (Laugesen et al., 2003); self-oriented perfectionism, socially-prescribed perfectionism, other-oriented perfectionism, perceived mastery, perceived constraints, tolerance-intolerance of ambiguity, and age (Buhr and Dugas, 2006); as well as dysfunctional attitudes (Dugas et al., 2004). In a nonclinical sample, Dugas, Gosselin, and Ladouceur (2001) explored the relationship between IU and worry by using each as a criterion variable. In predicting worry, IU explained an additional 42% of the variance after accounting for age, gender, responsibility (a variable related to obsessions and compulsions), and anxiety sensitivity; in predicting IU, worry explained an additional 33.9% of the variance after accounting for age, gender, measures of obsessions/compulsions, and panic sensations. Moreover, in an investigation manipulating level of uncertainty, Ladouceur, Gosselin, and Dugas (2000) found that worry levels increased and decreased subsequent to increases and decreases in uncertainty, respectively, leading the authors

to propose the possibility of a causal relationship between uncertainty and worry. Taken together, these studies show that IU and worry are closely related, and that worry is a stronger predictor of IU relative to other cognitive and behavioral variables.

1.3 **Cognitive Bias, Intolerance of Uncertainty, and Generalized Anxiety Disorder**

IU may also function as a cognitive schema leading to the development of worry (Dugas et al., 2004), potentially making IU a cognitive bias through which individuals process information in their environment. Cognitive biases in the anxiety disorders have been investigated for decades (e.g., MacLeod et al., 1986) and extant research supports information-processing conceptualizations in which anxious individuals exhibit enhanced responses in encoding, interpreting, and/or attending to negative stimuli. For example, information processing biases have been found in domains such as attention, interpretation, emotional associations, and repetitive negative thought (for a review, see Mathews and MacLeod, 2005). Investigating such biases in anxiety may have important theoretical and clinical implications: these biases may ultimately lead to, maintain, or even augment an individual's anxiety (Mathews, 1990; Mathews and MacLeod, 2002).

One particular bias observed in anxious populations is selective attention to threat-related stimuli (for a review of attention to threat-related stimuli in anxious and non-anxious populations, see Bar-Haim et al., 2007; MacLeod and Mathews, 1988; MacLeod and Mathews, 1991; Mogg et al., 1992). Moreover, this threat-related bias has been observed in individuals with GAD (for a review, see MacLeod and Rutherford, 2004). Relative to healthy control participants, individuals diagnosed with GAD evidence greater vigilance to threatening faces than to neutral faces

(Bradley et al., 1999) and greater vigilance to threatening words than to neutral words (MacLeod et al., 1986). Furthermore, participants with GAD more frequently endorse threatening interpretations (relative to positive interpretations) of ambiguous sentences in comparison to control participants (Eysenck et al., 1991).

1.4 **Assessment of Cognitive Bias via the Emotional Stroop Task**

Various paradigms have been used to investigate attentional biases. For instance, the emotional Stroop task presents affectively laden (e.g., threatening, neutral) words in various colors. Participants are then instructed to name only the color of the word while disregarding the potentially distracting content of the word. Research indicates that anxious individuals experience an interference effect on this task; that is, they demonstrate an attentional bias by evidencing longer latencies in naming the color in which threat-related stimuli are presented compared to neutral stimuli (Mathews and MacLeod, 1985; Mogg et al., 1989). One investigation using the emotional Stroop task compared individuals with GAD, individuals with social anxiety disorder (SAD), and healthy control participants to examine whether an attentional bias is evident only for disorder-specific words versus general highly affectively-laden words (Becker et al., 2001). Results indicated that individuals with GAD were slower than both the SAD group and the control group to name GAD-related words (e.g., “illness”). Whereas individuals with SAD evidenced slower response times to naming speech-related words relative to GAD-related, positive, and neutral words, individuals with GAD evidenced slower response times to naming GAD-related, speech-related, and positive words relative to neutral words. Thus, individuals with GAD evidenced an attentional bias toward general highly affectively laden words. Similar findings were reported by Bradley, Mogg, Millar, and White (1995), who found

that compared to control participants, individuals with GAD were slower to name the color of negative relative to neutral stimuli during a Stroop task. Taken together, these results indicate that individuals with GAD may evidence a more generalized attentional bias toward emotionally-charged words. Extant research, however, has yet to investigate whether a more specific attentional bias might exist for uncertainty-related stimuli among individuals with GAD.

1.5 Assessment of Cognitive Bias via the Probe Detection Task

Another method for investigating attentional biases is a probe detection paradigm, pioneered by MacLeod et al. (1986). In this task, the researchers briefly presented two words (word pairs) on a visual display unit. A total of 288 neutral and threat-related (i.e., physical and social threat) word pairs were presented. Whereas neutral word pairs consisted of two stimuli of the same valence, threatening word pairs consisted of one threat-related and one neutral word. Following the display of a word pair, one-third of the trials included a subsequent probe appearing in the same spatial location as one of the words (i.e., either a threat-related or neutral word); probes remained on the screen until a participant response was provided. In this paradigm, an attentional bias is evidenced by *shorter* response latencies. Results indicated that control participants responded more quickly when probes replaced the location of preceding neutral words than when probes replaced the location of preceding threat words; in contrast, individuals with GAD responded more quickly when probes replaced the location of preceding threat words than when probes replaced the location of preceding neutral words. Thus, it seems that anxious individuals orient more quickly toward threatening material (cf. Salemink et al., 2007). Since this seminal paper, researchers have sought to more precisely measure cognitive biases in anxiety disorders, including GAD.

Several investigators have examined IU as a potential cognitive bias. For example, Koerner and Dugas (2008) found that individuals high in IU rated positive, negative, and ambiguous vignettes as more “concerning” than did individuals low in IU. This effect was most pronounced in the appraisal of ambiguous vignettes, suggesting that individuals with high IU have a particularly negative construal of uncertainty. Similar results were reported by Anderson et al. (2012), who found that relative to healthy participants, individuals diagnosed with an anxiety disorder rated positive, negative, and ambiguous situations as more “concerning.” Furthermore, the authors reported that endorsement of the belief that uncertainty is “unfair” predicted interpretations of both negative and ambiguous situations as being more “concerning”. Although previous studies have found that IU is associated with negative interpretation biases, no investigations to date have used attentional bias paradigms in order to examine this phenomenon among individuals with GAD. Furthermore, a majority of researchers have only used general threat-related words or specific threat-related words (e.g., social threat, physical threat) in examining these phenomena. Therefore, it remains unclear whether individuals with GAD evidence an attentional bias toward uncertainty-related words.

1.6 **Study Aims**

To the best of our knowledge, no previous investigations have used a probe detection task to examine attentional biases toward uncertainty-related words among individuals with GAD. The use of probe detection procedures may offer some benefits over other methods. MacLeod et al. (1986) argued that because the emotional Stroop paradigm requires participants to state the color of a word when that word itself is negatively valenced, this paradigm introduces the risk that increased negative affect (as opposed to increased attention) is responsible for longer

reaction times. In contrast, the probe detection paradigm requires participants to react to a non-emotional probe that immediately follows either a threat-related or neutral stimulus, resulting in a reduced risk of reaction time being dependent on emotional state. Using such a paradigm may therefore allow for a more accurate measurement of attentional bias and information processing. Thus, the present study aimed to examine whether compared to individuals without GAD, those with GAD exhibit an attentional bias toward uncertainty-related stimuli. We hypothesized that relative to NonGAD participants, individuals with GAD would evidence an attentional bias toward uncertainty-related words such that they would evidence faster response latencies when responding to probes replacing uncertainty-related words compared to probes replacing neutral words. As a secondary aim, we sought to replicate previous studies showing that individuals with GAD have an attentional bias toward threat-related words (e.g., MacLeod et al., 1986). Moreover, by including both uncertainty-related and threat-related stimuli, our study allowed for a comparison between these two attentional biases.

2. METHODS

2.1 Participants

The sample ($N=31$) consisted of 13 individuals meeting diagnostic criteria for current GAD and 18 control participants with no current psychopathology, as determined by the Structured Clinical Interview for the *DSM-IV* (SCID; First et al., 2002). Overall, our sample was young ($M = 19.74$; $SD = 2.27$) and ethnically diverse (38.71% Caucasian; 32.26% Latino; 19.35% Asian; 9.68% African American).

All participants were recruited from the psychology undergraduate subject pool at a large, Midwestern, urban university. Inclusion criteria were either diagnosis of GAD or the lack of any symptoms of GAD. Exclusion criteria included a past or current manic episode, past or current psychosis, past or current schizophrenia, current substance dependence, current or past cognitive behavioral treatment, or a current prescription for an anxiolytic or antidepressant medication.

Participants were initially recruited based on their responses to the Generalized Anxiety Disorder Questionnaire for *DSM-IV* (GAD-Q-IV). As per recommendations by Newman et al. (2002), those endorsing a symptom score greater than or equal to 5.7 were recruited as potential GAD participants ($n = 38$), and those failing to endorse any GAD symptoms were recruited as potential NonGAD participants ($n = 28$). Some participants ($n = 4$) who were not recruited and did not meet inclusion criteria signed up for the study and were re-administered the GAD-Q-IV to assess their eligibility. Thus, the total number of potential participants was 70. Participants were screened again on the day of the experiment using the aforementioned criteria on the GAD-

Q-IV.¹ A total of 21 participants were excluded after failing to meet GAD-Q-IV inclusion criteria. In addition, three participants completed the study but were excluded from analyses (one participant discontinued after realizing he could not stay for the entire study, one participant did not follow study instructions, and one participant provided contradictory self-reports during the SCID making diagnosis inconclusive). Several participants who met GAD-Q-IV inclusion criteria were subsequently excluded after failing to meet formal diagnostic criteria for GAD as determined by the SCID ($n = 11$). Two GAD participants and one NonGAD participant were excluded based on a current diagnosis of substance dependence, and one NonGAD participant was excluded based on a current diagnosis of major depressive disorder.

In the final sample, no NonGAD participants met criteria for past diagnoses. Participants with GAD had comorbid diagnoses of current or past major depressive disorder ($n = 9$), specific phobia ($n = 6$), panic disorder ($n = 4$), social anxiety disorder ($n = 4$), alcohol abuse ($n = 3$), anorexia ($n = 2$), body dysmorphic disorder ($n = 2$), cannabis abuse ($n = 2$), posttraumatic stress disorder ($n = 2$), agoraphobia without panic disorder ($n = 1$), binge eating disorder ($n = 1$), and eating disorder not otherwise specified ($n = 1$).

¹ One exception was made to retain a NonGAD participant who had a GAD-Q-IV score of 0.33 on the day of the experiment.

2.2 **Measures**

2.2.1 **Structured Clinical Interview for *DSM-IV***

The Structured Clinical Interview for *DSM-IV* (SCID; First et al., 2002) was used to determine whether participants met *DSM-IV* diagnostic criteria for psychological conditions, including a GAD diagnosis. In addition, the SCID was used to assess exclusion criteria. The first author, a doctoral student in clinical psychology, administered the diagnostic interviews under the weekly supervision of the second author who reviewed all interviews with him. Prior to administering the SCID, the first author viewed all SCID 101 training videos and was trained to proficiency by the second author. The SCID has evidenced good inter-rater reliability ($\kappa = .75$; Lobbestael et al., 2011) and diagnostic accuracy when used by neophyte diagnosticians (Ventura et al., 1998). In contrast, the validity of the SCID is more difficult to quantify given the lack of “gold standard” comparison (Biometrics Research Department).

2.2.2 **Generalized Anxiety Disorder Questionnaire for *DSM-IV***

The Generalized Anxiety Disorder Questionnaire for *DSM-IV* (GAD-Q-IV; Newman et al., 2002) is a 9-item self-report measure assessing symptoms of GAD including chronicity, frequency, and intensity of worry. Furthermore, it measures essential criteria used in a diagnosis of GAD according to the *DSM-IV*, such as controllability of worry or feeling restless or keyed up or on edge. Using a cutoff score of 5.7, the measure has shown 89% specificity and 83% sensitivity in detecting cases and non-cases of GAD when using the Anxiety Disorders Interview Schedule for *DSM-IV* (Brown et al., 1994) as the gold standard. The GAD-Q-IV has also demonstrated good retest reliability. Newman et al. (2002) clarify that investigating internal

consistency within this measure is inappropriate because contingent upon response, participants may be directed to skip items. This study used a cutoff score of 5.7 for assigning participants to the GAD group; assignment to the NonGAD group was based on participants scoring a 0 on the GAD-Q-IV.

2.2.3 Beck Depression Inventory-II

The Beck Depression Inventory-II (BDI-II; Beck et al., 1996) is a 21-item self-report questionnaire that measures various symptoms of depression. Questions measure an array of domains including cognitive, affective, and behavioral symptoms, with items assessing symptoms such as guilt, suicidality, anhedonia, sadness, and sleep. The BDI-II has demonstrated high internal consistency (Dozois et al., 1998) and excellent retest reliability (Sprinkle et al., 2002). In addition, it has also demonstrated strong concurrent (Storch et al., 2004), criterion (Sprinkle et al., 2002), convergent, and discriminant validity (Steer and Clark, 1997). Because major depressive disorder is highly comorbid with GAD and evidences its own distinct response patterns in the attentional bias literature (Mathews and MacLeod, 2005), BDI-II score was used as a covariate in analyses examining attentional bias. We also used the BDI-II to ensure that depressive symptoms were equivalent across the different stimuli presentation orders used in the probe discrimination task.

2.2.4 Penn State Worry Questionnaire

The Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) is a 16-item self-report questionnaire measuring severity of trait worry. This measure has demonstrated high

internal consistency and good retest reliability. The convergent and discriminant validity of this measure is supported by correlations between the PSWQ and measures of anxiety, depression, and emotional control (Brown et al., 1992). We used the PSWQ to ensure that trait worry levels were equivalent across the different stimuli presentation orders used in the probe discrimination task.

2.2.5 Intolerance of Uncertainty Scale

The Intolerance of Uncertainty Scale (IUS; Buhr and Dugas, 2002) is a 27-item self-report measure assessing reactions to and beliefs about uncertainty. The IUS has evidenced high internal consistency, good retest reliability, and convergent and discriminant validity. We used the IUS to ensure that IU levels were equivalent across the different stimuli presentation orders used in the probe discrimination task.

2.2.6 World Health Organization Disability Assessment Schedule 2.0

The World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0; World Health Organization, 2010) is a 12-item self-report measure used to assess the impact of health and disability conditions in the past 30 days. The WHODAS 2.0 has shown high internal consistency, good retest reliability, and moderate convergent validity across several cultures and subpopulations. This measure has also been used with individuals with physical disabilities and psychological conditions (Üstün et al., 2010). The WHODAS 2.0 was used to assess participant disability and compare these levels across diagnostic groups.

2.3 Probe Discrimination Task

2.3.1 Selection of Word Stimuli

Three types of word pairs (uncertainty-related, threat-related, and neutral) were generated. Words connoting uncertainty were provided by Michele Dugas (personal communication, June 2013) from an unpublished manuscript. Threat-related and neutral words were obtained from the Affective Norms for English Words (ANEW; Bradley and Lang, 2010) collection. The ANEW is a standardized set of words rated by undergraduate participants using a 9-point scale indicating each word's valence and arousal level. Bradley and Lang (2010) asked participants to rate word valence on a 1 (unpleasant) to 9 (pleasant) Likert scale, and word arousal on a 1 (calm) to 9 (aroused) scale using the Self-Assessment Manikin (SAM) system. Using the published ANEW ratings, we aimed to select 16 threat-related words that had published valence ratings between 1 and 3 (representing unpleasant valence). However, in order to match word length across word pairs, our selection of threat-related words was constrained by the word length of the uncertainty-related words; therefore, three threat-related words had published valence ratings slightly above 3 ("ridicule" = 3.13; "scandal" = 3.32; "appall" = 3.61), yielding a mean valence rating of 2.43 ($SD = 0.60$) for the 16 threat-related words. We also aimed to select neutral words that had published valence ratings between 4 to 6 (representing the middle range of the scale). However, given similar constraints regarding word length, five neutral words had published valence ratings slightly above 6 ("orchestra" = 6.02; "satellite" = 6.10; "refrigerator" = 6.14; "binoculars" = 6.18; "watermelon" = 6.52), yielding a mean valence rating of 5.27 ($SD = 0.47$) for the 64 neutral words. As expected, t -tests demonstrated that threat-related and neutral words were significantly different with respect to both valence ($t(78) = 20.44$, $p < .001$) and arousal

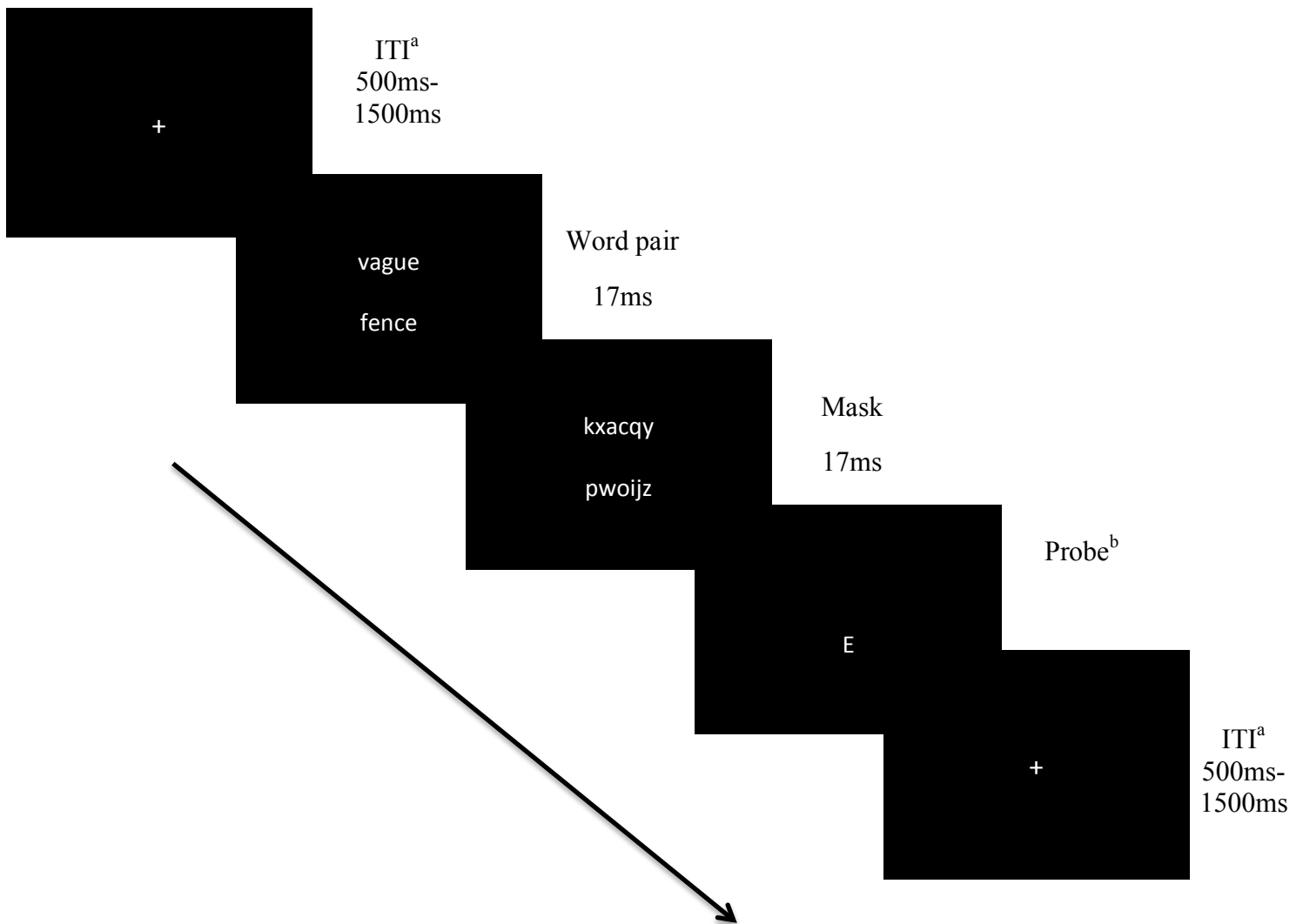
($t(78) = -5.83, p < .001$). Because uncertainty-related words were not selected from the ANEW system, valence and arousal comparisons were not possible for these words relative to the other two word types. Appendix provides a list of words utilized.

2.3.2 **Probe Task**

Participants were seated approximately 65cm from the computer screen and completed the probe discrimination task. We created three counterbalanced blocks of 48 trials, each of which was comprised of 16 consecutive trials of threat-neutral, uncertainty-neutral, or neutral-neutral word pairs. This yielded six counterbalanced presentations of the three blocks of trials, and participants completed one of these six possible presentation orders. Following a short break, these 48 trials were repeated a second time in the same order of presentation, yielding a total of 96 trials.

First, to orient the participant's attention toward the center of the screen, a fixation cross appeared with an inter-trial interval (ITI) lasting between 500ms and 1500ms. ITI time was randomized within this range to prevent participants from anticipating the timing of stimuli presentation. Next, a randomly selected word pair (i.e., threat-neutral, uncertainty-neutral, or neutral-neutral, depending on block) was presented for 17ms (for a similar procedure, see MacLeod et al., 2002). Next, a randomly generated string of letters, matched for preceding word pair length, replaced the word pair for 17ms. Then, either an "E" or "F" probe appeared in the same spatial location of one of the randomly-generated strings of letters (see Figure 1). Each probe remained on the screen until the participant pressed a button on the keyboard corresponding to the probe. Once the participant pressed the keyboard button, the next trial

commenced with a new fixation cross. See Figure 2. Word pairs, randomly-generated letter strings, and probes were approximately 1.2cm high, leading to a visual angle of less than 1° for each.



^a inter-trial interval.

^b probe remained on screen until participant responded.

Figure 1. Probe discrimination task trial.

2.3.3 **Procedure**

Upon arriving to the laboratory, participants were greeted by either a trained research assistant or a graduate student and completed an informed consent form. Participants were then re-administered the GAD-Q-IV to ensure that they continued to meet inclusion criteria on the day of the experiment. Next, participants were given instructions regarding how to complete the task, and once they confirmed their understanding, began 10 practice trials that consisted of a distinct set of words that were affectively neutral. After the practice session, participants completed the 96 experimental trials to assess attentional bias. All computer programs were administered on a 60Hz Pentium I processor desktop running E-Prime 2.0 software (Psychology Software Tools, Inc.).

Following the completion of the probe task, participants were administered the BDI-II, PSWQ, IUS, and WHODAS 2.0 through the online survey platform Qualtrics. Participants were then administered the SCID. Finally, they were debriefed and awarded research credit.

3. RESULTS

3.1 Data Reduction

A number of data cleaning procedures were utilized as per guidelines in previous probe detection studies (e.g., Behar et al., 2010; Hunt et al., 2006; Mathews et al., 1996). Trials were removed if participants responded earlier than 200ms or later than 1500ms, or if participants provided an erroneous response. These data reduction procedures resulted in no more than six trials being removed from any one participant's data ($M = 1.09$; $SD = 1.37$); in total, only 1.71% of the data were removed. Only threat-neutral trials and uncertain-neutral trials were included in subsequent analyses. Because neutral-neutral trials present words of the same valence, these trials have typically been excluded from analyses; that is, two types of words (e.g., threat and neutral) must be presented for a bias to appear.

Reaction times (RTs) were averaged for each participant by word type (threat-related or uncertainty-related), probe replacement (threat/uncertain word or neutral word), probe location (top or bottom), and probe type (E or F). This procedure resulted in 16 mean RTs for each participant. Because the number of possible combinations to present stimuli exceeded the total number of trials presented, some participants did not have data to compute all 16 mean RTs. Therefore, mean substitution from the appropriate diagnostic group (i.e., GAD or NonGAD) was used in these instances, yielding a total of seven mean substitutions imputed. RTs with z-scores ≥ 3.3 were identified for Winsor correction (Wilcox, 2012); a total of three data points were Winsorized.

To examine whether there was an effect of block presentation order on RT, we conducted two separate 6-way (Presentation Order) multivariate analyses of variance (MANOVAs) on mean RTs for each diagnostic group. Results indicated no effect of Presentation Order for either

the GAD group, $F(35, 25) = 1.73, p = .07$, or the NonGAD group, $F(60, 25) = 1.10, p = .41$.

Next, to ensure that trait IU, trait worry, depressive symptoms, and health disability were equivalent across presentation order for both the GAD and NonGAD groups, we conducted two separate 6-way (Presentation Order) MANOVAs on the BDI-II, PSWQ, IUS, and WHODAS 2.0 for each diagnostic group. Results indicated no multivariate effect of Presentation Order for either the GAD group, $F(35, 25) = 1.12, p = .39$, or the NonGAD group, $F(30, 55) = .78, p = .77$.

3.2 Attentional Bias Score Calculation

Attentional bias scores were computed using the formula:

$$\text{mean RT}_{\text{neutral}} - \text{mean RT}_{\text{threat/uncertain}}$$

In other words, we subtracted the mean RT from when probes (E or F) replaced threat-related or uncertainty-related words from the mean RT when probes replaced neutral words. A positive attentional bias score indicated an attentional bias toward threat-related or uncertainty-related words, whereas a negative attentional bias score indicated an attentional bias toward neutral words.

3.3 Preliminary Analyses

To compare the GAD and NonGAD groups on dimensions of psychopathology and disability, we conducted a one-way MANOVA (Group) on the BDI-II, PSWQ, IUS, and WHODAS 2.0. Results indicated that individuals with GAD had significantly higher scores on all measures (see Table I), except on one of the three supplementary questions from the

WHODAS 2.0. Specifically, relative to the NonGAD group, the GAD group reported more days with the presence of health-related difficulties, $F(1, 29) = 12.70, p < .001$, and more days in which their work or usual activities were reduced as a result of health conditions, $F(1, 29) = 14.84, p = .001$. In addition, the GAD group tended to report more days of being completely incapacitated in their work or usual activities as a result of health conditions $F(1, 29) = 3.88, p = .059$.

Table I**LEVELS OF PSYCHOPATHOLOGY AND DISABILITY AMONG GAD AND NONGAD GROUPS**

Measure	<u>GAD</u> M(<i>SD</i>)	<u>NonGAD</u> M(<i>SD</i>)
IUS ^{a*}	89.08 (19.91)	43.28 (10.43)
PSWQ ^{b*}	69.31 (8.59)	32.22 (8.41)
BDI-II ^{c*}	27.31 (10.29)	3.56 (3.38)
WHODAS 2.0 ^{d*}	8.85 (4.85)	2.94 (4.33)
WHODAS 2.0 Q1 ^{e*}	14.15 (9.22)	2.11 (3.60)
WHODAS 2.0 Q2 ^f	2.62 (5.55)	0.06 (0.24)
WHODAS 2.0 Q3 ^{g*}	4.00 (4.43)	0.00 (0.00)

^a Intolerance of Uncertainty Scale.

^b Penn State Worry Questionnaire.

^c Beck Depression Inventory II.

^d World Health Organization Disability Assessment Schedule 2.0.

^e Supplementary question “Overall, in the past 30 days, how many days were these difficulties present?”.

^f Supplementary question “In the past 30 days, for how many days were you totally unable to carry out your usual activities or work because of any health condition?”.

^g Supplementary question “In the past 30 days, not counting the days that you were totally unable, for how many days did you cut back or reduce your usual activities or work because of any health condition?”.

* $p < .001$.

3.4 Attentional Bias Analyses

To examine attentional bias to threat-related and uncertainty-related words, we ran a 2 (Group: GAD, NonGAD) X 2 (Trial Type: threat, uncertain) X 2 (Probe Location: top, bottom) X 2 (Probe Type: E, F) mixed-model ANCOVA with Group as the between-subjects factor, and Trial Type, Probe Location, and Probe Type as the within-subjects factors, on attentional bias scores. Because prior research indicates that depression- and anxiety-related disorders differentially impact performance on probe detection paradigms (Mathews and MacLeod, 2005), we controlled for BDI-II scores in the analysis. Results revealed no main effects of any variable, and no Group X Trial Type interaction, $F(1,28) = 1.51, p = .23$ (see Figure 2). Notably, observed power for this hypothesized interaction was low (0.22). To further explore the hypothesized effects, Cohen's d effect sizes were calculated. Whereas GAD and NonGAD participants' attentional bias toward threat-related words evidenced a large effect size ($d = 0.95$), the effect size for attentional bias toward uncertainty-related words was negligible ($d = 0.05$).

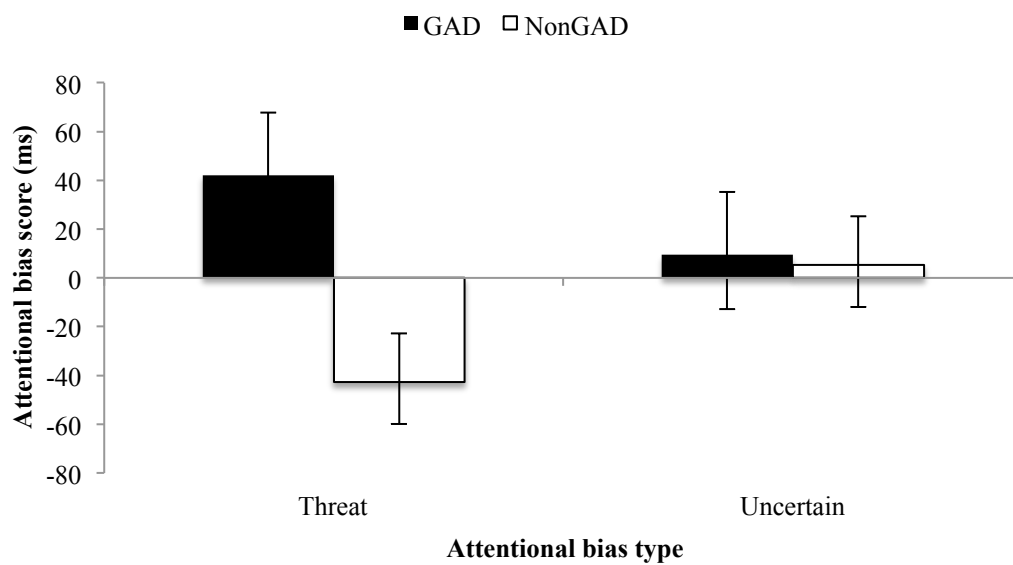


Figure 2. Mean attentional bias scores for threat- and uncertainty-related words for GAD and NonGAD participants.

Note. Error bars attached to each attentional bias score depict standard errors.

4. DISCUSSION

4.1 Summary

This study utilized a probe discrimination task to examine whether individuals with GAD evidence an attentional bias toward uncertainty-related stimuli. Although we had limited statistical power to properly examine hypothesized effects, our preliminary findings and accompanying effect size analyses suggest the possibility that individuals with GAD do *not* evidence such an attentional bias. Although results did not indicate a statistical difference between individuals with and without GAD on selective attention toward general threat, this effect size was large and in the expected direction, such that participants with GAD showed an attentional bias toward general threat whereas those without GAD showed an attentional bias away from general threat. This pattern of results is consistent with multiple previous studies indicating an attentional bias toward threat in GAD (MacLeod et al., 1986; Mathews et al., 1996; Mogg et al., 1995).

4.2 Effect Size Analysis

In seeking to understand why our results did not yield a significant attentional bias toward general threat among participants with GAD, we examined published effect sizes associated with this phenomenon across the literature. One study that presented stimuli for 100ms found that relative to individuals with low anxiety, those with high anxiety evidenced an attentional bias toward threat-related words with an effect size of $d = 0.75$ (Mogg et al., 1997). In another study presenting stimuli for 17ms, relative to healthy control participants, individuals diagnosed GAD evidenced an attentional bias to anxiety- and depressive-related words with an

effect size of $d = 0.63$ (Mogg et al., 1995). It is noteworthy that our investigation also entailed the presentation of stimuli for 17ms, and that our effect size was greater than that reported by Mogg et al. (1995). In a recent meta-analysis examining differences in attentional threat bias magnitude across variations in experimental procedures, Bar-Haim et al. (2007) computed effect sizes from studies using modified versions of the dot probe paradigm. They reported a between-subjects (anxious versus control participants) effect size of $d = 0.38$ when collapsing across stimulus type (i.e., word, pictorial) and presentation time (i.e., supraliminal, subliminal). A similarly small between-subjects (anxious versus control participants) effect size ($d = 0.37$) was found in studies using word stimuli (as opposed to pictorial stimuli) when collapsing across presentation time. Finally, a moderate between-subjects (anxious versus control participants) effect size ($d = 0.58$) was found in studies using subliminal presentation time when collapsing across stimulus type. Unfortunately, the authors did not provide an effect size for the exact experimental procedures in our study (GAD versus control participants viewing word stimuli with a subliminal presentation time). Thus, although methodological factors such as participant sample, stimulus type, and stimulus presentation time seem to yield different effect magnitudes, the between-subjects effect size in our study is larger than those found in several previous studies comparing anxious and control participants, as well as previous studies using word stimuli to depict threat.

4.3 **Specificity of Intolerance of Uncertainty to Generalized Anxiety Disorder**

In our examination of uncertainty-related stimuli, our findings suggest that IU may not be as threatening to individuals with GAD, or as central to understanding the condition, as has been suggested elsewhere (e.g., Dugas et al., 2004). It may be that this construct is more salient in

populations other than GAD. For example, Tolin, Abramowitz, Brigidi, and Foa (2003) found that greater levels of IU predicted checking rituals in individuals with obsessive-compulsive disorder (OCD). IU has also been linked to social anxiety disorder (Boelen and Reijntjes, 2009), posttraumatic stress disorder (White and Gumley, 2009), and depression (Gentes and Ruscio, 2011). Although no studies have examined whether an attentional bias toward uncertainty exists in these conditions, future studies of this sort will help to answer questions about which syndromes might be characterized by an underlying pre-attentive bias toward uncertainty-related stimuli.

4.4 **Intolerance of Uncertainty and Threat**

However, the notion that uncertainty is non-threatening to individuals with GAD is unsupported by literature measuring IU via alternative methods. For example, research using cognitive appraisal measures indicates that anxious individuals negatively appraise uncertainty (e.g., Anderson et al., 2012; Koerner and Dugas, 2008). Moreover, research experimentally manipulating levels of uncertainty has shown that relative to those with decreased IU, those with increased IU worried more about the outcome of a roulette gambling task (Ladouceur et al., 2000). Finally, another study randomly assigned high trait worry participants to either write about their worst fear coming true (exposure condition) or about an emotionally neutral future situation (non-exposure condition) for five sessions (Goldman et al., 2007). The investigators found that only in the exposure condition did IU significantly predict decreases in worry across sessions, and suggested that exposing participants to their feared situation via writing decreased participant IU toward this event, ultimately making the situation less threatening. Taken together,

research seems to indicate that uncertainty is indeed threatening to individuals with GAD when measured using alternative methodological approaches.

One possibility is that uncertainty *is* in fact threatening to individuals with GAD and central to understanding the nature of worry, but that this relationship is not detectable at nonconscious levels of cognitive processing. Prior research suggests that selective attention to threat in anxious individuals begins during a nonconscious stage of information processing (for a review, see Mathews and MacLeod, 2005). Although we did not find evidence of an attentional bias using a presentation time intended to capture nonconscious attentional bias, it might be that a bias reflecting the intolerance of uncertainty construct is evident only when stimuli are presented at a conscious stage of processing.

Another possibility is that individuals with GAD do feel threatened by uncertainty, but not to the degree previously suggested. Mathews and MacLeod (2005) propose that for survival purposes, all individuals have an internal threat system that, when sufficiently activated, directs their attention toward the salient threat. That is, an individual must be activated to his/her threshold before attention is subsequently directed toward a threatening stimulus. The authors suggest that in comparison to nonanxious individuals, anxious individuals have a lower threat threshold, thus explaining the faster deployment of attentional resources toward threat. Importantly, the IU-worry relationship seems to be partially mediated by ratings of perceived threat (Berenbaum et al., 2008), suggesting that levels of IU may be related to threat appraisal. Thus, perhaps uncertainty is not sufficiently threatening to activate individuals with GAD to this proposed alarm threshold. As a result, an attentional bias toward uncertainty-related stimuli may not be evident.

4.5 **Limitations**

Our investigation had several limitations. First, because our study was underpowered, it is difficult to make any conclusive statements regarding whether individuals with GAD evidence an attentional bias toward uncertainty-related stimuli. As a result, we are currently collecting additional data. Second, due to a finite number of words that depict uncertainty in the English language, we were quite limited in the number of uncertainty-related word pairs that could be uniquely presented. We presented each word pair twice, but ideally our study would have included a greater number of uncertainty-related words, resulting in the presentation of a greater number of trials without repetition. Third, it is possible that our uncertainty-related words were not sufficiently threatening to participants; this is consistent with Mathews and MacLeod's (2005) assertion that stimuli must activate the individual to threshold. Fourth, some investigators have questioned whether the probe detection paradigm is the best choice for accurate detection of attentional biases (e.g., Fox et al., 2001; Fox et al., 2002). Although the paradigm has been widely used to measure attentional biases, effect sizes have been small and inconsistent across studies (for a review, see Bar-Haim et al., 2007). Finally, there has been no consensus across investigators regarding the best possible methodological approach to detecting attentional biases using the probe detection task. For example, it remains unclear what the optimum number of trials, number of stimuli, and number of sessions are to detect attentional biases.

4.6 **Strengths**

In contrast, our study had a few recognizable strengths. First, we formally diagnosed individuals with GAD and used stringent inclusion and exclusion criteria. Second, using a subliminal presentation time facilitated testing whether attentional biases occurred during early as opposed to later stages of cognitive processing. Third, despite being homogenous in age, the sample was ethnically diverse.

4.7 **Future Directions**

Currently, the answer to whether individuals with GAD have an attentional bias toward uncertainty-related stimuli remains unclear. Future investigators should continue to examine this question using sample sizes large enough to provide sufficient statistical power. If such investigations do indicate that individuals with GAD have an attentional bias toward uncertainty-related stimuli, this knowledge should be implemented practically. Notably, attention bias modification (ABM) paradigms (e.g., Amir et al., 2009) have sought to decrease threat-related attentional bias by training individuals to attend to neutral rather than threat-related words. Results have demonstrated that ABM procedures can reduce attentional bias in a GAD sample and subsequently mitigate anxiety (Amir et al., 2009). Additionally, investigators might consider methodological variations of the probe paradigm. Examining attentional bias through supraliminal presentation time might help elucidate the processing level (i.e., nonconscious, conscious) at which this bias occurs.

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APPENDIX

Uncertain-neutral word pairs

vague	fence
maybe	opera
chance	pigeon
random	tendon
tricky	compel
varying	cabinet
doubtful	umbrella
puzzling	knitting
ambiguous	furniture
debatable	appliance
imprecise	vegetable
irregular	satellite
uncertain	hairdryer
mysterious	binoculars
hesitation	skyscraper
questionable	weightlifter

Threat-neutral word pairs

gloom	metal
germs	chalk
coffin	farmer
betray	tissue
appall	kidney
scandal	factory

ridicule	basement
starving	pamphlet
nightmare	fisherman
miserable	warehouse
regretful	character
blackmail	orchestra
anguished	procedure
frustrated	watermelon
distressed	scientific
disappointed	refrigerator

Neutral-neutral word pairs

stove	chair
penny	basin
ladder	barrel
ingest	fervor
enzyme	icebox
apology	descent
scissors	religion
building	industry
blowdryer	headlight
jellyfish	crocodile
groceries	secretary
structure	bicyclist
crossword	newspaper
suggestion	reflection

windshield lighthouse
continuation checkerboard

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Moran, T. P., Moser, J. S., & **Jendrusina, A.** (September, 2011). *It's not the size of the ERN than counts, it's how you use it: Evidence for a sex-moderated relationship between anxiety and the ERN.* Poster presented at the meeting of the Society for Psychophysiological Research, Boston, MA.

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Jendrusina, A. (2010, April). *Decision frames across anxious and non-anxious populations.* Symposium conducted at the meeting of the Michigan State University Undergraduate Research and Arts Forum, East Lansing, MI.

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Liberal Arts and Sciences PhD Travel Award, 2012, 2013, 2014

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EXPERIENCE:

Graduate research assistant, Latina/o Health in Social Context Lab, Department of Psychology, University of Illinois at Chicago, Chicago, Illinois, September 2013 - Present

Graduate research assistant, Laboratory for Emotion and Anxiety Disorders, Department of Psychology, University of Illinois at Chicago, Chicago, Illinois, August 2012 – Present

Undergraduate research assistant, Clinical Psychophysiology Lab, Department of Psychology, Michigan State University, East Lansing, Michigan, August 2009 – May 2010

Lab Manager, Clinical Psychophysiology Lab, Department of Psychology, Michigan State University, East Lansing, Michigan, May 2010 – July 2012

Collaborator, MSU Child Emotions Lab, Department of Psychology, Michigan State University, East Lansing, Michigan, May 2011 – July 2012

Honors college student, Senior thesis, Department of Psychology, Michigan State University, East Lansing, Michigan, August 2009 – May 2010

Undergraduate research assistant, Laboratory for Cognitive and Decision Sciences, Department of Psychology, Michigan State University, East Lansing, Michigan, September 2007 – May 2010

Honors college student, Honors fMRI Research Seminar, Department of Psychology, Michigan State University, East Lansing, Michigan, Fall 2007 – Spring 2008

TEACHING:

EXPERIENCE:

Graduate teaching assistant, Department of Psychology, University of Illinois at Chicago, Chicago, Illinois

Undergraduate Courses:

Introductory Psychology (PSY 100)

*Abnormal Psychology (PSY 270)

Social Psychology (PSY 312)

*Psychological Interventions (PSY 382)

Graduate courses:

*Interviewing (PSY 481)

IRB APPROVAL

Approval Notice

Amendment to Research Protocol and/or Consent Document – Expedited Review

UIC Amendment # 5

December 18, 2014

Alexander Jendrusina, B.A.

Psychology

1007 W Harrison Street

M/C 285

Chicago, IL 60612

Phone: (312) 727-9794 / Fax: (312) 413-4122

RE: **Protocol # 2013-0804**
“Information Processing and Worry”

Dear Mr. Jendrusina:

Members of Institutional Review Board (IRB) #2 have reviewed this amendment to your research and/or consent form under expedited procedures for minor changes to previously approved research allowed by Federal regulations 45 CFR 46.110(b)(2). The amendment to your research was determined to be acceptable and may now be implemented.

Please note the following information about your approved amendment:

Amendment Approval Date: December 18, 2014

Amendment:

Summary: UIC Amendment #5 dated December 8, 2014 and received December 10, 2014 is an investigator-initiated amendment about the following:

1) Adding a questionnaire to be administered in the mass testing setting for PCSH 100. It includes a validated measure that has been previously approved, the Intolerance of Uncertainty Scale, and three new questions that ask participants how they will react in specific uncertain situations. The questions are added to better measure a construct of interest. (Updated Initial Application, Protocol, v. 5, 12/08/2014, Mass testing Form, v. 1, 12/8/2014).

2) Adding Elizabeth Stevens as key research personnel (Appendix P).

Approved Subject Enrollment #: 80

Performance Sites: UIC

Research Protocol:

a) Information Processing and Worry; Version 5, 12/08/2014

Please note the Review History of this submission:

Receipt Date	Submission Type	Review Process	Review Date	Review Action
12/10/2014	Amendment	Expedited	12/18/2014	Approved

Please be sure to:

→ Use your research protocol number (2013-0804) on any documents or correspondence with the IRB concerning your research protocol.

→ Review and comply with all requirements on the OPRS website under:

"UIC Investigator Responsibilities, Protection of Human Research Subjects"
(<http://tiger.uic.edu/depts/ovcr/research/protocolreview/irb/policies/0924.pdf>)

Please note that the UIC IRB #2 has the right to ask further questions, seek additional information, or monitor the conduct of your research and the consent process.

Please be aware that if the scope of work in the grant/project changes, the protocol must be amended and approved by the UIC IRB before the initiation of the change.

We wish you the best as you conduct your research. If you have any questions or need further help, please contact the OPRS at (312) 996-1711 or me at (312) 996-9299. Please send any correspondence about this protocol to OPRS at 203 AOB, M/C 672.

Sincerely,

Anna Bernadska, M.A.

IRB Coordinator, IRB # 2

Office for the Protection of Research Subjects

Enclosure: None

cc: Evelyn Behar, Faculty Sponsor, Psychology, M/C 285
Michael E. Ragozzino, Psychology, M/C 285