ABSTRACT

Title of Document: THE EFFECT OF ANXIETY ON REPETITION PRIMING FOR VISUAL STIMULI.

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Anxiety strongly influences a person's experience by affecting, among others, cognition and learning. Theoretical models of anxiety indicate that the level of anxiety experienced by an individual affects how they analyze threat-related incoming information. The purpose of the present study was to investigate the relationship between anxiety and the difference in the time it takes to make simple decisions about repeatedly presented photographs. The study included 71 participants who completed a task based on the repetition priming effect. The photographs used for this task depicted human faces displaying a happy or fearful expression. The participants were presented twice with each photograph and were asked to indicate the gender of the face presented in the photograph. The outcome measure was the time that it took for each participant to react to the presented photographs.

The findings indicate that anxiety, worry, and intolerance of uncertainty affect the perception of visual stimuli, such that people with higher anxiety, worry, or intolerance of uncertainty react differently to such stimuli. People with a history of a DSM-IV anxiety

disorder diagnosis reacted faster to visual stimuli relative to healthy controls. The differences in information processing between people with high and low anxiety seem to provide support for cognitive theories that explain anxiety as the result of lack of habituation due to excessive avoidance and those that explain anxiety as the result of disproportionate allocation of cognitive resources.

THE EFFECT OF ANXIETY ON REPETITION PRIMING FOR VISUAL STIMULI

By

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Chapter 1: Introduction

Anxiety is the main and ever-present symptom in anxiety disorders, as classified and described in the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2000), which affect about 19 million adults in the United States every year (Grisel, Rasmussen, & Sperry, 2006). Feelings of anxiety may often be accompanied by unrelenting feelings of worry, apprehension, nervousness, fear, panic, obsessive thoughts, unwanted intrusive memories, nightmares, or repetitive ritualized behaviors. These feelings, thoughts, and behaviors are often characterized by dysregulation in muscle-tension or in sleep, respiratory, cardiovascular, or gastrointestinal systems.

Anxiety and fear are both important common elements found in all anxiety disorders. Anxiety has been described as an emotional state that is future-oriented, while fear has been described as an alarm reaction that is focused and inflexible (Antony, Orsillo, & Roemer, 2001). Intense anxiety and fear are often accompanied by additional negative affect, a sense of unpredictability and uncontrollability, avoidance of feared situations/experiences, reliance on safety behaviors in order to reduce perceived threat, difficulty concentrating, and worry (Antony, Federici, & Stein, 2009; Antony, et al., 2001).

Worry

Worry was first defined as an uncontrollable chain of thoughts charged with negative affect (Borkovec, Robinson, Pruzinsky, & DePree, 1983). This chain of thoughts aims to solve problems with uncertain outcomes, especially when some of these

outcomes may be negative. Hence, worry is closely related to the fear process (Borkovec et al., 1983). Worry has also been defined as an anticipatory cognitive process that is characterized by the tendency to interpret ambiguous stimuli as threatening, the tendency to predict negative outcomes for uncertain events, and the tendency to overestimate risk (Ladouseur, Gosselin, & Dugas, 2000). Worry has further been defined as fear-producing thoughts and images related to everyday-life experiences that have the potential to result in adverse consequences (Mathews, & Funke, 2006; Taylor, Thordarson, Sochting, 2002). These thoughts and images are thought to be uncontrollable, excessive, repetitive, and to remain unresolved in the absence of intervention (Mathews, & Funke, 2006).

According to cognitive theories of anxiety, worry is related to threat schemata in an individual's long-term memory (Mathews, & Funke, 2006). When these threat schemata are activated, they may increase vigilance for internal or external threats (e.g. negative evaluation or harm, respectively). Increased vigilance for threat and increased detection of potentially threatening stimuli is the antecedent of worry. The preferential processing of threatening stimuli, also known as biased information processing, can have causal effects on the etiology and maintenance of anxiety and worry (Koster, Fox, & MacLeod, 2009). Information processing biases in worriers are evidenced by the increased need for time and evidence to make decisions related to ambiguous stimuli (Tallis, Eysenck & Mathews, 1991).

Worry is often investigated in people diagnosed with General Anxiety Disorder (GAD) and by comparing people with GAD and pathological worry to low-worry non-anxious controls (Holaway, Rodebaugh, & Heimberg, 2006). Some studies indicate that worry is a characteristic of normal levels of anxiety and is not limited to people that meet

criteria for Anxiety Disorders. A study by Ruscio (2002) revealed that only a modest percentage of high worriers (20%) met diagnostic criteria for GAD. Hence, worry is a construct that defines the experience of anxiety and is not necessarily restricted to a specific GAD diagnoses. In this study, rather than a specific symptom of GAD, worry is conceptualized as a dimensional characteristic that is present in people who experience high levels of anxiety (Naliboff & Rhudy, 2009; Wells & Mathews, 2006; Starcevic & Berle, 2006; Gladstone, Parker, Mitchell, Malhi, Wilhelm, & Austin, 2005). The variables that have been identified as predictors of excessive worry are: intolerance of uncertainty, beliefs that worry has a protective function, negative orientation towards problem situations, and cognitive avoidance (Dugas, Gagnon, Ladouceur, & Freeston, 1998). The relationship between intolerance of uncertainty and worry remains strong even after taking into account anxiety and depression (Buhr, & Dugas, 2006).

Intolerance of Uncertainty

Intolerance of uncertainty (IU) has been defined as biased perception, interpretation, or negative emotional/cognitive/behavioral response to uncertain situations and events (Buhr & Dugas, 2006; Dugas, Hedayati, Karavidas, Buhr, Francis, & Philips, 2005; Dugas, Buhr, & Ladouceur, 2004). People with high IU perceive uncertain events as stressful and upsetting. They further interpret such events as negative, threatening, and unfair, and they avoid or are unable to act in uncertain situations. People with high IU are unable to tolerate the possibility of a negative outcome, even if the probability of such outcome is very small (Mathews, & Funke, 2006; Dugas et al., 2005). IU has been conceptualized as a dispositional characteristic, a personality trait, a cognitive process, and a cognitive filter (Dugas and Robichaud, 2007; Dugas et al., 2005; Fisher & Wells,

2009). It has been suggested that IU results in selective encoding and interpretation of information, such that people with high IU pay more attention to uncertain stimuli, go through greater elaborative encoding of uncertain information, have enhanced recollection of uncertain stimuli, and have greater tendency to interpret such stimuli as threatening (Dugas et al., 2005). Researchers suggest that preferential encoding of threatening information, threatening interpretation of uncertain stimuli, and preferential retrieval of threatening information results in extreme concern and worry when any physical or psychological peril is present (Koerner, 2008). Research investigating the influence of anxiety and of IU on information processing has indicated that IU is a unique contributor that defines the experience of anxiety beyond anxiety symptoms. IU has been conceptualized both as a cognitive vulnerability and as a characteristic of anxiety; it is part of a vicious circle where its presence influences worry which in turn interferes with information processing of uncertain stimuli, which then maintains and enhances anxiety symptoms (Koerner and Dugas, 2008).

Information Processing Bias

One of the factors deemed critical in the development and maintenance of intolerance of uncertainty, worry, and ultimately anxiety is biased information-processing (Koster, Fox, & MacLeod, 2009). Biased information processing is at the center of many theoretical models of anxiety and anxiety disorders (Rapee, 2001; Mogg, & Bradley, 1998; Mathews, & Mackintosh, 1998; Eysenck, 1992; Beck, & Clark, 1997; Clark, & Wells, 1995; Woody, & Rachman, 1994; Ohman, 1993; Williams, Watts, MacLeod, & Mathews, 1988; Foa & Kozak, 1986). Biased information processing in people with anxiety, rather than narrow, deficient, incorrect, or distorted, means selective information

processing that is negatively biased, resulting in higher-than-normal vigilance for threatening and other adverse stimuli.

Information processing biases occur in all people, and these biases are driven by a person's experiences and cognitions regarding the world and the self. In addition to the influence of normative human experiences on information processing, a great deal of attention has been focused on the influence of emotional and cognitive difficulties on this process. Research indicates that in anxious people information processing biases tends to reconfirm their view of the world as a dangerous place (Ouimet, Gawrinski, & Dozois, 2009). People suffering from depression tend to have longer reaction times due to motor and cognitive slowing, fail to respond to target stimuli, or focus on negative aspects of stimuli more often than non-depressed people Christensen, Carney, & Segal, 2006). People with ADHD tend to have slower processing speed and decreased accuracy in complicated tasks both as children and adults (Semrud-Clikeman, & Ellison, 2009; Mapou, 2009). Thus, when investigating information processing biases in anxiety, it is important to take into account several sources of bias that are likely present in the population of interest.

Information processing biases have been investigated during different stages of information processing—specifically during transformation of stimuli into subjective cognitive representations of these stimuli (encoding) (Amir, Coles, & Foa, 2002; MacLeod, 1991), during the process of assigning meaning and placing stimuli in a constellation of similar and related cognitive structures (interpretation) (Wilson, MacLeod, & Campbell, 2007; Amir, Coles, & Foa, 2002), and during recollection of subjective representations of stimuli that had been stored in memory (retrieval) (Mitte,

2008; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, van Ijzendoorn, 2007). While most researchers agree, in part, that anxiety is characterized by information processing biases (McNally & Reese, 2009); they disagree on the pattern and timeline in which such biases occur.

Theoretical Models of Information Processing Biases in Anxiety

Early cognitive theories of the etiology of anxiety proposed that anxiety is the result of enhanced automatic encoding of threatening stimuli, enhanced automatic retrieval of the same, enhanced automatic proliferation of anxiety schemata (Beck, 1976), and interpretation of uncertain stimuli as threatening (Bower, 1983). Although these theories propose different timelines and mechanisms of the automatic cognitive processes that enhance and maintain anxiety, they both predict facilitated processing of threatening stimuli.

Some later theories proposed that the attention of anxious individuals is immediately captured by threatening stimuli and attentional resources are disproportionately allocated to processing these stimuli during the initial, automatic stages of processing (Williams, Watts, MacLeod, & Mathews, 1988; Ohman, 1999). Other theories proposed that cognitive resources are disproportionately allocated towards threatening stimuli during later, elaborative, and interpretative processes (Mathews, & Mackintosh, 1998; Foa & Kozak, 1986; Mogg, Bradley, De Bono, & Painter, 1997).

Certain theoretical models propose biased or selective processing in both initial automatic and later conscious stages of information processing. These models include preferential processing of threatening stimuli during initial, automatic stages of information processing (Amir, Foa, & Coles, 1998; Beck & Clark, 1997; Eysenck, 1992;

Mogg et al, 1997; Williams, Watts, MacLeod, & Mathews, 1997). The preferential automatic processing is followed by sustained selective semantic elaboration of threatening stimuli (Beck & Clark, 1997), threatening interpretation of uncertain stimuli (Eysenck, 1992), or avoidance resulting in failure to assess threat accurately and failure to habituate to threatening stimuli (Williams, Watts, MacLeod, & Mathews, 1997; Amir, Foa, & Coles, 1998; Mogg et al, 1997).

Experimental Studies of Information Processing Bias in Anxiety, Worry, and Intolerance of Uncertainty

Research on information processing biases has provided support for the existence of such biases in people with specific anxiety disorders (Mogg & Bradley, 2005; Clark & McManus, 2002; Heinrichs & Hofman, 2001; Buckley, Blanchard, & Neill, 2000; Musa & Lepine, 2000; McNally, 1999; Summerfeldt & Endler, 1998). A systematic quantitative review of this research provided evidence that threat-related bias is a robust phenomenon, which differentiates non-anxious individuals from those with different types of anxiety across a variety of experimental conditions (Bar-Haim et al., 2007).

Research on information processing biases and worry or intolerance of uncertainty has provided support for biased recall for stimuli denoting uncertainty (Dugas et al., 2005), threatening interpretation of ambiguous statements (Dugas et al., 2005), indecisiveness and hypersensitivity regarding threat (Rassin & Muris, 2005), and concern and threatening appraisal regarding ambiguous situations (Keorner & Dugas, 2008). Studies investigating processing biases in worry and intolerance of uncertainty have used verbal-linguistic stimuli and have assessed biases during the interpretative and elaborative phase of information processing. Dugas et al. (2005) reasoned that words are

the ideal medium for investigating biases in information processing in worriers and people with high intolerance of uncertainty, because verbal-linguistic processes predominate in worry.

Paradigms Used in the Study of Information Processing Biases

Experimental paradigms used to investigate information processing differ in how presence of anxiety affects task completion and in how information processing biases are operationalized. The presence of anxiety can either facilitate or disrupt performance on a task. Most paradigms entail tasks performed in the presence and/or absence of threatening stimuli. In some paradigms the presence of threatening stimuli disrupts or interferes with task completion. In other paradigms the presence of threatening stimuli increases ease of completing the task in the presence of anxiety. The combined results of these types of experiments provide strong support for the presence of information processing biases in anxiety disorders.

The paradigms that have been used to investigate processing biases towards threatening stimuli are the emotional Stroop, dot-probe, emotional spatial cuing, and visual search (for an in-depth review of these paradigms and studies, cf. Bar-Heim et al, 2006). Information processing biases in these paradigms are operationalized as the difference in the time it takes an individual to react to threatening stimuli versus time to react to neutral or positive stimuli. Experiments using these paradigms allow for reaching conclusions with regards to information processing biases in general and specifically with regards to disproportionate allocation of cognitive resources in verbal-linguistic processing of threatening stimuli (emotional Stroop), engaged attention or inability to disengage attention with threatening stimuli (dot-probe task), engaged attention with

threatening stimuli (spatial cuing), and enhanced attentional capture of threatening stimuli (emotional visual search). These experiments do not allow for making conclusions with regards to the disproportionate allocation of cognitive resources during the non-verbal processing of threatening stimuli.

The bias toward prioritizing threat encoding is present at the earliest stages of attentional processes, as the individuals rapidly orient to and detect the crucial characteristics of a stimulus (Surcinelli et al, 2006; Bradley, Mogg, Falla, & Hamilton, 1998). The repetition priming task that will be used in this study aims to investigate disproportionate allocation of cognitive resources following attention capture and preceding verbal processing of threatening stimuli or disengagement from stimuli.

Repetition Priming

Repetition priming is the increased ease of processing a stimulus following a single previous presentation (Schacter, 1987). The repetition priming effect can be assessed by comparing the participants' reaction during the first time they are presented with a stimulus against their reaction during the second presentation of the same stimulus. The differences between initial and following presentations are observable in behavioral and biological reactions, such as reduced reaction time (Thomas & LaBar, 2005), increased probability of producing the primed stimulus (Zhou, Hu, Sun, & Huang, 2006), reduced brain activation evident in fMRI (Orfanidou, Marslen-Wilson, & Davis, 2006) and EEG data (Wiese, Schweinberger, Neuman, 2008).

Repetition priming tasks are thus characterized by consecutive presentations of stimuli. The first presentation of the stimulus is often indicated as the first or prime phase. In the second presentation or the test phase, the previously presented stimuli are

intermixed with new stimuli. The participants are usually asked to react to or to make cognitive or perceptual judgments that do not require recollection of previous encounters with the stimuli, such as categorize words as concrete vs. abstract, or categorize photographs of faces as male vs. female (Thomas & LaBar, 2005; Schwartz, Shook, Vaidya, & Deutsch, 2009). Often participants make cognitive or perceptual judgments regarding previously presented stimuli during the test phase of the tasks faster or more accurately than during the priming phase faster and more accurately than judgments regarding novel stimuli.

Researchers initially explored repetition priming through the use of cognitive tasks involving lexical decisions (Forbach, Stanners, & Hochhaus, 1974), word identification (Neisser, 1954), or word stem/fragment completion (Tulving, Schacter, & Stark, 1982). The study of repetition priming further evolved to include drawings (Cave, Bost, & Cobb, 1992) and photographs of objects and faces (Bruce, Burton, Carson, & Mason, 1994; Mitchell & Brown, 1988; Warren, & Morton, 1982; Uttl, Graf, & Santacruz, 2006). Repetition priming paradigms have been used with both normal and clinical samples (Danion, Williard-Schroeder, Zimmerman, Grange, Schlienger, & Singer, 1991; Enright & Beech, 1993; Thomas, & LaBar, 2005; Schwartz et al., 2009).

Repetition Priming Stimuli: Emotional Faces

The presentation of a human face is a powerful stimulus that initiates immediate cognitive processing (Wiese, Schweinberger, & Neuman, 2008). Within fractions of a second we perceive enough information from a presented face to make judgments concerning someone's gender, race and age (Bruce & Young, 1998). One of the vital characteristics of a face is the emotion expressed in that face (Wiese, Schweinberger,

Neuman, 2008). Emotionality is a characteristic that often results in a lasting and salient memory of that stimulus (Parrot & Spackman, 2000). Emotional expressions are one of the factors that have been investigated in the framework of repetition priming, in the attempt to better understand the impact of emotions on perception (Bentley, Vuilleumier, Thiel, Driver, & Dolan, 2003; Burton, Rabin, Wyatt, Frohlich, Vardy, & Dimitri, 2005; Campanella, Quinet, Bruyer, Crommelinck, & Guerit, 2002). Research to date indicates that the introduction of an emotional dimension leads to changes in the repetition priming effect; however, the findings are mixed and difficult to integrate (Burton et al., 2005; Bentley et al., 2003). The present study investigated the repetition priming effect for photographs of faces displaying happy or fearful expressions. The advantage of using photographs of emotional faces is that it requires minimal verbal-linguistic processing; it thus focuses the search for processing biases in the time window following the attention capture and preceding the verbal processing of threatening stimuli or disengagement from stimuli—a time-window that has not been investigated through the paradigms used in the studies to date (Bar-Heim et al., 2007).

Current Study

The purpose of the current study is to investigate the differences in the repetition priming effect of emotional stimuli in individuals differing in their anxiety level. Several studies have investigated the existence of the repetition priming effect for emotional stimuli (Lamy, Amunts, & Bar-Haim, 2008; Goetz; Goetz, & Robinson, 2007; Marchewka & Nowicka, 2007). The usual repetition priming paradigm involves presentation of initial stimuli followed presentation of initial stimuli intermixed with novel stimuli. The difference between the time it takes to react to old and novel stimuli

during the second presentation is calculated in order to establish the magnitude of the repetition priming effect. Similar to previous work, this study investigated how the emotional valence of the stimuli affects the repetition priming effect. Unlike prior work, this study investigated the differences in repetition priming effect in relation to anxiety levels.

The participants were instructed to react to the stimuli, namely photographs of faces displaying happy or fearful emotions. They were guided to process a neutral characteristic of the photograph, the gender of the face in the photograph, and not the characteristic that may carry threatening information, the emotion displayed by the face. This paradigm (Schwartz, Shook, Vaidya, & Deutsch, 2009) aimed to investigate differences in information processing following the attention capture and preceding the verbal processing of threatening stimuli or disengagement from stimuli. The full literature review appears in Appendix A.

Primary Aim and Hypothesis

Aim

The primary aim of the this study was to investigate the relationship between severity of anxiety and the repetition priming effect for pictures of unfamiliar fearful faces.

Hypothesis

It was hypothesized that severity of anxiety would have an effect on the repetition priming effect for fearful faces, such that participants with higher anxiety scores would display longer latencies in making judgments of the gender of these faces.

Secondary Aims and Hypotheses

Aim 1

One secondary aim of this study was to investigate the relationship between severity of Intolerance of Uncertainty and the repetition priming effect for pictures of unfamiliar fearful faces.

Hypothesis 1

It was hypothesized that the severity of Intolerance of Uncertainty would have an effect on the repetition priming effect for fearful faces, such that participants with higher intolerance of uncertainty scores would display longer latencies in making judgments of the gender of these faces.

Aim 2

Another secondary aim of this study was to investigate the relationship between severity of tendency to worry and the repetition priming effect for pictures of unfamiliar fearful faces.

Hypothesis 2

It was hypothesized that the severity of the tendency to worry would have an effect on the repetition priming effect for fearful faces, such that participants with higher worry scores would display longer latencies in making judgments of the gender of these faces.

Exploratory Aims

Exploratory Aim 1

An exploratory aim of this study was to investigate the differences in information processing biases in people with and without anxiety disorders as evidenced by longer latencies in making judgments of the gender of fearful faces.

Exploratory Aim 2

An exploratory aim of this study was to investigate the unique contributions of trait anxiety, worry, and intolerance of uncertainty to information processing biases as evidenced by longer latencies in making judgments of the gender of fearful faces.

Chapter 2: Method

The Institutional Review Board of the University of Maryland, College Park approved of the study procedures. I included the IRB approval memo in Appendix A.

Participants

I recruited participants through the Department of Psychology mass screening of the students registered to take the class Introduction to Psychology and through presentations in lower level psychology courses. The students were directed to the Sona system (http://psychology.umd.edu/research/sona.html), where they were able to sign up for the study. On the Sona system webpage the students were informed that the study aimed to investigate changes in the repetition priming effect; no information about the relationship of repetition priming to anxiety was included on the introductory information. The inclusion criteria for this study were that each participant be at least 18 years of age and a student at the University of Maryland, College Park. The exclusion criteria were a diagnosis of any psychotic disorders at any point during the participant's lifetime and current use of anti-anxiety medication. The participants that met the exclusion criteria completed the task and received credit for their participation; their data were not included in the analysis. Ninety-three participants signed up for the study and were randomly assigned to the order in which I exposed them to two kinds of photographs (i.e., happy or fearful).

Design Overview

I calculated power analyses for the primary aim of the study according to Cohen's set correlation approach (Cohen, Cohen, West, & Aiken, 2003). Studies investigating threat-related information processing biases in people with anxiety have yielded effect

sizes in the medium range (d = .45; Bar-Haim et al., 2007). Previous studies investigating specifically the relationship between the repetition priming effect and anxiety are scarce and do not provide the information necessary to determine the effect sizes (Enright & Beech, 1993; Thompson, 1981). Assuming a medium size effect of f^2 =.1511 for the relationship between anxiety and emotionality of stimuli and a sample size of 82, power $(1 - \beta)$ was estimated at 0.80.

Design Considerations

The primary focus of this study was to investigate information processing biases as measured by changes in the response time in people with varied levels of anxiety. Anxiety is associated with higher levels of experienced anxiety and atypical processing of threatening stimuli (Cooper, Rowe, & Penton-Voak, 2008; Mogg & Bradley, 1998). The participants' level of experienced anxiety was measured through self-report measures of anxiety and of constructs deemed crucial to the experience and etiology of anxiety, such as worry and intolerance of uncertainty. In addition, a current or lifetime diagnosis of an anxiety disorder was established through a clinical interview, in order to consider the role of such diagnosis on the reaction times to emotional stimuli.

Information processing biases become evident as anxious individuals interact with stimuli that reconfirm their expectations of ever-present danger (Ouimet, Gawrinski, & Dozois, 2009). Thus, the next consideration was with regard to the emotional expression displayed by the faces in the photographs that were presented to the participants.

It was necessary to address factors that may affect reaction time in order to differentiate and control for differences due to demographic or stimulus characteristics, rather than to a person's level of experienced anxiety and the emotion displayed in the

photographs (emotion). One consideration was the order in which the blocks of photographs were presented (block) – fearful photographs or happy photographs first. Another consideration was the gender of the face in the photograph (face gender) – male or female, and the position from the start of the task in which the block of photographs was presented (position). Consideration was also given to demographic characteristics, such as participant gender, race or ethnic identification, education, and age.

Reaction time, or the time it took for the participants to indicate as quickly as possible the gender of the face presented in a photograph, was the main outcome measure. Reaction time was first measured during the priming phase of the Repetition Priming Task and then it was measured again during the second presentation of the photographs. Due to the repetition priming effect, reaction times at priming phase were expected to be longer than at test phase (Schacter, 1987).

Assessments and Materials

The research study was conducted in the Laboratory of Human Psychophysiology at the University of Maryland, College Park, which includes a private space with a desk and computer.

Demographic Questionnaire

The demographic questionnaire was administered to obtain data on the participants' age, gender, ethnicity, and education. (Appendix A).

State-Trait Anxiety Inventory (STAI)

STAI is a self-report assessment instrument intended to differentiate between temporary feelings of anxiety and anxiety as a long-term personality trait in adults. STAI also measures severity of anxiety level (Tilton, 2008). This instrument was chosen

because it quantifies the level of anxiety, making it possible to test the secondary hypothesis of this study, which states that higher levels of anxiety will be associated with longer reaction times during the test phase of the repetition priming task. More importantly, STAI has sound psychometric properties. The Trait Subscale of the STAI has shown good stability in studies spanning 14 – 20 days, with test-retest correlations of .86 (Rule, & Traver, 1883; Spielberger, Gorsuch, Lushene, 1970). The STAI has been found to be reliable in large independent samples of college students, working adults, and military recruits, with alpha coefficients between .86 and .95 (Antony, Orsillo, & Roemer, 2001) with a median of .90 (Spielberger, Reheiser, Owen, & Sydeman, 2004). The STAI has two subscales that measure State and Trait characteristics. The scale has a four-factor structure that includes items regarding anxiety and mood, in both state and trait subscales (Vigneau & Cormier, 2008; McWillliams & Cox, 200; Bieling, Antony, & Swinson, 1998). Concurrent validity of the STAI has been demonstrated through significant correlations with other anxiety measures ranging from .73 to .85, and Cronbach's α coefficients for college students in the normative sample for trait anxiety ranged from .90 to .91 (Spielberger, 1983). In this study the reliability for the STAI was calculated separately for each subscale (Trait, State) and also for the Anxiety factor in each subscale. Cronbach's α coefficient for the STAI-Trait was .76, and the α coefficient for the anxiety items in the STAI-Trait was .869. Cronbach's α coefficient for the STAI-State was .71, and the α coefficient for the anxiety items in the STAI-State was .817.

Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders Axis I Disorders (SCID)

The SCID is a semi-structured interview based on the DSM-IV diagnostic criteria and is the most widely used assessment instrument in the United States (First & Gibbon, 2004). The SCID is organized in modules that cover psychological disorders in accordance with DSM-IV diagnostic criteria. This instrument was chosen because it is a widely used diagnostic instrument with good psychometric properties and it has been suggested as a good candidate for assigning diagnostic status in research studies (Antony, & Rowa, 2005). The SCID will be used to test the primary hypothesis of this study, which states that participants with an anxiety disorder will show impairment in implicit memory. The reliability of the SCID has been investigated using joint or videotaped interviews and has produced kappas ranging from 0.70 to 1.00 (Spitzer, Williams, Gibbon, & First, 1996). The validity of the SCID has been more challenging to measure; however, studies to date comparing it to standard clinical interviews reveal good validity, with kappa coefficients ranging from .57 to .76.

Intolerance of Uncertainty Scale (IUS)

IUS is a self-report assessment instrument intended to measure the emotional and behavioral consequences of feelings of uncertainty, how feelings of uncertainty reflect on one's character, the expectation of a predictable future, frustration with unpredictability, efforts to control the future, and inflexible answers in response to uncertainty (Freeston, Rheaume, Letarte, Dugas, & Ladouceur, 1994). This instrument was chosen because it quantifies intolerance of uncertainty, which is one of the factors that influence the experience of anxiety via cognitive biases (Dugas et al, 2005). Reliability studies have demonstrated that IUS has excellent internal consistency with $\alpha = .95$, and good 5-week test-retest reliability with $r = .74$ (Buhr & Dugas, 2000). The IUS has shown good

validity when used alongside measures of worry, *r*'s = .53 and .63, and trait anxiety, *r* = .57 (Freeston et al., 1994; Buhr & Dugas, 2000). In addition to the high correlation between measures of IU and anxiety or worry, IU has shown to be a unique contributor to the experience of anxiety beyond anxiety symptoms (Koerner & Dugas, 2008). The IUS in this study showed very good reliability with Cronbach's α coefficient .917.

The Penn State Worry Questionnaire (PSWQ)

PSWQ is a self-report questionnaire intended to measure the intensity of a tendency to excessive pathological worry, without reference to the content of worries (Robichaud et al, 2003; Roemer, 2001). This instrument was chosen because it quantifies an important factor that is related to the experience of anxiety as well as information processing biases (Mathews & Funke, 2006). The PSWQ has demonstrated good 2 to 10-week test-retest reliability in college samples with r's ranging from .74 to .93, and very good internal consistency with α ranging from .86 to .93. The PSWQ has shown good validity when used alongside measures of worry, *r*'s = .59 and .67, and anxiety, *r*'s = .40 to .74 (Davey, 1993; Meyer, Miller, Metzger, & Borkovec, 1990). The PSWQ in this study showed very good reliability with Cronbach's α coefficient .904.

The Hamilton Rating Scale for Depression (HAM-D)

HAM-D is a rating scale that is intended to measure the severity of depression. This instrument was chosen in order to gather information about the participants' symptoms of depression, which may affect information processing biases (Hamilton, 1960). In a meta-analytic study including 35 reliability estimates from 23 studies, the HAM-D demonstrated good reliability with a mean α of .79 (Lopez-Pina, Sanchez-Meca, & Rosa-Alcazar, 2009). The HAM-D has shown good validity when used alongside

measures of depression, with most r's measuring over the adequate level of .50 (Bagby, Ryder, Schuller, & Marshall, 2004). Two participants scored above the cutoff for mild depression, thus it was not possible to investigate the influence of depression scores on information processing biases.

The Adult ADHD Self-Report Scale (ASRS)

ASRS is a self-report questionnaire intended to assess the presence of symptoms of Attention Deficit/Hyperactivity Disorder (ADHD). This instrument was chosen in order to control for possible interferences of ADHD symptoms with information processing biases that might affect the primary aim of this study. Ten participants indicated experiencing symptoms highly consistent with ADHD. The ASRS has demonstrated good reliability with Cronbach's α coefficients .84 to .89 (Adler, Spencer, Faraone, Kessler, Howes, Biederman, & Secnik, 2006). The ASRS has shown good concordance when used alongside clinician diagnoses with an area under the receiver operating characteristic curve of .90 (Kessler, Adler, Gruber, Sarawate, Spencer, & Van Brunt, 2007).

Pictures of Faces

The picture stimuli consist of photographs of 60 unique faces, each shown both with a happy and fearful expression, for a total of 120 faces. The faces are balanced across gender (15 pictures in combinations of female/fearful, female/happy, male/fearful, and male/happy). The picture stimuli consist of photographs of 60 unique faces, each shown both with a happy and fearful expression, for a total of 120 faces. The faces are balanced across gender (15 pictures in combinations of female/fearful, female/happy, male/fearful, and male/happy). The photographs are part of the NimStim and Gur/Kohler

databases of photographs of faces displaying a variety of emotions, with fear and happiness as two of the possible emotions (Tottenham, Tanaka, Leon, McCarry, Nurse, Hare, Marcus, Westerlund, Casey, Nelson, 2010; Gur, Sara, Hagendoorn, Marom, Hughett, Macy, Turner, Bajcsy, Posner, Gur, 2002). These databases have been validated and have displayed an accuracy of identification rate between .79 and .80, which is acceptable for samples of photographs that include models of multi-racial/ethnic background (Gur, Schroeder, Turner, McGrath, Chan, Turetsky, Alsop, Maldjian, & Gur, 2002; Tottenham et al, 2009). The pictures were programmed and presented using E-Prime (E-Prime, 2001), which is software used to design experiments and collect data.

A pilot study was conducted in order to investigate the perceived difference in the emotional display in the photographs in our sample. Each picture was rated on a 4-point Likert scale, where 1 corresponded to "to a great extent" and 4 corresponded to "not at all." The averages of ratings are presented in Table 1. Separate t tests were conducted in order to compare the ratings of the happy and fearful photographs. The happy photographs were rated as significantly happier than the fearful photographs [t (10) = 9.78, $p < .001$] and the fearful photographs were rated as more fearful than the happy photographs [t (10) = 10.92, $p < .001$]. Also, the happy photographs were rated as significantly happier than fearful [t (10) = 8.6, $p < .001$] and the fearful photographs were rated as significantly more fearful than happy [t (10) = 13.86, $p < .001$].

Table 1. Ratings of Photographs of Faces Displaying Happy and Fearful Expression

	Happy Photographs	*Fearful Photographs*
Happy Rating	M = 1.57, SD = .49	M = 3.7, SD = .21
Fearful Rating	M = 3.71, SD = .36	M = 1.59, SD = .3

Procedure

Pre-session

Prior to the laboratory procedures, the students were randomly assigned to one of the *Order of Stimulus Emotion* groups.

Laboratory Session

The procedure for this study lasted approximately 90 minutes, with the laboratory procedure lasting about 60 minutes and the following clinical interview lasting between 20 and 40 minutes. The length of the laboratory procedure was stable and similar for all participants. The length of the clinical interview was dependant on the life experiences and pathology of a participant. The goal of the clinical interview was to diagnose psychological disorders rather than gather detailed information about the difficulties experienced by a participant, thus even interviews with participants that met criteria for several psychological disorders did not exceed 40 minutes. An overview of the procedures is presented in Table 2.

Table 2. ***Laboratory Protocol***

Time	*Time Lapse*	*Procedure*
Pre-session		Prepare randomization schedule for *Order of Stimulus emotion* and *Order of Procedure*
T – 34	10	Informed Consent
T - 24	2	Demographic Questionnaire
T – 22	10	STAI
T – 12	4	IUS
T – 8	4	PSWQ
T – 4	3	Instructions for Repetition Priming Task
t – 1	1	Repetition Priming Task Practice Trial
T 0	10	Repetition Priming Task
T + 10	5	Instructions for Recognition Task
T + 15	5	Recognition Task
T + 18	20-40	SCID-IV
T + 108	5	Debriefing and Conclusion

Note: IUS = Intolerance of Uncertainty Scale; PSWQ = Penn State Worry Questionnaire; SCID-IV = Structured Clinical Interview for DSM-IV; STAI = State-Trait Anxiety Inventory.

Upon arrival to the laboratory, participants were provided with a written description of the study procedures and asked to complete a written consent form. The participants were informed verbally about the procedures involved in this study, the potential risks of this study, issues pertaining to confidentiality, and their rights as participants (e.g., that they have the right to withdrawal from the study at any point in time).

Following the provision of informed consent, the participants were asked to complete a demographics questionnaire, the Intolerance of Uncertainty Scale, and the Penn State Worry Questionnaire. After these measures are completed, the participant was directed to the computer and asked to complete the computer task. After the participants completed the computer tasks, they were asked to complete the SCID.

Repetition Priming Task

The repetition priming task lasted no longer than 10 minutes. During this task, the participants were presented with photographs of faces displaying a happy or fearful expression (Schwartz et al, 2009). Each trial (presentation of a photograph) consisted of a 1000 ms pre-target fixation stimulus and a 1000 millisecond of target presentation. An overview of each trial is presented in Table 3.

Table 3. ***Repetition Priming Task Trials***

Presentation	*Time Duration*
Pre-target Fixation Stimulus	1000 milliseconds
Photograph	1000 milliseconds

The repetition priming task was preceded by 8 practice trials, containing photographs of an equal number of happy and fearful faces of an equal number of males and females. These practice faces were not included in the stimuli for the task itself. The picture stimuli for the repetition priming task consisted of a total of 120 presentations, using 60 photographs of 60 unique faces (15 pictures in combinations of female/fearful, female/happy, male/fearful, and male/happy). The photographs of the 60 unique faces (30 happy faces, 30 fearful faces) were divided in 10 blocks of 6 photographs of like emotional valence (5 blocks of fearful faces, 5 blocks of happy faces). The pictures in the blocks were randomized with regards to gender, with each block containing an equal number of pictures of males and females. As the participants were presented with each photograph, they indicated the gender of the presented face by pressing two buttons. The participants were presented with each block of 6 photographs twice, once in the priming phase and once in the test phase. Each test phase block of 6 photographs immediately followed the priming phase containing the same six photographs. During the repetition priming task, each participant was presented with only one out of the two photographs of each of the 60 unique faces in the database, specifically with 60 photographs out of the 120 photographs in the database. An overview of the Repetition Priming Task is presented in the following table (Table 4).

Table 4. ***Repetition Priming Task***

Block	*Phase*	*Fearful First*	*Happy First*	*Photograph ID#*[*]
1	Priming Block 1	Fearful	Happy	1, 2, 3, 4, 5, 6
	Test Block 1	Fearful	Happy	1, 2, 3, 4, 5, 6
2	Priming Block 2	Happy	Fearful	7, 8, 9, 10, 11, 12
	Test Block 2	Happy	Fearful	7, 8, 9, 10, 11, 12
3	Priming Block 3	Fearful	Happy	13, 14, 15, 16, 17, 18
	Test Block 3	Fearful	Happy	13, 14, 15, 16, 17, 18
4	Priming Block 4	Happy	Fearful	19, 20, 21, 22, 23, 24
	Test Block 4	Happy	Fearful	19, 20, 21, 22, 23, 24
5	Priming Block 5	Fearful	Happy	25, 26, 27, 28, 29, 30
	Test Block 5	Fearful	Happy	25, 26, 27, 28, 29, 30
6	Priming Block 6	Happy	Fearful	31, 32, 33, 34, 35, 36
	Test Block 6	Happy	Fearful	31, 32, 33, 34, 35, 36
7	Priming Block 7	Fearful	Happy	37, 38, 39, 40, 41, 42
	Test Block 7	Fearful	Happy	37, 38, 39, 40, 41, 42
8	Priming Block 8	Happy	Fearful	43, 44, 45, 46, 47, 48
	Test Block 8	Happy	Fearful	43, 44, 45, 46, 47, 48
9	Priming Block 9	Fearful	Happy	49, 50, 51, 52, 53, 54
	Test Block 9	Fearful	Happy	49, 50, 51, 52, 53, 54
10	Priming Block 10	Happy	Fearful	55, 56, 57, 58, 59, 60
	Test Block 10	Happy	Fearful	55, 56, 57, 58, 59, 60

[*] This is a simplified example; the order of the photographs will be randomized at every administration.

Task 2: Recognition Task

Following the Repetition Priming Task, the participants were given verbal instructions for the Recognition Task. The materials for the Recognition Task included all the 120 photographs in the database, and the participants were presented simultaneously with both the happy and fearful version of each face in the same slide. The participants were instructed to indicate which photograph from each pair they had seen during the Repetition Priming Task. Each slide was preceded by a 500 millisecond fixation stimulus: a white plus sign. The order of the target slides was randomized and self-paced. The position of the target photograph in the slides was random and alternated with respect to laterality. The data from this Task were collected for future studies.

Debriefing and Conclusion

Upon the completion of all tasks and assessment measures the participants were given information about the purpose of the study. They were informed that this study's purpose was to investigate information processing biases in people differing in levels of anxiety. They were also briefly explained theoretical models of information processing biases and how the tasks completed by the participants relate to the purpose of the study. It was predicted that during or as a result of the assessment procedures, some participants may realize that they have questions they would like to discuss with a mental health professional. Preparations were made for all participants to be provided with referrals to mental health professionals, obtained from an established referral list already in use at the University of Maryland Psychology Clinic.

Chapter 3: Results

Preliminary Analysis.

A set of preliminary analyses were conducted in order to determine if the reaction times in the sample for this study differed significantly on a variety of demographic characteristics and stimulus characteristics.

Demographic and Stimulus Characteristics

Ninety-three college students were recruited for the study and seventy-one were included in the final analysis; the data for two participants were lost due to technical difficulties, and the data for twenty participants were lost due to unforeseen equipment loss (stolen laptop storing database). The study sample included 31 (43.66%) males and 40 (56.33%) females. The participants ranged in age from 18 to 25 (M = 19.69, SD = 1.72). The study sample was diverse with regard to race and ethnicity: 35 (53.5%) participants identified as Caucasian/European American, 16 (22.5%) identified as African/African American, 8 (11.26%) identified as Asian/Asian America, 6 (8.45%) identified as Hispanic/Hispanic American, 1 (1.4%) identified as Native American, and 2 (2.8%) identified as Other and did not specify their race or ethnicity. The study sample was diverse with regard to education: 20 (40.08%) of the participants were freshmen, 17 (23.9%) were juniors, 13 (18.3%) were sophomores, and 12 (16.9%) were seniors.

The participants completed HAM-D and ASRS in order to investigate a possible relationship between depression and ADHD on information processing biases. Two participants scored above the cutoff for mild depression; thus it was not possible to investigate the influence of depression scores on information processing biases. Ten participants indicated experiencing symptoms highly consistent with ADHD. There were

no significant differences in reaction times to photographs of happy and fearful faces between people that experience symptoms of ADHD and those who did not [$t(69) = .01$, $p > .05$].

A series of univariate tests was conducted in order to investigate differences in the scores on STAI-State, STAI-Trait, PSWQ, and IUS based on the demographic characteristics (Table 5). These analyses indicated significant differences in the scores of STAI-State, STAI-Trait, and PSWQ based on Gender and in the scores of STAI-Trait based on Education. Post-hoc Bonferroni's tests showed that females had significantly higher STAI-State, STAI-Trait, and PSWQ scores than males. Post-hoc Bonferroni's tests showed that sophomores had significantly higher STAI-Trait scores than juniors; all other comparisons were not significant.

Table 5. Differences in STAI, PSWQ, and IUS Scores Based on Demographic Characteristics

	STAI-State	*STAI-Trait*	*PSWQ*	*IUS*
Age	F(6, 64) =.69, p >.05	F(6, 64) =1.66, p >.05	F(6, 64) =.79, p >.05	F(6, 64) =1.31, p >.05
Gender	F(1, 69) =12.11, p<.05*	F(1, 69) =5.39, p <.05*	F(1, 69) =7.21, p <.05*	F(1, 69) =1.05, p >.05
Ethnicity	F(5, 65) =.76, p >.05	F(5, 65) =.53, p >.05	F(5, 65) =.48, p >.05	F(5, 65) =.82, p >.05
Education	F(3, 67) =2.53, p >.05	F(3, 67) =3.35, p <.05*	F(3, 67) =1.81, p >.05	F(3, 67) =1.16, p >.05

A Linear Mixed Model analysis was conducted in order to investigate the effect of demographic and stimulus characteristics on response time (RT). The results did not yield any significant effects with regard to gender ($F (1, 8483) = 3.731$, $p = .053$), age [$F(1, 8482) = 3.094$, $p = .079$], and ethnicity [$F(1, 8479) = 3.108$, $p = .07$]. The results yielded a significant effect with regards to education [$F(1, 8473) = 41.16$, $p = .00$; Table 7]. Post-hoc Bonferroni's tests indicated that freshmen reacted significantly slower than sophomores, junior, and seniors; sophomores reacted significantly slower than seniors

and faster than freshman and juniors; juniors reacted significantly slower than sophomores and seniors and faster than freshman; and seniors reacted faster than freshman, sophomores, and juniors (Table 6).

Table 6. Education Means and SD's (in Milliseconds)

Education	*Mean*	*SD*
Freshmen	580.333	4.574
Sophomore	543.128	4.998
Junior	562.991	5.222
Senior	517.701	3.828

The results did not yield any significant effects with regard to the following characteristics of the photographs or their presentation: emotion [F(1, 8473) = .678, p = .410], block [F(1, 8532) = .247, p = .619], face gender [F(1, 8479) = 2.98, p = .086], and position [F(1, 8532) = .218, p = .641].

The results yielded a significant effect with regard to order of presentation of the happy and fearful faces, such that participants that were presented with the photographs of fearful pictures first (F) reacted faster than those presented with the photographs of happy faces first (H) [F(1, 8475) = 15.32, p = .00; M(F) = 556.941, SD (F) = 4.994; M(H) = 561.661, SD(H) = 4.724, Table 7].

Table 7. Demographic and Stimulus Characteristics with Significant Effects on Reaction Time

	Education	*Order*
Reaction Time	F(1, 8473) = 41.16, p = .00	F(1, 8475) = 15.32, p = .00

Assessment Measures

The assessment measures used to measure anxiety, worry, and intolerance of uncertainty were STAI-Trait, PSWQ, and IUS, respectively. Table 8 presents the correlations between anxiety, worry, and intolerance of uncertainty as measured by STAI, PSWQ and IUS. All assessment measures were significantly and positively correlated with each other. STAI-State and STAI-Trait showed satisfactory internal consistency; PSWQ and IUS showed excellent internal consistency. Means, standard deviations, and reliability coefficients of the study measures are also included in Table 8.

Table 8. Assessment Measures' Correlations, Means, SD's, and Reliability Coefficients

	STAI-State	*STAI-Trait*	*PSWQ*	*IUS*
STAI-State	1.00			
STAI-Trait	.831*	1.00		
PSWQ	.661*	.713*	1.00	
IUS	.464*	.623*	.617*	1.00
Mean	38.47	38.68	44.35	53.24
SD	10.27	10.12	14.85	15.12
Cronbach's α	.756	.707	.904	.917

*Statistically significant correlation (p = .01)

Table 8 presents the correlations between anxiety, worry, and intolerance of uncertainty as measured by STAI, PSWQ and IUS, and reaction time. All assessment measures were significantly and negatively correlated with reaction time (Table 9).

Table 9. Correlations between Assessment Measures and RT

	STAI-Trait	*PSWQ*	*IUS*
RT	-.051**	-.072**	-.108**

**. Correlation significant at the .01 level.

Anxiety and Repetition Priming

A linear mixed model analysis was conducted to examine the relationship between anxiety, as measured by STAI-Trait, and RT while controlling for the repetition of exposure and the emotion of the faces in the photographs. There was a significant relationship between repetition of exposure and reaction time [$F(1, 8477 = 18.299$, $p = .000$], such that, on average, reaction times during the second exposure were smaller than the reaction times during the first exposure. There was a significant relationship between of STAI-Trait scores and RT [$t(8482) = 21.836$, $p = .000$; $r^2 = .003$; $\beta = -.051$].

Further investigation of the relationship between STAI-Trait scores and RT indicated that people one standard deviation above the mean (STAI ≥ 49) reacted faster during both exposures compared to people one standard deviation below the mean of anxiety scores (STAI ≤ 29; Table 10).

Table 10. Response Time Means and SD's (in milliseconds) for High and Low STAI Scores

	1st Exposure Mean	1st Exposure SD	1st Exposure Std. Error	2nd Exposure Mean	2nd Exposure SD	2nd Exposure Std. Error
High Anxiety	556.41	295.87	3.21	543.27	295.59	3.21
Low Anxiety	571.27	286.75	3.11	557.75	286.47	3.11

Intolerance, Worry, and Repetition Priming

A linear mixed model analysis was conducted to examine the relationship between worry, as measured by PSWQ, and RT on the first and second exposure to faces with happy versus fearful expressions. There was a significant relationship between of PSWQ scores and RT [t(8482) = 44.393, p = .000; r^2 = .005; β = -.072]. Further investigation of the relationship indicated that people with scores one standard deviation above the mean (PSWQ ≥ 59) reacted faster during both exposures compared to people with scores one standard deviation below the mean of worry scores (PSWQ ≤ 29; Table 11).

Table 11. Response Time Means and SD's (in milliseconds) for High and Low PSWQ Scores

	1st Exposure Mean	1st Exposure SD	1st Exposure Std. Error	2nd Exposure Mean	2nd Exposure SD	2nd Exposure Std. Error
High Anxiety	552.69	291.08	3.16	541.26	290.15	3.15
Low Anxiety	575.99	297.52	3.23	560.70	297.52	3.23

A linear mixed model analysis was conducted to examine the relationship between intolerance of uncertainty, as measured by IUS, and RT on the first and second exposure to faces with happy versus fearful expressions. There was a significant relationship between IUS scores and RT [t(8482) = 101.176, p = .000; r^2 = .012; β = -.108]. Further investigation of the relationship indicated that people with scores one standard deviation above the mean (IUS ≥ 68) reacted faster during both exposures compared to people with scores one standard deviation below the mean in intolerance of uncertainty (IUS ≤ 38; Table 12).

Table 12. Response Time Means and SD's (in milliseconds) for High and Low IUS Scores

	1st Exposure Mean	1st Exposure SD	1st Exposure Std. Error	2nd Exposure Mean	2nd Exposure SD	2nd Exposure Std. Error
High Anxiety	542.46	255.11	2.77	529.12	255.11	2.77
Low Anxiety	572.25	256.95	2.79	558.90	256.95	2.79

Exploratory Analyses

The first exploratory aim of this study was to investigate the differences in the reaction time to happy and fearful stimuli during the first versus second exposure in individuals with and without anxiety disorders. A linear mixed model analysis was conducted to examine the relationship between anxiety, as diagnosed by the SCID, and the response time (RT) to faces displaying a fearful versus happy expression while controlling for the repetition of exposure and emotion of the face in the photograph. There was a significant relationship between a history of a diagnosis of an anxiety disorder and RT, such that people with a lifetime anxiety disorder (A) reacted to both fearful and happy stimuli faster than people without an anxiety disorder (NA) [F (1, 8481) = 81.9, p = .000; M(A) = 530.414, SD(A) = 3.365; M(NA) = 560.868, SD(NA) = 2.503).

Another exploratory aim of this study was to investigate the unique contributions of trait anxiety, worry, and intolerance of uncertainty to information processing biases as evidenced by reaction time. A mixed model analysis was conducted in order to investigate the unique contribution of each scale above and beyond their common variance. This analysis revealed the model that gave rise to the data, which included three

covariates, (order, education, gender), and a main effect of repetition and IUS; the PSWQ and the STAI did not appear to have a main effect (Table 13).

Table 13. Incremental Contribution of STAI, IUS, and PSWQ on RT

	F(1, 8477)	p
STAI-Trait	2.99	.083
IUS	51.74	.000
PSWQ	2.51	.113

The unique contribution of IUS negatively predicted reaction times, such that people higher in intolerance of uncertainty responded faster to the stimuli (Table 14).

Table 14. Direction of Prediction of STAI and IUS in RT

	t (8481)	p	β
IUS	-9.64	.000	-1.03

An exploratory analysis was proposed aiming to investigate whether worry is higher in the participants with GAD compared to participants with other anxiety disorders; however, the sample size of participants with GAD was inadequate (n = 2) and did not allow for such analysis.

Chapter 4: Discussion

Anxiety is a future-oriented emotional state, characterized by avoidance of feared stimuli, a sense of unpredictability and uncontrollability, and worry (Antony, Federici, & Stein, 2009; Antony, et al., 2001). Cognitive theories of anxiety relate worry and intolerance of uncertainty to continuously activated threat schemata and increased vigilance for threatening stimuli (Mathews, & Funke, 2006). As such, worry and intolerance of uncertainty can be conceptualized as phenomena that are crucial to the etiology and maintenance of anxiety. Previous research indicates that the presence of anxiety is associated with information processing biases (Mogg & Bradley, 2005; Clark & McManus, 2002; Heinrichs & Hofman, 2001; Buckley, Blanchard, & Neill, 2000; Musa & Lepine, 2000; McNally, 1999; Summerfeldt & Endler, 1998), such that people who experience high levels of anxiety process potentially threatening information differently. Previous experimental studies have provided support for the existence of information processing biases related to threatening stimuli during verbal-linguistic processing, attentional capture, engaged attention, and attentional disengagement (Bar-Heim et al, 2006). The aim of the current study was to investigate this phenomenon in the time following attentional capture and preceding verbal-linguistic processing.

The primary hypothesis of this study was that people higher in anxiety differ from those lower in anxiety in how they process threatening stimuli, such that they take longer to process them. This hypothesis was based on the theory that highly anxious people preferentially process threatening stimuli, spend more time in processing them, and experience difficulties with habituating to them (Amir, Foa, & Coles, 1998; Beck & Clark, 1997; Eysenck, 1992; Mogg et al, 1997; Williams, Watts, MacLeod, & Mathews,

1997). Current findings lend support to the existence of information processing biases in people higher in anxiety, as well as in people with a history of a diagnosis of an anxiety disorder. However, the main effect of anxiety – as indicated by both high STAI scores and a history of a diagnosis of an anxiety disorder – on reaction times, does not support the hypothesis that the repetition priming effect is smaller in those people. In fact, those higher in anxiety reacted faster during both first and second exposures to both happy and fearful stimuli. These findings would be better explained by theoretical models that describe anxiety as the result of failure to habituate to threatening stimuli due to avoidance of such stimuli (Williams, Watts, MacLeod, & Mathews, 1997; Amir, Foa, & Coles, 1998; Mogg et al, 1997). Similar findings were made with regard to the main effect of worry, as measured by PSWQ, and intolerance of uncertainty, as measured by IUS.

The secondary hypotheses of the current study suggested that the nature of the relationship between information processing biases and anxiety extends to worry and intolerance of uncertainty. Current findings lend support to these hypotheses.

As with the anxiety-reaction time relationship, high worry and high intolerance of uncertainty were associated with faster reaction times during both exposures (first and second exposure) and to faces with both expressions (happy and fearful). Anxiety is often accompanied by worry (Mathews & Funke, 2006). The theoretical model of worry and previous research indicate that, among others, intolerance of uncertainty and cognitive avoidance are the building blocks of worry (Dugas, Gagnon, Ladouceur, & Freeston, 1998). The faster reaction times associated with heightened worry seem to support the hypothesized association with an avoidant cognitive style (Buhr & Dugas, 2006).

As described above, intolerance of uncertainty has been conceptualized as a cognitive process or cognitive filter, and it can be conceptualized as one of the building blocks of worry and an anxiety filter (Dugas & Robichaud, 2007; Dugas et al., 2005; Fisher & Wells, 2009). Previous research has investigated the relationship between intolerance of uncertainty and other anxiety-related theoretical constructs, such as worry and anxiety sensitivity (Koerner and Dugas, 2008; Norton, 2005). The tasks used in the investigation of processing biases and intolerance of uncertainty typically rely on verbal processing of information (Mathews, & Funke, 2006; Dugas et al., 2005). The current study provides evidence that Intolerance of Uncertainty can be investigated in relation to implicit information processing biases. Intolerance of uncertainty was shown to have an effect on information processing, such that people with higher intolerance of uncertainty scores reacted faster to visual stimuli during both exposures.

A particularly interesting finding emerged in the investigation of the incremental contribution of STAI, PSWQ, and IUS in predicting reaction time. The unique contribution of IUS negatively predicted reaction times, such that higher IUS scores were associated with faster reaction times. This finding was consistent with the previously described findings regarding the relationships among anxiety, worry, and intolerance of uncertainty. The main effects for all three assessment measures, as well as the unique contribution of the IUS, indicate that higher scores are associated with faster reaction times, which supports a cognitive theoretical model based on avoidance (Amir, Foa, & Coles, 1998; Mogg et al., 1997; Williams, Watts, MacLeod, & Mathews, 1997).

An exploratory aim of this study was to investigate the differences in information processing between people with and without a history of a diagnosis of an anxiety

disorder. A history of an anxiety disorder may indicate certain cognitive vulnerabilities that may be present, even in the absence of a current anxiety disorder. The current study provides support for the existence of such cognitive vulnerabilities that become apparent in the information processing biases of these individuals. People with a history of an anxiety disorder reacted to visual stimuli faster that those without a history of a diagnosis of an anxiety disorder.

Limitations

Several limitations of this study need to be considered as a basis for future research. These limitations are with regard to fit of current findings with a theoretical framework, participant engagement during the task, and the lack of a variety of outcome measures.

Researchers have yet to establish findings as they pertain to the repetition priming effect in anxious populations. It has been proposed that the repetition priming effect is related to the ability to habituate, thus small repetition priming effects in anxious individuals were thought to indicate difficulties with habituation to previously encountered stimuli (Schwartz et al., 2009). The interpretation of current results is limited, given that they do not lend support to the postulated theoretical framework.

Another weakness of this study regards the number of participants. In the absence of previous studies investigating differences in the repetition priming effect due to individual differences, it was assumed that these differences produce medium effects. The effect of anxiety on the differences in repetition priming effect produces small effects and an investigation of these differences required a greater number of participants

The extent of attention and interest is also an issue with all experiments that rely on participant involvement. An accurate representation of one's performance requires a sufficient number of trials without being affected by eventual fatigue, boredom, or aggravation. The repetition priming task was not long; however, it may have proven monotonous for some subjects.

The main aim of the experiment was to examine whether anxiety had an effect on repetition priming as measured by reaction time. Reaction time is but one outcome measure, and the implications of such an experiment could be increased by the inclusion of physiological measures, such as electrodermal activity.

Conclusions and Future Directions

The findings of the current study indicate that anxiety, worry, and intolerance of uncertainty affect the perception of visual stimuli. These information processing biases are complex and multifarious. Significantly faster reaction times to visual stimuli were observed in relation to higher anxiety scores as measured by STAI and in people with a history of a diagnosis of an anxiety disorder based on the diagnostic criteria of the DSM-IV. Similar relationships were found when investigating the relationship between reaction times and tendency to worry and intolerance of uncertainty. These faster reaction times to potentially threatening visual stimuli seem to be consistent with cognitive theories that explain anxiety through the lack of habituation due to excessive avoidance (Antony, Federici, & Stein, 2009; Antony, et al., 2001). Concurrently, certain features of anxiety as uniquely captured by STAI, were associated with slower reaction times in people with higher anxiety scores. These findings seem to be consistent with cognitive theories that explain anxiety through excessive allocation of cognitive resources to the investigation of

potentially threatening stimuli and difficulties and difficulties (Williams, Watts, MacLeod, & Mathews, 1988; Ohman, 1999). These results seem to suggest that the mechanisms responsible for information processing biases associated with anxiety are the result of multiple, parallel, and intricate processes that need further investigation.

Evidence from the current study suggests a distinct relationship between intolerance of uncertainty and information processing biases. Presently, research investigating the effect of intolerance of uncertainty on information processing biases or behavioral activity typically associated with high anxiety is lacking. This study provides initial evidence that intolerance of uncertainty has an effect on these processes. Future research would benefit from using other well-established cognitive tasks in order to further explore the effect of intolerance of uncertainty on information processing. Future research would also benefit from using physiological measurements in order to explore the relationship between intolerance of uncertainty and bio-physiological characteristics that are typically associated with anxiety. The current study highlights the need for the investigation of intolerance of uncertainty as a mediator and moderator of anxiety.

One of the limitations of the current study related to the limited number of outcome measures. Future research investigating the effect of anxiety on the repetition priming effect would benefit from including additional outcome measures, such as physiological reactions to the stimuli.

Another limitation of this study related to the use of one cognitive task in order to investigate information processing biases and their relationship to trait anxiety. Future research would benefit from using several well-established cognitive tasks alongside repetition priming tasks.

Repetition priming is a well established effect; however, differences in the repetition priming effect are small. Future studies would benefit from including a larger number of participants in order to detect the differences and their relationship with measures of anxiety.

One of the findings of this study related to the effect of intolerance of uncertainty, as measured by IUS, on the repetition priming effect. This study may be relevant when examining etiological and maintenance factors of anxiety. Specifically, it appears that anxiety has an effect on information processing following attention capture and preceding verbal processing of threatening stimuli. Current theories of etiology and maintenance of anxiety would benefit from further investigation of intolerance of uncertainty as it relates to information processing biases and other physiological correlates of anxiety.

To summarize, this study provided support for the finding that higher trait anxiety is associated with information processing biases, such that highly anxious people react to stimuli differently. This relationship was also true for tendency to worry, intolerance to uncertainty, and a history of a diagnosis of an anxiety disorder.

Figure 1

Photographs of a Face with Fearful and Happy Expression

Fearful Expression	Happy Expression
	

Appendix A: Literature Review

Anxiety is the main and ever-present symptom in anxiety disorders, as classified and described in the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2000), which affect about 19 million adults in the United States every year (Grisel, Rasmussen, & Sperry, 2006). Feelings of anxiety may often be accompanied by unrelenting feelings of worry, apprehension, nervousness, fear, panic, obsessive thoughts, unwanted intrusive memories, nightmares, or repetitive ritualized behaviors. These feelings, thoughts, and behaviors are often characterized by dysregulation in muscle-tension or in sleep, respiratory, cardiovascular, or gastrointestinal systems.

Anxiety and fear are both important common elements found in all anxiety disorders. Anxiety has been described as an emotional state that is future-oriented, while and fear has been described as an alarm reaction that is focused and inflexible (Antony, Orsillo, & Roemer, 2001). Intense anxiety and fear are often accompanied by negative affect, a sense of unpredictability and uncontrollability, avoidance of feared situations/experiences, reliance on safety behaviors in order to reduce perceived threat, difficulty concentrating, and worry (Antony, Federici, & Stein, 2009; Antony, et al., 2001).

Worry

Worry was first defined as a negatively affect-laden and uncontrollable chain of thoughts and images that represents an attempt to engage in mental problem-solving on an issue of uncertain outcome containing the possibility of at least one negative outcome (Borkovec, Robinson, Pruzinsky, & DePree, 1983). Some further define worry as an

anticipatory cognitive process characterized by the tendency to interpret ambiguous stimuli as threatening, the tendency to predict negative outcomes for uncertain events, and the tendency to overestimate risk (Ladouseur, Gosselin, & Dugas, 2000). Still others have defined worry as fear-producing thoughts and images related to everyday-life experiences and the potential for these experiences to result in adverse ramifications (Mathews, & Funke, 2006; Taylor, Thordarson, Sochting, 2002). These thoughts and images are thought to be uncontrollable, excessive, repetitive, and to remain unresolved (Mathews, & Funke, 2006).

According to cognitive theories of anxiety, worry is related to the threat schemas in an individual's long-term memory (Mathews, & Funke, 2006). When threat schemas are activated, they may increase vigilance for threats that could be internal (e.g. negative evaluation) or external (e.g. harm). Increased vigilance for threat and increased detection of potentially threatening stimuli is the antecedent of worry. The preferential processing of threat detection or biased information processing can have causal effects on the etiology and maintenance of anxiety and worry (Koster, Fox, & MacLeod, 2009).) Research has shown that high worriers need a longer time and a greater amount of evidence to make decisions related to ambiguous stimuli (Tallis, Eysenck & Mathews, 1991). The relationship between intolerance of uncertainty and worry remains strong even after taking into account anxiety and depression (Buhr, & Dugas, 2006). Worry is often investigated by comparing people with General Anxiety Disorder (GAD) and pathological worry to low-worry non-anxious controls (Holaway, Rodebaugh, & Heimberg, 2006); however, a study by Ruscio (2002) indicated that only a modest percentage of high worriers (20%) met diagnostic criteria for GAD. Hence, worry is a

construct that defines the experience of anxiety and is not necessarily restricted to a specific GAD diagnoses. In this study, rather than a specific symptom of GAD, worry is conceptualized as a dimensional characteristic that is present in people with any anxiety disorders (Naliboff & Rhudy, 2009; Wells & Mathews, 2006; Starcevic & Berle, 2006; Gladstone, Parker, Mitchell, Malhi, Wilhelm, & Austin, 2005). The variables that have been identified as predictors of excessive worry are: intolerance of uncertainty, beliefs that worry has a protective function, negative orientation towards problem situations, and cognitive avoidance (Dugas, Gagnon, Ladouceur, & Freeston, 1998).

Intolerance of Uncertainty

Intolerance of uncertainty is hypothesized to affect clinical and non-clinical worry and anxiety via cognitive biases (Dugas et al, 2005). Intolerance of uncertainty has been defined as biased perception, as interpretation, and as negative emotional, cognitive and behavioral response to uncertain situations and events (Buhr & Dugas, 2006; Dugas, Hedayati, Karavidas, Buhr, Francis, & Philips, 2005; Dugas, Buhr, & Ladouceur, 2004). People with high intolerance of uncertainty perceive uncertain events as stressful and upsetting; they interpret uncertain events as negative, threatening, and unfair; they avoid or are unable to act in uncertain situations; and they are unable to tolerate the possibility that an event may have negative outcome, even if the probability of such outcome is very small (Mathews, & Funke, 2006; Dugas et al., 2005). Intolerance of uncertainty has been conceptualized as a dispositional characteristic, a personality trait, a cognitive process, and a cognitive filter (Dugas and Robichaud, 2007; Dugas, Hedayati, et al. 2005; Fisher & Wells, 2009). Dugas, Hedayati et al. (2005) suggested that intolerance of uncertainty results in selective information encoding and interpretation: people with high intolerance

of uncertainty pay more attention to uncertain stimuli, go through greater elaborative encoding of uncertain information, have enhanced recollection of uncertain stimuli, and have greater tendency to interpret such stimuli as threatening. Researchers suggest that this preferential encoding of threatening information, threatening interpretation of uncertain stimuli, and preferential retrieval from memory of threatening information results in extreme concern and worry when any physical or psychological peril is present (Koerner, 2008). Intolerance of uncertainty is a unique contributor that defines the experience of anxiety, beyond anxiety symptoms. Intolerance of Uncertainty has been conceptualized both as a cognitive vulnerability and as a characteristic of anxiety; it is part of a vicious circle where its presence influences worry which in turn interferes with information processing of uncertain stimuli (Koerner and Dugas, 2008).

Information Processing Bias

One of the factors deemed critical in the development and maintenance of intolerance of uncertainty, worry, and ultimately anxiety disorders is biased information-processing (Koster, Fox, & MacLeod, 2009). Biased information processing is at the center of many theoretical models of anxiety disorders (Rapee, 2001; Mogg, & Bradley, 1998; Mathews, & Mackintosh, 1998; Eysenck, 1992; Beck, & Clark, 1997; Clark, & Wells, 1995; Woody, & Rachman, 1994; Ohman, 1993; Williams, Watts, MacLeod, & Mathews, 1988; Foa, & Kozak, 1986). Biased information processing in people with anxiety, rather than narrow, deficient, incorrect, or distorted, means selective information processing that is negatively biased, resulting in higher-than-normal vigilance for threatening and other adverse stimuli.. It is worth noting that information processing biases occur in all people and these biases are driven by a person's experiences and

cognitions regarding the world and the self ; however, in anxious people these biases tends to reconfirm their view of the world as a dangerous place (Ouimet, Gawrinski, & Dozois, 2009). Information processing bias has been investigated during different stages of information processing—specifically during transformation of stimuli into subjective cognitive representations of these stimuli (encoding) (Amir, Coles, & Foa, 2002; MacLeod, 1991), during the process of assigning meaning and placing stimuli in a constellation of similar and related cognitive structures (interpretation) (Wilson, MacLeod, & Campbell, 2007; Amir, Coles, & Foa, 2002), and during the process by which subjective representations of stimuli that had been stored in memory are recalled or recognized (retrieval) (Mitte, 2008; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, van Ijzendoorn, 2007). While most researchers agree, in part, that anxiety is characterized by information processing biases (McNally & Reese, 2009), they disagree on the pattern and timeline in which such biases occur.

Theoretical Models of Information Processing Biases and Anxiety

Early cognitive theories of the etiology of anxiety proposed that anxiety is the result of enhanced automatic encoding and retrieval of threatening stimuli, and threatening interpretation of uncertain stimuli. Two such theories are the ones developed by Beck (1976) and by Bower (1983). Beck (1976) theorized that automatic maladaptive schemata facilitate the encoding and retrieval of threatening information, and threatening interpretation of uncertain information, which in turn results in anxiety disorders. Bower (1983) theorized that anxiety is enhanced and maintained through automatic proliferation of anxiety nodes throughout the semantic network. Despite the differences in the timeline

of the automatic cognitive processes that enhance and maintain anxiety, both theories predict facilitated processing of threatening stimuli.

Williams, Watts, MacLeod, & Mathews (1988) suggested that the attention of anxious individuals is immediately captured by threatening stimuli and that attentional resources are disproportionately allocated to processing these stimuli during the initial, automatic stages of processing. Ohman (1999) also suggested that information biases in anxious individuals take place during the initial pre-attentive processing of threatening stimuli. Others proposed that the attention of individuals with anxiety is not disproportionately engaged by threatening stimuli in the initial stages of perception, but resources are disproportionately allocated towards threatening stimuli during later, elaborative and interpretative processes (Mathews, & Mackintosh, 1998; Foa & Kozak, 1986; Mogg, Bradley, De Bono, & Painter, 1997).

Recent theoretical models of information processing in anxiety disorders have offered reconciliatory explanations of these biases. These theories include biased or selective processing in both initial and later, both automatic and conscious stages of information processing. They include preferential processing of threatening stimuli during initial, automatic stages and threatening interpretation and elaboration of uncertain stimuli during later, conscious stages of information processing. Beck and Clark (1997) proposed a model that includes initial automatic preferential processing of threatening stimuli, followed by sustained selective semantic elaboration of these stimuli. Eysenck (1992) proposed a model that includes initial automatic preferential processing of threatening stimuli, followed by threatening interpretation of uncertain stimuli. Other models include preferential initial, automatic processing of threatening stimuli, and

avoidance of these stimuli during later stages (Williams, Watts, MacLeod, & Mathews, 1997; Amir, Foa, & Coles, 1998; Mogg et al, 1997); this attention-avoidance pattern prevents individuals with anxiety from assessing the threat accurately and from habituating to the level of threat.

Experimental Studies of Information Processing Bias in Anxiety, Worry, and Intolerance of Uncertainty

Information processing biases in anxiety disorders have generated a great deal of interest followed by research investigating such biases in people with a specific anxiety disorder. Reviews of this research have provided support for the existence of processing biases in people with posttraumatic stress disorder, social phobia, obsessive-compulsive disorder, generalized anxiety disorder, panic disorder, and phobias.

Clark and McManus (2002) reviewed experimental studies that investigated information processing biases in people with social phobia. They found that people with social phobia tend to interpret ambiguous social events as threatening and negative social events as catastrophic. People with social phobia also have a bias towards detecting negative social responses, a bias toward recalling negative information about self when expecting difficult social interactions, and reduced allocation of cognitive resources to processing social cues. Heinrichs and Hofmann (2001) reviewed studies that used the emotional Stroop and the dot-probe paradigm to investigate attention, judgment, and memory biases in people with social phobia. They concluded that people with social phobia display attentional and judgmental biases towards socially threatening information, but added that there is not sufficient evidence for memory biases.

Mogg and Bradley (2005) reviewed experimental studies that used the emotional Stroop and visual probe tasks to investigate attentional biases in people with Generalized Anxiety Disorder (GAD). The researchers concluded that people with GAD, differently from normal controls and people with depression, have automatic attentional bias for external negative cues. The researchers added that evaluation of threatening stimuli, compared to attentional biases, has a stronger effect on the maintenance of anxiety.

Buckley, Blanchard and Neill (2000) reviewed experimental studies investigating intelligence, memory, and attentional biases in people with posttraumatic stress disorder (PTSD). The authors concluded that evidence for preconscious recognition processing bias was mixed. The researchers found evidence indicating preferential automatic encoding of trauma-related information and biased processing and interpretation of trauma-related information.

Summerfeldt and Endler (1998) reviewed experimental studies investigating cognitive biases in obsessive-compulsive disorder (OCD). The paradigms used in the studies were auditory threshold tasks, modified Stroop, and dot-probe detection. The authors concluded that evidence for information processing biases in people with OCD is inconclusive. The authors added that the mixed results may be attributed to the difficulty of identifying stimuli that are similarly threatening for the majority of people with OCD.

A systematic quantitative review of research investigating information processing biases in all anxiety disorders provided evidence that threat-related bias is a robust phenomenon, which differentiates non-anxious individuals from those with different types of anxiety across a variety of experimental conditions (Bar-Haim, Lamy, Pergamin,

Bakermans-Kranenburg, van Ijzendoorn, 2007). This evidence was consistent across anxiety disorders, ages of participants, and experimental paradigms.

Research on information processing biases and worry or intolerance of uncertainty has provided support for biased recall for stimuli denoting uncertainty (Dugas et al., 2005), threatening interpretation of ambiguous statements (Dugas et al., 2005), indecisiveness and hypersensitivity to threat (Rassin & Muris, 2005), and concern and threatening appraisal of ambiguous situations (Keorner & Dugas, 2008). Studies investigating processing biases in worry and intolerance of uncertainty have used verbal-linguistic stimuli and have assessed biases during the interpretative and elaborative phase of information processing.

Dugas at al. (2005) presented their participants with neutral words and words denoting uncertainty, after which they asked the participants to recall as many of the presented words as possible. The researchers found that participants with high intolerance of uncertainty recalled more uncertain words than they did neutral words, and participants with high intolerance of uncertainty recalled a greater proportion of uncertain words than participants with low intolerance of uncertainty. The researchers concluded that intolerance of uncertainty leads to biased recall for stimuli denoting uncertainty.

In a second study, the researchers sought to further explore the relationship between intolerance of uncertainty and information processing biases by examining the relationship between intolerance of uncertainty and interpretation of uncertain situations. Dugas et al. (2005) asked their participants to complete several questionnaires, one of them being the Ambiguous/Unambiguous Situations Diary (AUSD; Davey, Hampton, Farrell, & Davidson, 1992). The AUSD includes fictitious diary entries, half of which are

worded ambiguously. The participants are asked to rate their degree of concern for each item on a 5-point scale. The researchers found that people with high intolerance of uncertainty expressed more concern for the ambiguous items than did those with low intolerance of uncertainty. They also found that the tendency to make threatening interpretations of ambiguous statements was highly correlated to intolerance of uncertainty, more so than to anxiety, worry, or depression.

Rassin and Muris (2005) also used the AUSD to investigate the relationship between indecisiveness and hypersensitivity to threat. In addition to measures of indecisiveness, they included measures of worry and intolerance of uncertainty. The researchers found that threat perception was significantly associated with proneness to worry but it was not associated with intolerance of uncertainty.

Koerner and Dugas (2008) investigated the appraisals of ambiguous, negative, and positive vignettes from the AUSD (Davey et al., 1992) in people with high and low intolerance of uncertainty. They found that people with high IU, compared to those with low IU, appraised all types of ambiguous situations presented in the vignettes as more disconcerting. Further, high IU remained a robust predictor of disconcerting appraisals after anxiety symptoms, sex, and mood variables were statistically controlled. They also investigated the role of worry in disconcerting appraisals. They found that worry was a significant partial mediator of the relationship of IU to disconcerting appraisals of ambiguous situations. The authors explained that worry is a symptom of biased cognitive processes as well as an active actor in the perpetuation of these processes that give rise to worry in the first place. The authors hypothesized that worry is the activity that consumes cognitive resources that result in biased cognitive processes.

Dugas et al. (2005) reasoned that words are the ideal medium of investigating biases in information processing in worriers and people with high intolerance of uncertainty, because verbal-linguistic processes predominate in worry. This study will investigate the possibility that disproportionate allocation of cognitive resources permeates all cognitive processes and the relationship between worry or intolerance of uncertainty and biased information processing will be evident even when the ambiguous stimuli are non-verbal and the participants are required to make judgments about non-threatening and non-ambiguous characteristics of the stimuli.

Paradigms Used in the Study of Information Processing Biases

Two important characteristics of paradigms used to investigate information processing are the effect that presence of anxiety has on task completion, and the operationalization of bias. The presence of anxiety can either facilitate or disrupt performance on a task. One type of paradigms used to investigate information processing biases entails tasks performed in the presence and/or absence of emotional stimuli. This type of tasks reveals information processing bias through interference/disruption of task completion in the presence of threatening stimuli. Another type of paradigm used to investigate information processing entails tasks involving threatening stimuli. The threatening stimuli are used in such a way that presence of anxiety increases ease of task completion. The combined results of these types of experiments provide strong support for the presence of information processing biases in anxiety disorders.

The paradigms that have been used to investigate processing biases towards threatening stimuli are the emotional Stroop, dot-probe, emotional spatial cuing, and

visual search. These paradigms investigate different aspects of processing biases during the early stages of attentional processes.

Emotional Stroop

The emotional Stroop, like the classic Stroop, includes words written in colored font and the participants are required to state the name of the color rather than read the word. During the emotional Stroop, the participants are instructed to announce the font color of neutral and emotional words. Processing bias becomes evident when participants have longer reaction times when they announce the font color of threatening words compared to neutral words. The use of emotional Stroop paradigm has resulted in strong support for the existence of processing biases with threatening stimuli; however, this bias is evidenced during verbal-linguistic processing of the stimuli (Bar-Heim et al., 2007).

Dot-probe Task

During the dot-probe task, the participants are presented with two stimuli – one threatening and one neutral – that are replaced by a single probe in the location of either the threatening or the neutral stimulus. Processing bias becomes evident when participants have shorter reaction times when they react to probes replacing threatening stimuli compared to neutral stimuli. The use of dot-probe paradigm has resulted in strong support for the existence of biases in allocation of attention when presented with threatening stimuli; however, it remains unclear whether it provides support for enhanced attention engagement with threatening stimuli or impaired ability to disengage from such stimuli (Bar-Heim et al., 2007).

Spatial Cuing

During the emotional spatial cuing paradigm, the participants are presented with a neutral or a threat related cue in one of two locations and the cue is followed by a stimulus. The stimulus is presented at the same location as the cue the majority of the time and at the alternative location the rest of the time. Processing bias becomes evident when the difference in reaction time for same-location vs. alternative-location trials is greater for threat-related cues than it is for neutral cues. While providing support for processing biases for threatening information, the emotional cuing paradigm does not elucidate whether this bias is due to disproportionate allocation of cognitive resources or to impaired ability to disengage attention from threatening stimuli.

Emotional Visual Search

During the emotional visual search paradigm, the participants are presented with a group of photographs of faces displaying the same emotion or with a group of photographs of faces, with one of the faces displaying an emotion different from the rest. The participants are instructed to indicate whether the emotion displayed by the faces in the photographs is homogenous or heterogeneous. Processing bias becomes evident when there are shorter reaction times to heterogeneous groups of photographs where the divergent face is displaying a threatening emotion. Enhanced performance in detecting threatening stimuli indicates enhanced attentional capture of threatening stimuli; however, it remains unclear whether there is a disproportionate allocation of cognitive resources to the processing of threatening stimuli (Horstmann, Borgstedt, & Heuman, 2006).

In summation, the paradigms described above allow for making conclusions with regards to information processing biases in general, and specifically with regards to

disproportionate allocation of cognitive resources in verbal-linguistic processing of threatening stimuli (emotional Stroop), engaged attention or inability to disengage attention with threatening stimuli (dot-probe task), engaged attention with threatening stimuli (spatial cuing), and enhanced attentional capture of threatening stimuli (emotional visual search). The repetition priming task that will be used in this study will allow for investigation of the disproportionate allocation of cognitive resources during the non-verbal processing of threatening stimuli.

The bias toward prioritizing threat encoding is present at the earliest stages of attentional processes, as the individuals rapidly orient to and detect the crucial characteristics of a stimulus (Surcinelli et al, 2006; Bradley, Mogg, Falla, & Hamilton, 1998). The repetition priming task that will be used in this study aims to investigate disproportionate allocation of cognitive resources following the attention capture and preceding the verbal processing of threatening stimuli or disengagement from stimuli.

Repetition Priming

Repetition priming is the increased ease of processing a stimulus following a single previous presentation (Schacter, 1987). The repetition priming effect can be assessed by comparing the participants' initial reaction to a stimulus with the reaction to the following presentation of the same stimulus. The differences between initial and following presentations are observable in behavioral and biological reactions. Some behavioral indicators of priming are reduced reaction time (Thomas & LaBar, 2005), increased accuracy of identification (Sciama, & Dowker, 2007), and increased probability of producing the primed stimulus (Zhou, Hu, Sun, & Huang, 2006). Biological indicators

of priming include reduced brain activation evident in fMRI (Orfanidou, Marslen-Wilson, & Davis, 2006) and EEG data (Wiese, Schweinberger, & Neuman, 2008).

Repetition priming tasks are characterized by consecutive presentations of stimuli. The first presentation of the stimulus is often indicated as the first or prime phase. In the second presentation or the test phase, the previously presented stimuli are intermixed with new ones. The participants are usually asked to react to or to make cognitive or perceptual judgments that do not require recollection of previous encounters with the stimuli (Thomas & LaBar, 2005). Cognitive or perceptual judgments made during the test phase of the tasks are often made faster or more accurately than during the prime phase.

Repetition priming was initially explored through the use of cognitive tasks involving lexical decisions (Forbach, Stanners, & Hochhaus, 1974), word identification (Neisser, 1954), or word stem/fragment completion (Tulving, Schacter, & Stark, 1982). It further evolved to include drawings (Cave, Bost & Cobb, 1992) and photographs of objects and faces (Bruce, Burton, Carson, & Mason, 1994; Mitchell & Brown, 1988; Warren & Morton, 1982; Uttl, Graf, & Santacruz, 2006).

In a study by Bruce and Valentine (1985), the participants were shown pictures of famous people, and in the test phase were asked to report as quickly as possible if the face in the picture was familiar. The materials in the test phase included previously viewed pictures of famous people, novel pictures of the same celebrities, intermixed with completely new material. The researchers found significant effects of repetition priming. The priming effect was strongest in the presentation of previously viewed pictures, and smaller, yet still present, in the presentation of new pictures of the same celebrities.

Goshen-Gottstein and Ganel (2000) asked their participants to rate the apparent intelligence of presented faces. In the test phase, they asked their participants to decide as quickly and accurately as possible the gender of previously presented and novel faces, devoid of paraphernalia that could help in this judgment. The participants were significantly more accurate and faster in making sex judgments about the previously presented pictures, compared to the novel ones.

Stevenage and Spreadbury (2006) investigated the effect of a face's familiarity on repetition priming. The participants in the study viewed pictures of celebrities rated on account of their familiarity (high, intermediate and low), and made a gender decision. In the prime phase the participants viewed 32 pictures of varied familiarity; in the test phase the participants viewed a mixture of primed and unprimed stimuli. Priming effects were observed for all groups of previously presented stimuli, with less familiar stimuli showing a significantly stronger priming effect than more familiar ones.

Similar findings have been supported by studies employing event-related potential techniques (Begletier, Porjesz, & Wang, 1995; Itier & Taylor, 2002; Schweinberger, Pfütze, & Sommer, 1995; Trenner, Schweinberger, Jentzsh, & Sommer, 2004), and brain imaging technology (Bentley, Vuilleumier, Thiel, Driver, & Dolan, 2003; Orfanidou, Marslen-Wilson, & Davis, 2006; Pourtois, Schwartz, Seghier, Lazeyras, & Vuilleumier, 2005).

Repetition priming research has moved on to focus on the factors that influence priming, so as to account for the different patterns of the priming effect shown in different studies (Bruce, Burton, Carson, & Mason, 1994). Some of the factors that have been examined include participant perceptual involvement (Quinn & Macrae, 2005),

stimulus characteristic that the participants were asked to focus on (Wiese, Schweinberger, & Neuman, 2008), task congruency (Wiese, Schweinberger, & Neuman, 2008), amount of detail and size of stimulus (Bruce, Burton, Carson, & Mason, 1994), perceptual load (Jenkins, Burton, & Ellis, 2002), and similarity of stimuli in the prime and test phase (Bruce & Valentine, 1985)

Wiese, Schweinberger and Neuman (2008) instructed their participants to identify the gender or age of unfamiliar faces. In the second phase all the pictures were new and the task was switched: the participants that previously identified the gender of presented faces, now identified age, and vice versa.Later the task was a repetition of the first phase and the stimuli was old intermixed with new. The researchers found that priming in the age detection task was stronger and more accurate than in the gender detection task. Repetition priming in the gender identification task was observed when the priming and test task matched.

Quinn and Macrae (2005) asked the participants to passively view pictures of unfamiliar faces or identify the gender of the presented face as quickly as possible. In the test phase, the participants identified the gender of primed or novel faces. The authors found a priming effect only for the faces that were presented in the active encoding condition and concluded that the processing of unfamiliar faces does not occur automatically and that gender judgments facilitate stronger repetition priming effects. Mere presentation of the priming stimulus may not be sufficient to produce a behaviorally measured priming effect, and the effect is dependent on processing operations involving the stimulus (Macrae, Bodenhausen, Milne, Thorn, & Castelli, 1997).

Jenkins, Burton, and Ellis (2002) presented their participants in the prime phase with a display of a letter-string superimposed on the face of a celebrity. The researchers manipulated the perceptual load during the presentation of faces, by asking the participants to respond to the color of the letter-string (low load) or to the identity of a target letter (high load). During the test phase, they asked the participants to report on the familiarity of the faces and found that perceptual load had no effect on repetition priming.

Bruce, Burton, Carson, & Mason (1994), instead of using photographs, used the digitized cartoon versions on famous faces. They manipulated the pattern of light and dark elements in familiar faces (black and white or black and white with two additional levels of gray) and the size of the image. The researchers found stronger priming effects for images with more levels of gray, but no differences in the priming effect of images of different size.

Bruce and Valentine (1985) presented the participants with pictures of famous people, and in the test phase asked them to respond as quickly as possible if the faces were familiar. The researchers manipulated the view of the primed faces, by presenting different pictures of the same faces. They found strong support for repetition priming, but concluded that differences between the priming effects of two different views of famous faces were insignificant. A similar study conducted by Ellis, Burton, Young and Flude (1997) provided support for graded repetition priming effect, with more similar pictures producing stronger priming effects.

Repetition Priming Stimuli: Emotional Faces

The presentation of a human face is a powerful stimulus that initiates immediate cognitive processing (Wiese, Schweinberger, & Neuman, 2008). Within fractions of a

second we perceive enough information from a presented face so as to make judgments on someone's gender, race and age (Bruce, & Young, 1998). One of the vital characteristics of a face is the emotion of the face (Wiese, Schweinberger, Neuman, 2008). Emotionality is a characteristic that often results in a lasting and salient memory of that stimulus (Parrot & Spackman, 2000). Emotional expressions are one of the factors that have been investigated in the framework of repetition priming in the attempt to better understand the impact of emotions on perception (Burton, Rabin, Wyatt, Frohlich, Vardy, & Dimitri, 2005; Bentley, Vuilleumier, Thiel, Driver, & Dolan, 2003; Campanella, Quinet, Bruyer, Crommelinck, & Guerit, 2002). Previous research indicates that the introduction of an emotional dimension leads to changes in the repetition priming effect. This study will investigate the repetition priming effect for photographs of faces displaying happy or fearful expressions. The advantage of using emotional faces is that it requires minimal verbal-linguistic processing.

Burton et al. (2005) used pictures of two unfamiliar faces displaying neutral and negative expressions in different orientations of the head. During the exposure phase, the participants viewed 72 pictures and were asked to indicate which of the two faces was presented on the computer screen. During the test phase, 32 pictures from the exposure phase were intermixed with 32 novel pictures of the same two individuals and the participants performed the same task. The researchers found a stronger repetition priming effect for the pictures displaying negative expressions, compared to the neutral expression. Of all the negative emotions, fear yielded the slowest and least accurate responses.

Bentley et al. (2003) presented their participants with pictures of unfamiliar faces and houses situated at the poles of a cross-format display. The pictures of unfamiliar faces had a fearful or neutral expression. The participants were cued to attend to either the horizontal (east-west) or vertical (north-south) poles, and the participants were asked to respond as quickly and accurately as possible whether the attended to stimuli were the same. The researchers concluded that emotional stimuli reduce behavioral priming.

Campanella et al. (2002) used event-related potential technology to investigate the differences in responses to similar versus different faces with a happy or fearful expression. The stimuli were blocked in pairs including pairs of pictures displaying the same emotion, different emotions, or the same picture repeated twice. The researchers observed priming effects for same pairs evident in electrophysiological data, however the researchers recognized that the instructions may have prompted the participants to search for possible yet nonexistent differences in the pictures.

Research to date indicates that the introduction of an emotional dimension leads to changes in the repetition priming effect. Depending on the valence of the emotion, the repetition priming effect can be enhanced or reduced in non-clinical samples. The studies exploring the repetition priming effect with emotional stimuli have explored the effect of fearful faces, and have found support for the existence of the effect.

Appendix B: Instruments

Demographics Questionnaire

Please indicate your responses to the following questions, by checking the space before the appropriate answer.

Gender:
_____1. Male
_____2. Female

Age:
_____1. 18
_____2. 19
_____3. 20
_____4. 21
_____5. 22
_____6. 23
_____7. 24
_____8. 25

Ethnicity:
_____1. African/African American
_____2. Asian/Asian American
_____3. Caucasian/European American
_____4. Hispanic/Hispanic American
_____5. Native American
_____6. Pacific Islander/Pacific Islander American
_____7. Other

Education:
_____1. freshman
_____2. sophomore
_____3. junior
_____4. senior

State-Trait Anxiety Inventory

A number of statements which people have used to describe themselves are given below. Read each statement and then write the number in the blank at the end of the statement that indicates how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

1	**2**	**3**	**4**
not at all	**somewhat**	**moderately so**	**very much so**

1. I feel pleasant ____
2. I feel nervous and restless ____
3. I feel satisfied with myself ____
4. I wish I could be as happy as others seem to be ____
5. I feel like a failure ____
6. I feel rested ____
7. I am "calm, cool, and collected" ____
8. I feel that difficulties are piling up so that I cannot overcome them ____
9. I worry too much over something that really doesn't matter ____
10. I am happy ____
11. I have disturbing thoughts ____
12. I lack self-confidence ____
13. I feel secure ____
14. I make decisions easily ____
15. I feel inadequate _____
16. I am content ____
17. Some unimportant thought runs through my mind and bothers me ____
18. I take disappointments so keenly that I can't put them out of my mind ____
19. I am a steady person ____
20. I get in a state of tension or turmoil as I think over my recent concerns and interests ____

Intolerance of Uncertainty Scale

You will find below a series of statements which describe how people may react to the uncertainties of life. Please use the scale below to describe to which extent each item is characteristic of you (please write the number that describes you best in the space before each item).

1	**2**	**3**	**4**	**5**
not at all characteristic of me	a little characteristic of me	somewhat characteristic of me	very characteristic of me	entirely characteristic of me

_____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 not fair that there are no guaranties 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. Being uncertain allows me to foresee the consequences beforehand and to prepare for them.
_____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 uncertainly it 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 hate being taken by surprise.
_____20. The smallest doubt stops 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 stops me from sleeping well.
_____25. I must get away from uncertain situations.
_____26. The ambiguities in life stress me.
_____27. I can't stand being undecided about my future.

Penn State Worry Questionnaire

Enter the number that best describes how typical or characteristic each item is of you, putting the number next to the item.

1	**2**	**3**	**4**	**5**
Not at all typical		Somewhat typical		Very typical

_____1. If I don't have enough time to do everything, I don't worry about it.
_____2. My worries overwhelm me.
_____3. I do not tend to worry about things.
_____4. Many situations make me worry.
_____5. I know I shouldn't worry about things, but I just cannot help it.
_____6. When I am under pressure I worry a lot.
_____7. I'm always worrying about something.
_____8. I find it easy to dismiss worrisome thoughts.
_____9. As soon as I finish one task, I start to worry about everything else I have to do.
_____10. I never worry about anything.
_____11. When there is nothing more I can do about a concern, I don't worry about it anymore.
_____12. I've been a worrier all my life.
_____13. I notice that I have been worrying about things.
_____14. Once I start worrying, I can't stop.
_____15. I worry all the time.
_____16. I worry about projects until they are done.

Appendix C: Consent Form

Initials _____ Date _____

CONSENT FORM

Project Title	Repetition priming and recognition biases in individuals with and without anxiety.
Why is this research being done?	This is a research project being conducted by Dr. Barry Smith and Earta Norwood, M.S. at the University of Maryland, College Park. We are inviting you to participate in this research because you are at least 18 years of age and you are a student at the University of Maryland at College Park. The purpose of this research project is to explore how anxiety, a tendency to worry, and intolerance of uncertainty may influence cognitive processing of faces displaying different emotions.
What will I be asked to do?	The procedures involve one session which lasts approximately 2 hours 30 minutes. During the first part of the session, we will complete a structured clinical interview assessing for major psychological disorders and you will complete multiple questionnaires asking a variety of questions assessing your anxiety, tendency to worry, and intolerance of uncertainty. Sample items include: I am always worrying about something; I never worry about anything; I hate being taken by surprise; I feel calm, etc. You will then be asked to engage in two computer tasks that involve making simple decisions about pictures of faces presented on the screen. You will indicate your answers by pressing keys on a keyboard.
What about confidentiality?	All information collected during the course of the study is confidential, and your name will not be identified at any time to the extent permitted by law. We will do our best to keep your personal information confidential. Specifically, to protect your confidentiality, your name will not be included on any questionnaires or other collected data; instead, all data will be identified by a number only. Also, your consent form (the only paper containing your name) will be kept in a locked filing cabinet separate from the other information you provide. Only the person in charge of this study will have access to the filing cabinet with your consent form, and only study personnel will have access to your data in general, including the blood pressure measurements. All data from this study will be kept in a locked filing cabinet in a locked room for the duration of five years. Following this five year

	period, all data will be destroyed. The data you provide in this research study, without your name attached, will be grouped with data from other participants if the results of the study are used in scientific reports or presentations. Your information may be shared with representatives of the University of Maryland, College Park or governmental authorities if you or someone else is in danger or if we are required to do so by law. In accordance with legal requirements and/or professional standards, we will disclose to the appropriate individuals and/or authorities information that comes to our attention concerning child abuse or neglect or potential harm to you or others.
What are the risks of this research?	Risks to participants in the proposed study are minimal. You will undergo a clinical assessment. Some participants may be uncomfortable describing symptoms of psychological disorders that they may have. However, some people derive benefit from clinical interviews.
What are the benefits of this research?	This research is not designed to help you personally, but the results may help the investigator learn more about the effects of emotional processes on thought processes. We hope that, in the future, other people might benefit from this study through improved understanding of effects of certain emotions on specific aspects of how we think.
Do I have to be in this research? May I stop participating at any time?	Your participation in this research is completely voluntary. You may choose not to take part in this study at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study, or if you stop participating at any time, you will not be penalized, nor will you lose any benefits for which you otherwise qualify.
Is any medical treatment available if I am injured?	The University of Maryland does not provide any medical, hospitalization or other insurance for participants in this research study, nor will the University of Maryland provide any medical treatment or compensation for any injury sustained as a result of participation in this research study, except as required by law.
What if I have questions?	This research is being conducted by Dr. Barry Smith and Earta Norwood at the University of Maryland, College Park. If you have any questions about the research study itself, please contact Dr. Smith at bdsmith@psyc.umd.edu or (301) 405-5807 or Earta Norwood at enorwood@psyc.umd.edu.

	If you have questions about your rights as a research participant or wish to report a research-related injury, please contact: Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; 301-405-0678; irb@deans.umd.edu. This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.
Statement of Age of Subject and Consent	Your signature indicates that: you are at least 18 years of age, the research has been explained to you, your questions have been fully answered, and you freely and voluntarily choose to participate in this research project. ___ I agree to participate in this study ___ I do not agree to participate in this study
Signature and Date	_____ NAME OF PARTICIPANT _____ SIGNATURE OF PARTICIPANT _____ DATE

Appendix D: Protocol Script

Protocol Script: Assessment

Now I will give you a couple of questionnaires that you will fill out. After you have completed the questionnaires, I will ask you a few questions from a psychological diagnostic interview. The questions will be about your experiences and feelings. They are a standard set of questions that I ask to all participants. Do you have any questions?

Protocol Script: Task 1

Now you are ready to start with the first computer task. During this task, you will see a series of pictures of male or female faces on the screen. If the face is male, quickly press the left arrow key. If the face is female, quickly press the right arrow key. You must press the correct key as quickly as possible. Once you have made your choice, a new male or female face will appear on the screen and you must again quickly choose the left arrow key for males and the right arrow key for females as before. This will continue until this section of the experiment is complete. Before the task begins you will practice with a series of eight pictures. These pictures are not part of the experiment. After the practice session, you will start the first task. If you have any questions, please feel free to ask them now.

Protocol Script: Task 2

Now you are ready to start with the second computer task. During this task you will see two pictures on the screen. Both pictures will be of the same person showing different expressions. One picture will always be from task 1, and one picture will always be new, but both pictures will be of the same person's face. When the picture on the left is the same as during task 1, press the left arrow key. When the picture on the right is the

same as during task 1, press the right arrow key. You must press the correct key as quickly as possible. If you have any questions, please feel free to ask them now.

Appendix E: Debriefing

Debriefing Form

The purpose of this study is to investigate information processing biases in people with and without anxiety. Information processing denotes the mental processes by which we take in, interpret, and store in our memory any information that we encounter. Biased information processing means different and selective processing. Biased information processing does not mean narrow or distorted processing. Research indicates that information processing in people with anxiety is different from that in people without anxiety. Some theories propose that people with anxiety devote more time or energy to process potentially threatening information and have better memory for such information. Researchers are still trying to identify the specific ways in which these biases change perception in individuals with anxiety, and the timeline of their occurrence. Consequently, there is a need for research to better identify the factors that influence information processing biases and the timeline in which the processing biases unfold. This was the goal of the present study. Specifically, we are interested in the time difference that it takes to make decisions on stimuli encountered for the first and second time, and if these time differences are different in people with and without anxiety. Further, we are interested in the accuracy of memories concerning potentially threatening stimuli (the photographs of faces displaying fearful emotion) and if there are any differences in the accuracy of such memories between people with and without anxiety disorders.

To this end, you were asked to complete a number of questionnaires assessing anxiety factors, as well as to complete two computer tasks. The first task was designed to measure the time you needed to process the photographs presented on the computer screen and make simple decisions about them. The second task was designed to measure the accuracy of your memory for potentially threatening stimuli

Your participation in this study may help us discover ways in which people with anxiety differ in their perception of threatening stimuli from people without anxiety. This research may ultimately help in learning much more about the development and maintenance of anxiety, as well as the development of treatments aimed at reducing anxiety. If you have any questions, please ask the experimenter now, or contact Dr. Barry Smith at bdsmith@psyc.umd.edu or Earta Norwood at enorwood@psyc.umd.edu or (301) 405-5887.

Appendix F: Referral List

During or as a result of the assessment procedures completed in this study, you may realize that you have questions that you would like to discuss further with a mental health professional. Below you will find a list of referrals on and off campus in the case that you would like learn more information regarding any feelings of frustration, discomfort, or depression from a mental health professional. These referrals were obtained from an established referral list already in use at the University of Maryland Psychology Clinic:

Judith Sprei, Ph.D.	4701 Samgamore Rd. Ste. 1355 Bethesda, MD 20816	301-229-0065
Ruth Murray, M.D.	2340 University Blvd. E. Hyattsville, MD 20783	301-608-9205
Behavior Therapy Center (BTC) of Greater Washington	11227 Lockwood Dr., Silver Spring, MD 20901	301-593-4040, Fax: 301-593-9148
Dr. William Stixrud & Associates	8720 Georgia Ave., Suite 300 Silver Spring, MD 20910	301-565-0534, Fax: 301-565-2217
University of Maryland The Center for Health & Wellbeing	University Health Center University of Maryland College Park, MD 20742	301-314-5661
University of Maryland Psychology Clinic	Biology/Psychology Building, Ste. 2114, College Park, MD 20742	301-405-4808

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