The Roles of Concept Learning and Discrimination in Interpretation Biases and Fear Generalization: Transdiagnostic and Neuropsychological Perspectives for Anxiety Disorders

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Ashley N. Howell
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This dissertation titled

The Roles of Concept Learning and Discrimination in Interpretation Biases and Fear Generalization: Transdiagnostic and Neuropsychological Perspectives for Anxiety Disorders

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Abstract

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The Roles of Concept Learning and Discrimination in Interpretation Biases and Fear Generalization: Transdiagnostic and Neuropsychological Perspectives for Anxiety Disorders

Director of Dissertation: Julie A. Suhr

Negative interpretations of ambiguously threatening stimuli and over-generalized fear responding to benign situations are important cognitive mechanisms in the etiology and maintenance of anxiety-related disorders (e.g., Hirsch & Mathews, 2000; Lissek et al., 2008). These cognitive abnormalities may derive from over-active associative cognitive processes and under-active executive processes. Overarching assumptions of transdiagnostic cognitive phenomena have been proposed within the field of anxiety pathology. However, these assumptions have been largely based on disorder-specific studies, using disorder-specific stimuli. The current study: (a) implemented a novel transdiagnostic task to measure threat interpretation and fear response; and (b) tested the relations between over-generalized fear responding and trait anxiety severity. In addition, relations between executive functioning performance and threat interpretation styles were explored. Participants were 64 undergraduates (72% female, 80% Caucasian). Results indicated that high trait anxious individuals exhibited fear over-generalization, evidenced by higher perceived threat of benign stimuli and greater difficulty in stimulus discrimination over time, compared to low anxious individuals. High trait anxious individuals also responded faster to stimuli—suggesting less involvement of executive processing in potential threat response. However, counter to hypothesis, high and low
anxious participants demonstrated similar skin conductance response throughout the task. Preliminary exploratory analyses indicated that trait anxiety was not significantly related to executive functioning performance. Cognitive flexibility was related to higher accuracy in threat perception, but lower accuracy for ambiguous stimuli. Also, response inhibition and concept detection/description were related to faster responses to the stimuli. The current results provide additional support for transdiagnostic abnormalities in fear learning and stimulus discrimination among highly anxious individuals who face potential threat. Results also suggest need for additional research on the role of executive functioning in the etiology and maintenance of anxiety symptoms.
Acknowledgements

This project would not have been possible without the guidance and expertise of two important individuals. First, I want to thank my advisor, Dr. Julie Suhr, who supported (and expanded) my scientific endeavors, and who has greatly inspired my professional development. Next, I want to thank Mr. Robert Conatser, who programmed my ideas about this project into a functioning reality.

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Introduction

Anxiety, posttraumatic, and obsessive-compulsive disorders will affect about 25-30% of individuals during their lifetime (Barlow, 2002; Kessler et al., 2005). The Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association [APA], 2013) essentially defines each anxiety-related disorder by what is feared and avoided, and many resources have been devoted to studying each disorder in isolation. However, leading scientists propose a shift in focus from restrictive diagnostic labels to more transdiagnostic models (e.g., Hyman, 2010; Insel, 2013). There are many shared symptoms and neurobiological abnormalities among anxiety-related disorders, suggesting that they likely branch from core issues such as low thresholds for fear acquisition, abnormal processing of information, and anxiety dysregulation (e.g., Brown & Barlow, 2009). Studying these issues from a transdiagnostic framework may shed additional light on the etiology of anxiety pathology and improve the efficiency of assessment and treatment (e.g., Barlow et al., 2010; Brown and Barlow 2005, 2009; Gros, Simms, & Antony, 2011; Riskind & Williams, 2006).

An overarching and robust phenomenon in anxiety research is biased information processing, which involves abnormal associative (implicit; automatic; activating) and rule-based (explicit; controlled; inhibitory) processing of self-relevant threat stimuli. The multi-process model of anxiety (Ouimet, Gawronski, & Dozois, 2009) is an extension from dual systems models (e.g., Gawronski & Bodenhausen, 2006; Sloman, 1996; Strack & Deutsch, 2004) and posits that both associative and rule-based processes simultaneously function to identify threat. The purpose of the present study was to
examine, from a transdiagnostic approach, the relations between information processing biases and both trait anxiety and state fear response.

**Associative Processes: Interpretation Bias**

Semantic long-term memory consists of an immense interrelated network of concepts, and upon presentation of any stimulus, the concepts most closely connected to it are activated (Sloman, 1996). When associative processes are predominantly engaged, the accuracy of those associations is not yet assessed. (Potentially biased) heuristic assumptions thereby shape perception if effortful logic is not feasible (e.g., need for immediate action) or is under-utilized (e.g., low motivation or cognitive inflexibility) (e.g., Gawronski & Bodenhausen, 2006; Strack & Deutsch, 2004). One heavily researched area of processing in anxiety pathology is biased interpretation of events. Interpretation *bias* is “the tendency to interpret ambiguous situations in a positive or negative fashion” (Huppert et al., 2003, p. 569).

Negative interpretation biases are robustly observed among highly anxious individuals (Calvo & Castillo, 2001; Richards & French, 1992) and anxiety or other emotional disorder patients (Amir, Elias, Klumpp, & Przeworski, 2003; Eysenck, Mogg, May, Richards, & Mathews, 1991; Hirsch & Mathews, 2000). These findings have resulted from paradigms that are both implicit (Egloff & Schmukle, 2002; Williams, Mathews, & MacLeod, 1996) and explicit (e.g., Mathews & McIntosh, 2000) about the testing of anxiety. Negative interpretation bias has also been found to occur with (Wilson et al., 2006) or without (Richards & French, 1992) state anxiety induction. Furthermore, these biases are evident across the (cross-sectional) lifespan of anxious individuals with untreated symptoms (e.g., Dodd, Hudson, Morris, & Wise, 2012; Hadwin, Frost, French,
& Richards, 1997; Huppert et al., 2003; Waters, Craske, Bergman, & Treanor, 2008), but may normalize after successful treatment (Schreiber, Witthöft, Neng, & Weck, 2016; Reinecke, Rinck, Becker, & Hoyer, 2013). Also, building evidence indicates that patients with social anxiety disorder negatively interpret positive social outcomes (Alden, Taylor, Mellings, & Laposa, 2008; Weeks & Howell, 2012) and exhibit deficits in positive interpretation (Constans, Penn, Ihen, & Hope, 1999; Kashdan, Weeks, & Savostyanova, 2011). Collectively, negative interpretation bias is a trait-like phenomenon and plays a key etiological and maintaining role in anxiety pathology.

Associative processes also play specific roles in fear generalization. Fear generalization is an adaptive process wherein associative processes are quickly engaged to respond to novel stimuli based on the degree to which the stimulus is conceptually similar to a learned explicit threat cue. The greater the similarity between the novel stimulus and the learned threat cue, the more likely it is that the novel stimulus is perceived as threatening. Sometimes, strong similarity shared among stimuli can lead to difficulty in discriminating among them (Sidman, 1994). Research has found that highly anxious individuals not only have difficulty discriminating between exemplar threat stimuli and similar stimuli, but also have more difficulty than low anxious individuals when trying to discriminate threat levels with ambiguous (i.e., interpretation bias) or even benign stimuli (i.e., fear responses are over-generalized). Broadly, it may be that when faced with threat, anxious individuals have deficient discrimination learning and concept engagement skills compared to healthy individuals (Sachs, Anderer, Doby, Saletu, & Dantendorfer, 2003). Examination of fear over-generalization may inform the degree of risk for anxiety pathology and symptom severity. In fact, differences in how individuals
perceive ambiguous or benign situations may actually have more explanatory power for anxiety pathology than differences in response to explicitly threatening stimuli (e.g., Dymond, Dunsmoor, Vervliet, Roche, & Hermans, 2015).

Adult samples in which supportive data for fear (over)generalization have emerged have been characterized as broadly as: healthy (i.e., no history of psychiatric or medical disorders) (e.g., Dunsmoor & colleagues, 2009; 2011; 2012; 2013); openly recruited (undergraduate and /or community) (e.g., Lissek et al., 2008); high-low trait anxiety or neuroticism groups (e.g., Lommen, Engelhard, & van den Hout, 2010); and anxiety patient versus nonclinical control groups (e.g., Jovanovic, Kazama, Bachevalier, & Davis, 2012; Kaczkurkin & Lissek, 2013; Reinecke, Becker, Hoyer, & Rinck, 2010). Discriminative validity for this phenomenon has been demonstrated by slower fear acquisition and under-generalization among psychopaths, who exhibit deficits in arousal and consequence appraisal, when compared to controls (Hare, 1965; Lopez et al., 2013).

Cognitive-based fear generalization research has utilized several methodological approaches. One involves feature gradient discrimination, which includes a gradation of a stimulus feature and has been employed with both naturalistic and de novo (i.e., conditioned in-laboratory) stimuli. Another involves category membership, which requires learning of conditional properties of de novo-conditioned stimulus relationships. In studies on feature gradient discrimination, some researchers have used naturally affective stimuli (e.g., venomous animals) or neutral images from the human environment (e.g., tools) as the aversely conditioned (CS+), safely conditioned (CS-), or generalized stimuli (GSs). Using pre-conceptualized stimuli may be beneficial when confirming established theories and extending findings to new populations or contexts. However, use
of these stimuli may introduce pre-existing biases into the study, and dichotomously valenced stimuli, such as happy and angry faces, may introduce response demand characteristics. One way to resolve these issues is to use neutral stimuli, conditioned in the laboratory. Fear generalization (per skin conductance response [SCR], response time, and subjective threat perception) has been demonstrated using color (e.g., Dunsmoor & LaBar, 2013) or ring size (e.g., Lissek et al., 2008) as a gradated stimulus feature. For example, in the Lissek et al. (2008) study, the largest and smallest rings served as the CS+ or CS-, and the GSs included eight rings of varying diameter between the CS+ and CS-. Continuous decreases in fear potentiated startle (FPS) and self-reported threat ratings occurred as the presented stimulus became less similar to the CS+. This pattern of fear generalization has occurred in psychologically healthy samples (e.g., Lissek et al., 2008). Also, when compared to nonanxious controls, persons with generalized anxiety disorder (GAD) (Lissek, Kaczkurkin, et al., 2014), panic disorder (Lissek, Rabin, et al., 2010), and high threat estimation of obsessive beliefs (Kaczkurkin & Lissek, 2013) demonstrate over-generalized fear response toward “safer” stimuli. Similar findings have been found using nonsense figures, auditory tones, or proprioceptive movements (Dymond et al., 2014; Meulders & Vlaeyen, 2013; Meulders et al., 2013; Vervoort et al., 2014). Manipulation of methodological approaches has revealed that creating ambiguity with multiple GSs, and using a CS- that is similar to the CS+, evokes greater need for discrimination strategies than when only using one GS, or when the CS- is conceptually dissimilar to the CS+ (Haddad, Pritchett, Lissek, & Lau, 2012; Vervliet, Iberico, et al., 2011).
While many studies addressing the role of discriminative learning in fear generalization have used a single feature dimension, other studies (e.g., Dunsmoor, White, & LaBar, 2014) have isolated and tested conditional discrimination, which highlights stimulus associations based on membership rules (e.g., and; or; if). To illustrate, in a study by Vervliet and Geens (2014), participants had to deduce whether color or shape (depending on the assigned condition) was predictive of electric shock. The CS+ was a yellow triangle (A+X). If the CS- was a red triangle (B-X), then color [A+ or B-] indicated safety or threat. The GSs were a yellow square (AZ) and a blue triangle (CX). SCR and shock expectancy ratings generalized more to the yellow square than to the blue triangle for the color condition, based on CS+ membership rules. Notably, similar findings have occurred among combat veterans with posttraumatic stress disorder (PTSD; Grillon et al., 1998; Morgan et al., 1995).

In related studies, civilians and combat veterans with PTSD have shown overgeneralization of fear response and trouble inhibiting that response in the conditional presence of a CS- (safety)—further highlighting differences in threat discrimination learning (Jovanovic, Kazama, Bachevalier, & Davis, 2012; Briscione, Jovanovic, & Norrholm, 2014). Jovanovic and colleagues (2012) also used an AX+/BX- paradigm (Myers & Davis, 2004). An air blast to the larynx was indirectly paired with X, such that the blast was contingent on the presence of A (CS+) or B (CS-). An AB combination served as a single, ambiguous GS. AB elicited lower fear response than when A was paired with a novel stimulus (C). The authors inferred that the safety signal protected against generalized fear response. However, they did not test AC or AB versus BC. Thus, it could be that the safety signal did not protect against generalization, per se, but that
participants simply exhibited greater fear responses to a more threatening scenario (i.e., A+/uncertain) than to an ambiguous (A+/B-) scenario.

In an important extension of this research, Jovanovic and colleagues (2009) tested PTSD and control group differences in response to ambiguous stimuli. They found that individuals with remitted PTSD responded similarly to healthy controls; both groups exhibited similar FPS to the threat signal, accurately discriminated between danger and safety trials, and transferred the safety signal contingency to ambiguous trials. Alternatively, current PTSD patients showed stronger FPS to the threat cue and failed to detect differences between threat and either safety or ambiguous stimuli. Relatedly, Lissek et al. (2009) found that GAD patients, versus healthy controls, reported greater threat ratings to simultaneous danger and safety cue presentations, but equally strong ratings to the danger cue alone. Collectively, there is evidence that both feature discrimination and membership contingency skills play roles in fear acquisition and generalization, and that highly anxious individuals show relative deficits in these skills when faced with potentially aversive outcomes. However, a great deal of this work was limited to unselected populations or focused on one anxiety disorder—limiting the ability to deduce transdiagnostic implications.

**Rule-Based Processes and Executive Functioning**

As reviewed above, most cognitive-based studies of anxiety pathology have focused on associative processes (e.g., Amir et al., 2003; Bar-Haim et al., 2007). In contrast to associative processes are explicit and more conscious rule-based processes. According to process models (Gawronski & Bodenhausen, 2006; Ouimet et al., 2009; Strack & Deutsch, 2004), engaging in symbolic and inferential reasoning enables valid
testing of associative processes; propositions must be assessed for logical consistency and, therefore, truth or falsity. Persistent inconsistency between experience and belief reveals that the underlying belief is flawed. It is important to restate that, while associative and rule-based routes work in conjunction with one another, they may sometimes be in conflict (Strack & Deutsch, 2004). This conflict occurs when the emotional valence of stimuli is ambiguous or when stimuli are closely related (Shepard, 1987), when cognitive resources are taxed due to distress or arousal (McNally, 1996), or when motivation is low. Thus, individuals who typically experience high arousal and are less skilled in cognitive control while distressed may engage heuristic associative processes (and related cognitive biases) more so than low-anxious individuals (Amir, Foa, & Coles, 1998; Eysenck et al., 1991) and thereby exhibit fear over-generalization.

In addition, adaptive balance of associative and rule-based processes may be mediated or moderated by individual differences in working memory capacity, or the capacity to “maintain information in a conscious, active state, [and] to support thought processes by mental transformations” (p. 963, Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008). For example, Salemink, Friese, Drake, Mackintosh, and Hoppitt (2013) found that working memory capacity moderated interpretation bias in both implicit and explicit social anxiety. Findings from another pair of experiments (Booth & Sharma, 2014) indicated that “loading” participants’ working memory capacity, via digit span or visuospatial memory tasks, led to greater attentional bias behaviors to fear-conditioned stimuli. In summary, three core variables appear to impact threat processing and anxiety disorder vulnerability: (1) numerous and sensitive threat-concept associations; (2) high
levels of arousal that impede online usage of rule-based systems; and (3) low working memory and executive control capacities (Ouimet et al., 2009).

As such, executive functioning may further explicate rule-based components of information processing. Executive functioning involves rule-based neurological circuits and performance, such as planning, extemporaneous shifting in problem-solving strategies depending on contextual changes (i.e., cognitive flexibility), and working memory (e.g., Smitherman, Huerkamp, Miller, Houle, & O’Jile, 2007; Williams et al., 2009). Executive engagement has been measured in two key ways: (1) neuroimaging of prefrontal cortical areas, oftentimes during a task of interest; and (2) executive task performance, per neuropsychological assessment, which provides behavioral evidence and estimates how trait executive (dis)ability may impact daily functioning. There is much convergent evidence that relevant prefrontal cortical areas are involved with executive functioning performance tasks (e.g., Castaneda et al., 2008; Smitherman et al., 2007). More pertinent to the current study, multimodal assessment of executive imaging and information processing data provide support for the important role of prefrontal cortices during emotion and stress regulation tasks (e.g., Goldin, McRae, Ramel, & Gross, 2008; Williams, Suchy, & Rau, 2009) and during the discriminative process in fear generalization (e.g., Dunsmoor, Prince, Murty, Kragel, & LaBar, 2011). Thus, it follows that executive performance would be related to anxiety symptom severity and degree of subjective and behavioral fear generalization. Of the studies that have tested the potential role of executive performance in anxiety pathology, the majority have tested for group differences in performance on neuropsychological assessment batteries, and outside of anxiety provocation contexts (e.g., Smitherman et al., 2007). The most
frequently tested domains of executive functioning performance within studies of anxiety pathology and emotion regulation include: working memory capacity (including visual and verbal working memory), visual and verbal recall; cognitive flexibility/set-shifting, and modified attention and interpretation tasks (e.g., see Castaneda et al., 2008). However, to our knowledge, no research to date has investigated the relation between executive functioning performance and degree of fear generalization.

The data are mixed as to whether executive performance deficits actually exist for highly anxious or anxiety disorder patients, compared to healthy controls. In addition, almost all related research has used a between-groups approach, driven by the hypothesis that the anxious group would demonstrate “deficits” (i.e., relative to the control group; e.g., Castaneda, Tuulio-Henriksson, Marttunen, Suvisaari, & Lönnqvist, 2008 for a review). Because group difference tests are oftentimes based upon extreme samples of a population, and thus can be limited in statistical power and generalizability to other samples, using an individual differences approach within a more anxiety-diverse sample (e.g., Booth & Sharma, 2014; Salemink et al., 2013) may help to resolve mixed findings. Furthermore, deficit-driven tests in the absence of multimodal assessment limits understanding the implications of possible executive functioning differences for anxiety patients versus controls. For example, if it is assumed that individuals with low-average executive functioning performance are at greater risk for anxiety disorders, due in part to poorer emotion regulation capability and threat misinterpretation (e.g., Affrunti & Woodruff-Borden, 2015), do samples with relative executive performance deficits actually demonstrate poorer fear regulation? Little research has tested this question, but some evidence hints at possible moderating effects of executive functioning on anxiety-
related issues. For example, Bomyea and Amir (2011) found that inhibitory control practice modulated the number of thought intrusions during a thought suppression task. Also, Eysenck and colleagues (2005) found that trait, but not state, anxiety was related to poorer performance on an executive nonverbal task—providing evidence for a trait phenomenon and against the notion that deficits derive merely from anxious arousal during testing (see also Booth & Sharma, 2014, described above).

Another limitation is that the majority of neuropsychological and anxiety research has been limited to specific anxiety disorders (i.e., OCD and PTSD; Castaneda et al., 2008). Similar to issues with disorder-specific interpretation bias studies, generalizability of findings to transdiagnostic cognitive features of anxiety pathology is limited. Overall, important next steps in understanding cognitive mechanisms of anxiety disorders include within-subjects testing and multimodal assessment for individuals with diverse presentations of anxiety and executive cognitive ability.

Summary of Limitations and the Current Study

Altogether, cognitive-based research on anxiety disorders may be replicated and extended by: utilizing de novo-conditioned stimuli to control for preexisting biases and to test transdiagnostic phenomena; incorporating more complex conditional properties for safety and threat categorization, as well as several ambiguous stimuli, to test nuances in fear learning, concept discrimination, and fear generalization; using individual difference designs to improve power and external validity; and exploring the relationships among state fear generalization, trait measures of anxiety, and executive performance.

For the current study, a computerized paradigm (the Fear Interpretation and Generalization Task; FIGT) was developed to assess relations among conditioned fear
responding, trait anxiety symptoms, and executive functioning performance. Participants reported a full spectrum of trait anxiety severity (minimal to severe) and included individuals who did or did not meet criteria for a current anxiety disorder (see Participants). During the FIGT, participants had to discriminate level of safety or threat among stimuli that were distinct but related, to an ordinal degree, using conditional strategies. The FIGT included stimuli that were saliently conditioned (CS+ and CS-), several GSs that were more similar to the CS+ or CS- (Similar+ and Similar-), and stimuli that were ambiguously threatening. Fear response was operationalized as event-related (ER) SCR, response time, and subjective safety/threat perception (dichotomous safety/danger ratings and continuous-scale ratings).

Hypotheses

**Measure validation.** First (1), it was hypothesized that in the total sample, and during the conditioning process of responding to only CS+ and CS- stimuli: (1a) continuous danger ratings, (1b) number of dichotomously selected “danger” (versus “safe”) ratings, and (1c) ER-SCR would be higher on average for the CS+ versus CS- stimuli, but (1d) not for response time (e.g., Lissek et al., 2008). Second (2), it was hypothesized that while testing responses to GSs as well, (2a) continuous danger ratings, (2b) number of dichotomously selected “danger” ratings, and (2c) ER-SCR would be positively associated with degree of similarity of the GS group to the CS+ (i.e., from a dimensional perspective: CS-, Similar-, Ambiguous, Similar+, and CS+). Further, it was hypothesized (2d) that participants would take longer to respond to increasingly ambiguous stimuli, due to greater need for rule-based processing.
Roles of trait anxiety. Additionally, it was hypothesized that fear response gradients would be higher (i.e., greater fear response) and flatter (i.e., broader generalization) across stimulus groups, and throughout GS testing, for high versus low anxious individuals. Fear responses were operationalized as: (3a) continuous danger ratings; (3b) number of dichotomous danger ratings; and (3c) ER-SCR. It was also expected that (3d) reaction time would be lower (i.e., faster) and flatter for high versus low anxious individuals across stimulus groups, indicative of lower involvement of rule-based processing and greater reliance on associative heuristics.

Exploratory analyses. Exploratory analyses were conducted to test relations among: individual differences in executive functioning performance (i.e., response inhibition; concept formation and recognition; cognitive flexibility); FIGT outcome measures, and trait anxiety (see Appendix A for a detailed rationale summary).
Methods

Participants

Participants included in analyses were 64 undergraduates ($M_{age} \approx 19$; 72% female; 80% Caucasian; see Table 1 for details). Psychodiagnostic assessment indicated that about 30% of participants met criteria for one or more DSM-IV anxiety disorder (see Table 1). Participants were recruited through a web-based experiment sign-up system available through the psychology department. Participants first provided consent to anonymously complete a battery of online prescreen measures, which included a trait anxiety symptom measure (Self-Rating Anxiety Scale; SAS; Zung, 1971) and demographic information.¹

Eligibility criteria for signing-up for the study included being 18 or older and speaking English as a native language. Two participants who spoke English as a second language participated before the English criterion was incorporated into the study; thus, their data were not included in analyses. Non-eligibility criteria were assessed during consent and included self-reported history of cardiac, neurological, or musculoskeletal disorders, and use of psychoactive substances before testing. Other exclusionary criteria included metal plates or screws in either hands or arms, broken/irritated skin at any electrode placement site, and participant-suspected pregnancy. Only one individual who arrived for the study met an exclusionary criterion; this person was compensated for his/her time and excused. Participants were compensated with course credit and $5.00.

¹ For the purposes of recruiting a diverse and continuous sample of trait anxiety levels among participants, participants could see and sign up for the study if they met prerequisite inclusionary demographic or cut-off score requirements: “within normal range”; “minimal to moderate anxiety”; and by combining the two most severe group tiers, “marked to extreme anxiety” (see also SAS section below).
Table 1
*Sample Descriptive Statistics (n = 64)*

<table>
<thead>
<tr>
<th></th>
<th>M (SD)</th>
<th>% of Total Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Anxiety (SAS)</td>
<td>38.7 (9.9)</td>
<td></td>
</tr>
<tr>
<td>Trait Depression (PHQ-9)</td>
<td>7.4 (6.1)</td>
<td></td>
</tr>
<tr>
<td>Intelligence Estimate (WTAR)</td>
<td>102.6 (10.4)</td>
<td></td>
</tr>
<tr>
<td>Visuospatial Working Memory (SA-WMS-IV)</td>
<td>10.6 (2.5)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>19.1 (1.4)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>71.9</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>28.1</td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity</td>
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<tr>
<td>White/Caucasian (non-Hispanic)</td>
<td>79.7</td>
<td></td>
</tr>
<tr>
<td>Black/African-American</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>Hispanic/Latino(a)</td>
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<td></td>
</tr>
<tr>
<td>Multiracial</td>
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<tr>
<td>Pacific Islander/Native Hawaiian</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td>Middle Eastern</td>
<td>1.6</td>
<td></td>
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</tbody>
</table>
Table 1: continued

**Current Diagnostic Information a**

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<tr>
<th>Diagnosis</th>
<th>Percentage</th>
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<tr>
<td><strong>No Current Diagnosis</strong></td>
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<tr>
<td><strong>Anxiety Disorder Diagnoses</strong></td>
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<td>Social Anxiety Disorder</td>
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<tr>
<td>Generalized Anxiety Disorder</td>
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</tr>
<tr>
<td>Panic Disorder/Agoraphobia</td>
<td>6.3</td>
</tr>
<tr>
<td>Posttraumatic/Acute Stress Disorders</td>
<td>6.3</td>
</tr>
<tr>
<td>Obsessive-Compulsive Disorder</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Other Emotional Disorder Diagnoses</strong></td>
<td>29.7</td>
</tr>
<tr>
<td>Major Depressive Disorder-Current Episode</td>
<td>15.6</td>
</tr>
<tr>
<td>Dysthymia (Persistent Depression)</td>
<td>12.5</td>
</tr>
<tr>
<td>Bipolar-Related Disorder</td>
<td>1.6</td>
</tr>
<tr>
<td>Bulimia Nervosa or Binge Eating Disorder</td>
<td>4.7</td>
</tr>
<tr>
<td><strong>Non-Emotional Disorder Diagnoses</strong></td>
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</tr>
<tr>
<td>Alcohol Use Disorder</td>
<td>17.2</td>
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<tr>
<td>Marijuana Use Disorder</td>
<td>10.9</td>
</tr>
<tr>
<td>History of hallucinations/delusions</td>
<td>4.7</td>
</tr>
<tr>
<td>Antisocial Personality Disorder</td>
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</tbody>
</table>

Note: SAS = Zung Self-Rating Anxiety Scale; PHQ-9 = Patient Health Questionnaire; WTAR = Wechsler Test of Adult Reading; SA-WMS-IV = Spatial Addition of the Wechsler Memory Scales-IV
Diagnoses were determined via the MINI-International Neuropsychiatric Interview, 5.0; diagnosis reports are non-exclusive and typically comorbid

**Materials and Measures**

**Fear Interpretation and Generalization Task (FIGT).** The FIGT is a novel computer program designed to assess degree of fearful response to threatening stimuli, fear generalization to related but non-threatening stimuli, and threat interpretation bias toward ambiguously threatening stimuli. Outcome measures include subjective perception of threat/safety levels of stimuli (i.e., dichotomous safe/dangerous decisions and bipolar scale [1-11] ratings; see Boddez et al.[2013] concerning validity of self-report shock expectancy ratings in human fear conditioning), as well as objective response times for dichotomous ratings. The subjective responses reflect explicit judgment-making about threat perception, whereas reaction time reflects emotional associations with minimal influence of intentional processes (e.g., Fazio & Olson, 2002). For the dichotomous ratings, the number of “dangerous” decisions was calculated per stimulus group, per trial battery. Time (in ms) from stimulus onset to key-press for the dichotomous rating was used to measure reaction time, which was square-root transformed before analyses due to the skewed nature of reaction time data (e.g., Whelan, 2008).

The FIGT was written in and controlled by LabVIEW software (National Instruments, Austin, TX). This software also recorded the subjective and response time data. An 18.5in computer screen was used with a viewing distance of approximately 60cm from the participant. Stimuli include 12 shapes, created from all possible exclusive permutations of size (large; small); color (black; white); and form (three regular polygons with different numbers of vector points) (see Figure 1). Stimuli are each presented on a
grey square background (11X11.5 cm) that is centered on a black screen. The grey background is equidistant in hue (red, green, blue values, all = 120) from the white (all values = 240) and black (all values = 0) stimuli. Stimuli are equally distanced from the bottom of the grey square to preclude illusions of stimulus proximity. Two of the 12 stimuli (large black diamond and small white diamond) are 100% paired with shock (CS+) or 0% paired with shock (CS-) during conditioning phases (see Procedures). Whether each stimulus was conditioned as the CS+ or CS- was counterbalanced to control for possible inherent bias. (See Appendix C for pilot study results.) The FIGT consists of four phases, which are further described below.

![Stimuli](image)

*Figure 1. Stimuli used in the fear interpretation and generalization task (FIGT)*

**Aversive stimulus.** Mild percutaneous shock was used for conditioning and delivered by the Digitimer DS7A constant current stimulator (Digitimer Ltd, Hertfordshire, England). Mild shock is a widely used method for fear conditioning, as indicated by change in outcome variables (e.g., Dunsmoor & LaBar, 2013; Greenberg et al., 2013a). Each shock was 2ms in duration and delivered to the dorsal wrist area of the participant’s non-dominant hand. The intensity of shock was calibrated for each participant prior to the start of the experiment to be “uncomfortable”, in order to control for individual differences in discomfort tolerance (see Discomfort Threshold, below).
**Skin conductance response.** In addition to the subjective responses and response times recorded throughout the FIGT, ER-SCR was measured. SCR, which is principally regulated by the sympathetic nervous system, has been empirically supported and convergently validated with subjective and other physiological data as a variable of reactivity to novel or emotionally salient stimuli (Arnett, Smith, & Newman, 1997; Fowles, 1993), particularly during fear/anxiety elicitation (e.g., Blechert, et al., 2006; Chan & Lovibond, 1996; Collet et al., 1997; Tamaren, Carney, & Allen, 1985; Vlemincx et al., 2009). SCR and response time have been shown to be more robust measures of fear than cross-sectional skin conductance level or heart rate (Edgerly & Levis, 2005).

For the present study, ER-SCR data (in \(\mu S\)) was collected with the GSR100C amplifier. Recordings were acquired by the BIOPAC Systems MP-100 hardware and analyzed with AcqKnowledge (version 4.1.0) software (BIOPAC Systems, Inc.). A pair of silver-silver chloride electrodes were strapped to the palmer side of the distal phalanges of the index and middle fingers (e.g., Freedman et al., 1994; Scerbo, Freedman, Raine, Dawson, & Venables, 1992) of the participant’s non-dominant hand. The wells of the electrodes were filled with electrode gel (BIOPAC Systems, Inc.) before placement to ensure appropriate contact and conductance. Participants were asked to remain as still as possible during recordings to reduce artifacts (Cahill & Alkire, 2003). An SCR was considered as event-related if the peak SCR occurred between 1-4s following stimulus onset and the ER-SCR amplitude was \(0.02\mu S\) or higher (Dawson, Schell, & Filion, 2007). ER-SCRs were averaged for each stimulus category, per phase battery. ER-SCR amplitudes below \(0.02\mu S\) were transformed as zero. Data were square-root transformed due to the skewed nature of SCRs (e.g., Dawson et al., 2007).
See Appendix C for detailed psychometrics and Appendix D for non-copyrighted measures.

**Self-Rating Anxiety Scale** (SAS; Zung, 1971). The SAS is a 20-item measure of general anxiety levels, including cognitive, affective, and somatic symptoms from the “past several days.” The SAS is able to distinguish patients with anxiety disorders from those with schizophrenia, depression, personality disorder, and transient stress (Zung, 1971), and has demonstrated good internal consistency and good convergent validity in open college samples (Judah et al., 2013; Olatunji, Deacon, Abramowitz, & Tolin, 2006).

Cutoff scores have been psychometrically supported for the SAS (Michelson & Mavissakalian, 1983; Olatunji et al., 2006; Zung, 1971) (raw scores: below 36 = *within normal range*; 36-47 = *minimal to moderate anxiety*, 48-59 = *marked to severe anxiety*, and 60 – 80 = *extreme anxiety*). Recruitment target groups were normal range, minimal to moderate anxiety, and severe to extreme anxiety to achieve a broad distribution of trait anxiety. Consenting participants first completed the SAS as part of an anonymous online prescreen. Individuals who scored within designated score ranges (which were tailored across time according to recruitment needs) could see and sign up for the study. Across two semesters for prescreen participants (*n* = 2,079), *M*(SD) = 36.0(9.0), and scores that were 1SD (score = 45), 2SD (score = 54), and 3SD (score = 63) above the mean were generally consistent with the previously established cut-off scores. Participants were also asked to complete the SAS as part of a self-report battery after arriving and consenting for the study. The lab-administered SAS demonstrated good internal consistency, α = .86.

For Hypothesis 3, the SAS was median split (38) to test between-subjects effects for stimuli and across time. Of the participants who scored at or above 38, 47.1% met
criteria for an anxiety disorder. Of the participants who scored below 38, 96.7% did not meet criteria for an anxiety disorder, $\chi^2 = 15.62$, $p < .001$, $\phi = .49$ (see Table 2).

Table 2
Cross-Tabulation of Number of Individuals: SAS Median-Split Score by Anxiety Disorder Status

<table>
<thead>
<tr>
<th>SAS (Median Split [38])</th>
<th>Low</th>
<th>High</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Anxiety Disorder</td>
<td>29</td>
<td>18</td>
<td>47</td>
</tr>
<tr>
<td>Anxiety Disorder(s)</td>
<td>1</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>34</td>
<td>64</td>
</tr>
</tbody>
</table>

*Note: SAS = Zung Self-Rating Anxiety Scale*

**Mini-International Neuropsychiatric Interview, Version 5.0.0.** (MINI; Sheehan et al., 1998). The MINI is a clinician administered structured interview designed to assess for diagnostic features of major DSM-IV-TR and ICD-10 psychiatric disorders. The MINI has been compared to other structured interviews and has been found to agree in 85-95% of cases (Sheehan et al., 1998).

**Wechsler Test of Adult Reading** (WTAR; Psychological Corporation, 2001). The WTAR is designed to assess crystallized intelligence among individuals fluent in English and was normed using a large and nationally representative sample. It is a clinician-administered measure, and the participant reads aloud 50 increasingly difficult words. The WTAR has excellent internal consistency and test-retest reliability within age groups relevant for the current study, and is strongly correlated with general intelligence.
quotients (Psychological Corporation, 2001). The WTAR was used to rule out effects of crystallized intelligence on the outcome measures.

**Wechsler Memory Scale-IV: Spatial Addition** (WMS-IV; Wechsler, 2008b). For the Spatial Addition test, participants must remember location of dots on two separate pages, add or subtract locations, and hold and manipulate visual spatial information. The Spatial Addition test demonstrated good to excellent internal consistency, adequate test-retest reliability, and excellent convergent and discriminant validity in the age ranges of interest (Wechsler, 2008b). This task was administered to explore effects of visuospatial working memory performance on the outcome variables.

**Delis-Kaplan Executive Functioning System: Color-Word Interference Test** (D-KEFS; Delis, Kaplan, & Kramer, 2001). The Color-Word Interference test is modeled after the classic Stroop task, throughout which participants are asked to name color patches and then read the words of colors in black ink. Next, during an interference task, participants are asked to inhibit the automatic task of reading the words and only name conflicting word ink colors. Last, participants must switch between naming the color of the ink or reading the word based on a stimulus cue. Completion times are used as the primary performance measures. The Color-Word Interference test demonstrated good internal consistency, questionable to acceptable test-retest reliability (although the time between administrations varied widely), and convergent validity with other executive functioning tasks (Delis et al., 2001). The Color-Word Interference test was administered to explore effects of response inhibition and rule-shifting skills on the outcome measures.

**Delis-Kaplan Executive Functioning System: Sorting Test.** The Sorting Test involves the use of cards that display both perceptual stimuli and printed words. There
are two sorting conditions (spontaneous *Free Sorting* and structured *Sort Recognition*) that assess components of concept detection and problem-solving. For the former, the examinee is asked to sort the cards into two groups, so that cards in each group are the same in some way, and then to explain their sort. For the latter, the examiner makes card sorts, and the examinee attempts to describe the concepts used to generate each sort. Feedback is not provided, and performance is generally scored as number of correct sorts and accuracy of sort descriptions. Within the age demographic of interest, the Sorting Test demonstrated acceptable internal and test-retest reliability and convergent validity (Delis et al., 2001). The Sorting Test was administered to explore effects of concept formation/recognition and problem-solving skills on the outcome measures.

**Wisconsin Card Sorting Task-64: Second Computerized Version** (WCST-64-CV2; Kongs, Thompson, Iverson, & Heaton, 2000). The WCST-64-CV2 is a more expedient and accessible version of the original Wisconsin Card Sorting Task (WCST; Berg, 1948; Grant & Berg, 1948). It requires the ability to use abstract reasoning strategies and to shift those strategies across changing stimulus conditions to obtain a goal (Kongs et al., 2000). During the WCST, participants are asked to match a target card with one of four other cards, based on various card features. However, participants are never told the matching rule, and the rule changes after each set without notice. “Correct” or “Incorrect” feedback is provided per match, and they must use this feedback to shift their matching strategy. The WCST generates a number of psychometric scores, including demographically-normed scores for perseverative errors, non-perseverative errors, and conceptual level responses achieved. The WCST-64-CV2 is highly correlated with the original version and demonstrated very good internal and test-retest reliability.
within a healthy adult sample (Kongs et al., 2000). The WCST-64-CV2 was administered to explore effects of concept formation and rule-shifting skills on the outcome measures.

**Procedures**

**Informed consent and electrode fitting.** All participants provided informed consent to participate in the study after an overview of procedures were described and inclusionary/exclusionary criteria were reviewed and confirmed. After consent, participants were asked to sit at the computer desk where the stimulus-only display screen for the FIGT was placed. This desk was located within a windowless, undecorated, and temperature-controlled room, and the participant chair faced the screen and wall. The experimenter managed all software and hardware at a computer desk facing the opposite wall. Thus, participants were unable to see the experimenter or equipment while completing discomfort threshold and FIGT tasks. After participants were seated, they were fitted with SCR electrodes and asked to sit still and quietly for four minutes. This was to allow for acclimation to temperature, measure average baseline skin conductance level, and ensure achieved detection of skin conductance (Dawson et al., 2007). Next, the stimulator was secured to the non-dominant wrist, and discomfort threshold was assessed.

**Discomfort threshold assessment.** After each shock throughout this procedure, participants stated their physical discomfort using a numerical scale. The scale ranged from 0 to 50: 0 (*felt nothing*), 1 (*just noticeable*), 25 (*slightly uncomfortable*), 40 (*uncomfortable, but not painful*), and 50 (*painful*), where 40 was the target level of discomfort. A peak-trough staircase procedure was used. Starting at 0mA, intensity was increased each time by 4mA until the participant reported a number above 40 (peak).
Then, intensity was decreased by 8mA until the participant reported below 40 (trough). This process was repeated two additional times, starting from the trough of the prior set. Discomfort threshold was defined as the average stimulation intensity (mA) of the last two peaks and troughs, and the stimulator was set to this value for the duration of the FIGT. Average threshold for discomfort was $M = 19.18$, $SD = 7.74$ (range = 6 – 40mA).

**Fear interpretation and generalization task (FIGT).** After discomfort threshold was determined and set on the stimulator, participants were administered the “computerized task.” The FIGT is comprised of four phases, described below.

*Habituation phase.* During the habituation phase, participants were asked to passively view a slideshow consisting of one trial presentation of all stimuli (12 total) (i.e., “different images that [they would] encounter later on”). Each trial was 4s and followed by a 5s masking slide consisting of a white fixation point on a black background. The habituation phase was designed to control for the effects of stimulus novelty on the rating, response time, and ER-SCR measures.

*Conditioning phase.* During the conditioning phase, participants were asked to passively view the CS+ and CS- stimuli (i.e., “images that [they were] going to encounter, […and to] pay attention to them, because [they would] also encounter them

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2 Pilot participants reported that it was more difficult to discriminate between stimulations when decreasing by 4mA from peak levels, requiring more shocks to achieve a trough. This raised concerns about potential habituation and unnecessary participant discomfort. Trough-targeted decreases were set to 8mA, and improvements were observed in discrimination and fewer administrations needed to achieve a trough.

3 A limit of 40mA was implemented, because past research indicates that 40mA is a pain threshold for 90% of healthy college participants (France, France, al’Absi, Ring, & McIntyre, 2002). The stimulator was set to 40mA for the eight participants who reached 40mA before achieving a peak rating.

4 A small correlation existed between threshold (mA) and trait anxiety severity, $r = .21$, $p = .10$. 

later”). There were 12 trials of the CS+ and 12 trials of the CS- (i.e., large black diamond or small white diamond, respectively [counterbalanced across participants]). Each trial was 4s and followed by a 5s masking slide, and all were presented in a semi-randomized order. Electric shock was 100% paired with CS+ appearances, at 500ms before each CS+ offset. The CS- was never paired with shock. Thus, participants were introduced to dichotomous conditioning (i.e., reliably “safe” versus “dangerous”). For this and all remaining phases, the experimenter left the room. Participants indicated phase completion by pressing the button of a remote bell chime, conveniently located on the desk. The Conditioning Phase was followed by a three minute arousal-reduction task that involved watching a silent video of a dripping water faucet.

**Practice phase.** This phase was designed to introduce and allow practice of key-press responses, as well as to reinforce conditioned response to CS+ and CS- shapes. It included 12 trials of the CS+ and 12 trials of the CS-, semi-randomly ordered. Participants were informed that they would “practice how to respond to images that [they would] encounter”. They were instructed to place the pointer and middle fingers of their dominant hand on the left and right arrow keys of the keyboard, and to continue resting their non-dominant hand (equipped with SCR and stimulator equipment) on the desk. Participants were asked to identify, as quickly and accurately as possible within 4s, whether each image was safe or dangerous by pressing the designated key (i.e., a dichotomized subjective response). Immediately after key-press, the screen presented a bipolar scale for them to rate, from 1 (Totally Safe) to 11 (Totally Dangerous), each encountered stimulus (i.e., continuous subjective response), within 10s and using the arrow and Enter keys. They were then presented with the masking slide, followed by the
next stimulus. For the practice phase only, they received verbal and shock feedback when appropriate. Text feedback (“This object is dangerous”) and shock were delivered if participants identified the CS+ as “safe” or rated a CS+ as below 11. Feedback (“This object is safe”) and no shock were delivered if participants identified a CS- as “dangerous” or rated it above 1. If participants took longer than 4s to rate a stimulus as safe or dangerous, or longer than 10s for the continuous scale, they received feedback only (“You took longer than [4; 10] seconds. Please respond faster”).

**Generalization phase.** The generalization phase was designed to measure degree of interpretation bias and fear generalization, as well as potential extinction effects for the CS+ and CS- over time. The instructions were the same as the previous task, but participants were informed that they would “encounter additional images” and to “give what [they believed to be] the closest to the best response”. All 12 stimuli were presented and included the CS+, CS-, and 10 GSs (i.e., four Similar +/- stimuli and six Ambiguous stimuli). The stimuli within each battery were semi-randomly ordered, and there were four uninterrupted batteries. During the generalization phase, neither feedback nor shock was administered to prevent unintended category membership formation of the 10 GSs. Participants were not informed of this beforehand, to preserve effort and conditioning.

**Remaining tasks.** After the FIGT, participants were offered a break. They were then administered the battery of neuropsychological tests in the following order: WTAR, Color-Word Interference, Spatial Addition, Sorting Task, and WCST-64-CV2. After the neuropsychological tests, the experimenter administered the MINI, followed by the self-report questionnaires, compensation, and debriefing.
Results

Preliminary Analyses

**Testing for potential confound variables.** Preliminary analyses were conducted to determine if demographics, self-reported history of ADHD or head injury diagnoses, proxy crystallized intelligence (WTAR), or visuospatial working memory performance (Spatial Addition) were significantly related to the FIGT outcome measures. *T*-tests and bivariate correlations were used, and alpha level was set to .003 (.05/20) per Bonferroni corrections for family-wise error rates, and for each fear response outcome measure. *P*-value results indicated that the outcome measures did not significantly differ according to gender (male/female; all *ts* ≤ |3.01|, *ps* ≥ .004), race (Caucasian/non-Caucasian; *ts* ≤ |2.55|, *ps* ≥ .01), or endorsement of an ADHD diagnosis, past concussion, or head injury, *ts* ≤ |2.67|, *ps* ≥ .01. They also did not significantly relate to intelligence, *rs* ≤ |.31|, *ps* ≥ .01, or visuospatial working memory, *rs* ≤ |.28|, *ps* ≥ .02, with the exception that better working memory was related to lower ER-SCR for the CS+ in the last battery of the generalization phase, *r* = -.50, *p* < .001, but with no similar trends for prior trials.

Primary Analyses

**Hypothesis 1.** It was hypothesized that in the total sample during the Practice Phase, continuous and dichotomous ratings and ER-SCR, but not response time, would be higher for the CS+ versus CS-. Paired-sample *t*-tests were used, and Bonferroni corrections were applied (*α* = .05/4 = .0125). As hypothesized, participants: (1a) rated CS+ stimuli as more dangerous than CS- stimuli, *t* = 46.97, *p* < .001, *d* = 5.89; (1b) identified CS+ stimuli as categorically “dangerous”, more often than CS- stimuli, *t* = 29.11, *p* < .001, *d* = 3.70; (1c) exhibited greater ER-SCR amplitude for the CS+ versus
CS- stimuli, \( t = 3.45, p = .001, d = .45; \) and \((1d)\) responded with similar speed to both CS+ and CS- stimuli, \( t = 1.63, p = .11, d = .18. \) Thus, data indicate that participants were appropriately conditioned to CS+ and CS- stimuli, with regard to both explicit decision-making and implicit threat response, and that there was no evidence for inherent biases or need for additional processing time for either conditioned stimulus type.

Hypothesis 2. Next, for the Generalization Phase, it was hypothesized that higher/more frequent threat ratings and ER-SCR would linearly increase alongside degree of stimulus group similarity to the CS+ (i.e., Similar+, Ambiguous, Similar-, CS-). Further, it was hypothesized that response time would have a quadratic trend across stimulus groups, such that increases in ambiguity would be associated with longer response time due to greater need for effortful processing. Repeated measures (RM) analyses of variance (ANOVAs) were used. Effects of time (4 trials) on stimulus type (5) were explored. Sphericity could not be assumed per Mauchly’s tests, thus Huynh-Feldt analyses were used for all RM ANOVAs to correct for this violation.

As hypothesized, there were significant or near-significant within-subjects (small) interaction effects of stimulus type and time when predicting continuous or dichotomous subjective ratings (\( \alpha = .05/2 = .025 \)), both \( F_s \geq 2.56, ps \leq .03, \eta^2_{ps} = .04. \) Within-subjects main effect contrasts indicated that \((2a)\) participants provided higher (i.e., increasingly dangerous) ratings, and \((2b)\) more often identified the stimulus as “dangerous,” as stimulus group similarity to the CS+ increased; linear models were the best fit, with very large effect sizes, \( F_s (1, 63) \geq 219.48, ps < .001, \eta^2_{ps} = .78. \) In addition, both types of danger ratings linearly declined over time, to a moderate effect, likely due to extinction of conditioning, both \( F_s (1, 62) \geq 6.34, ps = .01, \eta^2_{ps} = .09. \)
(2c) Results were similar when conducting analyses with ER-SCR as the outcome variable, within-subjects interaction $F(8.69, 529.89) = 2.28, p = .02, \eta^2_p = .04$.

Inconsistent with the hypothesized linear pattern, within-subjects contrast main effects indicated that a quadratic pattern for stimulus type was the best-fitting model (when ordered from CS+ to CS-), with a large effect, $F(1, 61) = 11.77, p = .001, \eta^2_p = .16$. ER-SCR increased as degree of ambiguity increased. There was a linearly declining effect for time, $F(1, 61) = 7.80, p = .007, \eta^2_p = .11$. Graphical and marginal means patterns indicated that participants exhibited greater ER-SCR to Similar+ and Ambiguous stimuli, followed by CS+ and Similar-/CS- stimuli, during the first battery. Over time, ER-SCR to all stimuli declined toward threshold SCR amplitude level (.02), likely due to extinction effects, but ER-SCR to Ambiguous stimuli remained relatively more elevated.

(2d) Finally, there was a significant and moderately sized interaction between stimulus type and time for response time, within-subjects $F(9.05, 570.15) = 2.95, p = .002, \eta^2_p = .05$. Main effect contrasts supported hypothesis; a large quadratic effect for stimulus type was the best-fitting model, $F(1, 63) = 15.72, p < .001, \eta^2_p = .20$, such that participants took longer to respond with increasing ambiguity. Response time linearly declined over time, $F(1, 63) = 5.12, p = .03, \eta^2_p = .001$, such that participants responded faster over time for all stimulus types. This linear effect was very small.

**Hypothesis 3.** Additionally, it was hypothesized that fear response gradients would be higher (i.e., greater fear response) and flatter (i.e., broader generalization) across stimulus type groups and Generalization Phase batteries for individuals with high,

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5 ER-SCR data missing for two participants
versus low, trait anxiety. RM ANOVAs were conducted. Anxiety status (high; low) was the between-subjects variable, and time and stimulus type were within-subjects variables.

(3a) For continuous ratings, there was a small three-way interaction effect of anxiety group*stimulus group*time, $F(5.41, 335.30) = 2.83, p = .01, \eta^2_p = .04$. The effect of trait anxiety status on the stimulus group*time interaction was significant, $F(5.41, 335.30) = 2.40, p = .03, \eta^2_p = .04$ (see Figure 2). However, the effect of time on stimulus*anxiety groups was only nearing significance, $F(1.93, 119.68) = 2.70, p = .07, \eta^2_p = .04$, with also a small-to-medium effect size. The impact of stimulus group on the time*anxiety interaction was non-significant, $F(1.66, 103.05) = .30, p = .70, \eta^2_p = .005$, with a very small effect size. Low anxious individuals maintained learning of stimulus group safety/danger levels across trials, whereas high anxious individuals demonstrated greater difficulty in discriminating threat levels among stimuli over time. Averaged across time, and inconsistent with hypothesis, high anxious individuals rated the CS+ as less dangerous, and to a moderate effect, between-subjects $F(1, 62) = 4.59, p = .04, \eta^2_p = .07$. However, this phenomenon may be explained by regression from certainty (i.e., CS+ = 11) to uncertainty (i.e., score of 6) over time, which is consistent with hypotheses. Also, high anxious individuals consistently reported Similar- and CS- stimuli as being more dangerous, consistent with hypothesis. There was a near-significant difference (and moderate effect size) for the CS-, between-subjects $F(1, 62) = 3.63, p = .06, \eta^2_p = .06$.

(All other stimulus type between-subjects effects: $F$s $[1, 62] \leq 1.26, ps \geq .27, \eta^2_ps \leq .02$.)
Figure 2. Continuous danger ratings for stimulus groups, across trial batteries, for low and high anxious groups

Left = Low anxious; Right = High anxious; *compared to low-anxious group, \( t_s \geq |2.05|, ps \leq .047, d_s \geq .61, \) for CS+ and CS- stimuli.

(3b) For forced-choice ratings, the three-way interaction effect of anxiety group*stimulus group*time was nearing significance and had a small effect size, \( F(5.92, 361.12) = 1.96, p = .07, \eta^2_p = .03. \) The within-subjects interaction (stimulus group*time) was removed. When controlling for one another, the stimulus type*anxiety status interaction was nearing significance, \( p = .079, \eta^2_p = .04, \) and the time*anxiety status interaction was non-significant, \( p = .72, \eta^2_p = .004. \) Thus, the two within-subjects variables were tested in two separate equations. First, the effect of anxiety status on stimulus type was tested, separately for each trial battery (four tests). Next, the effect of anxiety status on time was tested, separately for each stimulus type (five tests).
Results indicated that there were significant and moderately-sized stimulus type*anxiety status interactions for only the last two trials, $F$s $\geq 3.17, ps \leq .04, \eta^2_{ps} \geq .05$ (first two trials: $F$s $\leq 1.21, ps \geq .28, \eta^2_{ps} \geq .02$), such that the linear patterns (i.e., more “dangerous” categorizations as the stimulus type was more similar to the CS+) were steeper for the low anxious group and flatter for the high anxious group (similar to continuous rating results in 3a). The time*anxiety status interaction was also significant, but only for the CS+, $F(2.85, 173.69) = 3.33, p = .02, \eta^2_p = .05$ (all other interaction effects with time: $ps \geq .26, \eta^2_{ps} \leq .02$), such that low anxious individuals generally maintained learning that the CS+ stimulus was “dangerous” without reinforcement, whereas number of danger categorizations linearly declined over time in the high anxious group (similar to continuous rating results in 3a). There was a small and non-significant between-subjects effect, $F(1, 61) = 2.07, p = .16, \eta^2_p = .03$, for the CS+ across time. However, there was a medium and significant between-subjects effect for the CS- across time, $F(1, 62) = 4.89, p = .03, \eta^2_p = .07$. High anxious individuals identified the CS- as dangerous more often than low anxious individuals (all Similar+/− and Ambiguous stimulus between-subjects effects: $ps \geq .22, \eta^2_{ps} \leq .02$). Thus, forced-choice safe/danger ratings demonstrated similar effects as the continuous ratings.

(3c) For ER-SCR amplitude, there was a small and non-significant three-way interaction effect, $F(8.83, 529.85) = 1.01, p = .43, \eta^2_p = .02$. There were also small and non-significant two-way interactions between anxiety status and time or stimulus type, while controlling for one another, $F$s $\leq .96, ps \geq .41, \eta^2_{ps} \leq .02$. Thus, the effect of

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6 There were no significant anxiety group differences in average skin conductance level during baseline ($M = 7.89, SD = 1.84$) or discomfort threshold measurements ($M = 9.18, SD = 2.09$), $ts \leq .65, ps \geq .52$. 
anxiety status on stimulus types was tested first, separately for each trial battery (four tests). Next, the effect of anxiety status on time was tested, separately for each stimulus type (five tests). ER-SCRs for stimulus types were similar for both high and low anxiety groups, across each battery, $F_s \leq 1.38, ps \geq .24, \eta^2_ps \leq .02$. There was a significant and medium between-subjects effect on overall ER-SCR, only for the last battery, $F(1, 60) = 5.81, p = .02, \eta^2_p = .09$. Average ER-SCR was significantly lower for the high anxious versus low anxious group, contrary to hypothesis (see Figure 3). Results also indicated that ER-SCR differences across time were similar for both high and low anxiety groups, and for all stimulus types, $F_s \leq 1.93, ps \geq .13, \eta^2_ps \leq .03$. The between-subjects effect was moderate (albeit non-significant) for the ambiguous stimuli, $F(1, 60) = 3.91, p = .052, \eta^2_p = .06$, with a trend that high anxious individuals produced lower ER-SCR amplitude to ambiguous stimuli ($M = .06, SE = .02$) than low-anxious individuals ($M = .11, SE = .02$), contrary to hypothesis (all other between-subjects effects: $ps \geq .26, \eta^2_ps \leq .02$).

(3d) Similarly for response time, there was no three-way interaction or two-way interaction of anxiety status on stimulus type or time (when controlling for one another), $F_s \leq 1.47, ps \geq .15, \eta^2_ps \leq .02$. There were also no interaction effects of anxiety status on stimulus type for each battery (4 tests), or on time for each stimulus type (five tests), $F_s \leq 2.20, ps \geq .08, \eta^2_ps \leq .03$. There was, however, a significant between-subjects effect for Similar- stimuli. High anxious individuals responded significantly faster to Similar-stimuli, on average across batteries, than low anxious individuals, $F(1, 62) = 4.68, p = .03, \eta^2_p = .07$, partially consistent with hypothesis about overgeneralization to “safe”
stimuli (see Figure 4). There were no between-subjects effects for the other stimuli, inconsistent with hypothesis (all other between-subjects effects: \( ps \geq .10, \eta^2 ps \leq .04 \)).

**Figure 3.** Skin-conductance response amplitude, averaged across all stimulus types and time for the generalization phase; 95% CIs; values in this graph are non-transformed.
**Figure 4.** Response time for Similar- stimuli during the generalization phase; 95% CIs; values in this graph are non-transformed.

**Exploratory Analyses**

Exploratory analyses examined correlations among: individual differences in trait anxiety; executive functioning performance (i.e., response inhibition; cognitive flexibility/rule-shifting; and concept formation and recognition); and FIGT outcome measures (see Appendix A for a summary). See Appendix B for supplemental analyses.

Subjective responses were coded as correct or incorrect for the continuous ratings only (given the similar outcomes for dichotomous ratings). A percentage of accurate responses for each stimulus type across time was calculated. “Correct” responses were operationalized as follows: CS+ (11); Similar+ (8-10); Ambiguous (5-7); Similar- (2-4); CS- (1). ER-SCR amplitude and response time were averaged for each stimulus group and across time. Correlations were calculated among these variables, trait anxiety, and executive functioning (see Table 3). Results indicated that individual differences in anxiety had small, non-significant relations with color-word interference, sorting (DKEFS), or Wisconsin card sorting task performances, all $r_s \leq |.16|$, all $p_s \geq .21$.

However, better performance in inhibition and inhibition/switching was significantly related to faster response time for the ambiguous, Similar-, and CS- stimuli. Higher skills in organizing and describing preexisting concepts were also significantly related to faster response time, but for the CS+ and CS- only. Interestingly, fewer non-

---

7 After controlling for color reading, better switching performance was related to faster response time for the CS-, $r = -.32$, $p = .01$, and switching/inhibition performance was related to faster response time for Similar- stimuli, $r = -.30$, $p = .02$ (all other $r_s \geq -.23$, $p_s \leq .07$).
perseverative errors in group pattern detection and greater conceptual level responses
(i.e., better performance) were related to greater accuracy for the conditioned stimuli, but
lower accuracy for the generalized stimuli—particularly ambiguous stimuli.
Table 3
Bivariate Correlations among Study Measures for the Generalization Task

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<th>SAS</th>
<th>PHQ</th>
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<th>Average ER-SCR Amplitude</th>
<th>Average Response Time</th>
<th>M (SD)</th>
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<td>S-</td>
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Note: *Inhibition = (CWI: Inhibition), Flexibility = (CWI: Switching), Concept Sorting = (ST: Free Sorting), Description = (ST: Recognition), WCST = WCST: Concept Learning and Cognitive Flexibility

bRatings: Average % Accuracy

aInhibition = (CWI: Inhibition), Flexibility = (CWI: Switching), Concept Sorting = (ST: Free Sorting), Description = (ST: Recognition), WCST = WCST: Concept Learning and Cognitive Flexibility
Table 3: continued

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<td>.80 (.23)</td>
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Note: **bold font** = *p* < .05; italicized font = *p* < .10.

CWI = Color-Word Interference; ST = Sorting Task; WCST = Wisconsin Card Sorting Task; SAS = Self-Rating Anxiety Scale; PHQ = Patient Health Questionnaire; CS+ = Conditioned stimulus (shock); CS- = Conditioned stimulus (no shock); S+/- = Similar+/−; A = Ambiguous

a All standard scores per age range (and education level, for WCST) were used; 50th percentile for DKEFS = 10; WCST = 100.

b Correct continuous ratings operationalized as follows: CS+ (11); Similar+ (8-10); Ambiguous (5-7); Similar- (2-4); CS- (1)

c Means and standard deviations before skin conductance and response time measures were transformed.
Discussion

Results were generally consistent with hypotheses concerning the relations between trait anxiety and threat interpretation biases for non-disorder-specific stimuli. First, for the Practice Phase and in support of Hypothesis 1, participants: rated CS+ stimuli as more dangerous than CS- stimuli; more often categorically identified CS+ stimuli as “dangerous” versus CS- stimuli; and exhibited greater ER-SCR for the CS+ versus CS- stimuli; but responded equally as quickly to both CS+ and CS- stimuli with dichotomous ratings. Thus, results for all subsequent tasks can be interpreted with the premise that participants were appropriately conditioned to CS+ and CS- stimuli, with regard to both explicit decision-making and implicit threat response, and that the CS+ and CS- stimuli developed for this study elicited similar processing times to respond.

With regard to subjective threat level ratings, for the Generalization Phase, rating patterns were consistent with Hypothesis 2. Participants provided higher (i.e., increasingly dangerous) ratings, and more often identified the stimulus as “dangerous,” as stimulus group similarity to the CS+ increased. This result provides further support for Pavlovian fear acquisition theory, as well as theory purporting that fear learning is generalized to novel events, in part, by cognitive processes of feature similarity/discrimination and categorical association (e.g., Dunsmoor & LaBar, 2013; Lissek, 2008; Lissek, 2012). In addition, threat ratings linearly declined over time, likely due to extinction effects in the absence of reinforcement (e.g., Myers & Davis, 2007; Vervliet & Geens, 2014). Thus, the FIGT may be a useful tool in future research that aims to measure fear acquisition, ambiguous threat interpretation, and fear generalization.
Hypothesis 3 was also largely supported when investigating anxiety status differences in subjective ratings. Results indicated that threat interpretation ratings across stimulus types were appropriately steeper for the low anxious group and flatter for the high anxious group—implicating over-generalized responding and poorer discriminative ability for highly anxious individuals. Also, whereas low anxious individuals maintained learning of the threat likelihoods for the stimulus groups, over the four batteries, high anxious individuals’ perception of threat for CS+ stimuli regressed (toward “equal/don’t know” ratings) over time. This finding suggests that greater trait anxiety was associated with relatively lower accuracy when reporting threat likelihood for the CS+ stimulus without explicit reinforcement. These results corroborate previous research on differences in fear generalization for individuals with high versus low anxiety symptoms (e.g., see Greenberg et al., 2013b; Kaczkurkin & Lissek, 2013; Kopp et al., 2005; Lissek et al., 2014 for de novo stimuli). It is also worth noting that these results parallel other findings on likelihood of risk for encountering threatening situations. For example, there is some evidence that some individuals with PTSD may be more vulnerable to subsequent trauma due to second-guessing their perceptions of threat likelihood (e.g., Marx & Soler-Baillo, 2005). There is no research to our knowledge that has investigated whether individuals with DSM-5 anxiety disorders are preliminarily at greater risk for index stressor events, or subsequent stressor events, due to difficulties in threat discrimination. This preliminary cognitive feature is only speculative, however, and the current results would need to be replicated and extended to address this question.

Notably, both groups demonstrated similar and consistent ratings to ambiguous stimuli. This lack of difference is inconsistent with past disorder-specific research, which
has found significant negative interpretation bias for anxiety patients when faced with fear-relevant ambiguous stimuli (e.g., Bar-Haim et al., 2007; Kopp et al., 2005). First, the lack of significant differences may be due to the nature of the stimuli. It is possible that interpretation bias to ambiguous information is more robust with disorder-relevant, and thereby more salient, stimuli. However, fear generalization studies found differences between high and low anxiety groups when interpreting ambiguous de novo stimuli (e.g., Jovanovic et al., 2012). The lack of significant difference may also be due to the severity of the symptoms of anxiety in the participant groups. Whereas much related research has used extreme/clinical versus control groups (e.g., Jovanovic et al., 2012; Kopp et al., 2005), the current study recruited across the trait anxiety spectrum and included some individuals who did not meet diagnostic criteria for any specific anxiety disorder.

The current study’s results do point out, however, that the more robust cognitive predictor of interference and distress may be the extent to which individuals over-generalize threat to benign stimuli, due to this phenomenon’s counter-evolutionary implications. Consistent with Hypothesis 3, high anxious individuals consistently reported CS- (continuous and dichotomous) stimuli as being more dangerous.

In contrast to the subjective interpretation ratings, ER-SCR results were generally inconsistent with Hypothesis 2 (i.e., when testing all participants, regardless of anxiety status). Specifically, there was a quadratic rather than a linear trend for ER-SCRs to stimulus groups. Greater ER-SCR was elicited for the ambiguous stimuli, and ER-SCR levels declined over time, likely due to extinction effects. These results corroborate the notion that humans may have greater subjective and skin conductance stress response during encounters with uncertain threat, compared to encounters with certain threat (e.g.,
Grupe & Nitschke, 2011), but are inconsistent with prior fear generalization studies that found the skewed, linear trend that was hypothesized for the current study (e.g., Dunsmoor & LaBar, 2013). However, it is important to note that past fear generalization research did not include absolutely ambiguous GSs (i.e., their “ambiguous” stimuli were more or less related to the CS+ or CS-). Thus, current findings may highlight the nuanced yet important role of threat ambiguity in physiological aspects of fear generalization.

Also, inconsistent with Hypothesis 3, stimulus type differences in ER-SCR were similar for both high and low anxiety groups. Thus, it could be something about the stimuli or samples that elicited similar ER-SCRs from both anxiety status groups. Or, it could be that explicit interpretation differences are simply more robust differential indicators than ER-SCR. Unexpectedly, and only for the last battery, overall ER-SCR amplitude was significantly lower for the high anxious group versus low anxious group. Given that highly anxious participants failed to maintain accurate categorization of threatening stimuli over time, relative to low anxious individuals, it may logically follow that ER-SCR was lower for highly anxious participants by the end of the task.

Finally, response time findings were generally consistent with Hypothesis 2. Participants took longer to categorize ambiguous stimuli as “safe” or “dangerous” and were faster to categorize CS+ and CS- stimuli, suggesting increased processing of stimulus information with increasing threat ambiguity. Participants also responded faster over time, suggesting improved confidence, learning effects, or reduced effort after no reinforcement. Contrary to Hypothesis 3, response time was similar for both high and low anxious participants, with the exception of a significant between-subjects effect for Similar- stimuli. Highly anxious individuals responded significantly faster to these
stimuli than low anxious individuals, which corroborates findings that high anxious individuals are more likely to over-generalize fearful response to safe stimuli, possibly due in part to more associative, and less rule-based, processing of information (e.g., Ouimet et al., 2009). In line with this theory, the lack of significant differences for the explicitly conditioned CS- could be due to floor effects—limiting possible differences.

With regard to exploratory analyses, there was no clear indication that trait anxiety was related to performance on executive function measures. Thus, these relations may either be theoretically non-significant, or a greater sample size is required to detect significance among these small correlations. There may also be moderating factors that are driving spuriously small relations, and the use of a young adult, degree-seeking sample might have restricted the potential range of executive performance scores.

Exploratory analyses did indicate that better performances in inhibition and inhibition/switching (per Color-Word Interference tasks) were significantly related to faster response time for the ambiguous, Similar-, and CS- stimuli. These correlations appear most relevant compared to other executive functioning measures, given that Color-Word Interference measures were based on time to completion. Better performance in concept detection and description was also significantly related to faster response time, but for the conditioned stimuli only (CS+ and CS-). Relations with preexisting concept detection and descriptive ability may be more robust for the conditioned stimuli, because they were the only stimuli explicitly categorized during the FIGT. Lastly, fewer non-perseverative errors and more conceptual level responses were related to more accurate ratings for the conditioned stimuli. These results provide convergent and test validity
support for the FIGT, which was designed to test the roles of rule-based learning and application during threat interpretation.

However, unexpectedly, fewer non-perseverative errors and more conceptual level responses were related to less accurate ratings for the generalized stimuli—particularly ambiguous stimuli. It may be that individuals with greater ability in concept development and utilization tend to seek categorization of the environment, such that generalized, more ambiguous threat stimuli were rated in a more dichotomized, and thus less accurate, fashion. For example, while not tested in the context of cognitive flexibility, there is evidence (Mezulis, Abramson, Hyde, & Hankin, 2004 for a review) that psychologically healthy individuals demonstrate positive, self-serving attributional bias when faced with uncertainty. Overall, these exploratory results highlight potential areas for further study about the role of executive functioning in fear interpretation bias.

**Theoretical and Methodological Implications**

The current results have several implications for understanding the etiology and maintenance of anxiety-related pathology. First, the current results integrate, replicate, and extend prior research on interpretation bias and fear generalization (e.g., Amir et al., 2003; Eysenck et al., 1991; Hirsch & Mathews, 2000; Jovanovic et al., 2012; Kaczkurkin & Lissek, 2013; Reinecke et al., 2010), and provide additional support for multi-process models of information processing for anxiety (Ouimet et al., 2009). The current results address several limitations in the literature by utilizing de novo-conditioned stimuli to control for preexisting biases, because transdiagnostic theory about cognitive biases in anxiety disorders has been largely derived by assumptions made on similar outcomes across disorder-specific constraints. Even when preexisting, pathology-related fears were
controlled via novel conditioning, individuals with higher pathological anxiety demonstrated difficulty in discriminating among threat-related stimuli, which increasingly worsened over time. High anxious individuals also demonstrated faster reaction time, consistent with less rule-based processing that is important for regulating heuristic assumptions and subsequent strong emotion (Ouimet et al., 2009). Thus, it may be that anxiety disorders derive, in part, from a core pathology in fear concept formation and retrieval in the face of potential threat to one’s safety or integrity, but manifest differently according to personal or vicarious learning experiences (e.g., social humiliation; trauma; cultural beliefs). Next steps to confirm that transdiagnostic phenomena indeed occurred include determining whether similar results emerge for each anxiety disorder (even without disorder-specific stimuli).

In addition, the current study increased the complexity of the conditional properties of stimulus groups, in order to explicate nuances of safety versus threat discrimination and categorization. Humans are perpetually bombarded with stimuli, and rarely are aspects of threat and safety mutually and entirely exclusive. Thus, the current results are arguably more representative of real-world encounters with stimuli and provide additional support for the importance of using ambiguous and benign stimuli, in addition to threatening stimuli, when measuring cognitive biases.

The current study also extended the interpretation bias literature via multimethod assessment (subjective and objective measures), which has been increasingly encouraged in psychopathology research (e.g., De Los Reyes & Aldao, 2015), and with preliminary exploration of how executive functioning performance is involved in adaptive versus biased threat interpretation. It is important to note that while multimethod studies enrich
the construct and external validity of the results, they may also demand greater statistical power. For example, participants tend to respond in a similar fashion to various self-report measures, and these explicit responses may relate more modestly to implicit behavioral and physiological measures (e.g., see Paulhus & Vazire, 2009, for a review).

**Implications for Assessment and Treatment of Anxiety Disorders**

Should these findings replicate in future studies, there are several implications for the assessment and treatment of anxiety-related disorders. First, degree of fear generalization, particularly toward benign stimuli, may indicate degree of risk (before onset), severity (post-onset), and likelihood of treatment response. Results may also highlight mechanisms of treatment in cognitive behavioral therapies—the most scientifically supported psychological approach for treating anxiety-related disorders. Namely, cognitive components of CBT encourage clients to think more flexibly when hypothesis testing about the probability of negative outcomes or the cost of actual negative outcomes. The behavioral components of CBT allow for clients to challenge heuristic assumptions about threat via exposure to corrective learning experiences (e.g., Clark & Beck, 2010). Thus, it may be that CBT enhances flexibility in threat-related concept formation and engagement across daily experiences. Importantly, knowing which clients have more rigid and over-generalized threat interpretation may inform treatment resistance and facilitate the clinician’s ability to conceptualize tailored intervention.

**Limitations and Future Directions**

It is important to note that there are several limitations that warrant consideration for the interpretation of results and for future directions. First, the study was conducted using a degree-seeking sample of young adults, the majority of whom were Caucasian
females—limiting generalizability of results. Replicating results in more diverse samples, with regard to age, race/ethnicity, education level, sex, and clinical status is warranted for the purposes of generalizability. In addition, while all participants denied current influence of a drug or substance at the time of participation, it cannot be determined if any participants were actually under the influence of a prescribed or nonprescribed psychoactive substance that may have affected the outcome variables. Next, while participant responses were measured over time, this time was discrete (i.e., up to 10 minutes for the Generalization Phase) and cross-sectional in nature. Should the current results replicate for similar and longer durations of testing time, future studies may employ a longitudinal design to inform predictive validity of the FIGT for the etiology and maintenance of anxiety-related pathology (e.g., from early adolescence, during which time anxiety pathology typically manifests [Kessler et al., 2005], to adulthood. Furthermore, assessing for state anxiety throughout all measurements may parse apart and inform how fear may not only be affected by the gating features of executive functioning, but also how anxious arousal may affect performance on logical tasks. As a conceptual limitation, while ER-SCR results did support adequate fear conditioning, subsequent results were not consistent with hypotheses. It could be argued that subjective and response time results are indicative of task learning in general, and not due to fear or anxiety. Thus, it is important to further test these relationships and to further explore the impetus for participants’ responses.

With regard to future directions, future analyses and studies should test for the effects of interacting dual processes (e.g., executive functioning and state anxiety) on the outcome variables, because associative and rule-based processes are, by nature,
interactive (e.g., Ouimet et al., 2009). Mechanisms of effective treatment may be further explicated by testing for possible changes in patterned responses before, during, and after symptom reduction in treatment. Significant changes may further implicate abnormal threat concept categorization as a mechanism of distress and impairment from anxiety. Finally, the current study was conducted within a laboratory setting, with monetarily expensive hardware, and with electric shock. These circumstances may not be appropriate for all populations or contexts. For the purposes of accessibility, future research should test whether similar results can be achieved within other settings and with other methods of fear conditioning (e.g., screaming lady paradigm; Lau et al., 2008). Overall, results extend important theory for the etiology and maintenance of anxiety pathology and support future, larger-scale research endeavors in this area of study.
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Appendix A: Detailed Review of Exploratory Tests

I. A task for *crystallized intelligence* (i.e., the ability to use skills, knowledge, and experience, via intellectual achievement) was administered (i.e., the Wechsler Test of Adult Reading; WTAR; The Psychological Corporation, 2001) in order to account for pre-existing individual differences that may confound fear generalization outcomes for reasons unrelated to the study hypotheses. Group differences and WTAR relations with the outcome variables were preliminarily tested, in order to determine whether intelligence should be covaried during analyses.

II. As reviewed in the Rule-Based Processes section (e.g., Hofmann et al., 2008; Ouimet et al., 2009; Salemink et al., 2013), working memory (and in the case of tasks utilizing visual stimuli, visual working memory) may play an important role in processing and responding to potentially threatening information. The Spatial Addition subtest of the Wechsler Memory Scale -IV (WMS-IV; Wechsler, 2008b) was administered to explore the relational convergence between individual differences in visuospatial working memory performance and fear generalization outcomes.

III. It is currently unclear in the emotion regulation literature as to whether individuals with anxiety disorders have over-active automatic fear responding, deficient fear gating/regulation, or both (e.g., Goldin et al., 2009; Lissek et al., 2006). Furthermore, there are different elements to top-down emotion regulation that are important to consider, namely: inhibition that impedes onset of fear responses; and down-regulation of fearful response (via logical appraisal throughout shifts in contextual information). To date, neuroimaging data has been recorded in tandem of fear
generalization studies reviewed above, and which point toward executive functioning per activation of the prefrontal cortex (Dunsmoor et al., 2007; Dunsmoor & LaBar, 2012; Dunsmoor et al., 2011; Greenberg et al., 2013a, 2013b; Lissek, Bradford, et al., 2013). However, this line of research has not yet tested for the convergence between individual differences in fear generalization and executive functioning performance.

IV. With regard to “cold” (i.e., designed so as to have limited emotion elicitation) response inhibition, a modified Stroop task was administered (i.e. the Color-Word Interference Test of the Delis-Kaplan Executive Functioning System [D-KEFS] battery; Delis, Kaplan, & Kramer, 2001). The relational convergence between individual differences in the generalization task outcomes and performance on response inhibition was explored.

V. With regard to “cold” executive functioning/set-shifting, a modified Wisconsin Card Sorting Task (WCST-64 Card Version; Kongs, Thompson, Iverson, & Heaton, 2000) was administered to explore potential convergent relationships between individual differences in set-shifting performance and fear generalization.

VI. In line with cognitive-affective findings and theory, reviewed above, concept formation and flexible engagement of learned concepts may influence individual differences in threat perception. It will be explored as to whether fear generalization task outcomes significantly relate to performance in abstract concept sorting (via the Sorting Test of the D-KEFS battery).
Appendix B: Supplemental Analyses

It was tested as to whether (1) similar results were found when testing depression, versus trait anxiety, in order to determine specificity of the results to anxiety pathology. Namely, symptoms of depression have been found to impact cognitive tasks (e.g., Friedman, 1964), and may affect avoidance behavior found during fear generalization tasks (van Meurs et al., 2014). (2) It was also explored whether fear generalization outcome variables were significantly related to: (a) severity scores of specific anxiety disorder symptom measures and (b) transdiagnostic variables of anxiety disorders (i.e., intolerance of uncertainty, distress intolerance, discomfort intolerance, anxiety sensitivity, neuroticism, and emotion regulation strategies).

(1) First, trait anxiety was significantly and highly positively related to depression, $r = .79$, $p < .001$. Hypotheses 3(a-d) were retested, except that depression (median split at 6; a value within mild depression range; Spitzer et al., 1999) was entered instead of trait anxiety. For continuous threat ratings, dichotomous safe-danger ratings, ER-SCR, and response time, there were no significant two- or three-way interactions among depression status, stimulus group, or time (with the exception of the within-subjects interaction for stimulus type and time), when both within-subjects variables were tested simultaneously, $Fs \leq 2.95$, $ps \geq .06$, $\eta^2_{ps} \leq .05$.

However, after testing interactions with time and stimulus type, separately, depression interacted only with stimulus type, in the last two batteries, and only for the continuous and dichotomous ratings, all $Fs \leq 3.73$, $ps \leq .04$, $\eta^2_{ps} \geq .05$. Comparable with anxiety, more highly depressed individuals rated the Similar+ stimuli as less dangerous, and especially, the CS- and Similar- stimuli as more dangerous. For response time, there
was a significant interaction between depression status and time for the ambiguous stimuli, $F(2.39, 145.91) = 2.93, p = .047, \eta^2_p = .05$. Depressed individuals took (non-significantly) more time to respond to ambiguous stimuli in the first trial than low depressed individuals, to a very large effect, $t(58.781) = 1.41, p = .16, d = .37$ (all other time point $ps \geq .28, ds \leq .28$). Depression status did not interact with anxiety status when predicting overall averages of subjective ratings, ER-SCR, or response time for any stimulus group during the Generalization Phase, per univariate ANOVA tests, $Fs \leq 2.80$, $ps \geq .10, \eta^2_ps \leq .05$.

(2) Second, bivariate trends (see Table B1) indicated that PTSD symptoms for trauma-exposed individuals may be most strongly related to the study outcome variables, compared to other disorder symptoms. In addition, symptoms of fear-based disorders (i.e., panic disorder, specific phobia, social anxiety disorder) were more so related to greater fear responding to threatening and ambiguous stimuli than to safe stimuli. On the other hand, more complex anxiety-related disorder symptoms (i.e., generalized anxiety, PTSD, OCD), demonstrated more pervasive and over-generalized fear responding to safe stimuli. These bivariate relations ranged from small to moderate.
Table B1

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<th>Symptom Measures</th>
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<td>S-</td>
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Note: bold = p < .05; italicized = p < .10; underlined = rs ≥ .10; PDSS = Panic Disorder Severity Scale; LSAS = Liebowitz Social Anxiety Scale; SMSP = Symptom Measure of Specific Phobia; GAD7 = Generalized Anxiety Disorder scale-7; PCL = PTSD Checklist; OCI-R = Obsessive Compulsive Index-Revised; ASI = Anxiety Sensitivity Index; DTS = Distress Tolerance Scale; DIS = Discomfort Intolerance Scale; IUS = Intolerance of Uncertainty Scale-12; DERS = Difficulty in Emotion Regulation Scale; IPIP-50 = Interpersonal Personality Item Pool; CS+ = conditioned stimulus (shock); CS- = conditioned stimulus (no shock); S+ = Similar+; S- = Similar-; A = Ambiguous; * If endorsed trauma
Appendix C: Additional Psychometrics

Fear Interpretation and Generalization Task

Development. All outcome data was collected simultaneously, in order to accurately infer converging phenomena that are objective (i.e., psychophysiological) and subjective (i.e., self-report) in nature. To do so, technical incorporations of LabView, AcKnowledge, and Digitimer Stimulator hardware and software were made (in collaboration with a biostatistical and software expert of the psychology department, Mr. Conatser) in order to achieve real-time syncopation of outcome assessment measures. Specifically, the stimulus presentation software program (via LabView) was designed to emit a noise pulse to the Digitimer stimulator hardware at the offset of each CS+ stimulus presentations during the conditioning and practice phases. This pulse was channeled to an external connector on the Digitimer (designed by Digitimer, Inc. for these purposes) to elicit production of electric shock, but only at a level that was manually set by the experimenter on the stimulator hardware. Second, with each shock, a split noise signal was directly sent to a BIOPAC hardware channel that was not being utilized by the SCR sensor. Because AcKnowledge can record online inputs from multiple channels, both SCR data and “spikes” in static signals to indicate the onset of electric shock were recorded in parallel time. Third, in order to accurately determine SCR latency after each stimulus onset during the FIGT, the FIGT (via LabView) was also designed to emit a split noise signal to online recording in AcKnowledge software (via a third MP100 BIOPAC hardware channel) at the instant each stimulus appeared on the screen (in order to “mark” the starting point of each stimulus onset in the SCR data output). Thus, the use of three parallel channels allowed for synchronized online measurement and more
accurate data analysis and interpretation, and allowed for SCR measurement without researcher interference and potential human error. Before ER-SCR analysis, “event markers” were placed at each indicator of a slide presentation.

**Pilot results.** Pilot data was collected using an openly-recruited sample of graduate psychology student volunteers \(n = 10\); blind to hypotheses), to ensure patterns of methodologically-induced fear conditioning and fear generalization. Symptom-related and neuropsychological assessment data were not collected for privacy purposes. Results supported methodologically-induced fear conditioning. Specifically, throughout the Practice Phase, participants rated the aversively conditioned stimulus (CS+) as significantly more threatening than the safely conditioned stimulus (CS-), \(t(9) = 51.59, p < .0001\), and exhibited greater average SCR for images of the CS+ versus CS-, \(t(9) = 2.57, p = .03\). Results also supported adaptive generalization of fear responses. Throughout the Generalization Phase, perceived threat was linearly and positively related to the number of stimulus features shared with the CS+ (i.e., stimulus type), \(F(4,36) \geq 9.36, ps \leq .005\). In addition, there was a parabolic trend between reaction time and stimulus type, across generalization testing trials. As would be expected, participants took longer to decide how to categorize the ambiguous stimuli as safe or dangerous, and were fastest in categorizing the conditioned stimuli, \(F(4,36) \leq 3.04, p \geq .03\). There was also a parabolic trend for SCR and stimulus type across trials. Interestingly, highest SCR was expressed for the ambiguously threatening stimuli, \(F(4,36) \leq 2.69, ps \geq .047\).

**Self-Report Questionnaires**

Questionnaires were administered over the Internet in computerized format using Qualtrics, LLC systems. Participant responses were tied to a unique subject identification
number. Please see Appendix D for a copy of all self-report measures.

**Anxiety, traumatic stress, and obsessive-compulsive symptom measures.** The following measures were administered in the proposed study to explore trending relationships with the outcome measures and symptoms associated with specific anxiety or anxiety-related disorder symptoms.

The *Liebowitz Social Anxiety Scale* (LSAS; Liebowitz, 1987) self-report (SR) version is comprised of 24 items rated on two 4-point Likert-type scales: fear (from *none* to *severe*) and avoidance (*never* to *always*) of social situations that are performance (e.g., “speaking up at a meeting”) or interactive (e.g., “meeting strangers”) in nature. Higher scores indicate greater severity. The LSAS-SR has consistently demonstrated strong psychometric features that are comparable to those of the clinician-administered LSAS, with regard to factor structure (Fresco et al., 2001; Oakman, Van Ameringen, Mancini, & Farvolden, 2003), good 12-week test–retest reliability (clinical sample, $r_s \geq .79$), internal consistency for both social anxiety disorder ($\alpha = .95$) and non-anxious controls ($\alpha = .94$), and convergent and discriminant validity (e.g., Baker, Heinrichs, Kim, & Hofmann, 2002; Fresco et al., 2001).

The *7-Item Generalized Anxiety Disorder Scale* (GAD-7; Spitzer, Kroenke, Williams, & Lowë, 2006) is a psychometrically supported measure of generalized anxiety disorder symptom severity. Participants are asked how often in the past two weeks they have been bothered by anxiety symptoms (e.g., trouble relaxing). Participants respond according to a 4-point Likert scale, from 0 (*not at all*), to 3 (*nearly every day*) seven items. In general populations (e.g., Lowë et al., 2008), confirmatory factor analyses substantiated a one-factor structure, with factor invariance for gender and age. In
addition, good internal consistency (α = .89) has been demonstrated, as well as criterion, factorial, procedural, and construct validity in both general clinical samples, as evidenced by strong associations with other established measures of anxiety and diagnoses of GAD (Kroenke et al., 2007; Löwe et al., 2008; Spitzer et al., 2006).

The Panic Disorder Severity Scale (PDSS; Shear et al., 1997)-Self Report Version (-SR) is a 5-item measure designed to assess symptoms of panic disorder. The first item asks about number of panic attacks in the past week, and the remaining items refer to the nature of these panic attacks and related avoidance and anxiety. Items are rated on a 5-point Likert scale ranging from 0 (none) to 4 (extreme). The PDSS-SR items were derived by removing two items from the original, clinician-administered PDSS (Shear et al., 2001). Good inter-rater/test-retest (2-day; r = .71; ICC = .81) and internal reliability (e.g., α = .88; ICC=.81), as well as sensitivity to change in treatment, has been demonstrated in clinical outpatient samples (e.g., Houck, Spiegel, Shear, & Stat, 2002; Shear et al., 2001; Wu et al., 2010).

The Severity Measure for Specific Phobia for Adults (Craske, Wittchen, Bogels, Stein, Andrews, & Lebeu, 2013) was developed to assess degrees of severity of specific phobia symptoms, based upon DSM-5 (APA, 2013) criteria, but also additionally including panic-type symptoms (i.e., “felt a racing heart, sweaty, trouble breathing […]”). The measure has 10 items that include five different groups of phobias, including (a) driving, flying, tunnels, bridges or enclosed spaces; (b) animals or insects; (c) heights, storms or water; (d) blood, needles or injections; and (e) choking or vomiting. The individual completing the form chooses the one group that causes the most anxiety and answers items according to the endorsed group on a scale of 0 (never) to 4 (all of the
time). To date, there has been no psychometric data disseminated about this measure. However, it does specifically assess for DSM-5 criteria for specific phobia with the aim of obtaining dimensional, severity data.

The PTSD Checklist-Civilian Version (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993) is a 17-item, Likert-type, self-report checklist of PTSD symptoms based closely on the DSM-IV criteria, including symptoms of reexperiencing, avoidance/numbing, and hyperarousal. Respondents rate the degree to which they have been bothered by that particular symptom over the past month. Alphas range from .89 to .97. Validity is supported via significant positive correlations with other validated PTSD measures, general measures of pathology, and clinician-administered structured interviews for PTSD (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Weathers et al., 1993). A PCL for DSM-5 (APA, 2013) criteria has also recently been released; however, there is less psychometric data and there is some preliminary evidence that the PCL-5 may not add clinical utility beyond upon the PCL for DSM-IV (e.g., Hodge, Riviere, Wilk, Herrell, & Weathers, 2014). For the current study, total scores were calculated only if the participant endorsed experiencing a traumatic event as part of the questionnaire.

The Obsessive Compulsive Inventory-Revised (OCI-R; Foa et al., 2002) is a shortened version of the Obsessive Compulsive Inventory (OCI; Foa, Kozak, Salkovskis, Coles, & Amir, 1998) that measures obsessive compulsive symptoms. The OCI-R yields a total score, as well as six subscales: washing (e.g., “I wash my hands more often and longer than necessary”), checking (e.g., “I repeatedly check doors, windows, drawers, etc.”), ordering (e.g., “I get upset if objects are not arranged properly”), obsessing (“I am
upset by unpleasant thoughts that come into my mind against my will”), hoarding (e.g., “I collect things I don’t need”), and neutralizing (“I find it difficult to control my own thoughts”). Foa and colleagues (2002) shortened the original OCI, in order to reduce length and redundancy. The OCI-R has been shown to maintain excellent psychometric properties in a mixed sample of patients with OCD, anxiety disorders, and non-patients. In an undergraduate sample (Hajcak, Huppert, Simons, & Foa, 2004), the OCI-R has demonstrated adequate 4 week test–retest reliability for the full scale ($r = .70$) and subscale scores ($r_s = .58 - .77$), proposed factor structure, and high internal consistency (total score $\alpha = .88$). In addition, convergent validity with other measures of obsessive-compulsive symptoms has been moderate to excellent, with good divergent validity (e.g., Hajack et al., 2004).

The Patient Health Questionnaire (PHQ-9; Spitzer et al., 1999) is a self-report questionnaire assessing depression symptoms. The PHQ-9 assesses the frequency of nine DSM-IV (APA, 2000) depression symptom items (e.g., “feeling down, depressed, or hopeless”) in the past two weeks, with response options of 0 (Not at all) to 3 (Nearly every day). The PHQ-9 is commonly used for screening and for informing diagnosis, as well as selecting and monitoring treatment. This screening tool has been validated as being highly correlated with diagnosis by mental health professionals (Diez-Quevedo, Rangil, Sanchez-Planell, Kroenke, & Spitzer, 2001; Henkel et al., 2004; Kroenke, Spitzer, & Williams, 2001; Lowe, 2004) and other depression assessment tools (Henkel et al., 2004; Kroenke et al., 2001; Lowe, 2004; Martin, Winfried, Klaiberg, & Braehler, 2006) in a variety of populations. In addition, the PHQ-9 has demonstrated good to excellent internal consistency in both clinical and general/cigarette-smoking samples (as
Transdiagnostic anxiety-related measures.

The *Self-Rating Anxiety Scale* (SAS; see Zung, 1971 for original article) is a 20-item self-report measure of general anxiety levels, including cognitive, affective, and somatic symptoms from the “past several days” (e.g., “I feel afraid for no reason at all.”; “I can feel my heart beating fast.”; “I have nightmares.”). Each item is rated on a 4-point Likert scale with responses ranging from 1 (*Little or none of the time*) to 4 (*Most or all of the time*). In addition, the SAS shows good internal consistency (split-half $r = .71$) and is able to distinguish patients with anxiety disorders from those with schizophrenia, depression, personality disorder, and transient situational disturbance (Zung, 1971). The SAS has demonstrated good internal consistency ($\alpha = .81$) and correlates with measures of similar constructs (i.e., body vigilance, fearful cognitions, fear of evaluation, and depression; range: .40 to .64) in open college samples (e.g., Judah et al., 2013; Olatunji, Deacon, Abramowitz, & Tolin, 2006).

Cutoff scores have been determined and psychometrically supported for the SAS (Zung, 1971; Michelson & Mavissakalian, 1983; Olatunji et al., 2006) (raw total scores: below 36 = *within normal range*, 36-47 = *minimal to moderate anxiety*, 48-59 = *marked to severe anxiety*, and 60 – 80 = *extreme anxiety*). Because the current study recruited a college sample, it was reasonable to assume that few successfully recruited individuals would score in the “extreme anxiety” group. Thus, recruitment target groups were normal range, minimal to moderate anxiety, and severe to extreme anxiety to achieve a broad distribution of trait anxiety and to test for individual differences. Participants first completed the SAS as part of an anonymous online prescreen for which all participants
had consented. Individuals who scored within prerequisite ranges (which were tailored across time according to recruitment needs) could see and sign up for the study. Consistently across two semesters, \( M(SD) = 36(9) \) for prescreen participants \( (n = 2,079) \), and psychology students’ scores \( 1SD (45), 2SD (54), \) and \( 3SD (63) \) above the mean was generally consistent with previously established cut-off scores. Participants were also asked to complete the SAS as part of a self-report battery after signing up, arriving, and consenting for the current study.

The fifty-item *International Personality Item Pool* (IPIP-50; Goldberg, 1992) measures the Big Five dimensions of personality (i.e., Extroversion, Agreeableness, Conscientiousness, Openness, and Neuroticism). Participants score items on a five-item Likert scale ranging from *nothing like me* to *very much like me*. A briefer 20-item version of the IPIP-50 (i.e., Mini-IPIP) was developed by Donnellan, Oswald, Baird, and Lucas (2006). Donnellan and colleagues found convergent, discriminant, and criterion-related validity (e.g., predicting later positive affect, negative affect, and quality of life) for scores on the Mini-IPIP comparable to that found with the IPIP-50. Test–retest correlations for the Mini-IPIP (6-month, \( r = .87 \); 9-month, \( r = .82 \)) were also comparable with the longer version. The individual subscales of the Mini-IPIP have shown consistent internal reliability (e.g., Neuroticism/Emotional Stability \( \alpha = .82 \); e.g., Cooper, Smillie, & Corr, 2010; Donnellan et al, 2006). Cooper and colleagues (2010) found a five factor structure of the Mini-IPIP dimensions were very much equivalent to those assessed by other Big Five dimension instruments and the IPIP-50.

The *Distress Tolerance Scale* (DTS) is a 15-item self-report measure, in which respondents indicate, on a 5-point Likert scale (1 = *strongly agree* to 5 = *strongly*...
disagree), the extent to which they can experience, accept, and withstand distressing psychological states (Simons & Gašer, 2005). Greater distress intolerance is indicated by lower total scores on the DTS (Simons & Gašer, 2005). The DTS has been found to demonstrate adequate to good internal consistency (α = .89) (e.g., Cougle, Bernstein, Zvolensky, Vujanovic, & Macatee, 2013), good test-retest reliability (6 month; intra-class \( r = .61 \)), and convergent and discriminant validity (e.g., was negatively associated with measures of negative affectivity, \( r = -.59 \), and lability, \( r = -.51 \), and positively correlated with positive affectivity, \( r = .26 \)) (Simons & Gašer, 2005).

The Discomfort Intolerance Scale (DIS; Schmidt, Richey, & Fitzpatrick, 2006) is a 5-item measure on which participants indicate, on a 7-point Likert-type scale (0 = not at all like me to 6 = extremely like me), the degree of agreement toward statements that relate to their tolerance of discomfort. Factor analysis indicates that the DIS is comprised of two distinct sub-factors, Intolerance of Discomfort or Pain (2 items: e.g., “I can tolerate a great deal of physical discomfort” – reverse scored), and Avoidance of Physical Discomfort (3 items: e.g., “I take extreme measures to avoid feeling physically uncomfortable”). As in past work, the DIS total score will be employed in the present study to measure the global discomfort intolerance factor (Schmidt, et al., 2006, 2007). The subscales and total score have showed adequate to excellent internal consistency: intolerance of discomfort or pain (\( \alpha = .90 \)); avoidance (\( \alpha = .61 \)), and total score (\( \alpha = .75 \)) (Cougle et al., 2013), convergent and discriminant validiity, and good factorial stability across twelve weeks (Factor 1 = .63, Factor 2 = .66) (Schmidt et al., 2006).

The Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007) is a revision of the original ASI (Reiss et al., 1986). The ASI-3 is a 16-item measure in which respondents
indicate, on a 5-point type scale (0 = very little to 4 = very much), the degree to which they are concerned about possible negative consequences of anxiety symptoms (e.g., “It scares me when I feel shaky”). The ASI-3 contains three subscales regarding feared anxiety-related outcomes: physical concerns; cognitive concerns; and social concerns. The ASI-3 subscales have demonstrated acceptable to good internal consistency in several countries (as .73 to .91), as well as convergent, discriminant, and criterion validity.

**Intolerance of Uncertainty Scale – 12** (IUS-12; Carleton, Norton, & Asmundson, 2007). The IUS-12 is a 12-item short-form of the original 27-item Intolerance of Uncertainty Scale (Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994) that measures reactions to uncertainty, ambiguous situations, and the future (e.g., “Unforeseen events upset me greatly”). Items are scored on a 5-point Likert scale ranging from 1 (not at all characteristic of me) to 5 (entirely characteristic of me). The IUS-12 has a strong, positive correlation with the original scale, $r = .96$, and has been shown to have two factors, including prospective (anxiety) IU (7 items; e.g., “I can’t stand being taken by surprise”) and inhibitory (anxiety) IU (5 items; e.g., “When it’s time to act, uncertainty paralyses me”), both with identically high internal consistencies, $\alpha = .85$ (Carleton, Norton, et al., 2007). The IUS-12 has demonstrated a stable 2-factor structure in at least three independent samples (Carleton, Norton, et al., 2007; Carleton, Sharpe, et al., 2007; McEvoy & Mahoney, 2011). McEvoy and Mahoney (2011) have provided a compelling argument that prospective IU and inhibitory IU are more appropriate labels for the IUS-12 subscales, reflecting the fact that responses have not been anxiety-specific; accordingly, the revised subscale names have been adopted herein even though the
current research focuses on the total score. Acceptable internal consistency has been found for both community (α = .91) and clinical (α = .92) samples, and there is evidence that the IUS-12 has a dimensional structure (Carleton et al., 2012).

The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) is a multidimensional self-report measure that assesses six, CFA-supported related domains of emotion dysregulation: (1) nonacceptance of emotional responses (6 items: “When I'm upset, I feel ashamed with myself for feeling that way”); (2) difficulties engaging in goal-directed behavior when distressed, or poor distress tolerance (5 items: “When I'm upset, I have difficulty getting work done”); (3) impulse control difficulties under negative emotional arousal, or negative urgency (6 items: “When I'm upset, I become out of control”); (4) lack of emotional awareness (6 items, all reverse-coded: “When I'm upset, I acknowledge my emotions”); (5) limited access to effective emotion regulation strategies (8 items: “When I'm upset, I believe that there is nothing I can do to make myself feel better”); and (6) lack of emotional clarity (5 items: “I am confused about how I feel”). Participants indicate how often each statement applies to them using scales ranging from 1 (almost never) to 5 (almost always), with higher scores indicating greater emotion dysregulation. The DERS has demonstrated convergent validity, such that it has been found to be associated with borderline personality disorder (e.g., Bornvalova et al., 2008), eating disorders (e.g., Harrison, Sullivan, Tchanturia, & Treasure, 2009), anxiety disorders (e.g., Bardeen, Kumpula, & Orcutt, 2013), self-harm (Gratz & Roemer, 2008), and substance use (e.g., Bonn-Miller, Vujanovic, Zvolensky, 2008). In addition, the DERS has been shown to be sensitive to treatment effects (e.g., Axelrod, Perepletchikova, Holtzman, & Sinha, 2011). Past research has found the DERS to have
adequate psychometric properties (e.g., Giromini, Velotti, de Campora, Bonalume, Zavattini, 2012; Gratz & Roemer, 2004)

**Neuropsychological Assessments**

**Wechsler Test of Adult Reading** (WTAR; The Psychological Corporation, 2001). The WTAR was designed to assess crystallized intelligence among individuals fluent in English between the ages of 16-89. The WTAR was normed using a large and nationally representative sample. It is a clinician-administered measure in which the participant is asked to read aloud a series of 50 words that are printed on a page. The words become more difficult to pronounce as the participant progresses through the task. The WTAR has excellent internal consistency within the age groups relevant for the proposed study (ages 18-19: \( \alpha = .90 \); and ages 20-24: \( \alpha = .92 \); The Psychological Corporation, 2001). The 2-12 week test-retest reliability is also excellent within the relevant age range (ages 18-24, \( r = .92 \); The Psychological Corporation, 2001). The WTAR has been shown to be strongly correlated with the Verbal Intelligence Quotient (VIQ: \( r = .74 - .79 \)) as well as the Full-Scale Intelligence Quotient (FSIQ: \( r = .70 - .74 \) from the Wechsler Adult Intelligence Scale – III (Wechsler, 1997). Norms are available that allow researchers to estimate an individual’s FSIQ using the WTAR standard score. The WTAR standard score was used in the current study to ensure that no preexisting differences in estimated intellectual ability affected performance on the FIGT. The WTAR administration took about 3-5 minutes.

The **Spatial Addition subtest of the Wechsler Memory Scale -IV** (WMS-IV; Wechsler, 2008b) was administered to explore the relational convergence between individual differences in visuospatial working memory performance and fear...
generalization outcomes. The Spatial Addition task requires minimal motor function as the client must (a) remember location of dots on two separate pages; (b) add or subtract locations; (c) and hold and manipulate visual spatial information. Reliability coefficients for the Spatial Addition subtest within the population age-range of interest is good to excellent (ages 18-19: $\alpha = .89$, ages 20-24: $\alpha = .92$; Wechsler, 2008b). The test-retest reliability of the Spatial Addition subtest is considered adequate (corrected $r = .77$), although the time between administrations varied widely (14-84 days, mean = 23 days). The Spatial Addition subtest of the WMS-IV also demonstrates excellent convergent and discriminant validity. It took approximately 10 minutes to administer.

The **Wisconsin Card Sorting Task** (WCST; Berg, 1948; Grant & Berg, 1948) was developed to measure executive functioning performance, given that it requires the ability to use abstract reasoning ability strategies and the ability to shift those strategies across changing stimulus conditions to obtain a goal (Kongs et al., 2000). Research suggests that WCST performance predominantly reflects a function of the dorsolateral prefrontal cortex (dIPFC) (Ritter et al., 2004), which with regard to the proposed study, has been found to be activated during top-down information processing and effortful emotion regulation (e.g., Goldin et al., 2008; Levesque et al., 2003; Ochsner et al., 2002, Ochsner et al., 2004; Phan et al., 2005). In addition, the WCST has demonstrated sensitivity to frontal lobe damage and dysfunction (e.g., Drewe, 1974; Milner, 1963; Robinson, Heaton, Lehman, & Stilson, 1980; Weinberger, Berman, & Zec, 1986). During the WCST, participants are asked to match a target card with one of four other cards, based features of the cards. However, participants are never told the matching rule, and the rule changes after a series of sets without notice. Feedback on whether the selection is
correct or incorrect is provided, and they must use this feedback to shift their matching strategy. Once the participant has made a specified number of consecutive “correct” matches to the sorting principle, the sorting principle shifts without warning, and feedback must be utilized to guide learning of the new sorting rule.

The WCST-64 Card Version (WCST-64; Kongs, Thompson, Iverson, & Heaton, 2000) was developed in response to concerns for patient comfort and managed care restrictions. It uses only the first 64 WCST cards, thereby reducing administration time while retaining the task requirements of the standard version. The WCST-64 also eliminates variability in the number of cards administered, allowing the user to easily compare test-retest stability and individual test results with normative and validity data. In developing the shortened version, WCST protocols were re-scored for the first 64 cards administered, although general instructions remain the same. The normative sample includes both adults (18 to 89 years of age) and children (6 to 17 years of age). The WCST-64 is highly correlated with the longer original version (Spearman's correlations of 0.90 for raw scores, 0.80 for $t$-scores), and the WCST-64 and has demonstrated very good reliability (average interval = 6.7 weeks) within a healthy adult sample, generalizability coefficients = .60 - .85; Kongs et al., 2000). The second computerized version of the WCST-64 (WCST-64-CV2; Heaton & PAR staff, 2005) was administered for during the current study. The task takes approximately 10-15 minutes to complete and generates a number of psychometric scores, including numbers, percentages, and percentiles of: trials to complete first category; total correct and errors; perseverative errors; and learning to learn (i.e., improvement in efficiency). Normed WCST-64
performance scores have demonstrated variance within general, non-cognitively impaired populations (e.g., Kongs et al., 2000).

**Delis-Kaplan Executive Functioning System** (D-KEFS; Delis, Kaplan, & Kramer, 2001) is a battery of executive functioning performance, including measures of attention, language, perception, and ability to generate higher levels of creative and abstract thought. Normative scores have been obtained in a large U.S. population, and both for children and adults (ages 8-89). The D-KEFS comprises nine tests that measure different executive functions. For the current study, the Color-Word Interference Test and the Sorting Test were administered.

The **Color-Word Interference Test** is modeled after the classic Stroop (1935) task, during which participants are asked to name color patches, read the words (in black ink) of colors, and then the interference task, during which participants are asked to inhibit the more automatic task of reading the words of colors in order to name discordant ink colors in which the words are printed. During the D-KEFS task, a fourth condition was introduced, during which participants must switch between interference tasks (i.e., naming the color of the ink or reading the spelling of the word). Completion times are used as the primary performance measures. In addition, a composite score is derived by combining performance on Color Naming and Word Reading. Current evidence indicates that the internal consistency for the Color-Word Interference subtest within the population age-range of interest (calculated by correlating split-half correlations among performance across conditions) is good (ages 16-19: $\alpha = .75$, ages 20-29: $\alpha = .82$; Delis et al., 2001). The test-retest reliability values of the subtest scores are considered questionable to acceptable ($r$-values between .62 and .76), although the time between
administrations varied widely (9-74 days, mean = 25 days). Inhibition and Inhibition/Switching scores of the Color-Word Interference Test have been found to be moderately correlated ($r_s = |.20 \text{ to } .53|$) with number of correct categories and number of perseverative responses on the WCST—implying related yet distinct components of executive functioning (Delis et al., 2001). Although, it is worth noting that for this subtest specifically, these associations have been preliminarily tested in a small sample [$n = 23$]). This subtest was utilized as a proxy measure for participant performance in response inhibition via executive functioning and took approximately 10 minutes to complete.

The *Sorting Test* involves the use of cards that display both perceptual stimuli and printed words (thus giving the examinee the option to use verbal or nonverbal strategies to sort the cards). During the task, 16 different sorting concepts are incorporated across two sets of cards. There are also two sorting conditions (spontaneous, Free Sorting and structured, Sort Recognition) to assess components of concept-formation and problem-solving skills. For the former, the examinee is presented with six cards that display both perceptual features and printed words, and the examinee is asked to sort the cards into two groups. This task also measures the examinee’s ability to initiate problem-solving behavior. For the latter, after the examiner makes eight card sorts, the examinee attempts to identify and describe the right rules or concepts used to generate the sort. Right/Wrong feedback is never provided, and performance is scored for both accuracy of sort and descriptions of the sorting concepts. Early studies of the D-KEFS Sorting Test have indicated that the test is sensitive to several executive-function deficits in lesion patients (e.g., Delis, Squire, Bihrlle, & Massman, 1992). Due to the interdependence of card sorts within a card set, internal consistency analyses within a
card set are limited. When internal consistency of the Free Sorting condition was estimated as the correlation between card set 1 and card set 2 (with each functioning as equivalent half tests), reliability coefficients for the Sorting Tests’ conditions within the population age-range of interest were acceptable (ages 16-19: $\alpha_s = .72 - .74$, ages 20-29: $\alpha_s = .75 - .78$; Delis et al., 2001). The test-retest correlations of the subtest scores were moderate ($rs = .50 - .60$), though the time between administrations varied widely (9-74 days, mean = 25 days). The Sorting Test also moderately correlates with similar constructs (e.g., WCST scores; $rs = |.38 - .59|$). The Sorting Test took approximately 10 minutes to administer.
Appendix D: Scales and Measures

Zung Self-Rating Anxiety Scale (SAS)

For each item below, please place a check mark (✓) in the column which best describes how often you felt or behaved this way during the past several days. Bring the completed form with you to the office for scoring and assessment during your office visit.

<table>
<thead>
<tr>
<th>Place check mark (✓) in correct column.</th>
<th>A little of the time</th>
<th>Some of the time</th>
<th>Good part of the time</th>
<th>Most of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 I feel more nervous and anxious than usual.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 I feel afraid for no reason at all.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 I get upset easily or feel panicky.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 I feel like I'm falling apart and going to pieces.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 I feel that everything is all right and nothing bad will happen.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 My arms and legs shake and tremble.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 I am bothered by headaches neck and back pain.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 I feel weak and get tired easily.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 I feel calm and can sit still easily.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 I can feel my heart beating fast.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 I am bothered by dizzy spells.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 I have fainting spells or feel like it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 I can breathe in and out easily.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 I get feelings of numbness and tingling in my fingers &amp; toes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 I am bothered by stomach aches or indigestion.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 I have to empty my bladder often.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 My hands are usually dry and warm.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 My face gets hot and blushes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 I fall asleep easily and get a good night's rest.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 I have nightmares.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mini-IPIP

Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence.

1 – Very inaccurate
2 – Moderately inaccurate
3 – Neither accurate nor inaccurate
4 – Moderately accurate
5 – Very accurate

1. Am the life of the party.
2. Don’t talk a lot.
3. Am relaxed most of the time.
4. Have difficulty understanding abstract ideas.
5. Have a vivid imagination.
6. Keep in the background.
7. Sympathize with others’ feelings.
8. Make a mess of things.
9. Seldom feel blue.
10. Am not interested in abstract ideas.
11. Am not interested in other peoples’ problems.
12. Get chores done right away.
13. Often forget to put things back in their proper place.
15. Do not have a good imagination.
16. Talk to a lot of different people at parties.
17. Am not really interested in others.
18. Like order.
19. Have frequent mood swings.
20. Feel others’ emotions.
Distress Tolerance Scale

Directions: Think of times that you feel distressed or upset. Select the item from the menu that best describes your beliefs about feeling distressed or upset.

5 Strongly disagree
4 Mildly disagree
3 Agree and disagree equally
2 Mildly agree
1 Strongly agree

1. _____ Feeling distressed or upset is unbearable to me.
2. _____ When I feel distressed or upset, all I can think about is how bad I feel.
3. _____ I can’t handle feeling distressed or upset.
4. _____ My feelings of distress are so intense that they completely take over.
5. _____ There’s nothing worse than feeling distressed or upset.
6. _____ I can tolerate being distressed or upset as well as most people.
7. _____ My feelings of distress or being upset are not acceptable.
8. _____ I’ll do anything to avoid feeling distressed or upset.
9. _____ Other people seem to be able to tolerate feeling distressed or upset better than I can.
10. _____ Being distressed or upset is always a major ordeal for me.
11. _____ I am ashamed of myself when I feel distressed or upset.
12. _____ My feelings of distress or being upset scare me.
13. _____ I’ll do anything to stop feeling distressed or upset.
14. _____ When I feel distressed or upset, I must do something about it immediately.
15. _____ When I feel distressed or upset, I cannot help but concentrate on how bad the distress actually feels.
Discomfort Intolerance Scale

Directions: Select the item from the menu that best describes your beliefs about pain.

<table>
<thead>
<tr>
<th>0 – Not at all like me</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 –</td>
</tr>
<tr>
<td>2 –</td>
</tr>
<tr>
<td>3 – Moderately like me</td>
</tr>
<tr>
<td>4 –</td>
</tr>
<tr>
<td>5 –</td>
</tr>
<tr>
<td>6 – Extremely like me</td>
</tr>
</tbody>
</table>

1. I can tolerate a great deal of physical discomfort
2. I have a high pain threshold
3. I take extreme measures to avoid feeling physically uncomfortable
4. When I begin to feel physically uncomfortable, I quickly take steps to relieve the discomfort
5. I am more sensitive to feeling discomfort compared to most persons
ASI-3

Enter the number from the scale below that best describes how typical or characteristic each of the 16 items is of you, putting the number next to the item. You should make your ratings in terms of how much you agree or disagree with the statement as a general description of yourself.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>very little</td>
<td>a little</td>
<td>some</td>
<td>much</td>
<td>very much</td>
</tr>
</tbody>
</table>

1. It is important for me not to appear nervous.
2. When I cannot keep my mind on a task, I worry that I might be going crazy.
3. It scares me when my heart beats rapidly.
4. When my stomach is upset, I worry that I might be seriously ill.
5. It scares me when I am unable to keep my mind on a task.
6. When I tremble in the presence of others, I fear what people might think of me.
7. When my chest feels tight, I get scared that I won't be able to breathe properly.
8. When I feel pain in my chest, I worry that I'm going to have a heart attack.
9. I worry that other people will notice my anxiety.
10. When I feel "spacey" or spaced out I worry that I may be mentally ill.
11. It scares me when I blush in front of people.
12. When I notice my heart skipping a beat, I worry that there is something seriously wrong with me.
13. When I begin to sweat in a social situation, I fear people will think negatively of me.
14. When my thoughts seem to speed up, I worry that I might be going crazy.
15. When my throat feels tight, I worry that I could choke to death.
16. When I have trouble thinking clearly, I worry that there is something wrong with me.
17. I think it would be horrible for me to faint in public.
18. When my mind goes blank, I worry there is something terribly wrong with me.
**IUS-12**

Please select the number that best corresponds to how much you agree with each item:

<table>
<thead>
<tr>
<th></th>
<th>Not at all characteristic of me</th>
<th>A little characteristic of me</th>
<th>Somewhat characteristic of me</th>
<th>Very characteristic of me</th>
<th>Entirely characteristic of me</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Unforeseen events upset me greatly.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. It frustrates me not having all the information I need.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Uncertainty keeps me from living a full life.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. One should always look ahead so as to avoid surprises.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. A small unforeseen event can spoil everything, even with the best of planning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. When it’s time to act, uncertainty paralyses me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. When I am uncertain I can’t function very well.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. I always want to know what the future has in store for me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
9. I can’t stand being taken by surprise. | 1 | 2 | 3 | 4 | 5  
10. The smallest doubt can stop me from acting. | 1 | 2 | 3 | 4 | 5  
11. I should be able to organize everything in advance. | 1 | 2 | 3 | 4 | 5  
12. I must get away from all uncertain situations. | 1 | 2 | 3 | 4 | 5
DERS

Please indicate how often the following statements apply to you by writing the appropriate number from the scale below on the line beside each item:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>almost never</td>
<td>sometimes</td>
<td>about half the time</td>
<td>most of the time</td>
<td>almost always</td>
</tr>
<tr>
<td>(0-10%)</td>
<td>(11-35%)</td>
<td>(36-65%)</td>
<td>(66-90%)</td>
<td>(91-100%)</td>
</tr>
</tbody>
</table>

1) I am clear about my feelings.
2) I pay attention to how I feel.
3) I experience my emotions as overwhelming and out of control.
4) I have no idea how I am feeling.
5) I have difficulty making sense out of my feelings.
6) I am attentive to my feelings.
7) I know exactly how I am feeling.
8) I care about what I am feeling.
9) I am confused about how I feel.
10) When I’m upset, I acknowledge my emotions.
11) When I’m upset, I become angry with myself for feeling that way.
12) When I’m upset, I become embarrassed for feeling that way.
13) When I’m upset, I have difficulty getting work done.
14) When I’m upset, I become out of control.
15) When I’m upset, I believe that I will remain that way for a long time.
16) When I’m upset, I believe that I’ll end up feeling very depressed.
17) When I’m upset, I believe that my feelings are valid and important.
18) When I’m upset, I have difficulty focusing on other things.

19) When I’m upset, I feel out of control.

20) When I’m upset, I can still get things done.

21) When I’m upset, I feel ashamed with myself for feeling that way.

22) When I’m upset, I know that I can find a way to eventually feel better.

23) When I’m upset, I feel like I am weak.

24) When I’m upset, I feel like I can remain in control of my behaviors.

25) When I’m upset, I feel guilty for feeling that way.

26) When I’m upset, I have difficulty concentrating.

27) When I’m upset, I have difficulty controlling my behaviors.

28) When I’m upset, I believe that there is nothing I can do to make myself feel better.

29) When I’m upset, I become irritated with myself for feeling that way.

30) When I’m upset, I start to feel very bad about myself.

31) When I’m upset, I believe that wallowing in it is all I can do.

32) When I’m upset, I lose control over my behaviors.

33) When I’m upset, I have difficulty thinking about anything else.

34) When I’m upset, I take time to figure out what I’m really feeling.

35) When I’m upset, it takes me a long time to feel better.

36) When I’m upset, my emotions feel overwhelming.
Liebowitz Social Anxiety Scale (LSAS)

This measure assesses the way that social phobia plays a role in your life across a variety of situations. Read each situation carefully and answer two questions about that situation. The first question asks how anxious or fearful you feel in the situation. The second question asks how often you avoid the situation. If you come across a situation that you ordinarily do not experience, we ask that you imagine "what if you were faced with that situation," and then, rate the degree to which you would fear this hypothetical situation and how often you would tend to avoid it. Please base your ratings on the way that the situations have affected you in the last week. Fill out the following scale with the most suitable answer provided below.

<table>
<thead>
<tr>
<th>Fear or Anxiety</th>
<th>Avoidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = None</td>
<td>0 = Never (0% of the time)</td>
</tr>
<tr>
<td>1 = Mild (Tolerable)</td>
<td>1 = Occasionally (1-33% of the time)</td>
</tr>
<tr>
<td>2 = Moderate (Distressing)</td>
<td>2 = Often (34-67% of the time)</td>
</tr>
<tr>
<td>3 = Severe (Disruptive)</td>
<td>3 = Severe (68-100% of the time)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Fear or Anxiety</th>
<th>Avoidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Telephoning in public</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Participating in small groups</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Eating in public places</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Drinking with others in public places</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Talking to people in authority</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Acting, performing, or giving a talk in front of an audience</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Going to a party</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Working while being observed</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Writing while being observed</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Calling someone you don’t know very well</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Talking with people you don’t know very well</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Meeting strangers</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Urinating in a public bathroom</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Entering a room when others are already seating</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Being the center of attention</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Speaking up at a meeting</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Taking a test</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Expressing a disagreement or disapproval to people you don’t know very well</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Looking at people you don’t know very well in the eyes</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Giving a report to a group</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Trying to pick up someone</td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>Returning goods to a store</td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Giving a party</td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>Resisting a high pressure salesperson</td>
<td></td>
</tr>
</tbody>
</table>
**OCI-R**

The following statements refer to experiences that many people have in their everyday lives. Circle the number that best describes **HOW MUCH** that experience has **DISTRESSED or BOTHERED** you during the **PAST MONTH**. The numbers refer to the following verbal labels:

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>A little</th>
<th>Moderately</th>
<th>A lot</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I have saved up so many things that they get in the way.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>I check things more often than necessary.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>I get upset if objects are not arranged properly.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>I feel compelled to count while I am doing things.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>I find it difficult to touch an object when I know it has been touched by strangers or certain people.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>I find it difficult to control my own thoughts.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>I collect things I don’t need.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>I repeatedly check doors, windows, drawers, etc.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>I get upset if others change the way I have arranged things.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>I feel I have to repeat certain numbers.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>I sometimes have to wash or clean myself simply because I feel contaminated.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>I am upset by unpleasant thoughts that come into my mind against my will.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>I avoid throwing things away because I am afraid I might need them later.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>I repeatedly check gas and water taps and light switches after turning them off.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>I need things to be arranged in a particular way.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>I feel that there are good and bad numbers.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>I wash my hands more often and longer than necessary.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>I frequently get nasty thoughts and have difficulty in getting rid of them.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Generalized Anxiety Disorder 7-item (GAD-7) scale

<table>
<thead>
<tr>
<th>Over the last 2 weeks, how often have you been bothered by the following problems?</th>
<th>Not at all sure</th>
<th>Several days</th>
<th>Over half the days</th>
<th>Nearly every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Feeling nervous, anxious, or on edge</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Not being able to stop or control worrying</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Worrying too much about different things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Trouble relaxing</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Being so restless that it’s hard to sit still</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Becoming easily annoyed or irritable</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Feeling afraid as if something awful might happen</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

*Add the score for each column*  

| Add the score for each column | + | + | + |

Total Score (*add your column scores*)

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?

| Not difficult at all               | __________ |
| Somewhat difficult                | __________ |
| Very difficult                    | __________ |
| Extremely difficult               | __________ |

# PATIENT HEALTH QUESTIONNAIRE (PHQ-9)

**NAME:** ______________________________ **DATE:** ______________________________

Over the last 2 weeks, how often have you been bothered by any of the following problems?

*(use "✓" to indicate your answer)*

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Several days</th>
<th>More than half the days</th>
<th>Nearly every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Little interest or pleasure in doing things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Feeling down, depressed, or hopeless</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Trouble falling or staying asleep, or sleeping too much</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Feeling tired or having little energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Poor appetite or overeating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Feeling bad about yourself...or that you are a failure or have let yourself or your family down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Trouble concentrating on things, such as reading the newspaper or watching television</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Moving or speaking so slowly that other people could have noticed. Or the opposite...being so fidgety or restless that you have been moving around a lot more than usual</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Thoughts that you would be better off dead, or of hurting yourself</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

*(Healthcare professional: For interpretation of TOTAL, please refer to accompanying scoring card.)*

10. If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

<table>
<thead>
<tr>
<th></th>
<th>Not difficult at all</th>
<th>Somewhat difficult</th>
<th>Very difficult</th>
<th>Extremely difficult</th>
</tr>
</thead>
</table>

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A2663B 10-04-2005
PTSD Checklist (PCL)

Patient Name: ___________________________  Date: ___________________________

If an event listed on the Life Events Checklist happened to you or you witnessed it, please complete the items below. If more than one event happened, please choose the one that is most troublesome to you now.

The event you experienced was _____________________________________________

Instructions: Below is a list of problems and complaints that people sometimes have in response to stressful life experiences. Please read each one carefully, then circle one of the numbers to the right to indicate how much you have been bothered by the problem in the past month.

<table>
<thead>
<tr>
<th>BOTHERED BY</th>
<th>NOT AT ALL</th>
<th>A LITTLE BIT</th>
<th>MODERATELY</th>
<th>QUITE A BIT</th>
<th>EXTREMELY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Repeated disturbing memories, thoughts, or images of the stressful experience?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Repeated, disturbing dreams of the stressful experience?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Suddenly acting or feeling as if the stressful experience were happening again (as if you were reliving it)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Feeling very upset when something reminded you of the stressful experience?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Having physical reactions (e.g., heart pounding, trouble breathing, or sweating) when something reminded you of the stressful experience?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Avoiding thinking about or talking about the stressful experience or avoiding having feelings related to it?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Avoiding activities or situations because they remind you of the stressful experience?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. Trouble remembering important parts of the stressful experience?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Loss of interest in activities that you used to enjoy?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. Feeling distant or cut off from other people?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. Feeling emotionally numb or being unable to have loving feelings for those close to you?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12. Feeling as if your future will somehow be cut short?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. Trouble falling or staying asleep?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>14. Feeling irritable or having angry outbursts?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>15. Having difficulty concentrating?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>16. Being “super alert” or watchful or on guard?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>17. Feeling jumpy or easily startled?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
PDSS-SR

Several of the following questions refer to panic attacks and limited symptom attacks. For this questionnaire, define a panic attack as a sudden rush of fear or discomfort accompanied by at least 4 of the symptoms listed below. In order to qualify as a sudden rush, the symptoms must peak within 10 minutes. Episodes like panic attacks but having fewer than 4 of the listed symptoms are called limited symptom attacks. Here are the symptoms to count:

- Rapid or pounding heartbeat
- Sweating
- Trembling or shaking
- Breathlessness
- Feeling of choking
- Chest pain or discomfort
- Nausea
- Dizziness or faintness
- Feelings of unreality
- Numbness or tingling
- Chills or hot flashes
- Fear of losing control or going crazy
- Fear of dying

PDSS1. How many panic and limited symptom attacks did you have during the past week?

0 = No panic or limited symptom episodes
1 = No full panic attacks and no more than 1 limited symptom attack/day
2 = 1 or 2 full panic attacks and/or multiple limited symptom attacks/day
3 = More than 2 full attacks but not more than 1/day on average
4 = Full panic attacks occurred more than once a day, more days than not

PDSS2. If you had any panic attacks or limited symptom attacks during the past week, how distressing (uncomfortable, frightening) were they while they were happening? If you had more than one, give average rating.

0 = Not at all distressing, or no panic or limited symptom attacks during the past week
1 = Mildly distressing
2 = Moderately distressing
3 = Severely distressing
4 = Extremely distressing

PDSS3. During the past week, how much have you worried or felt anxious about when your next panic attack would occur, or about fears related to the attacks (for example, that they could mean you have physical or mental health problems or could cause you social embarrassment)?

0 = Not at all
1 = Occasionally only mildly
2 = Frequently or moderately
3 = Very often or to a very disturbing degree
4 = Nearly constantly and to a disabling extent
PDSS4. During the past week, were there any places or situations (e.g., public transportation, movie theaters, crowds, bridges, tunnels, shopping malls, being alone) you avoided, or felt afraid of (uncomfortable in, wanted to avoid or leave), because of fear of having a panic attack? Please rate your level of fear and avoidance this past week.

0 = None: no fear or avoidance
1 = Mild: occasional fear and/or avoidance, but I could usually confront or endure the situation.
2 = Moderate: noticeable fear and/or avoidance, but still manageable.
3 = Severe: extensive fear and avoidance.
4 = Extreme: pervasive disabling fear and/or avoidance.

PDSS5. During the past week, were there any activities (e.g., physical exertion, sexual relations, taking a hot shower or bath, drinking coffee, watching an exciting or scary movie) that you avoided, or felt afraid of, because they caused physical sensations like those you feel during panic attacks or that you were afraid might trigger a panic attack? Please rate your level of fear and avoidance of those activities this past week.

0 = No fear or avoidance of situations or activities because of distressing physical sensations
1 = Mild: occasional fear and/or avoidance
2 = Moderate: noticeable avoidance, but still manageable
3 = Severe: extensive fear and avoidance
4 = Extreme: pervasive and disabling avoidance
Severity Measure for Specific Phobia—Adult

Name: ___________________________ Age: ______ Sex: Male □ Female □

Date: ____________________________

The following questions ask about thoughts, feelings, and behaviors that you may have had in a variety of situations.

Please check (□) the item below that makes you most anxious. Choose only one item and make your ratings based on the situations included in that item.

<table>
<thead>
<tr>
<th>☐ Driving, flying, tunnels, bridges, or enclosed spaces</th>
<th>☐ Animals or insects</th>
<th>☐ Heights, storms, or water</th>
<th>☐ Blood, needles, or injections</th>
<th>☐ Choking or vomiting</th>
</tr>
</thead>
</table>

Please respond to each item by marking (☐ or x) one box per row.

During the PAST 7 DAYS, I have…

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Occasionally</th>
<th>Half of the time</th>
<th>Most of the time</th>
<th>All of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. felt moments of sudden terror, fear, or fright in these situations</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. felt anxious, worried, or nervous about these situations</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. had thoughts of being injured, overcome with fear, or other bad things happening in these situations</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. felt a racing heart, sweaty, trouble breathing, faint, or shaky in these situations</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. felt tense muscles, felt on edge or restless, or had trouble relaxing in these situations</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. avoided, or did not approach or enter, these situations</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. moved away from these situations or left them early</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. spent a lot of time preparing for, or procrastinating about (i.e., putting off), these situations</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. distracted myself to avoid thinking about these situations</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. needed help to cope with these situations (e.g., alcohol or medications, superstitious objects, other people)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Demographics Questionnaire

Age: __________

Gender:
- Female
- Male
- Transgender Female
- Transgender Male
- Gender not described above: __________________________

Ethnicity/Race:
Are you: (Check all that apply)
- White
- Black or African American
- Hispanic/Latino(a)
- American Indian or Alaskan Native
- Asian
- Native Hawaiian or Pacific Islander
- Other (specify) __________________________

Note: If you can describe your ethnicity more specifically (e.g., primary country or countries of origin), please do so here: __________________________

Primary Language
- English
- Spanish
- Other (specify) __________________________
Religion

- Protestant Christian
- Catholic
- Jewish
- Muslim
- Atheist
- Agnostic
- Other (specify) ___________________

What category best describes your annual household income? (check one):

- Under $10,000
- $10,000 - $19,999
- $20,000 - $29,999
- $30,000 - $39,999
- $40,000 - $49,999
- $50,000 - $74,999
- $75,000 - $99,999
- $100,000 - $150,000
- Over $150,000

Sexual Orientation (check one):

- Exclusively heterosexual
- Bisexual
- Exclusively gay/lesbian
- Unsure/Questioning
- Sexual orientation not listed above: ___________________

Have you ever been assessed and diagnosed by a health professional with the following (check all that apply):

- Concussion
- Traumatic Brain Injury
- Attention Deficit-Hyperactivity Disorder (inattentive and/or hyperactive subtypes)
- None of these