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THE EFFECTS OF VERBAL AND IMAGINAL WORRY ON PHYSIOLOGICAL AND SUBJECTIVE FUNCTIONING DURING INTEROCEPTIVE EXPOSURE

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Abstract

Previous research (Borkovec & Hu, 1990; Borkovec, Lyonfields, Wiser, & Deihl, 1993; Hazlett-Stevens & Borkovec, 2001; Peasley-Miklus & Vrana, 2000) has documented the inhibitory effects of worry on cardiovascular reactivity to subsequently presented fear-relevant stimuli. However, although theoretical assertions point to the verbal-linguistic (as opposed to imagery-based) nature of worry as the cause of these inhibitory effects, extant research investigating the effects of worrisome thinking on subsequent anxiety-eliciting tasks has not isolated the verbal linguistic nature of worry as the active ingredient in its suppressive effects on arousal. The present investigation employed a condition in which worrisome imagery was used as a comparison to test the hypothesis that worry's verbal linguistic nature is at the genesis of its inhibitory effects. Participants high in anxiety sensitivity were asked to engage in verbal worry, imaginal worry, or relaxation prior to repeated presentations of a rebreathing task. Results indicated that verbal worry was associated with increases in subjective distress and decreases in heart rate across rebreathing periods, whereas imaginal worry was associated with relatively steady levels of both subjective distress and heart rate across periods. Relaxation was associated with decreases in both subjective distress and heart rate across rebreathing periods. Furthermore, participants in the verbal worry induction experienced greater frequency of panic attacks during the final rebreathing period relative to participants in the relaxation induction. Theoretical and clinical implications of these findings are discussed.

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Chapter 1: Avoidance Paradigms of GAD and Panic Disorder

Cognitive and behavioral avoidance is a hallmark characteristic of anxiety disorders. The ability to experience and habituate to objects, events, thoughts, images, somatic sensations, and emotions related to a fear is normal and adaptive, but for individuals with anxiety disorders, these processes are interrupted, leading to enhanced and sustained anxiety in the face of feared stimuli. Two such conditions are generalized anxiety disorder (GAD) and panic disorder. In panic disorder, interoceptive cues are associated with forthcoming and uncontrollable extreme distress; panic attacks are therefore frequently followed by avoidance techniques designed to preclude future panic attacks. In GAD, worry may serve as an inhibitory process wherein core fear and/or related affective/somatic experiences are cognitively avoided (Borkovec, Alcaine, & Behar, 2004). Such cognitive and behavioral avoidance responses theoretically lead to maintenance of the disorders in that individuals fail to learn that the somatic cues associated with anxiety are not dangerous and will decrease in severity over time.

These conceptualizations of panic and GAD have a historical foundation in Mowrer's (1947) two-stage theory of fear. Mowrer's theory posits that fear originally emerges via classical conditioning and is maintained via operant conditioning, in which avoidance of fear cues results in a decrease in negative states and is thus negatively reinforced. In order to extinguish fear, behavioral treatments for anxiety have accordingly relied primarily on exposure techniques consisting of repeated presentations of the feared stimulus with avoidance response prevention. Relatedly, Foa and Kozak (1986) asserted that a necessary component of successful extinction is the accessing of the full fear structure in memory to allow for full emotional processing, and that physiological

activation and ensuing habituation are important indicators of such successful emotional processing.

Mowrer's theory can be used to conceptualize the acquisition and maintenance of fear across the anxiety disorders. Indeed, when applied to anxiety disorders characterized by motoric avoidance to fear cues (e.g., panic disorder, phobias, PTSD), the theory has traditionally provided the framework from which cognitive-behavioral theory conceptualizes the maintenance of the fear response. Despite not being characterized by motoric avoidance, GAD can also be conceptualized from a Mowrerian perspective as described later. In this chapter, I review the predominant theories of fear-acquisition and -maintenance in panic disorder and GAD, as well as the empirical evidence supporting these formulations.

Avoidance Paradigm in Panic Disorder

The 1980s witnessed a sharp increase in research on panic, wherein three primary formulations of panic disorder were most prominent. First, the cognitive model of panic (Clark, 1986, 1988; Beck, 1987; Beck, Emery, & Greenberg, 1985) stipulated that catastrophic misinterpretations of normal somatic sensations as dangerous or even fatal lead to an increase in those somatic cues and, ultimately, to the onset of panic attacks. Treatment therefore accordingly focused on cognitive restructuring of the automatic thoughts associated with those sensations. Second, the hyperventilation formulation (Ley, 1985a, 1985b) stipulated that panic results from dysfunctional breathing patterns that lead to hyperventilation and, when mixed with misattributions about the cause of those somatic sensations, to panic attacks. Treatment based on this formulation accordingly focused on teaching patients how to exercise control over and alter their

breathing patterns and, to this end, included CO_2 inhalation and voluntary hyperventilation techniques. Finally, the interoceptive conditioning formulation (Griez, Lousberg, van den Hout, & van der Molen, 1987; van den Hout, van der Molen, Griez, & Lousberg, 1987) stated that the somatic sensations that accompany a panic attack become the phobic stimuli themselves through Pavlovian conditioning and, when experienced, lead to further panic attacks. Interoceptive exposure therefore involved exposure to the feared stimuli (i.e., the somatic sensations).[1]

Since its introduction, this third formulation has been regarded as the predominant conceptualization of panic disorder and is closely related to Mowrer's (1947) theory. According to this formulation, fear emerges as a result of interoceptive conditioning, in which physiological sensations such as a racing heart, sweaty palms, and shortness of breath become associated with danger. Furthermore, fear is maintained through both avoidance of such sensations and avoidance of situations and settings that in the past have elicited the sensations. In order to extinguish the feared response in panic disorder, behavioral interventions accordingly focus on repeated exposure to interoceptive cues and to situations that elicit those sensations.

However, despite the fact that exposure-based treatments for panic disorder are successful in achieving significant improvement in patients presenting with this condition (see Behar, in preparation), many individuals receiving these treatments still suffer from panic attacks both at treatment end and at long-term follow-up assessment moments. More recently, some investigators have begun to pay greater attention to individual differences in response to exposure-based treatments for panic disorder (e.g., Beck & Wolf, 2001) to explain such differential response rates. For example, Beck and Shipherd

(1997) documented two response patterns to repeated inhalations of CO_2 in panic disorder patients: fear habituation and fear sensitization. Shipherd and Beck (1998, as cited in Beck, Shipherd, & Read, 1999) further found that nonhabituators reported more intense catastrophic thoughts during repeated presentations of CO_2 relative to habituators, suggesting that such individuals may pay excessive attention to the cognitions that arise during their fear responses. Furthermore, Beck et al. (1999) replicated documentation of the two groups (habituators and sensitizers) and the catastrophic thoughts finding using a group of nonclinical individuals selected on the basis of high scores on the Anxiety Sensitivity Index.

Investigations of cognitive mechanisms in panic disorder have also sought to identify plausible explanations for differential response rates resulting from panic treatment. Foa and Kozak's (1986) theory of emotional processing states that cognitive disengagement from or avoidance of threatening information can also serve to preclude full accession of the fear structure and therefore reduce the effectiveness of exposure therapy. Although many investigations have shown that patients with anxiety disorders exhibit attentional biases for threatening information (see Mathews & MacLeod, 1994; McNally, 1996), research on memory biases for threat cues in panic disorder is mixed. Some studies have concluded that memory biases do exist in panic disorder (e.g., Becker, Rinck, & Margraf, 1994; Cloitre & Liebowitz, 1991; Cloitre, Shear, Cancienne, & Zeitlin, 1994; McNally, Foa, & Donnell, 1989), whereas others have found no evidence of memory bias (e.g., Otto, McNally, Pollack, Chen, & Rosenbaum, 1994; Pickles & van den Broek, 1988; Rapee, 1994). In an effort to examine the possible contribution of individual differences to such inconsistent findings, McNally, Otto, Yap, Pollack, and

Hornig (1999) employed a directed forgetting paradigm (Johnson, 1994) using positive, neutral, and threatening words. Results failed to provide evidence that panic patients exhibit a memory bias for threatening information. However, they did find a nonsignificant trend indicating that cognitive avoidance of threat material was associated with greater left hemisphere activation in the control group and greater right hemisphere activation (shown in previous studies to be correlated with negative affective states, Davidson, 1993) in the panic disorder group. This finding corroborates the results of another investigation (Otto et al., 1994) indicating that cognitive avoidance was associated with less left hemisphere bias in individuals with GAD and panic disorder. This suggests that avoidance of threat cues may be more salient in panic disordered individuals who experience higher levels of negative affect, but less salient in those for whom panic states are less negatively valenced.

Although few investigators have explored such potential reasons for why some individuals may respond less well to exposure-based treatments for panic disorder, knowledge about the avoidance functions of GAD, a condition that frequently co-occurs with panic disorder, may provide some hypotheses regarding this issue. Specifically, it may be that GAD and/or its core process of worry, characterized by inhibitions of somatic activation and preclusion of fear structure accession, may interfere with habituation mechanisms in the treatment of panic.

Avoidance Paradigm in Worry

Research on GAD has yielded important knowledge regarding the basic nature of worry, its defining feature. In a review of the theoretical and empirical underpinnings of the avoidance theory of worry, Borkovec et al. (2004) presented the theoretical rationale

behind and empirical evidence for the possibility that worry functions as a cognitive avoidance of somatic and affective experience. The theoretical underpinnings of the theory are found in Mowrer's (1947) two-stage theory of fear, but as stated earlier, GAD is characterized not by specific environmental fear-inducing triggers which can be motorically avoided, but rather by internal cognitive activity that elicits subjective anxiety and distress. Due to this lack of external fear cues, therapy for GAD cannot make use of the traditional behavioral exposure techniques that have been shown to be effective for other anxiety-related problems. There is, however, a possibility that *cognitive* avoidance can also maintain a fear response. For example, Borkovec (1974) found that snake-fearful participants who were asked to employ an avoidance response following exposure to items in a hierarchy showed increased arousal over time relative to participants in systematic desensitization and implosive therapy conditions. Grayson and Borkovec (1978) found that participants who imagined avoiding a phobic stimulus reported greater increases in fear across hierarchy scenes than did participants who imagined effectively coping with the feared situations. Additionally, Grayson, Foa, and Steketee (1982) found a similar phenomenon in the treatment of obsessive-compulsive disorder with respect to attention: habituation of heart rate and subjectively reported fear across two sessions was more successful for participants who were given exposure with attention-focusing followed by exposure with distraction relative to participants who were treated with the opposite order of exposure techniques. It seems, then, that *cognitive* avoidance can contribute to the maintenance of anxiety and may also dampen the habituation that otherwise ensues from repeated exposure to anxiety-provoking material.

Given that worriers experience repeated exposure to their worries on a daily basis due to the ruminative nature of worrisome thinking, such repeated exposure would theoretically lead to habituation of the anxiety response. Clearly, however, this does not happen. Similarly to the individual with obsessive-compulsive disorder who frequently experiences intrusive thoughts related to the obsession and yet fails to habituate to the anxiety associated with those thoughts because of behavioral attempts (in the form of compulsions) to reduce the anxiety, individuals with GAD likely employ an avoidance response in an attempt to mitigate the anxiety resulting from worry.

The first indication that worry may function as an avoidance response came from an investigation of the basic nature of the worry process. Borkovec and Inz (1990) found that during periods of relaxation, GAD clients reported equal amounts of thought and imagery whereas nonanxious individuals reported a predominance of imagery. During worrisome periods, however, both the GAD and nonanxious groups reported a predominance of thought activity. More recently, Stöber, Tepperwien, and Staak (2000) found that thinking about worrisome topics was associated with less imagery than was thinking about topics that were non-worrisome in nature. They also found that as levels of worrisome thinking increased, levels of imagery decreased. Thus, worry is a primarily thought-based, verbal linguistic event, and not imagery-based in nature, and may indeed occur as an avoidant response to anxiety-provoking images.

The fact that worry is verbal linguistic in nature has important implications for the physiological experience associated with periods of worrisome activity. Vrana, Cuthbert, and Lang (1986) found that verbal articulation of fearful material led to little cardiovascular activity, whereas imagery of fearful material led to a considerable

cardiovascular response. This finding raises the possibility that worry, being verbal linguistic in nature, may be associated with an inhibition of cardiovascular activity. This is in contrast to other anxiety disorders which are associated with a facilitation of sympathetic autonomic activity. For example, results of a recent investigation (Behar, Zuellig, & Borkovec, 2005b) suggested that while worry was associated with a predominance of verbal linguistic activity (replicating the findings from Borkovec & Inz, 1990), trauma recall (which has been shown to be associated with an increase in autonomic activation; Pitman, Orr, Forgue, deJong, & Claiborn, 1987) was associated with a predominance of imaginal activity.

Indeed, several psychophysiological investigations have found evidence of an inhibitory process associated with worrisome activity. First, Borkovec and Hu (1990) found that inducing worrisome thinking in speech phobic individuals before presenting them with the feared stimulus (i.e., images of giving a speech) significantly reduced somatic activity in response to the fear images. This finding was in contrast to the heightened subjective anxiety reported by these participants during the imaginal exposure, as well as to the strong cardiovascular response to the feared images shown by groups who engaged in relaxed or neutral thinking prior to image presentations.

Second, in an extension of this experiment, Hazlett-Stevens and Borkovec (2001) investigated the effects of a period of worry on *in vivo* exposure to giving a speech. Results indicated that although a period of worry did not lead to less cardiovascular response to the subsequent phobic task, it was associated with greater subjective anxiety ratings during repeated *in vivo* exposure relative to neutral and relaxation conditions. The authors argued that the motor component of giving a speech overpowered the otherwise

inhibitory effects of a worry period on physiological activation, but maintained that the heightened anxiety subjectively reported by participants indicated a maintenance of anxious meaning, as opposed to the extinction of fear shown by groups who engaged in relaxation or a neutral task prior to the exposures.

Third, Peasley-Miklus and Vrana (2000) randomly assigned victimization-fearful or victimization- and speech-fearful participants to engage in 30 second periods of worrisome or relaxing thinking and to then imagine feared victimization or speech-giving scenes. Results suggested that there was greater heart rate suppression during fear imagery following a period of worry relative to a period of relaxation.

Fourth, Borkovec, Lyonfields, Wiser, and Deihl (1993) randomly assigned participants to engage in one of five types of mental activity (relaxation, general worry, worry focusing on thoughts, worry focusing on images, or worry focusing on affect) prior to presenting a phobic image. Results indicated that only those participants asked to engage in thought-based worry experienced significantly less heart rate response relative to participants asked to engage in relaxation. Importantly, correlational analyses provided preliminary evidence that it is specifically the verbal nature of worry that leads to its remoteness from physiological activation. For participants in the General Worry condition, greater amounts of worrisome thinking were related to less cardiovascular response; on the other hand, for participants in the Relaxation condition, greater amounts of thought activity were related to *more* cardiovascular response.

Worry's verbal nature also has implications for the affective experiences associated with this process. Results from four investigations offer support for this claim. First, Behar et al. (2005b) randomly assigned participants to undergo 5-minute inductions

of relaxation followed by 5-minute inductions of worry and trauma recall, with the order of presentation of these latter two inductions reversed for a randomly selected half of participants. Following each 5-minute induction, participants were asked to rate (using a 1-5 Likert scale) the amount of relaxed, anxious, and depressed affect each task had elicited. The order of presentation of the worry and trauma recall tasks allowed for an investigation of the potential effects of one state on affective experiences during the next state. Results indicated that worry was inhibitive of anxious affect during a subsequent trauma recall task, and that for individuals with both GAD and PTSD symptoms, worry served to inhibit depressed affect during a subsequent period of trauma recall. This study offers support for the view of worry (which is verbal linguistic in nature and associated with a lack of increased cardiovascular activity) as inhibitory of anxious (and depressive) responding in a subsequent anxiety-eliciting (specifically trauma recall) task.

Second, Butler, Wells, and Dewick (1995) exposed participants to a distressing video and subsequently asked them to either engage in silent verbal linguistic worry about the content of the film, imagine scenes from the film, or "settle down." Results indicated that immediately following exposure to the film, participants asked to worry reported lower subjective anxiety relative to participants who were asked to imagine film scenes. Additionally, worrying about film scenes was associated with a greater frequency of intrusive images about the film in the days following the laboratory task relative to imagining film scenes. Because the investigators did not include a condition in which imagery-based worry (as opposed to mere imagery or mere worry) was employed, the results of this study and others employing similar worry inductions permit only speculation that it is the verbal linguistic nature of worrisome thinking that is associated

with decreased emotional processing following exposure to a distressing stimulus and an increase in intrusive mentation in the days following exposure.

As stated, such investigations provide preliminary support for the hypothesis that the verbal nature of worry leads to its remoteness from affective experience, but the omission of experimental groups that are asked to employ imagery-based worry precludes this unambiguous conclusion. Because existing studies (with the exception of Borkovec et al., 1993) did not differentiate between the effects of imagery- versus thought-based worry, Behar, Vescio, and Borkovec (2005a) sought to improve upon this limitation in an investigation using Wegner's thought suppression paradigm that simultaneously examined (a) the effects of suppressing thoughts versus images of neutral versus worrisome stimuli and (b) the effects of habituation over two consecutive periods of expressing mentation about such stimuli. Consistent with past studies of worry suppression, results failed to find a rebound effect regardless of valence (worrisome, neutral) or mentation content (thoughts, images).[2] However, results did indicate that a decrease in worrisome mentation across two consecutive expression periods was more pronounced when the worrisome material was imagery-based rather than thought-based in nature. This finding provides support for the assertion set forth by Borkovec et al. (2004) that it is specifically the verbal nature of worry that leads to the maintenance and/or perpetuation of worrisome activity in its preclusion of emotional processing, and further raises the possibility that imaginal exposure for worry may be one effective component of treatment for GAD.

Given this preliminary evidence that imaginal exposure might lead to a decrease in worrisome mentation relative to continued verbal articulation of worrisome material,

our lab group has examined the potential effectiveness of an experimental manipulation consisting of imaginal exposure to impact the processes involved in the suppression of emotion displayed by individuals with an analogue diagnosis of GAD. Participants identified via the Generalized Anxiety Disorder Questionnaire - IV (Newman et al., 2002) were enrolled in a brief, 2-session worry intervention. Participants were randomly assigned to a condition in which they received training in how to worry using vivid images or a condition in which they were guided in worrying as they normally do (i.e., using verbal linguistic activity). In addition, participants within each of these groups were randomly assigned to think/imagine the *best* or *worst* possible outcome of their worries. The "best outcome" condition was designed to be akin to cognitive restructuring techniques in that participants were asked to construct a 4-step hierarchy of outcomes that were objectively just as likely to occur as their feared outcome, but which were less anxiety provoking in nature. The "worst outcome" condition was designed to be akin to systematic desensitization techniques in that participants were asked to construct a 4-step hierarchy of feared outcomes, with the most feared outcome as the final step in the hierarchy. Practice of two primary worry topics was employed during two sessions with a trained experimenter, as well as daily to maximize likelihood of eventual decrease in subjectively experienced anxiety. At pre- and post-training moments, participants underwent a physiological assessment in which they viewed pictures selected from the International Affective Picture System (IAPS; Lang, Ohman, & Vaitl, 1988) chosen to represent each arousal/valence combination from a 3 (Valence: positive, neutral, negative) X 3 (Arousal: low, medium, high) design. Each arousal/valence combination consisted of three pictures presented for a total of two minutes. During this time,

participants' heart rate, interbeat interval, respiratory sinus arrhythmia (a measure of parasympathetic activity), and pre-ejection period (a measure of sympathetic activity) were measured. Participants also completed pre- and post-intervention symptom measures (the Penn State Worry Questionnaire, the State Trait Anxiety Inventory, the Beck Depression Inventory, the Emotional Control Questionnaire, and the Dysfunctional Attitudes Scale) as well as daily diaries of the subjective amount of anxiety experienced during the daily practice period. Results have indicated that although self-report questionnaire data did not reveal evidence of pre- to post-intervention improvement (in trait anxiety, depression, emotional control, and maladaptive thought style), interesting effects did emerge from the daily diary data. First, although the "best-case" condition led to greater reductions in daily anxiety levels from the first to the last day of the monitoring periods when participants were asked to focus on thought-based as opposed to imagery-based mentation, the "worst-case" scenario condition led to greater reductions in daily anxiety levels during this period when participants were asked to focus on imagery-based as opposed to thought-based mentation. The greatest reduction in daily anxiety was evidenced by those in the "worst-case" scenario condition who were trained in imagery techniques, suggesting that this "imaginal exposure" condition was associated with the highest degree of change. Upon inspecting a plot of both average daily anxiety and average anxiety during the practice periods, it was evident that for those in the imaginal exposure condition there was a "spike" in reported anxiety on the first day of the second week of training/monitoring, offering plausible evidence for a "peaking" or activation in anxiety levels resulting from this condition but absent in other conditions (Behar & Yamasaki, 2002). Furthermore, heart rate data indicated a greater pre- to post-

intervention increase in physiological response to high (but not medium or low) arousal pictures only for those participants undergoing imaginal exposure (as opposed to the other three conditions; Behar, Yamasaki, Borkovec, & Ray, 2003). These physiological data converge with the daily diary data to suggest that imaginal exposure for worry has a potentiating effect on subjective and physiological anxiety and indicates that such a technique may help to decrease trait levels of anxiety when implemented in more complete treatment packages for GAD. Also, the results of this investigation converge with a study by Nelson and Harvey (2002) in which individuals meeting the diagnostic criteria for insomnia were randomly assigned to undergo verbally-based or imagery-based worry inductions prior to sleep. Results of that investigation suggested that participants undergoing imagery-based worry about an upcoming speech task reported experiencing greater negative affect and arousal regarding the speech task before sleeping (indicative of activation of fear), less anxiety and discomfort regarding the speech task upon waking (indicative of emotional processing), and shorter sleep-onset latency compared with the verbally-based worry group.

An additional piece of empirical support for the view of worry as an avoidance response comes from the work of Graham Davey on evaluative conditioning. Jones and Davey (1990) showed that rehearsal of an unconditioned stimulus previously employed in an aversive conditioning task led to enhanced fear responses to a previously conditioned fear stimulus. The inhibitory nature of worry, however, is shown in Davey and Matchett's (1994) study which offered evidence that worrisome (relative to neutral or somatically anxious) thinking prior to rehearsal of the unconditioned stimulus precluded the enhancement of fear that would otherwise be expected. This result suggests that in

addition to reducing the likelihood of extinction during repeated exposure, worry suppresses the strengthening of anxiety responses that would otherwise occur during unconditioned stimulus rehearsal.

Several of the investigations presented thus far examined the effects of worry on affective and somatic anxiety in other anxiety syndromes and support the assertion that worry serves an inhibitory function and therefore serves as an avoidance response to internal affective, cognitive, and somatic threat cues. Specifically, worry has been shown to have an inhibitory effect on a subsequent speech-phobic task (both imaginally [Borkovec & Hu, 1990] and *in vivo* [Hazlett-Stevens & Borkovec, 2001]), a subsequent period of victimization- and speech-giving images (Peasley-Miklus & Vrana, 2000), and a subsequent period of trauma recall (Behar et al., 2005b). Given this evidence and the fact that worry is pervasive in the other anxiety disorders (Barlow, 2002), its inhibitory nature may play an important role in the maintenance of conditioned fear in these other anxiety syndromes, and may also interfere with therapeutic attempts at symptom amelioration. As stated earlier, one such disorder that is highly comorbid with worry and GAD is panic disorder. Given worry's inhibitory functions as outlined herein, it is quite likely that comorbid worry and GAD interfere with extinction of fear during repeated exposures to panic-inducing situations and sensations, especially given theoretical assertions that physiological activation is a necessary component of habituation and extinction and given findings that worry inhibits precisely this type of activation. Next, I will review the evidence and theoretical conceptualizations regarding GAD's comorbidity with other anxiety syndromes in general and with panic disorder in particular.

Chapter 2: Comorbidity of GAD With Other Anxiety Syndromes

Research on the comorbidity of GAD has indicated that approximately 80% of clients with a principal diagnosis of GAD have at least one additional current anxiety or mood diagnosis (Brawman-Mintzer et al., 1993; Brown & Barlow, 1992; Massion, Warshaw, & Keller, 1993; Brown, Campbell, Lehman, Grisham, & Mancill, 2001a) and it is rare to find "pure" cases of GAD (Bruce, Machan, Dyck, & Keller, 2001). Additionally, comorbid GAD has been shown to remit with treatment for other anxiety disorders (e.g., panic disorder; Brown, Antony, & Barlow, 1995), and comorbid anxiety disorders have been shown to remit with treatment for primary GAD (Borkovec, Abel, & Newman, 1995; Newman, Przeworski, & Borkovec, 2001).

Based on this evidence as well as evidence of low diagnostic reliability for GAD (Brown, Di Nardo, Lehman, & Campbell, 2001b), some investigators have called into question whether GAD is associated with sufficient discriminant validity to constitute a formal diagnosis on its own (e.g., Brown, Barlow, & Liebowitz, 1994). Specifically, Brown et al. (1994) argued that GAD may be the "basic" anxiety disorder out of which other anxiety and mood disorders emerge.

Although worry is the primary defining feature of GAD, its presence in other anxiety disorders is marked, and GAD is one of the most commonly diagnosed comorbid conditions for these other syndromes (Brown & Barlow, 1992). As Borkovec et al. (2004) argue, widespread presence of GAD and worry in the anxiety disorders makes the basic knowledge we have acquired about this condition potentially relevant to our understanding of the basic nature and treatment of other anxiety diagnoses. For example, if emotional processing (as defined by Foa & Kozak, 1986) is a necessary condition for

the treatment of anxiety disorders, and if GAD (a commonly comorbid condition) or worry (a process pervasive among the anxiety disorders) preclude emotional processing, then their presence may contribute to the maintenance of those anxiety symptoms and may interfere with otherwise efficacious therapeutic techniques aimed at reducing such symptoms.

Comorbidity of GAD with Panic Disorder

Because the distinctness of GAD as a syndrome has been called into question, several researchers have evaluated its discriminant validity from other anxiety syndromes. One such matter of discriminant validity that has received special attention has been that between GAD and panic disorder. To begin with, GAD and panic disorder share an interesting history. Both conditions were originally conceptualized as the two "non-phobic" anxiety conditions and were combined under the common umbrella of anxiety neurosis. With the publication of *DSM-III* (APA, 1980), they were introduced as separate entities, at which time panic disorder was no longer conceptualized as a nonphobic response and was instead commonly conceptualized as an interoceptive conditioning response.[3]

Early GAD literature reveals that GAD patients often report experiencing panic attacks (Barlow, 1988). Among patients with GAD, rates of panic disorder have been found to range from 11% to 27% (Brawman-Mintzer et al., 1993; Sanderson, Di Nardo, Rapee, & Barlow, 1990). Among patients with panic disorder, rates of GAD have been found to range from 13% to 36% (Brown & Barlow, 1992; Sanderson et al., 1990). Finally, Brown et al. (2001a) reported 41% current and 47% lifetime comorbidity rates for GAD and panic disorder.

Whether the distinctness of these two conditions as presented in the *DSM* is accurate has been a topic of controversy over the past two decades, but in general scientific evidence indicates that the two disorders are indeed distinct entities. The first piece of evidence suggesting their distinctness showed that imipramine was effective for alleviating panic attacks, but not for alleviating GAD (Klein, 1964).[4] Further evidence in favor of a distinction comes in part from behavior genetics studies of the etiology of the disorders (Mendlewicz, Papdimitriou, & Wilmotte, 1993). Many theorists call upon evidence showing that vulnerability for panic disorder is genetically heritable whereas it is not for GAD (e.g., Noyes et al., 1992). However, McNally (1994) cautions that there are problems with this argument, including that (a) GAD may artificially appear to be less heritable than panic disorder in earlier studies because *DSM-III* hierarchical rules precluded a diagnosis of GAD when panic disorder was present and that (b) studies suggesting that GAD is non-heritable may be problematic, with some studies (e.g., Kendler, Neale, Kessler, Heath, & Eaves, 1993) showing evidence in favor of GAD's heritability.

Additional evidence for the distinctness of panic disorder and GAD comes from comparisons of symptoms of the two disorders (Okasha, Bishry, Khalil, Darwish, el Dawla, & Shohdy, 1994; Anderson, Noyes, & Crowe, 1984); comparisons of personality characteristics, onset, course, and treatment outcome (Anderson et al., 1984); comparisons of thought and image content during anxiety episodes (Breitholtz, Johansson, & Öst, 1999; Breitholz, Westling, & Öst, 1998); and comparisons of anxious reactions to CO_2 challenges suggesting that only individuals with panic disorder

experience subjectively reported increases in anxious symptoms (Verburg, Griez, Meijer, & Pols, 1995; Perna, Bussi, Allevi, & Bellodi, 1999).

An interesting distinction between panic and GAD was reported by Noyes et al. (1992), who noted that the symptoms of panic disorder patients were characterized by autonomic reactivity, whereas the symptoms of GAD patients were characterized by central nervous system reactivity, and indeed others have found that worry (the central feature of GAD) is characterized not only by central nervous system reactivity but also by autonomic suppression (e.g., Borkovec & Hu, 1990). This marked difference in the physiological correlates of GAD and panic symptoms raises the question of what happens physiologically when panic and worry coexist, as they often do.

In addition to evaluating genetic and self-report differences between the two conditions, an evaluation of laboratory experiments aimed at investigating the differences between these two disorders is also helpful in understanding the potential influence of worry on panic symptoms. Roth, Wilhelm, and Trabert (1998) exposed individuals with panic disorder, GAD, and nonanxious controls to repeated presentations of a voluntary breath holding procedure in which participants were instructed to hold their breath for 12 trials of 30 seconds each, with 60-second periods of normal breathing time between each breath-holding task. Results suggested that heart rate acceleration occurring just prior to breath holdings was greater for individuals with GAD than for individuals with panic disorder or nonanxious controls, but that the two groups did not differ physiologically or with respect to self-reported symptoms immediately following the task. Additionally, Perna et al. (1999) exposed individuals with panic disorder, GAD, panic disorder with comorbid GAD, and nonanxious control participants to 35% CO_2-induced air, a

biological challenge stimulus that has been shown to elicit panic symptoms in individuals with panic disorder. Results indicated that although the comorbid group reported experiencing greater pre-CO_2 challenge anxiety than the panic group, the comorbid group experienced a smaller increase in number of endorsed panic symptoms (+9.0) from pre- to post-inhalation than did the panic group (+13.8). This difference in increase, however, did not reach significance.

Both of these investigations show evidence of heightened anxiety in individuals with GAD just prior to an interoceptive challenge, but a lack of group differences during or immediately following the challenge. The finding that a diagnosis of GAD was associated with heightened anxiety just prior to exposure may speak to the temporal orientation to future events characteristic of the condition (Molina, Borkovec, Peasley, & Person, 1998), and suggests that such anticipation of negative events is particularly distressing for individuals with GAD. Additionally, despite this increase in subjective and physiological anxiety in GAD groups, GAD was not associated with heightened activation just following the interoceptive tasks. One plausible hypothesis is that the presence of GAD served to inhibit full emotional processing of the interoceptive cues that would otherwise lead to greater activation in the GAD group, given its heightened pre-exposure arousal. Support for this hypothesis would come from the evidence presented earlier suggesting that a period of worry is associated with suppressed cardiovascular activity during a subsequent anxiety-eliciting task. An important methodological distinction, however, lies in the fact that previous research indicating that worry serves an inhibitory function in subsequent anxiety tasks used a period of induced worry in the procedure, whereas the two studies with panic disorder only utilized trait-GAD groups

and did not have state manipulations of worry. Given this, a crucial next step in elucidating a causal influence of worry on emotional processing of panic symptoms is to induce a worry state prior to interoceptive exposure.

Summary

Theoretical conceptualizations suggest that the inhibitory nature of worry finds its genesis in the verbal linguistic nature of the worry process, which makes worry remote from the somatic and affective experience of anxiety which is necessary for full emotional processing and habituation of the subjective anxious response (Borkovec et al., 2004). No investigations to date, however, have isolated the verbal linguistic nature of worry in an effort to ascertain whether indeed it is this quality that leads to suppression of somatic and affective experience during a subsequent anxiety-eliciting task. Furthermore, given GAD's high level of comorbidity with panic disorder, it is likely that worry interferes with full emotional processing of somatic fear cues in panic disorder and therefore ultimately serves a maintaining mechanism for this syndrome, potentially accounting for some of the variance in response to treatment for this condition. Although past research has examined the effects of exposure to interoceptive cues in GAD, it has not evaluated the role of state worry on anxious responding during those exposure periods. The proposed study seeks to (1) examine the role of worry in a panicogenic biological challenge task using individuals with high anxiety sensitivity and (2) test the hypothesis that it is specifically the verbal linguistic nature of worry that causes its inhibitory functions. To this end, participants in the present experiment were randomly assigned to undergo relaxation inductions or worry inductions that focused on either verbal linguistic activity or imaginal activity just prior to repeated presentations of a

biological challenge task. Participants included in the experiment were selected on the basis of their high levels of anxiety sensitivity. The next chapter presents a thorough review of the anxiety sensitivity construct and the questionnaire designed to measure it.

Chapter 3: Anxiety Sensitivity

A crucial component of exposure-based treatment for panic disorder is the elicitation of panic sensations both within and between sessions. Patients are typically asked to engage in biological challenges that reproduce the somatic sensations that have come to elicit a fearful response and that often lead to panic attacks. Several biological challenges are known to induce symptoms of panic in human beings. However, not all individuals respond to such challenges in the same way. Indeed, a task that produces a full-blown panic attack in one person may produce little more than minor discomfort in another. Such inter-individual differences in physiological, behavioral, cognitive, and emotional responses to biological challenges have been argued to be largely influenced by psychological factors. One such psychological variable hypothesized to mediate responses to biological challenge procedures is anxiety sensitivity.

Anxiety Sensitivity: An Individual Differences Factor

Anxiety sensitivity (AS) is theorized to be a dispositional trait that is characterized by a fear of autonomic arousal and the physical sensations associated with anxiety states (e.g., increased heart rate, dizziness, nausea, shortness of breath; Reiss & McNally, 1985; Reiss, Peterson, Gursky, & McNally, 1986). Anxiety sensitivity as an individual differences variable has played a central role in theoretical conceptualizations of panic disorder (McNally, 1990; Reiss, 1991). These theoretical conceptualizations posit that the physiological arousal characteristic of anxiety becomes feared by individuals who are sensitive to such sensations and thereby becomes capable of eliciting increased anxiety with the potential for escalating into a panic attack.

This construct is closely related to the cognitive model of panic disorder, which stipulates that catastrophic misinterpretations of normal somatic sensations can escalate into acute anxiety experiences because those sensations are interpreted as being dangerous and even potentially fatal (Clark, 1986, 1988; Beck et al., 1985; Barlow, 2002). Such catastrophic cognitions include the belief that somatic sensations are indicative of impending physical catastrophe, social embarrassment, and/or mental incapacitation (Stewart, Taylor, & Baker, 1997). Indeed, some investigations (e.g., Schmidt, Lerew, & Jackson, 1997, 1999) offer support for the view of anxiety sensitivity as a cognitive predisposition or diathesis for the later development of panic disorder. Anxiety sensitivity also bears a relationship with the "fear of fear" construct as posed by Goldstein and Chambless (1978) – another construct with close ties to cognitive theories of emotional disorders. However, McNally (1990) asserted that the core difference between the two constructs is that anxiety sensitivity is not theoretically related to interoceptive conditioning formulations and refers only to *beliefs* about the symptoms of anxiety, whereas the fear of fear construct refers to conditioned fear responses to those anxiety symptoms.

Etiology of Anxiety Sensitivity

Although little is known about the etiology of anxiety sensitivity, several investigators have sought to propose possible mechanisms by which this trait develops. Family studies of panic disorder have shown that the condition tends to run in families (e.g., Goldstein et al., 1994; Noyes, Crowe, Harris, Hamra, McChesney, & Chaudhry, 1986; Fyer, Mannuzza, Chapman, Martin, & Klein, 1995; Goldstein, Wickramaratne, Horwath, & Weissman, 1997). Furthermore, given evidence of the heritability of panic

disorder emerging from twin studies (Torgersen, 1983; Skre, Onstad, Torgersen, Lygren, & Kringlen, 1993; Kendler et al., 1993; Perna, Caldirola, Arancio, & Bellodi, 1997), many theorists have speculated that panic patients share a genetic risk factor for panic that is biological in nature (e.g., sensitivity to CO_2; Perna, Cocchi, Bertani, Arancio, & Bellodi, 1995). However, Stein, Jang, and Livesley (1999) showed in a twin study that the *psychological* construct of anxiety sensitivity was 45% heritable. Furthermore, their results suggested that this heritability ratio was similar for groups reporting both high and low AS levels, suggesting that levels of AS characteristic of panic disorder are not more genetically heritable than lower, subclinical AS levels.

Given the 45% estimate of heritability reported by Stein et al. (1999), it is clear that environmental factors also play a substantive role in the etiology of AS. In the original proposal of the anxiety sensitivity construct, Reiss and McNally (1985) posed an "enhanced reactivity" hypothesis for the development of AS. They posited that individuals are more likely to develop high anxiety sensitivity if they typically experience heightened autonomic arousal in response to stress. Stein and Rapee (1999) reviewed limited support for this position. For example, Sturges and Goetsch (1996) found evidence of greater heart rate response ($p < .06$) among high AS women to a mental arithmetic stressor, but not a caffeine ingestion stressor, relative to low AS women. Additional evidence supporting this hypothesis is reviewed by Stein and Rapee (1999).

However, several investigations have failed to provide support for the enhanced reactivity hypothesis. One such study by Shostak and Peterson (1990) reported a lack of differences in muscle tension and systolic blood pressure resulting from a mental arithmetic stressor task between nonclinical low, moderate, and high AS groups. Another

study failed to find differences between nonclinical low and high AS groups in heart rate response to a hyperventilation task (Asmundson, Norton, Wilson, & Sandler, 1994). Finally, a third study found no differences between nonclinical low, moderate, and high AS groups on heart rate response to an aversive loud noise stressor (Stewart & Pihl, 1994).

Other investigators have studied potential learning mechanisms in the development of AS. A classical conditioning (i.e., interoceptive conditioning) formulation would posit that individuals who experience somatic arousal symptoms (e.g., a racing heart, shortness of breath) followed by a frightening event such as a panic attack might associate the two stimuli and learn to fear arousal symptoms in the future. However, many individuals with high levels of AS have never experienced a panic attack (Donnell & McNally, 1990; Cox, Endler, Norton, & Swinson, 1991), suggesting that the pairing of somatic arousal with a panic attack is not necessary for the development of high AS.

Alternatively, research on vicarious and instrumental learning principles may offer some useful information regarding the etiology of AS. Vicarious learning of anxiety sensitivity might take place if a child observed a parent experiencing autonomic arousal and communicating beliefs about the harmfulness of those symptoms, whereas instrumental learning of anxiety sensitivity might occur if a child received special attention after complaining of such symptoms (positive reinforcement) or were allowed to stay home from school (negative reinforcement).

Watt, Stewart, and Cox (1998) found that, compared to individuals with lower anxiety sensitivity, high AS individuals retrospectively reported greater frequency of both

vicarious and instrumental learning experiences involving somatic symptoms. It is important to note, however, the importance of establishing specificity of this finding for *anxiety*-related somatic symptoms, since "somatic symptoms" may also include illness-related sensations (e.g., stomach problems, respiratory problems, pain). The evidence for specificity of anxiety-related symptoms has been mixed, with two studies failing to find evidence of specificity. Watt et al. (1998) found that the high anxiety sensitivity participants in their investigation reported a greater frequency of both anxiety-related *and* illness-related symptoms relative to participants with lower levels of AS. In an extension of this study, Watt and Stewart (2000) found that AS was significantly positively correlated with retrospectively reported parental modeling and instrumental learning responses to their children's and their own anxiety-related *and* non-anxiety-related somatic symptoms.

On the other hand, another investigation did find specificity of anxiety-related symptoms. Ehlers (1993) found that panickers reported a greater history of both vicarious and instrumental learning experiences relative to normal controls for anxiety-related symptoms but no differences for non-anxiety-related symptoms. Taken together, these results suggest that both panic disorder and high AS are characterized by past vicarious and instrumental learning experiencing involving somatic symptoms, but whereas high AS is associated with past learning experiences involving anxiety-relevant and non-anxiety-relevant symptoms, panic is associated specifically with learning experiences involving anxiety-relevant symptoms. Corroborating this conclusion, Stewart et al. (2001) found that in a group of young adults, AS mediated the relationship between panic frequency and both anxiety-related and non-anxiety-related symptoms.

The Anxiety Sensitivity Index

The most commonly used measure of anxiety sensitivity is the Anxiety Sensitivity Index (ASI; Reiss, Peterson, Gursky, & McNally, 1986; Peterson & Reiss, 1992). The ASI is a 16-item self-report measure that assesses an individual's fear of anxiety and the individual's beliefs about the potential consequences of anxiety-related sensations. For example, the ASI asks respondents to indicate the degree to which they agree with the items "It scares me when I feel faint"; "When I notice my heart is beating rapidly, I worry that I might have a heart attack"; and "It scares me when I am unable to keep my mind on a task." Peterson and Reiss (1992) reported a mean of 19.01 (SD = 9.11) for a large nonclinical normative sample (*N* = 4,517). In a group of military cadets undergoing a stressful training situation, Schmidt et al. (1997) reported similar scores on the ASI (*M* = 19.8, SD = 8.0). Finally, Rapee, Brown, Antony, and Barlow (1992) reported that in a clinical sample, patients with panic disorder (without agoraphobia) exhibited substantially higher scores on the ASI (*M* = 36.4, SD = 10.3). The psychometric properties of the ASI have been widely investigated, and the measure has been translated into several languages, including Spanish, German, Hebrew, French, and Dutch. In this section, I review the reliability, validity, and factor structure of the ASI.

Reliability of the ASI

The ASI has favorable internal consistency (alpha coefficients ranging from .80 to .90) for both nonclinical and clinical samples (Peterson & Reiss, 1992; Telch, Shermis, & Lucas, 1989). Peterson and Heilbronner (1987) reported high Guttman split-half reliability (*r* = .85) and a Cronbach's alpha of .88 for the ASI. Additionally, retest reliability of the ASI is good, with reliability coefficients of .75 reported for 2-week

periods (Peterson & Reiss, 1992; Reiss et al., 1986), .72 for 2-year periods (Rodriguez, Bruce, Pagano, Spencer, & Keller, 2004), and .71 for periods of over three years (Peterson & Reiss, 1992; Maller & Reiss, 1992).

Construct Validity of the ASI

Several investigations have attested to the construct validity of the ASI. ASI scores reported by agoraphobic patients following treatment are equal to the scores reported by control participants (McNally & Lorenz, 1987), providing evidence that the ASI is sensitive to clinical improvement. Reiss et al. (1986; replicated using a clinical sample by McNally & Lorenz, 1987) showed that the ASI was correlated more highly than was a measure of anxious frequency with a measure of fearfulness, suggesting that the ASI is a measure of anxiety sensitivity and not merely a measure of anxiety or neuroticism in general. Also, although panic disorder and GAD patients score similarly on measures of trait anxiety, panic disorder patients evidence higher mean ASI scores (M = 36.2) than do GAD patients (M = 26.2) (Taylor, Koch, & McNally, 1992).[5] Indeed, anxiety sensitivity's distinctness from trait anxiety has been a topic of much theoretical and empirical inquiry. In arguing for the construct validity of the ASI, it is important to provide evidence that anxiety sensitivity, or the fear of the symptoms of anxiety, is distinct from trait anxiety, or the fear of stressors in general. Investigations examining the relationship between the ASI and the Sate Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) show that the correlation between state and trait anxiety is larger than the correlation between anxiety sensitivity and trait anxiety. Furthermore, in a factor analytic study, two factors representing Anxiety Sensitivity and Trait Anxiety correlated r = .39, offering support for the view of AS and

trait anxiety as distinct constructs (Taylor, Koch, and Crockett, 1991). Studies have also offered support for the ASI's incremental validity over trait anxiety measures in explaining variance in fearfulness (e.g., McNally & Lorenz, 1987; Reiss et al., 1986).

However, research on the specificity of anxiety sensitivity to panic disorder has yielded some mixed results. On the one hand, many lines of evidence suggest a close relationship between AS and panic. For example, the ASI distinguishes undergraduate students who have experienced recent panic attacks (ASI $M = 21.1$, SD = 8.9, $N = 105$) from those who have not ($M = 16.3$, SD = 8.1, $N = 155$) (Peterson & Sacks, 1987, as cited in Plehn & Peterson, 2002). Also, high AS individuals report a greater history of unpredictable panic (32.4%) relative to medium AS (15.6%) and low AS (5.1%) individuals (Donnell & McNally, 1990). Furthermore, Taylor et al. (1992) compared the ASI scores of six groups of individuals with different anxiety disorders and a nonanxious group. Results indicated that those with panic disorder exhibited the highest scores on the ASI, suggesting that panic bears a particular relationship with AS.

On the other hand, there is evidence suggesting that panic disorder is not unique in its relationship to high AS. For example, all of the anxiety groups in the Taylor et al. (1992) study except for the specific phobia group likewise scored more highly on the ASI compared to the nonanxious group. Several other studies have shown that despite the fact that AS is most often associated with panic disorder, it is also an important construct in various other conditions, including depression (Schmidt et al., 1997), PTSD (McNally, Luedke, Besyner, Peterson, Bohm, & Lips, 1987), and other anxiety disorders (Taylor et al., 1992). Also, Reiss et al. (1986) found that agoraphobic patients had significantly higher ASI scores than did non-agoraphobic anxiety disorder patients, who in turn had

significantly higher ASI scores than did a normative college student group, suggesting that AS is particularly high in agoraphobia. There is even reason to believe that a panic diagnosis is independent of the experience of high AS. Many individuals with high AS have no history of panic attacks (e.g., 11.8%; Donnell & McNally, 1990). Therefore, high AS is not necessarily dependent on past experiences with panic.

A review of the literature did not reveal any investigations of the ability of the ASI to detect cases and non-cases of panic disorder (e.g., through receiver operating characteristic analyses). In conclusion, it seems that although most individuals with panic disorder score highly on the ASI, not all individuals with high anxiety sensitivity have panic disorder.

Predictive Validity of the ASI

Despite the fact that past panic symptoms are not a prerequisite for the existence of high AS, high AS is theorized to act as a risk factor for the development of anxiety in general and of panic symptoms in particular. Indeed, both prospective studies and experimental laboratory studies have provided empirical evidence in support of this assertion.

Prospective Studies. Three prospective investigations have examined the ability of the ASI to predict panic symptoms over time. First, Maller and Reiss (1992) found that ASI scores predicted the frequency and intensity of panic attacks three years later in a student population. Furthermore, students with high ASI scores were significantly more likely to develop an anxiety disorder (including panic disorder) relative to individuals with low ASI scores. Because Maller and Reiss (1992) did not rule out the possibility that trait anxiety might have accounted for the development of panic

symptoms, Schmidt et al. (1997; replicated in Schmidt et al., 1999) sought to replicate and extend their findings by including a measure of trait anxiety. Schmidt et al. (1997) tested a group of US Air Force Academy cadets before and after completing a 5-week stressful cadet training procedure. Results indicated that after controlling for trait anxiety and panic symptom history, high scores on the ASI predicted the development of anxiety and depression following the stressful training as well as a greater number of panic attacks during training. These results replicated the findings reported by Maller and Reiss (1992) and further indicated that the predictive validity of the ASI was not better explained by trait anxiety symptoms. Finally, Plehn and Peterson (2002) further extended past findings from the two previous studies by conducting a long-term prospective investigation of the predictive validity of the ASI. They conducted an 11-year follow-up investigation using a group of undergraduate students (no longer students at Time 2) and found that (a) both the ASI and trait anxiety were significant predictors of the development of panic symptoms when controlling for history of panic symptoms; (b) the ASI was the only significant predictor of self-reported panic attacks; and (c) only trait anxiety was a significant predictor of panic disorder, despite the fact that the ASI had been the only significant predictor of self-reported panic attacks (i.e., a central component needed for a diagnosis of panic disorder). Taken together, these prospective studies suggest that the ASI is a valid predictor of the development of panic symptoms, and the Plehn and Peterson (2002) study provides preliminary evidence that trait anxiety – but not anxiety sensitivity – is the only significant predictor of panic disorder.

Experimental Studies. Although prospective studies such as the three reviewed above offer valuable information regarding the predictive validity of the ASI,

experimental studies have the added advantage of being capable of demonstrating that the ASI predicts panic symptoms during actual laboratory procedures designed to elicit the very somatic sensations that are theoretically feared by individuals with high levels of AS.

Biological challenge tests are widely used to provoke panic sensations in individuals with panic disorder under controlled laboratory conditions. Such challenges include sodium lactate infusions (Gaffney, Fenton, Lane, & Lake, 1988; Liebowitz et al., 1985), caffeine ingestion (Charney, Heninger, & Jatlow, 1985), inhalation of carbon dioxide (Griez et al., 1987; Woods, Charney, Goodman, & Heninger, 1987), and hyperventilation tasks (Gorman et al., 1984; Rapee, 1986). Rapee et al. (1992) found that individuals with a panic disorder diagnosis report greater subjective responses to both voluntary hyperventilation and CO_2 inhalation tasks relative to individuals with other (non-panic) anxiety diagnoses, who in turn report greater responses relative to control participants. They further found that participants meeting criteria for panic disorder as an *additional* diagnosis reported greater subjective responses relative to participants with anxiety disorder diagnoses and *no* additional panic diagnosis. Holt and Andrews (1989a, 1989b) compared responses to voluntary hyperventilation and CO_2 inhalation among participants with panic disorder, social phobia, and GAD and found that those with panic disorder reported greater fears of impending doom relative to the two other diagnostic groups. Therefore, it is clear that a diagnosis of panic disorder is associated with fearful responses to biological challenge procedures.

In their original proposal of the AS construct, Reiss and McNally (1985) suggested that responses to biological challenges could also be explained by an

individual's level of anxiety sensitivity. Indeed, several experimental laboratory investigations have shown that ASI scores predict symptoms during panicogenic biological tasks in both clinical and nonclinical samples. In testing a sample of anxiety disorder patients presenting for treatment, Rapee et al. (1992) found that prechallenge ASI score was the best predictor of response to CO_2 inhalation and a voluntary hyperventilation procedure in a sample of anxiety disorder patients, whereas measures of anxiety and social anxiety did not predict subjective responses to the procedures. Similarly, Rapee and Medoro (1994) provided evidence for the ability of the ASI to predict severity of cognitive and affective (and, in Study 3, somatic) symptoms in response to a hyperventilation procedure above and beyond the variance accounted for by trait anxiety.

Undergraduate student participants who score highly on the ASI and who have no history of panic respond similarly to panic patients during biological challenges (e.g., CO_2 challenge, Telch & Harrington, 1992 as cited in McNally & Eke, 1996). Therefore, laboratory investigations employing student samples can provide valuable information regarding the predictive validity of the ASI, given that these participants respond similarly to clinical participants. Many of these investigations have used voluntary hyperventilation procedures to induce bodily sensations. For example, Holloway and McNally (1987) reported that undergraduate participants scoring highly on AS reported higher levels of anxiety and more hyperventilation sensations in response to a hyperventilation challenge than did participants scoring low on AS (although it should be noted that covariance analyses indicated that the higher levels of anxiety, but not hyperventilation sensations, were due to elevated pre-challenge levels of anxiety). In a

replication and extension of this study, Donnell and McNally (1989) found that regardless of history of panic, participants with high AS reported more physical sensations and greater anxiety than did participants with low AS. In fact, a history of panic led to enhanced response to hyperventilation only for participants with high AS, whereas it had no impact on response for participants with low AS. Furthermore, Asmundson et al. (1994) exposed high and low AS undergraduate participants with and without a history of panic to a voluntary hyperventilation procedure and found that high AS participants self-reported greater symptoms than did low AS participants, despite the lack of a history of panic.

McNally has investigated even more specific aspects of the ASI's predictive validity by testing the hypothesis that individuals are more likely to respond with heightened anxiety when there is a match between the sensations induced by the biological challenge procedure and the specific anxiety-relevant sensations feared by the individual. However, the two studies testing this hypothesis yielded different results. In one study, fear of suffocation was a better predictor of self-reported anxiety and bodily sensations in reaction to paper bag rebreathing than was anxiety sensitivity or breath holding duration (a measure of CO_2 sensitivity) in an undergraduate sample (McNally & Eke, 1996). In the other study, the ASI was a better predictor of response to a paper bag rebreathing task than was fear of suffocation (Eke & McNally, 1996). Given these mixed findings, it remains unclear whether fear of suffocation would be a better predictor of responses to a paper bag rebreathing procedure, which increases central CO_2 levels. Furthermore, it is possible that fear of suffocation and anxiety sensitivity predict roughly

equal variance in response to this challenge, and that both predict more variance relative to a measure of trait anxiety (Eke & McNally, 1996).

Factor Structure of the ASI

Empirical investigations examining the factor structure of the ASI have yielded conflicting results. As originally proposed, anxiety sensitivity was conceptualized as a unitary construct (Reiss & McNally, 1985). However, since the original proposal there has been considerable disagreement regarding whether the ASI is unifactorial or multifactorial, and even among theorists who agree on the multifactorial approach there remains disagreement regarding the number of factors that comprise the measure. Studies employing factor analytic methods to address this issue are useful given that the existence of different factors may indicate the existence of different mechanisms within AS. Knowledge regarding such mechanisms of AS facilitates research on the possibility that different mechanisms may have different causes, may increase the risk for developing comorbid conditions (e.g., a factor corresponding to a fear of publicly observable anxiety reactions may increase the risk for developing comorbid social anxiety), and may respond differentially to treatment.

The unifactorial view. Early studies employing factor analytic strategies provided evidence supporting the unitary view of AS. For example, Reiss et al. (1986) reported that 13 of the 16 ASI items loaded onto a single factor, leading those researchers to espouse a unitary view of AS. Since then, other investigations have likewise found evidence in favor of a single factor.

Taylor et al. (1991) administered the ASI and the STAI-T to 142 spider phobic students and 93 psychiatric outpatients and found evidence in favor of a unifactorial

solution in both samples. Taylor, Koch, McNally, & Crockett (1992) found that the orthogonal 4-factor model proposed by Telch, Shermis, and Lucas (1989) as discussed below produced a goodness-of-fit index that was comparable to a single-factor solution. Taylor et al. (1992) endorsed the single-factor model and argued that the 4-factor solutions proposed by others (Telch et al., 1989; Wardle, Ahmad, & Hayward, 1990) were inappropriate on the basis of high interfactor correlations. Indeed, a common argument in favor of a unidimensional solution of the ASI is that factors from multifactorial solutions tend to correlate with one another. Cox, Parker, and Swinson (1996) found mean intercorrelations of .50 in a patient sample and .48 in a student sample, but maintained that these intercorrelations were low enough to retain a multidimensional view of the ASI.

Importantly, several investigators have asserted that unidimensional models do not provide a satisfactory fit for the data (e.g., Cox et al., 1996; Schmidt & Joiner, 2002). Moreover, it is common for multidimensional measures to be intercorrelated (Cox et al., 1996), and the assertion that AS is likely hierarchical in nature (Lilienfeld, Turner, & Jacob, 1996) suggests that it may be best to conceptualize AS as multidimensional in nature with a higher-order general AS factor.

The multifactorial view. Several investigations employing factor analytic techniques have indicated that the ASI consists of three lower-order factors labeled Fear of Somatic Sensations, Fear of Cognitive Dyscontrol, and Fear of Publicly Observable Anxiety Symptoms (see Zinbarg, Mohlman, & Hong, 1999 for a review). Moreover, studies examining the correlates of ASI factors provide support for this multidimensional conceptualization of AS. For example, the Fear of Somatic Sensations factor of the ASI

has been found to be the strongest predictor of response to challenges designed to elicit panic symptoms (Zinbarg, Brown, Barlow, & Rapee, 2001) and is most strongly associated with a panic disorder diagnosis (Zinbarg, Barlow, & Brown, 1997; Taylor, Koch, Woody, & McLean, 1996). The Fear of Cognitive Dyscontrol factor has been found to be more strongly related to depression than to panic disorder (Blais et al., 2001; Taylor et al., 1996). Finally, the Fear of Publicly Observable Anxiety Symptoms factor is more closely related to fear of negative evaluation and social phobia diagnoses (McWilliams, Stewart, & MacPherson, 2000; Zinbarg et al., 1997). Furthermore, many investigators have argued for the hierarchical nature of the ASI, such that these three lower-order factors are subsumed under a single high-order factor measuring global anxiety sensitivity (Zinbarg et al., 1997).

There appears to be some convergent validity (reviewed by Zinbarg et al., 1999) for the existence of the three lower-order factors listed above. For example, Wardle et al. (1990) also reported the existence of these three factors in an administration of the ASI to 166 agoraphobic patients and 120 control participants, but proposed an additional factor in addition to these three for a 4-factor solution that explained 60% of the variance in both the patient and control samples. Their fourth factor was Fear of Gastrointestinal Difficulties.

Telch, Shermis, and Lucas (1989) employed a much larger sample (N = 840) and likewise reached a 4-factor solution that explained 53.5% of the total variance, but two of their factors differed from those of Wardle et al. (1990). The four factors reported by Telch et al. were Fear of Somatic Sensations, Fear of Cognitive Dyscontrol, Loss of Control, and Cardiopulmonary Failure.

One important disclaimer (pointed out by Schmidt & Joiner, 2002) is that even the best-fitting solutions provide limited fit for the data and often do not meet accepted criteria standards. Because of this, some investigators have proposed expanding the ASI's item pool in order to increase the reliability of the measure's subscales/factors. Indeed, one common criticism of the ASI is that it contains too few items to adequately measure the different factors, especially given that most of the items measure fears of somatic sensations and relatively few measure fears of cognitive symptoms and fears of publicly observable symptoms. Deacon, Abramowitz, Wood, and Tolin (2003) argued that in addition to containing an insufficient number of items, the ASI suffers from poor wording and from poor face validity on select items.

Development of the ASI-Revised

Accordingly, the ASI-Revised (ASI-R; Taylor & Cox, 1998) was developed to improve the assessment of AS and its factors. The ASI-R contains 36 items (including 10 of the ASI's original 16 items) and was constructed to separately measure fears of different anxiety symptoms. Taylor and Cox (1998) concluded that the ASI-R consists of four factors (Fear of Respiratory Symptoms, Fear of Publicly Observable Anxiety Reactions, Fear of Cardiovascular Symptoms, and Fear of Cognitive Dyscontrol) and correlates $r = .94$ with the ASI, providing evidence that it is a valid measure of anxiety sensitivity as measured by the original scale.

Using a nonclinical sample, Deacon et al. (2003) reported that the ASI-R has excellent internal consistency (.95). Furthermore, they concluded that the ASI-R is hierarchical in nature, yielding a single higher-order factor and four lower-order factors (Beliefs About Harmful Consequences of Somatic Sensations, Fear of Publicly

Observable Anxiety Reactions, Fear of Cognitive Dyscontrol, and Fear of Somatic Sensations Without Explicit Consequences [the first factor measures anxious affect, whereas the fourth factor measures anxious cognition]). In an attempted replication of this four-factor solution (Deacon et al., 2003, Study 2), the authors concluded that the factors Fear of Publicly Observable Anxiety Reactions and Fear of Cognitive Dyscontrol corroborated the findings from Taylor and Cox (1998), and that the other two somatic factors likely represent a blend of the two somatic factors reported by Taylor and Cox.

Chapter 4: Conclusions

This investigation contributes to a broader understanding of the mechanisms by which worry acts as an avoidance response as well as the specific ways in which its inhibitory nature affects the maintenance of panic disorder. Several factors make this knowledge especially important:

- **The presence of worry may be a key factor in the maintenance of other anxiety disorders, including panic disorder.** Worry prevents emotional processing (Borkovec et al., 2004). Given that extinction of fear responses in other anxiety disorders theoretically depends on accession of the fear structure (Foa & Kozak, 1986), the pervasive presence of worry in other anxiety disorders (Barlow, 2002) makes it likely that its inhibitory nature serves a maintaining mechanism in other syndromes by precluding such emotional processing.
- **Little laboratory research has been conducted on the comorbidity between GAD and panic disorder**. Of the investigations that have been conducted in this area, participants meeting criteria for GAD were included in order to examine the effects of interoceptive cues on anxious responding for this group (Roth et al., 1998; Perna et al., 1999). However, no experimental manipulations of worrisome thinking have been employed. Results from other research on the effects of worry on subsequent anxiety-eliciting tasks, however, suggest that such state worry manipulations may be essential in detecting the suppressive effects of worrisome thinking (e.g., Borkovec & Hu, 1990; Hazlett-Stevens & Borkovec, 2001).
- **Several researchers have argued that GAD may not truly be a separate entity, and that instead it may be the "basic" anxiety disorder out of which others**

emerge. An important step in evaluating the taxonomy of GAD is to examine its role in the other conditions with which it overlaps. Given the high degree of comorbidity between GAD and panic disorder (Brown et al., 2001a) and the dearth of research on the relationship between these two classes of symptoms, laboratory investigations of the role of worry in panic symptoms are needed.

- **Research investigating the effects of worrisome thinking on subsequent anxiety-eliciting tasks has not isolated the verbal linguistic nature of worry as the active ingredient in its suppressive effects on arousal.** Employing a condition in which worrisome imagery (versus customary verbal worry) is used would provide the necessary comparison to identify worry's verbal linguistic nature as the mechanism through which worry's inhibitory effects are manifest.

Chapter 5: Methods

Design

This investigation employed repeated presentations of a biological challenge procedure in a 3 (Pre-exposure Induction: relaxation, worry-verbal, worry-imaginal) X 3 (Exposure Period: first, second, third) mixed model design using individuals selected on the basis of their high levels of anxiety sensitivity. Additionally, one week following the laboratory task, 78% (N = 58) of participants returned to the laboratory to participate in somatic, cognitive, and affective symptom recall and recognition tasks. This latter portion of the experiment constitutes a pilot study to investigate potential memory biases resulting from worry in individuals with high AS. Although the results of this pilot investigation are not reported here, such knowledge may be valuable in informing future research on the nature of worry and its impact on panic symptoms.

Participants

Participants (N = 75 [15 male]) for the investigation were recruited from the undergraduate student population at Penn State University. The sample was 78.4% (N = 58) Caucasian, 6.8% (N = 5) Black, 4.1% (N = 3) Hispanic, 4.1% (N = 3) Asian, and 5.4% (N = 4) multiple ethnicity, with 1.4% (N = 1) of the sample declining to indicate race/ethnicity. Chi-square analyses indicated that the representation of races/ethnicities and the representation of gender did not differ across conditions of the experiment. Participants ranged in age from 18 to 41 (M = 19.30, SD = 3.49); age was not significantly different across conditions of the experiment.

Selection of Participants. As part of a group testing session, all participants were administered the Anxiety Sensitivity Index (ASI). High scorers on the ASI were

recruited for the experiment, as opposed to individuals who met the diagnostic criteria for panic disorder. Nonclinical participants with high levels of anxiety sensitivity have been shown to report more physical symptoms and higher anxiety relative to individuals with low levels of anxiety sensitivity (Holloway & McNally, 1987), and this enhanced responsivity to hyperventilation is evident even among individuals who have never experienced a panic attack (Donnell & McNally, 1989). Furthermore, scientific findings suggest that anxiety sensitivity – not a history of panic – is the primary predictor of enhanced reactivity to biological challenge procedures. For example, level of AS predicts emotional responsiveness to a caffeine ingestion task whereas history of panic does not (Telch, Silverman, and Schmidt, 1996), and among individuals with no history of panic, those with high AS report more symptoms during a voluntary hyperventilation task relative to those with low AS (Asmundson et al., 1994). Similarly, individuals with high AS experience enhanced reactivity to a hyperventilation task relative to individuals with low AS, and a history of panic enhances this response in individuals with high AS but not in those with low AS (Donnell and McNally, 1989).

Individuals scoring at least a 32 on the ASI were eligible for participation. In a sample of college students, Holloway and McNally (1987) reported that the high AS group employed in their study had a mean ASI score of 31.5 (SD = 9.1). Therefore, a cutoff of 32 was used for the present study in order to yield a sample whose ASI scores were at least this high. This cutoff was also chosen on the basis of its inclusion of individuals scoring more than one standard deviation above the mean for unselected participants as reported in several investigations (e.g., Peterson & Reiss [1992], *M* = 19.01, SD = 9.11; Carter, Suchday, & Gore [2001], *M* = 18.49, SD = 8.04; Reiss et al.

[1986], female *M* = 20.05, SD = 10.2, male *M* = 15.4, SD = 8.1). This cutoff also included individuals scoring higher than the mean for participants with panic disorder (*M* = 18.3, SD = 8.37, Plehn & Peterson, 2002) and panic disorder with agoraphobia (*M* = 32.1, SD = 11.3, Rapee et al., 1992). The psychometric properties of the ASI were reviewed in detail in Chapter 3. Furthermore, the use of the ASI in this investigation in particular is discussed in additional detail later.

Furthermore, because scores on the ASI and the Penn State Worry Questionnaire are likely to be correlated, an effort was made to recruit participants whose PSWQ scores fell at the low, middle, and high ends of the possible range (16-80) of PSWQ scores. This step ensured that results would not merely be due to high levels of trait worry.

Participant Recruitment. Participants meeting the inclusionary criterion were initially contacted via telephone for a brief screening. In order to reduce expectancy effects, the study's purpose was concealed both during initial telephone contact and during the experiment by describing the investigation as an inquiry into the effects of breathing rate on physiological activity. In order to ensure the safety of participants, several exclusionary criteria were instituted. These criteria included current respiratory problems (including asthma), cardiovascular problems, a history of stroke, or a history of epilepsy. Although individuals currently taking medication were included in the experiment, individuals whose medication dosage had changed in the eight weeks prior to participation in the experiment were excluded. Individuals were asked about these health conditions during telephone screening (as scripted in the Telephone Screening Form, Appendix A) and the research assistant making telephone calls kept a record of all

potential participants' responses on copies of the Medical Condition Screening Form (Appendix B).

Of the 97 individuals who were invited to participate in the experiment, 3 were excluded on the basis of health-related criteria (2 heart, 1 respiratory), and an additional individual was excluded because her medication dosage had changed in the eight weeks prior to being contacted for the study. A total of 19 contacted individuals chose to decline the invitation to participate in the experiment.

Measures Administered to Participants

Anxiety Sensitivity Index (ASI; Peterson & Reiss, 1992; Reiss et al., 1986) and *Anxiety Sensitivity Index – Revised* (ASI-R; Taylor & Cox, 1998). The ASI is a 16-item self-report measure on which respondents indicate using a 5-point (0-4) Likert scale their beliefs regarding the consequences of their anxiety symptoms. The ASI has demonstrated excellent psychometric properties in both clinical and nonclinical samples as reviewed in Chapter 3 of this document. The ASI-R is a 36-item measure of anxiety sensitivity and includes 10 of the original ASI items in addition to 26 others that were included to more comprehensively and reliably measure the dimensions of anxiety sensitivity. The psychometric properties of the ASI-R have not been as extensively researched as have those of the ASI, and no investigations have been conducted to test the extent to which the revised measure predicts fearful responding to biological challenge procedures. Therefore, only the original ASI was used to select participants. However, given that the developers of the ASI-R provide scoring rules to derive six subscale scores (Fear of Cardiovascular Symptoms, Fear of Respiratory Symptoms, Fear of Gastrointestinal Symptoms, Fear of Publicly Observable Anxiety Reactions, Fear of

Dissociative and Neurological Symptoms, and Fear of Cognitive Dyscontrol), the ASI-R was administered to participants to permit testing for equivalence on the six subscales across experimental groups. Furthermore, because participants were selected on the basis of scores on the original ASI, the six items from the ASI that do not appear in the ASI-R were included in the version administered. The resulting 42-item measure, which encompasses both the ASI and the ASI-R, appears in Appendix C. Items 1-16 comprise the original ASI (with items 5, 7, 13, 14, 15, and 16 representing the six items from the ASI that were not retained by the developers of the ASI-R). As proposed by Taylor and Cox (1998), the sum of items 6, 9, 17, 25, 33, and 39 yields the Fear of Cardiovascular Symptoms subscale; the sum of items 10, 19, 21, 22, 24, 32, and 38 yields the Fear of Respiratory Symptoms subscale; the sum of items 8, 11, 20, and 31 yields the Fear of Gastrointestinal Symptoms subscale; the sum of items 1, 3, 18, 26, 28, 30, 36, and 41 yields the Fear of Publicly Observable Anxiety Reactions subscale; the sum of items 4, 23, 27, 29, 34, and 35 yields the Fear of Dissociative and Neurological Symptoms subscale; and the sum of items 2, 12, 37, 40, and 42 yields the Fear of Cognitive Dyscontrol subscale.

Three investigations found that the ASI's Fear of Somatic Sensations factor is the strongest predictor of fearful responding to CO_2 (Zinbarg et al., 2001) and hyperventilation (Carter et al., 2001; Brown, Smits, Powers, & Telch, 2003). In selecting participants, however, all three factors of the ASI were used for the following reasons. First, widespread disagreement regarding the factor structure of the ASI makes the exclusion of certain factors potentially problematic in the process of selecting participants. Second, the vast majority of studies investigating the ASI's ability to

predict fearful responding to experimental biological challenge tasks utilized total ASI scores as opposed to scores on only one factor. Third, two of the three studies (Zinbarg et al., 2001; Brown et al., 2003) finding superior predictive validity for the Physical Concerns subscale utilized participants with anxiety disorders, whereas the present experiment utilized nonclinical participants. Fourth, investigators documenting the superior predictive validity of the Physical Concerns subscale have not suggested a cutoff score on this factor for selecting participants most likely to show a response to biological challenges. Finally, investigations have shown that different factors of the ASI possess sensitivity for different symptoms during biological challenge. For example, Brown et al. (2003) found that the Physical Concerns subscale was the best predictor of subjective fear, whereas the Social Concerns subscale was the best predictor of behavioral tolerance to the task. Zinbarg et al. (2001) found that the Physical Concerns subscale was the best predictor of fear ratings, whereas the Mental Incapacitation subscale was the best predictor of depression. Because the present investigation was concerned with affective, cognitive, somatic, and physiological responses to a hyperventilation task, the total ASI score (derived by summing all three factors) was utilized in selecting participants.

Panic Disorder Severity Scale – Self Report Version (*PDSS-SR*; Houck, Speigel, Shear, & Rucci, 2002). This measure was designed to identify diagnosable panic disorder based on *DSM-IV* diagnostic criteria. The PDSS – Interview Version (Shear et al., 1997) was shown to have good interrater reliability, moderate internal consistency, and favorable validity. The PDSS-Self Report Version begins with a working definition of a panic attack (including a list of symptoms) and consists of seven questions about the respondent's experiences with panic attacks. It was shown to have good internal

consistency (.917, compared to .923 for the interview version), retest reliability (.81), and sensitivity to change in treatment (mean decrease of 7.3, SD = 5.1 following cognitive behavioral treatment). For the present investigation, two items were added to the beginning of the PDSS in order to assess each participant's history of panic attacks. These two questions were phrased as follows: "How many panic attacks (as defined above) have you experienced in your life (total number)?" and "How many panic attacks (as defined above) have you experienced in the past week (total number)?" These questions were included in order to test for equality of panic attack history across experimental conditions.

Agoraphobic Cognitions Questionnaire (*ACQ*; Chambless, Caputo, Bright, & Gallagher, 1984). The ACQ is a 15-item measure assessing the extent to which an individual has specific commonly-reported thoughts when he/she is nervous and frightened. The ACQ yields two subscales: Loss of Control and Physical Concerns. Studies have demonstrated the ACQ's adequate internal consistency ($\alpha = .80$) and retest reliability (.86; Chambless et al., 1984). Additionally, Chambless et al. (1984) reported good convergent and discriminant validity for this scale.

Body Sensations Questionnaire (*BSQ*; Chambless et al., 1984). The BSQ is a 17-item self report measure of the degree to which individuals experience anxiety as manifest by specific somatic sensations (e.g., heart palpitations, numbness in arms). Retest reliability of the BSQ is fair (.67) and has been shown to have favorable internal consistency (.87). One study reported that the BSQ correlated $r = .66$ with the ASI (McNally & Lorenz, 1987).

State Trait Anxiety Inventory – Trait Version (*STAI-T*; Knight, Waal-Manning, & Spears, 1983; Spielberger et al., 1983). The STAI-T is a 20-item self-report questionnaire on which respondents rate their general level of anxiety on a 4-point (1-4) Likert scale ranging from "almost never" to "almost always". Research has shown that this measure possesses good internal consistency ($\alpha = .88$), retest reliability, and validity (Knight et al., 1983).

Generalized Anxiety Disorder Questionnaire - IV (GAD-Q-IV; Newman et al., 2002). This questionnaire was designed to identify diagnosable GAD based on *DSM-IV* criteria. The GAD-Q-IV has good internal consistency, retest reliability, strong convergent and discriminant validities, and a specificity of .97 and sensitivity of .69 when the Anxiety Disorder Interview Schedule (ADIS-IV; Brown, DiNardo, & Barlow, 1994) was used as the standard of comparison. The degree of concordance between the GAD-Q-IV and ADIS-IV diagnoses was equivalent to the reliability reported for GAD diagnoses from two independently administered ADIS-IV interviews (.67; Newman et al., 2002; Brown et al., 2001b). The GAD-Q-IV was employed to identify individuals who met the criteria for GAD or who were identified as Non-GAD (i.e., they did not endorse GAD criteria A, B, C, and E [APA, 1994]).

Penn State Worry Questionnaire (*PSWQ*; Meyer, Miller, Metzger, & Borkovec, 1990). The PSWQ is a 16-item measure of the frequency and intensity of worry. The PSWQ was shown to have high internal consistency (.91) and high retest reliability (Meyer et al., 1990). When administered to a large student sample, a PSWQ cutoff score of 62 discriminated between individuals with and without GAD with a sensitivity of .75 and a specificity of .86 (Behar, Alcaine, Zuellig, & Borkovec, 2003). The PSWQ has

also been shown to distinguish individuals with GAD from individuals with other anxiety disorders (Brown, Antony, & Barlow, 1992). Finally, correlations between the PSWQ and measures of anxiety, depression, and emotional control supported the convergent and discriminant validities of the measure (Brown et al., 1992).

Posttraumatic Stress Disorder Checklist (*PCL*; Weathers, Litz, Herman, Huska, & Keane, 1993). The PCL is a 17-item self-report measure of the *DSM-IV* symptoms associated with a diagnosis of PTSD. When administered to a sample of Vietnam veterans, the PCL was shown to have good internal consistency (.97), as well as good convergent validity with the Mississippi Scale (.93), the PK scale of the MMPI-2 (.77), and the Impact of Event Scale (.90). When using the Structured Clinical Interview for *DSM-IV* Axis I Disorders (SCID; First, Spitzer, Gibbon, & Williams, 1997) as the standard of comparison, the PCL was efficient at predicting a PTSD diagnosis with a sensitivity of .82 and a specificity of .83. The PCL was employed to identify individuals who met criteria A, B, C, and D for PTSD or who were identified as NonPTSD based on their lack of endorsement of these four criteria (APA, 1994).

Procedure

Pre-Experimental Procedure. Upon arriving for the experiment, participants were given information about the procedures involved in the study and were asked to provide their signed informed consent. Participants were also asked to complete a packet of questionnaires to measure levels of psychopathology. These questionnaires consisted of the PDSS-SR, ACQ, BSQ, STAI-T, GAD-Q-IV, and PCL (in counterbalanced order, but with the PCL always placed last, given that it inquires about potentially traumatic events that may prompt highly negatively valenced memories that could in turn influence

responses on subsequently administered measures). Copies of these questionnaires appear in Appendix C.

Participants were then asked to wash their hands with warm, soapy water in order to prepare the fingers' skin for the electrodes that would measure electrodermal activity. They were then led into a small experimentation room adjoined to a larger laboratory that housed psychophysiological equipment and audio-visual equipment that allowed for communication between the two rooms. Bilateral sites on participants' lower rib cages were wiped using an alcohol preparation pad, and Redux electrolyte paste (Electro-Cap, Inc.) was used to fill Ag-AgCl 7-mm electrodes (Med Associates). This enabled recording of an electrocardiogram (ECG) signal, which was sampled at 256 Hz with a 60 Hz notch filter and amplified by a Neuroscan (Neurosoft) system. Electrodes were also attached to the pads of the second and fourth fingers of participants' non-dominant hands. This enabled recording of electrodermal activity (EDA) using the same (Neuroscan) system.

Once the psychophysiological equipment had been attached, the experimenter explained all experimental procedures to the participants. The explanation provided to participants consisted of instructions for and a demonstration of the breathing procedure, instructions regarding the completion of questionnaires, and a small training session to explain the differences between verbal and imaginal activity. The breathing procedure employed in the present investigation has been used by several other investigators (e.g., McNally & Eke, 1996) and consisted of breathing rapidly and deeply into a paper bag. This procedure is very similar to typical hyperventilation tasks often used in biological challenge experiments, except that it *increased* CO_2 levels as a result of having

participants rebreathe their own air (including their CO_2) from the paper bag that they held over their mouths. In contrast, typical hyperventilation tasks that do not use paper bags *decrease* CO_2 levels. The ethical considerations of employing this biological challenge procedure warrant mentioning. Harrington, Schmidt, and Telch (1996) found that although nonclinical participants with high anxiety sensitivity experienced more panic during a CO_2 inhalation task than did participants with low anxiety sensitivity, AS status did not significantly predict the development of panic symptoms over the course of the year following their experiment. Thus, by selecting individuals with high levels of anxiety sensitivity, the likelihood of eliciting fearful responses to a biological challenge procedure was maximized while not exposing participants to the risk of developing panic symptoms in the future. In order to further ensure the safety and comfort of participants, the experimenter observed participants constantly using video monitoring equipment. Also, as part of the informed consent procedure, participants were told that they were free to discontinue the experiment at any time. Finally, participants who showed extremely high levels of discomfort during a rebreathing task were asked by the experimenter if they were alright immediately following completing of the post-rebreathing-task self-report questionnaire. No participants elected to prematurely discontinue the experiment.

Experimental Procedure. Following the explanation and demonstration, the experimenter left to the main laboratory room housing equipment controls. After this point, all pre-recorded instructions were given to participants via audio equipment, and the participants and experimenter communicated as needed (e.g., to clarify instructions, to re-demonstrate the rebreathing procedure). Immediately following the experimenter's departure, the participant completed a baseline self-report measure (consisting of a

Subjective Units of Distress [SUDs] rating and the Positive and Negative Affectivity Scale [PANAS], as described below). A copy of this baseline self-report measure appears in Appendix D. Following this, a 2-minute resting baseline period was implemented during which participants were instructed to sit still and relax. Autonomic activity during this period served as a resting baseline measure of all autonomic parameters.

Following this 2-minute resting baseline was a 3-minute rebreathing baseline period. Participants were asked to hold a plain brown paper bag to their mouths so that their mouths were completely covered and so that no air escaped during the rebreathing. An electronic metronome (set at 60 beeps per minute) beeped once each second, and the participant was instructed to complete one breathing cycle for every other beep (i.e., to inhale with a beep, then exhale with a beep, and so on until asked to stop) for a total of 30 breath cycles each minute. The experimenter watched the participant from the adjoining room to ensure that the participant was breathing deeply and maintaining rhythm with the metronome. When a participant failed to breathe deeply enough, allowed air to escape through the sides of the bag, or breathed too quickly or too slowly, the experimenter re-entered the room just before the first rebreathing task (i.e., following the first induction period, described below) in order to re-demonstrate the procedure for the participant and to ensure his/her understanding of the procedure. Participants were not interrupted during the actual rebreathing procedure, even if they were not going at the appropriate pace.

Following this 3-minute baseline rebreathing period, participants underwent a 3-minute period in which they engaged in the mental activity induction dictated by the

condition to which they were randomly assigned. Participants in the Relaxation condition were asked to employ slowed diaphragmatic breathing and to relax their minds and bodies as much as possible. Participants in the Worry-Imagery condition were asked to use vivid imagery to worry about the upcoming rebreathing task by imagining the sensations and emotions associated with the procedure. Finally, participants in the Worry-Verbal condition were asked to worry about the upcoming rebreathing task using verbal, thought-based activity. Instructions for each of these three conditions can be found in Appendixes E, F, and G (respectively).

Immediately following each of the three repetitions of the manipulation (verbal worry, imaginal worry, or relaxation), participants completed a manipulation check questionnaire that assessed the percentage of time they were actually engaged in the task and the percentage of thoughts, images, or neither they noticed during the manipulation. These ratings served to ensure that (a) participants were engaged in the manipulations to the same degree across conditions, (b) worrying using verbal activity elicited more thought than imaginal activity, (c) worrying using images elicited more imaginal than thought activity, and (d) relaxing was associated with roughly equal amounts of thought and imagery activity (as previously documented in Behar et al., 2005b). Manipulation check questionnaires for both the worry and relaxation conditions appear in Appendix H.

Following the first mental activity induction, the first rebreathing procedure began. The procedure was repeated two more times for a total of three repeated exposures to the rebreathing procedure, each time preceded by the mental activity induction. Following each rebreathing task (including the baseline rebreathing task

described above), participants were asked to complete a Symptom Questionnaire, described later.

Post-Experimental Procedure. After conclusion of the third and final rebreathing task, participants were informed that the experiment was over and were asked to spend a few moments engaged in slowed, diaphragmatic breathing in order to undo any potentially adverse effects of having participated in the worry and/or rebreathing procedures. Exactly seven days after the laboratory task, each participant returned to the laboratory to complete two memory tasks. In the free recall task, participants were asked to recall the somatic symptoms they experienced during the rebreathing procedures the previous week by listing them on a standardized form and to rate the severity of those symptoms. They were also asked to recall the severity of their anxiety (SUDS rating) and the thoughts they experienced during the rebreathing on a standardized form. They then gave the experimenter this form and then immediately completed the recognition task, in which they were asked to indicate whether during the rebreathing procedures the previous week they experienced a sudden onset of fear, anxiety, or discomfort; the severity with which they experienced the 13 panic symptoms; whether they experienced the cognitions listed in the ACQ; and their negative affect during those rebreathing tasks as measured by the PANAS. As stated earlier, these data are not presented herein.

Assessment of Subjective Reactions to Rebreathing

Immediately following each rebreathing procedure, participants were asked to complete the Symptom Questionnaire (SQ; adapted from Sanderson, Rapee, & Barlow, 1989), a multi-trait measure designed to assess somatic, cognitive, and affective symptoms experienced in response to the rebreathing procedures. The SQ as used in the

experiment appears in Appendix I. In order to assess *somatic* symptoms, participants were first asked to indicate using a yes/no response choice whether at any point during the rebreathing procedure they suddenly felt more frightened, anxious, or extremely uncomfortable. They were then asked to indicate on a 10-point scale (0 = symptom not at all noticed; 9 = symptom very intensely felt) the severity of the 13 *DSM-IV* symptoms of a panic attack (pounding heart, sweating, shaking, shortness of breath, choking sensation, chest pain, abdominal distress, dizziness or lightheadedness, derealization or depersonalization, fear of losing control or going crazy, fear of dying, paresthesias, and/or chills or hot flushes). Participants were coded as having experienced a panic attack if they (a) endorsed "yes" to the item assessing the experience of a sudden onset of fear, anxiety, or discomfort and (b) endorsed at least 4 of the 13 symptoms at a level of 5 or higher. The endorsement of at least 4 symptoms is consistent with the *DSM-IV* definition of a panic attack, and the requirement of a minimum severity of 5 for those symptoms was chosen because this represents a relatively more severe reaction on the 10-point scale employed. Participants were also asked to complete a SUDS rating on which a 0-100 scale was provided. In order to assess *affective* symptoms, participants were administered the PANAS. The PANAS was developed by Watson, Clark, and Tellegen (1988) as a brief measure of affect and yields the factors Positive Affectivity and Negative Affectivity. For the present experiment, only Negative Affectivity scores were calculated. In order to assess *cognitive* symptoms, participants were administered the Agoraphobic Cognitions Questionnaire and asked to indicate whether they experienced any of the cognitions listed on that measure during the breathing task. It should be noted that past investigations of the effects of worry on functioning during subsequent anxiety-

inducing tasks (e.g., Borkovec & Hu, 1990; Hazlett-Stevens & Borkovec, 2001) have measured only affective and physiological/somatic symptoms. Therefore, the inclusion of cognitive symptoms in this investigation was exploratory in nature.

The SQ was administered to participants immediately following the baseline rebreathing task as well as immediately following each of the three repetitions of the mental activity induction. The recall and recognition tasks administered one week after the experiment appear in Appendixes J and K (respectively).

Hypotheses

Four central hypotheses were posed for the present investigation. First, I predicted that the Relaxation and Worry-Imagery groups would show a gradual decline in subjectively reported symptoms across rebreathing tasks, whereas Worry-Verbal would show a maintenance of reported symptoms across the tasks. Support for this prediction would be consistent with findings by Borkovec and Hu (2001), who found that [verbal] worry was associated with greater subjectively reported fear than was relaxation during exposure to subsequent fear-relevant stimuli, and would further provide evidence of greater fear structure accession in the Worry-Imagery group (as evidenced by successful decreases in anxiety across repeated exposures).

Second, I predicted that although all three inductions would be associated with a gradual decrease in physiological activation (HR, EDA) across repeated presentations of the rebreathing task (due to the effects of habituation), the decrease across rebreathing tasks would be greatest for Worry-Verbal and least for Worry-Imagery, with Relaxation falling between these two. Support for this prediction would be consistent with findings by Borkovec and Hu (1990) that verbally-based worry is associated with inhibited

cardiovascular activity during subsequent exposures to fear cues whereas relaxation is associated with greater cardiovascular responding during subsequent exposure to fear cues. Furthermore, these findings would provide empirical support for the theoretical assumption that the inhibitory effects of worry lie in its verbal linguistic nature and its remoteness from imaginal activity. If these three inductions led to non-different levels of physiological reactivity to rebreathing tasks, this finding would be consistent with past research employing *in vivo* exposure to fear cues (Hazlett-Stevens & Borkovec, 2001; Segerstrom, Glover, Craske, & Fahey, 1999), and would lend support to Hazlett-Stevens and Borkovec's (2001) hypothesis that the motor demands of *in vivo* exposure to fear cues may wash out experimental effects on physiological reactivity.

Third, it was unclear whether autonomic reactivity (HR, EDA) would differ during imagery-based worry inductions, verbal worry inductions, and relaxation inductions. On the one hand, past evidence employing these three manipulations found non-different cardiovascular responding between the three types of mental activity (Borkovec et al., 1993). On the other hand, findings by Vrana et al. (1986) that imagery of fearful material elicits greater cardiovascular reactivity than does verbal articulation of the same material is consistent with the prediction that imagery-based worry would produce greater autonomic (HR, EDA) response relative to verbally-based worry. Such a finding would provide the first piece of evidence that worrying using vivid imagery facilitates physiological fear activation during the worry process.

Fourth, consistent with findings by Hazlett-Stevens and Borkovec (2001), I predicted that parasympathetic activity would increase across exposures to the

rebreathing task. Past evidence does not warrant predictions regarding differential effects of induction on parasympathetic activity.

Chapter 6: Results

Data Reduction

Reduction of Self-Report Data. Participants' responses on the Symptom Questionnaire yielded five scores as follows: (1) the *Total Symptom Score* (TSS; Perna et al., 1999) was derived by summing the 0-9 ratings of the severity with which each of the 13 *DSM-IV* panic symptoms was experienced; (2) the *SUDs* rating consisted of the 0-100 subjective distress rating indicated by participants; (3) the *Cognitive Symptom Score* consisted of the number of cognitive symptoms on the ACQ that participants indicated experiencing (indicated by circling "Yes"); (4) the *Negative Affect* score was the sum of the 10 negatively-worded items on the PANAS; and (5) the *occurrence of panic attacks* was the number of participants from each condition who experienced a panic attack (as operationally defined earlier) during each rebreathing task.

Reduction of Psychophysiological Data. All psychophysiological data reduction took place on a PC-based computer. A MATLAB program written specifically for this investigation identified R-spikes within the sampled ECG data and calculated the number of R-spikes per minute of data to yield Heart Rate (HR). The program also yielded mean successive differences (MSDs), a cardiovascular measure of vagal tone. MSDs were calculated by computing the mean of the absolute values of successive differences in intervals (in msec) between R-spikes in the ECG. MSD has been used in previous investigations as a valid indicator of parasympathetic activity (e.g., Thayer, Friedman, & Borkovec, 1996). Each participant's ECG was visually inspected by the author (who was kept blind to condition) to ensure that MATLAB had accurately marked all R-spikes.

All EDA recordings were likewise visually inspected by the author, who counted the number of electrodermal responses that occurred within each task. In counting responses, three scoring rules were employed as per suggestions by Kaloupek (personal communication, 2005). First, a response was counted if the time from the point of inflection to the peak was five seconds or less. Second, for a response that occurred before the response prior to it had reached tonic levels, the second response was counted only if the initial response's tracing had gone back down or had remained flat. Finally, peaks that began before the task had ended were counted, but peaks that began prior to the onset of the task (and therefore peaked within the task interval) were not counted.

Preliminary Analyses

Assumptions of Normality. Prior to analysis, the data were examined for fit between the distributions of psychopathology questionnaires (e.g., PSWQ), experimental self-report (e.g., TSS), and physiological data and the assumptions of normality. Any case whose *z*-score exceeded 3.3 was considered a univariate outlier and, if appropriate, underwent the Windsor method in order to convert it to one unit above or below the next closest unit. For the psychopathology questionnaire data, four cases (all from the PDSS [three from the query about number of lifetime panic attacks, and one from the query about number of panic attacks in the past week]) were univariate outliers (*zs* = 5.23, 4.10, 3.82, and 5.68, respectively). These four data points were not converted because the author felt that it was important to examine potential group differences caused by these extreme values, given that differences in past experience of panic might differentially affect participants' subjective and physiological experiences during the experimental procedures. Seven cases from the self-report data and 14 cases from the physiological

data were univariate outliers. All of these data points were converted to one unit above the next closest unit in accordance with the Windsor method. It should also be noted that for the majority of the psychophysiological data outliers, notes taken by the experimenter while participants were undergoing experimental procedures indicated good reasons for converting these values (e.g., one participant was habitually breathing faster than the metronome dictated, one participant paused during a rebreathing task).

Data were also screened for multivariate outliers using Mahalanobis distance as the criterion, $\chi^2(4)$ with an alpha criterion of .001. No multivariate outliers were found.

Equivalence of environmental conditions and psychopathology. Given that temperature and humidity are environmental variables that can affect physiological reactivity, preliminary analyses sought to ensure that the experimentation room's temperature and humidity were equivalent across the three experimental conditions. Indeed, the results of a multivariate analysis of variance (MANOVA) indicated that room temperature (M = 72.90°F, SD = 3.64°F) and room humidity (M = 32.35%, SD = 15.04%) did not differ across the three conditions in the experiment.

Preliminary analyses also sought to ensure that levels of psychopathology did not differ across experimental conditions. Measures of psychopathology included trait worry (PSWQ) and anxiety (STAI-T); PTSD symptoms (PCL) and panic disorder symptoms (PDSS-SR); number of panic attacks in a participant's life and past week; and levels of bodily sensations (BSQ), agoraphobic cognitions (ACQ), and anxiety sensitivity (as defined by the total ASI score and by the six factors of the ASI-R). Results of a multivariate analysis of variance (MANOVA) indicated that participants across the three experimental conditions did not differ on any of these measures, including number of

panic attacks in the past week and month (despite the presence of outliers on these two measures). Table 1 presents mean scores on all of these measures. Furthermore, analyses examined whether rates of GAD symptoms were equivalent across conditions. Results indicated that the number of participants who met the diagnostic criteria for GAD as measured by the GAD-Q-IV ($N = 11$) did not differ across the three conditions, $\chi^2(2) = 3.04$, $p < .05$. Taken together, these analyses suggest that random assignment to condition was successful in producing equivalent scores on these measures of psychopathology.

Preliminary physiological analyses. Preliminary analyses also examined the appropriateness of covarying baseline levels of physiological activity in subsequent analyses. Stern, Ray, and Quigley (2001) suggest using baseline levels of physiological indexes as a covariate for physiological data during task periods when the baseline levels are highly correlated with task levels and when one is interested in the task-related physiological measures. These correlations appear in Table 2 and indicate that baseline levels of physiological indexes were moderately to highly correlated (*r*s ranging from .37 to .93) with task levels, and that all correlations were significant. Therefore, baseline physiological measures were entered as covariates in all subsequent physiological analyses.

Manipulation Checks

Analyses were run to examine the effectiveness of the experimental manipulations. First, in order to assess whether participants across the three conditions spent comparable percentages of time engaged in the mental activity (verbal worry, imaginal worry, or relaxation) stipulated by those inductions, a 3-way (Manipulation

Period) repeated measures ANOVA was performed on the percentages of time participants reported having actually been engaged in the activity dictated by the induction instructions. Results indicated a main effect of Induction, $F(2,71) = 4.78$, $p < .05$. Follow-up comparisons using a Bonferroni adjustment further indicated that participants spent less time engaged in worry-imagery ($M = 44.84\%$, SD = 23.23%) than they did in worry-verbal ($M = 61.32\%$, SD = 26.86%) or in relaxation ($M = 61.63\%$, SD = 26.80%).

Second, *t*-tests were run to assess whether the instruction to worry using verbal activity indeed yielded more verbal activity than imagery, and that the instruction to worry using imagery indeed yielded more imagery than verbal activity. Consistent with the intended manipulation, participants in the Worry-Verbal condition reported experiencing more verbal activity (averaged across the three induction periods; $M = 72.87\%$, SD = 18.24%) than imagery ($M = 18.68\%$, SD = 13.42%), $t(24) = 9.26$, $p < .001$. However, participants in the Worry-Imagery condition reported experiencing non-different levels of imagery ($M = 47.84\%$, SD = 20.13%) and verbal activity ($M = 38.17\%$, SD = 19.18%), $t(24) = 1.40$, *ns*. Finally, participants in the Relaxation condition reported experiencing non-different levels of imagery ($M = 46.54\%$, SD = 23.67%) and verbal activity ($M = 37.11\%$, SD = 22.55%), $t(23) = 1.07$, *ns*. This last finding was consistent with past evidence suggesting that relaxation inductions yield roughly equal levels of thoughts and images (Behar et al., 2005b).

In sum, although the instruction to worry using verbal activity produced a predominance of verbal activity, the instruction to worry using images did not produce a predominance of imaginal activity. Furthermore, participants spent more time actually

engaged in verbal worry than in imaginal worry. These findings are consistent with prior evidence suggesting that worry is a predominantly verbal-linguistic process (Behar et al., 2005b; Borkovec & Inz, 1990) and also underscores the challenge of teaching participants to worry using vivid imagery. However, it should be noted that although imagery was not the *predominant* mental activity reported by participants in this condition, it was *higher* than the level of imagery reported in the Worry-Verbal condition, $t(48) = 6.03$, $p < .001$, with a large effect size ($d = 1.74$).

Self-Report Data Analyses

Construction of composite scores. Composite scores were created in order to better align measures to underlying constructs of theoretical importance and reduce data in situations in which the shared variance between measures approached very high levels (i.e., $r = .7$ or greater). Specifically, although the Symptom Questionnaire included five measures (TSS, SUDs, agoraphobic cognitions, NA, and occurrence of panic attacks), it should be noted that these five measures are not indicators of five discrete underlying constructs. For instance, although the purpose of including the TSS was to provide a measure of panic symptoms, inspection of the 13 panic symptoms reveals that although 10 of these are somatic in nature (e.g., pounding heart, sweating), three of them are cognitive in nature (i.e., feeling of unreality and detachment from self, fear of losing control or going crazy, fear of dying) and therefore represent an index of the same underlying construct as measured by the Agoraphobic Cognitions Questionnaire. Similarly, both the SUDs and NA are measures of subjective distress.

In an effort to accurately measure somatic symptoms, subjective distress, and cognitive symptoms as discrete constructs, correlations were run to assess the degree of

variance shared by variables thought to measure the same constructs. The three cognitive symptoms of the TSS (TSS-Cog) were found to correlate with the ACQ strongly, $r = .71$. These two variables, sharing 50.4% of their variance, were strongly related and were therefore combined to form a composite "cognitive symptoms" variable. Similarly, SUDs ratings and NA were found to correlate $r = .83$ (68.9% shared variance) and were combined to form a composite "subjective distress" variable. The remaining 10 items from the TSS (TSS-Som) were assigned the label "somatic symptoms." Because these were the only items measuring somatic symptoms, they were not combined with any other items from the Symptom Questionnaire. The resulting composite scores (as opposed to the original variables) were entered as dependent variables in subsequent analyses. These three new indexes were constructed by summing the standardized scores of each original measure to yield single standardized measures of somatic symptoms, subjective distress, and cognitive symptoms.

In summary, the data derived from the five measures on the Symptom Questionnaire were used to create three composite scores (somatic symptoms, subjective distress, cognitive symptoms) which were conceptualized as representing three discrete constructs. It should be noted that the correlations between these three dependent variables were moderate-to-strong (ranging from $r = .48$ to $r = .67$). However, despite this relatively high degree of shared variance between the three variables, their theoretical independence justified retaining them as three distinct dependent variables in the analyses. Also, because occurrence of panic attacks was a discrete (as opposed to continuous) measure, it was analyzed separately.

Inferential Tests. A 3 (Induction: Relaxation, Worry-Verbal, Worry-Imagery) X 4 (Rebreathing Period: Baseline, 1st, 2nd, 3rd) repeated measures MANOVA was run on the three composite dependent variables (i.e., standardized measures of somatic symptoms, subjective distress, and cognitive symptoms). Given the moderate-to-high correlations between the three dependent variables (DVs) and the presence of a theoretical rationale for entering them in a meaningful order, it was appropriate to interpret the Roy-Bargman stepdown analyses instead of the univariate analyses in order to allocate the shared variance to specific factors (Tabatchnik, 2001). In Roy-Bargman analyses, the order in which DVs are entered into the analysis dictates the subsequent allocation of shared and unique variance. Specifically, the first DV entered in the analysis is allocated its full (unique and shared) variance, and subsequent DVs are allocated only their unique variance over those entered previously. As such, DVs were entered in an order consistent with theoretical and empirical priorities. Given the nature of the exposure task in this experiment (i.e., a panicogenic task meant to elicit somatic sensations), somatic symptoms was entered into the MANOVA first. Given that the two prior investigations (Borkovec & Hu, 1990; Hazlett-Stevens & Borkovec, 2001) utilizing similar methodology as that employed in this study found heightened subjective anxiety during repeated exposures to feared stimuli following periods of worry, subjective distress was entered into the MANOVA second. Finally, because cognitive measures were included in the study for purposes of multi-trait assessment and for exploratory purposes, cognitive symptoms was entered into the MANOVA last.

Results indicated that there was an overall significant multivariate Induction X Period interaction, F (18,126) = 1.73, $p < .05$. The results of the Roy Bargman stepdown

analyses indicated that the Induction X Period interaction was significant for the subjective distress measure, F (6,212) = 2.94, $p < .01$, but not for the somatic symptoms or cognitive symptoms measures.

Follow-up analyses for the subjective distress finding involved the computation of difference scores between each Rebreathing Task pair, followed by a one-way ANOVA with Scheffé (Scheffé, 1953) post-hoc comparisons on each difference score. Three significant task pair comparisons emerged (see Figure 1). First, the Baseline Rebreathing – 1st Rebreathing Task pair comparison was significant, F (2,73) = 8.20, $p < .001$, and indicated that (a) whereas relaxation was associated with a significant decrease in subjective distress from the Baseline Rebreathing task to the 1st Rebreathing task, verbal worry was associated with a significant increase in subjective distress between these periods ($p < .001$), and that (b) whereas verbal worry was associated with this significant increase, the level of subjective distress in worry-imagery remained unchanged between these periods ($p < .05$). Second, the Baseline Rebreathing – 2nd Rebreathing Task pair comparison was significant, F (2,73) = 4.39, $p < .05$, and likewise indicated that whereas relaxation was associated with a significant decrease in subjective anxiety, verbal worry was associated with a significant increase in subjective anxiety between these two periods ($p < .05$). Finally, the Baseline Rebreathing - 3rd Rebreathing Task pair comparison was significant, F (2,73) = 6.11, $p < .01$, and likewise indicated that whereas relaxation was associated with a significant decrease in subjective distress, verbal worry was associated with a significant increase in subjective distress between these two periods ($p < .01$). Moreover, paired samples t-tests indicated that the subjective distress reported by participants in the imaginal worry condition remained unchanged across rebreathing

periods. Finally, there were no significant differences in subjective distress at any of the four rebreathing periods between induction conditions.

Occurrence of panic attacks during each rebreathing task was also examined. Chi-square tests were run on the number of participants meeting the criteria for the occurrence of a panic attack during each of the four Rebreathing Periods (Baseline, 1st, 2nd, 3rd). Only the chi-square test on the 3rd Rebreathing Period was significant, $\chi^2(2) = 5.70$, $p < .05$. Follow-up analyses involved running separate chi-square tests for each of the three condition pairs during the 3rd Rebreathing Period. Results indicated that only the relax – verbal worry task pair comparison yielded a significant difference in frequency of panic attacks, $\chi^2(1) = 5.38$, $p < .05$. During the 3rd Rebreathing Period, participants in the verbal worry condition experienced a higher frequency of panic attacks than did participants in the relaxation condition, with the frequency of panic attacks in the imaginal worry condition falling nonsignificantly in between these two other conditions (see Figure 2).

In sum, the results of the self-report measures were partially consistent with the first hypothesis. Verbal worry was associated with an increase in subjective distress (but not somatic or cognitive symptoms), and relaxation was associated with a decrease in subjective distress. However, contrary to predictions, imagery-based worry was not associated with a decrease in subjective distress across repeated exposures of the rebreathing task.

Psychophysiological Data Analyses

Intercorrelations between the psychophysiological dependent variables (heart rate [HR], mean successive differences [MSD], electrodermal activity [EDA]) reveal that

although HR was correlated with MSD $r = -.52$, EDA was very weakly correlated with both HR ($r = -.05$) and with MSD ($r = .03$). Given that EDA did not share a high degree of variance with the other two measures, three separate univariate analyses of variance were run as opposed to a MANOVA.

Heart rate. A 3 (Induction) X 4 (Rebreathing Period) mixed model ANCOVA, with resting baseline HR entered as a covariate, was run on HR. There was a main effect of Period, $F(3,68) = 3.32$, $p < .05$, which was qualified by an Induction X Period interaction, $F(6,138) = 2.67$, $p < .05$ (see Figure 3). Follow-up analyses involved the computation of difference scores between each task pair, followed by a one-way ANOVA with Scheffé post hoc comparisons on each difference score. Two significant task pair comparisons emerged. First, the Baseline Rebreathing – 2nd Rebreathing Task pair comparison was significant, $F(2,73) = 4.20$, $p < .05$, and indicated that relaxation was associated with a greater rate of decrease between these two tasks relative to verbal worry ($p < .05$). It should be noted that heart rate at the 2nd Rebreathing Task did not differ between these two conditions, and this effect was likely due to the (nonsignificantly) higher heart rate during baseline rebreathing in the relaxation condition. Second, the 1st Rebreathing Task - 3rd Rebreathing Task pair comparison was significant, $F(2,73) = 3.41$, $p < .05$, and indicated that whereas heart rate did not change significantly between the 1st and 3rd Rebreathing periods for the imaginal worry condition, the verbal worry condition was associated with a significant decrease in heart rate between these two periods ($p < .05$). These results were partially consistent with the second hypothesis in that Worry-Verbal was associated with a greater decrease in heart rate across rebreathing periods than was Worry-Imagery.

To examine potential differences in HR during the manipulation periods, a 3 (Induction) X 3 (Manipulation Period: 1st, 2nd, 3rd) mixed model ANCOVA, with resting baseline heart rate entered as a covariate, was run on heart rate during the three manipulation inductions (i.e., the three periods of verbal worry, imaginal worry, or relaxation). Results indicated a main effect of Period, $F(2,69) = 5.69$, $p < .01$. Pairwise comparisons using a Bonferroni adjustment indicated that heart rate was significantly higher during the first manipulation induction ($M = 73.80$, SD = 12.51) than during the third manipulation induction ($M = 72.31$, SD = 11.59), $p < .01$, and that it was significantly higher during the second manipulation ($M = 73.28$, SD = 13.03) than during the third, $p < .01$. Contrary to the third hypothesis, no effects involving Induction emerged.

Mean successive differences. A 3 (Induction) X 4 (Rebreathing Period) mixed model ANCOVA, with resting baseline MSD entered as a covariate, was run on MSD. Contrary to the fourth hypothesis, no significant effects involving Induction or Period emerged. To examine potential differences in parasympathetic activity during the manipulations, a 3 (Induction) X 3 (Manipulation Period) mixed model ANCOVA, with resting baseline MSD as the covariate, was run on MSD during the three manipulation inductions. No effects involving Induction or Manipulation Period emerged.

Electrodermal Activity. A 3 (Induction) X 4 (Rebreathing Period) mixed model ANCOVA, with resting baseline EDA entered as a covariate, was run on EDA. Contrary to the second and third hypotheses, no significant effects involving Induction or Period emerged. To examine potential differences in sympathetic activity during the manipulations, a 3 (Induction) X 3 (Manipulation Period) mixed model ANCOVA, with

resting baseline EDA as the covariate, was run on EDA during the three manipulation inductions. No effects involving Induction or Manipulation Period emerged.

Chapter 7: Discussion

The present study sought to empirically test theoretical assertions that the verbal-linguistic (as opposed to imagery-based) nature of worry is the cause of worry's inhibitory effects. To this end, participants high in anxiety sensitivity were asked to engage in periods of verbal worry, imaginal worry, or relaxation prior to repeated presentations of a rebreathing task. Participants' autonomic (heart rate, sympathetic, and parasympathetic) activity was measured, as well as the somatic symptoms, subjective distress, and cognitive symptoms that they experienced during the rebreathing procedures.

Results indicated that whereas imagery-based worry was associated with relatively steady levels of both subjective distress and heart rate across periods, verbal worry was associated with increases in subjective distress and frequency of panic attacks, but inhibited cardiovascular response, during the subsequent panicogenic task. This finding lends empirical support to the theoretical assertion that it is specifically the verbal linguistic (as opposed to imagery-based) nature of the worry process that is associated with worry's inhibitory effects. Also, it rules out an important rival hypothesis that remained untested by previous research. Specifically, by comparing verbal to imaginal worry, the present investigation ruled out the possibility that the inhibitory effects of worry on subsequent anxiety-eliciting tasks as found in past research was merely due to the effects of habituation. Instead, it seems that, consistent with theoretical assertions (Borkovec et al., 2001), it is indeed the thought-based nature of the worry process that is responsible for worry's inhibitory effects.

According to Foa and Kozak (1986), emotional processing – a necessary condition for successful habituation and extinction of fear – requires physiological activation. Worry's inhibition of cardiovascular response precludes accession of the fear structure, and thus precludes successful extinction of fear. These results suggest that, specifically, the verbal nature of worry precludes fear activation during exposure to panic sensations, thus leading to increases in subjective discomfort and increases in panic frequency, while at the same time muting the physiological activation needed for eventual habituation. This replicates past evidence suggesting that worry leads to increased subjective distress (Borkovec & Hu, 1990; Hazlett-Stevens & Borkovec, 2001) and inhibited cardiovascular response (Borkovec & Hu, 1990) during repeated exposures to social anxiety tasks, and extends these findings to panic-relevant inductions.

The present results differed from results reported by Hazlett-Stevens and Borkovec (2001), who found that although worry was associated with greater subjective anxiety compared to relaxation during a subsequent speech-giving task, there were no differential cardiovascular effects across conditions. These investigators attributed the lack of cardiovascular findings to the complex cognitive-motor task required for giving a speech *in vivo*. However, results of the present investigation, which likewise entailed a motorically demanding task performed *in vivo*, yielded cardiovascular results consistent with results reported by Borkovec and Hu (1990). Several differences exist between the Hazlett-Stevens and Borkovec (2001) investigation, the Borkovec & Hu (1990) investigation, and the present investigation that might explain Hazlett-Stevens's discrepant findings. First, Hazlett-Stevens and Borkovec utilized a 12-minute worry induction compared with Borkovec and Hu's 30-second and the present study's 3-minute

worry inductions. Several participants from our laboratory have anecdotally remarked that they find it difficult to worry for even 5-minute periods. It may be that worrying for long periods of time erases the inhibitory effects of worry because participants are no longer worrying after a few minutes. Second, Hazlett-Stevens and Borkovec instructed participants in the worry condition to worry about giving a speech on the topic of "Ways in Which Unemployment Could Be Decreased." It could be that participants spent these 12 minutes engaged not in worry, but rather in planning what they would be saying during the speech itself.

Contrary to predictions, imagery-based worry did not produce increased cardiovascular response during the subsequent rebreathing tasks. One possible reason for this is that this manipulation was not entirely successful. Specifically, participants engaged in the imaginal worry induction for less time than they engaged in the verbal worry or relaxation inductions, and those in the imaginal worry condition reported non-different levels of thought- and imagery-based activity (whereas participants in verbal worry reported a predominance of thought-based activity). It may be that the verbal quality of worry is so habitual that participants had a difficult time "staying with" a worry-relevant image. Indeed, Borkovec et al. (2003) suggested that the worry process likely contains occasional catastrophic images that are replaced by verbal activity that is less distressing in nature and that subsequent verbal activity is thus negatively reinforced as a result of this decreased distress. Therefore, participants' difficulty focusing primarily on images during the imaginal worry condition in the present study may be a result of the motivated avoidance of images that are associated with both subjective distress and somatic activation resulting from those images. As a result, whatever effects

the imaginal worry condition may have had on physiological activation during subsequent rebreathing periods may have been erased by quickly shifting to the less-distressing thought-based worry. It might be that increased physiological activation (and, therefore, greater accession of the fear structure) during panicogenic tasks might indeed ensue following imaginal worry that is predominantly imagery-based in nature.

It is noteworthy that the inductions did not produce differential self-reports of somatic symptoms or cognitive symptoms, which were included as measures in this experiment but not in previous experiments examining worry's inhibitory effects. Rather, the inductions only yielded effects for the more general "subjective distress" measure. This suggests that worry impacts subjective functioning at the broad level of general distress, and not at the more specific levels of somatic and cognitive functioning. On the other hand, the cardiovascular results suggest differential effects on objectively measured somatic functioning. This relates to Lang's (1979) bioinformational model, which stipulates that the anxiety disorders lie on a continuum according to the degree of concordance they exhibit between self-report, behavioral, and physiological responses. GAD is theorized to be placed at the far left of this continuum, such that it displays low levels of concordance between response propositions. The present study lends support to this theoretical placement given the lack of concordant findings between cardiovascular data and self-reported somatic symptoms following periods of worrisome activity.

Results of this investigation also indicated that the three inductions (verbal worry, imaginal worry, relaxation) failed to produce differences in physiological activation. This finding replicated previous research indicating that these same three inductions were not associated with differential cardiovascular response (Borkovec et al., 1993), and

failed to support the prediction (based on past work by Vrana et al., 1986) that imaginal worry would be associated with increased cardiovascular response. However, it should be noted that the limited effectiveness of the imaginal worry manipulation may have reduced the increased autonomic reactivity that might otherwise result from imaginal worry periods. Additionally, it may be that the participants employed in both this investigation (high ASI participants) and in the Borkovec et al. (1993) study (speech anxious participants) were prone to experience anxious affect during periods of relaxation, which may have reduced differences between the relaxation induction and the worry inductions. Indeed, past research shows evidence of relaxation-induced anxiety reactions in participants selected on the basis of high levels of general tension and trained in relaxation methods (Heide & Borkovec, 1983).

The present findings have implications for the treatment of panic disorder. Cognitive behavioral interventions for panic focus on the use of panicogenic exercises (e.g., hyperventilation, spinning in a chair, breathing through a straw) designed to expose patients to feared bodily sensations. As in any exposure-based treatment, clinicians must be careful not to introduce any procedure or allow the patient to engage in any behaviors that reduce the amount of physiological activation resulting from the exposures. According to the present results, verbally-based worry about an upcoming panicogenic task is associated with less physiological activation and fewer panic attacks during those tasks relative to relaxation. This suggests that comorbid worry (which is predominantly thought-based in nature) may ultimately be associated with maintenance of symptoms in panic disorder. Because worry is a commonly comorbid condition with panic, and because worry about future panic attacks is even a diagnostic criterion for panic disorder,

it may be important to address comorbid worry/GAD for the purpose of maximizing the effects of treatment for panic disorder. Specifically, clinicians may choose to treat GAD symptoms using methods prescribed for that condition (Behar & Borkovec, in press; Borkovec & Sharpless, 2004). Alternatively, based on results from the present investigation suggesting that imagery-based worry was associated with less decrease in heart rate across rebreathing periods than was verbal worry, clinicians may make use of imagery training in the treatment of panic disorder in order to decrease the likelihood that worry will interfere with successful emotional processing. Replication of these results is warranted before such a technique is incorporated into existing exposure-based treatments for panic disorder.

Future research investigating the phenomena discussed in this investigation would also usefully improve upon the limitations of the present investigation. First, because the imaginal worry manipulation failed to produce a predominance of imagery activity, thereby limiting the degree to which hypotheses relative to that induction could be validly tested, future research should take steps to increase the likelihood that imagery-based worry inductions successfully produce a predominance of imaginal activity. Specifically, researchers might spend more time training participants to worry using vivid imagery by conducting a series of practice trials in which participants are asked to imaginally worry about an idiosyncratic topic of worry and to rate the percentage of thoughts and images they noticed during each practice trial. Trials could be repeated until participants had successfully reached a pre-determined criterion (e.g., 75% imagery). Second, future research aimed at elucidating the effects of verbal versus imaginal worry on subsequent fear-relevant stimuli would usefully include manipulations involving participants'

idiosyncratic worry topics. Although the panic-relevant worries induced in this experiment are pertinent to the worries experienced by individuals with panic disorder regarding future attacks, they may not generalize to the type of worrying that occurs more generally in GAD.

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Footnotes

1. Exposure-based treatments for panic disorder also often include *in vivo* exposure to environmental cues that trigger panic sensations in individuals.
2. As is noted by the authors, lower power for this rebound analysis leaves open the possibility that indeed a rebound effect did exist for one or more conditions.
3. It is also doubtful whether this conceptualization still applies to GAD. The avoidance theory of worry (Borkovec et al., 2004) makes a case for the concept of worry as being remote from affective experience and associated with individuals' avoidance of thinking about more distressing topics (Borkovec & Roemer, 1995). Whether GAD is a type of "emotion phobia" is unclear, as such a conceptualization has not been elaborated upon theoretically or empirically.
4. This finding was later contradicted (e.g., Rickels, Downing, Schweizer, & Hassman, 1993).
5. Similarly, Rapee et al. (1992) reported that panic disorder patients scored higher on the ASI (M = 36.4, SD = 10.3) relative to GAD patients (M = 28.6, SD = 10.6).

Appendix A: Tables and Figures

Table 1.

Means and standard deviations of scores on all self-report questionnaires administered to participants in all three experimental conditions.

	Experimental Condition		
	Relaxation (N = 24)	Worry-Verbal (N = 25)	Worry-Imagery (N = 25)
Anxiety Sensitive Index (16-item)	37.67 (6.10)	36.64 (4.45)	38.56 (5.08)
Anxiety Sensitivity Index – Revised			
Cardiovascular Symptoms	7.42 (4.29)	8.20 (5.07)	9.44 (3.98)
Respiratory Symptoms	12.71 (7.36)	12.12 (6.20)	14.64 (4.72)
Gastrointestinal Symptoms	6.33 (3.24)	6.60 (2.97)	6.68 (2.61)
Publicly Observable Reactions	19.67 (6.23)	17.44 (5.94)	18.84 (5.97)
Dissociative/Neuro Symptoms	11.79 (3.56)	10.92 (3.70)	12.48 (3.68)
Cognitive Dyscontrol	7.67 (3.67)	7.96 (3.89)	9.60 (3.83)
Penn State Worry Questionnaire	54.00 (15.67)	49.48 (17.38)	52.76 (14.65)
State Trait Anxiety Inventory	46.33 (10.57)	41.72 (11.18)	43.88 (10.16)
Panic Disorder Self Report Scale	.68 (.61)	.49 (.55)	.49 (.58)
Number of lifetime panic attacks	13.05 (25.16)	4.88 (6.54)	5.52 (14.94)
Number of past week panic attacks	.46 (1.22)	.20 (.65)	.16 (.47)
Agoraphobic Cognitions Questionnaire	25.29 (6.59)	24.60 (6.05)	25.64 (6.99)
Loss of Control subscale	14.83 (4.96)	15.04 (4.80)	15.08 (4.64)
Physical Concerns subscale	10.46 (2.75)	9.56 (1.94)	10.56 (2.95)
Body Sensations Questionnaire	41.92 (11.48)	39.20 (12.49)	37.96 (11.86)
Posttraumatic Stress Disorder Checklist	23.04 (15.36)	19.88 (15.10)	21.24 (14.35)

Table 2.

Correlations between resting baseline and tasks for heart rate, mean successive differences, and electrodermal responses

	Task						
Resting Baseline Index	Breathe Baseline	Induct #1	Breathe #1	Induct #2	Breathe #2	Induct #3	Breathe #3
RBL Heart Rate	.77*	.93*	.75*	.90*	.84*	.89*	.70*
RBL Mean successive differences	.44*	.89*	.52*	.77*	.50*	.69*	.37*
RBL Electro-dermal Responses	.53*	.77*	.45*	.71*	.49*	.61*	.49*

Note. RBL = resting baseline; Induct = Induction (Relaxation, Worry-Verbal, or Worry-Imagery); Breathe = Rebreathing Period

*Correlation is significant at the .01 level (two-tailed).

Figure 1.

Subjective distress reported by participants during the rebreathing tasks following periods of relaxation, verbal worry, or imaginal worry.

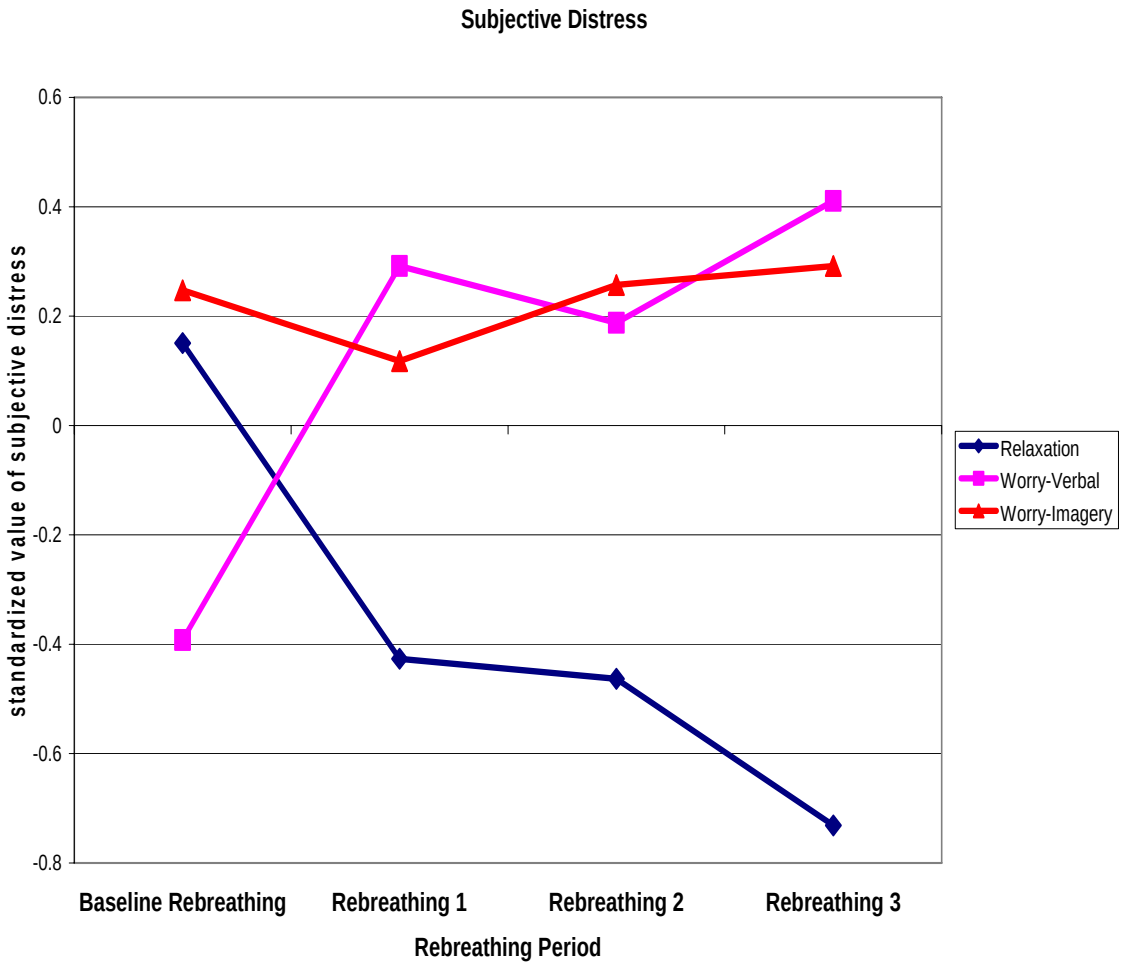


Figure 2.

Frequency of panic attacks experienced by participants during the rebreathing tasks following periods of relaxation, verbal worry, or imaginal worry.

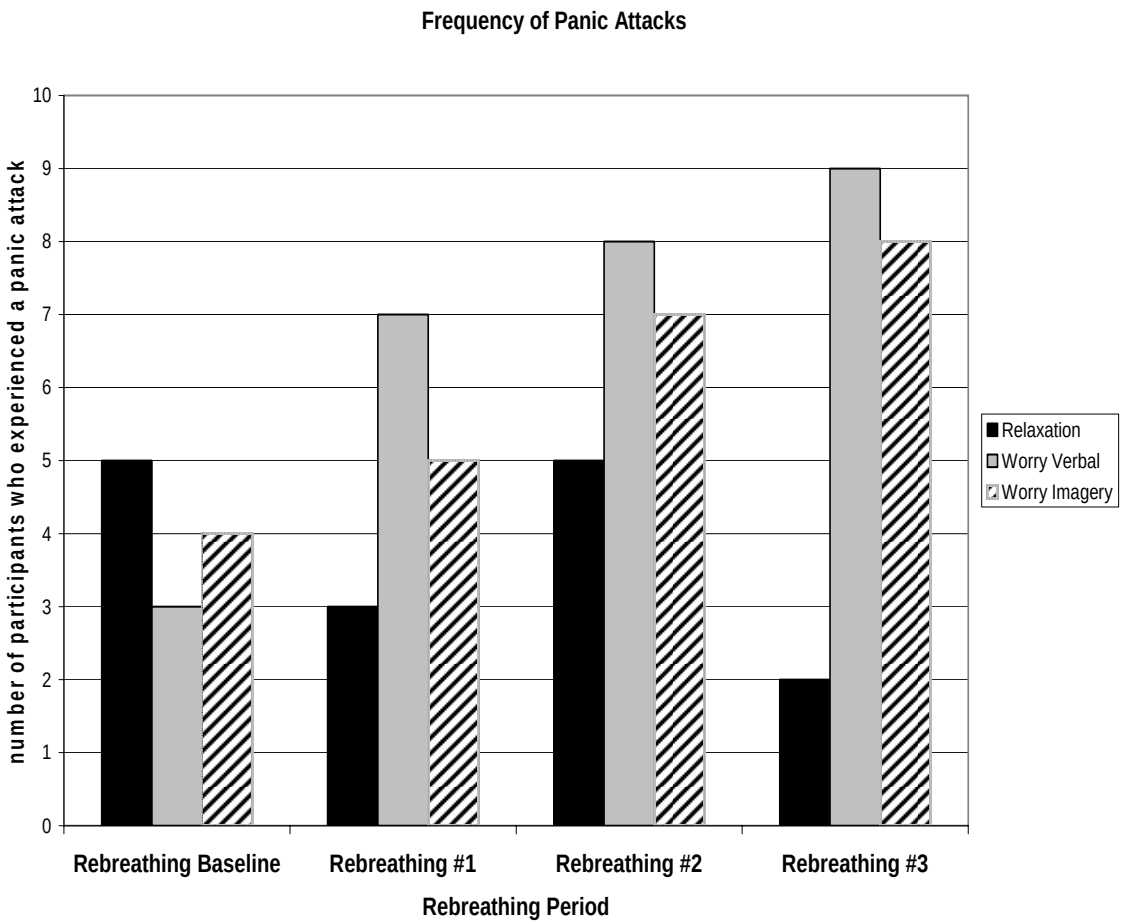
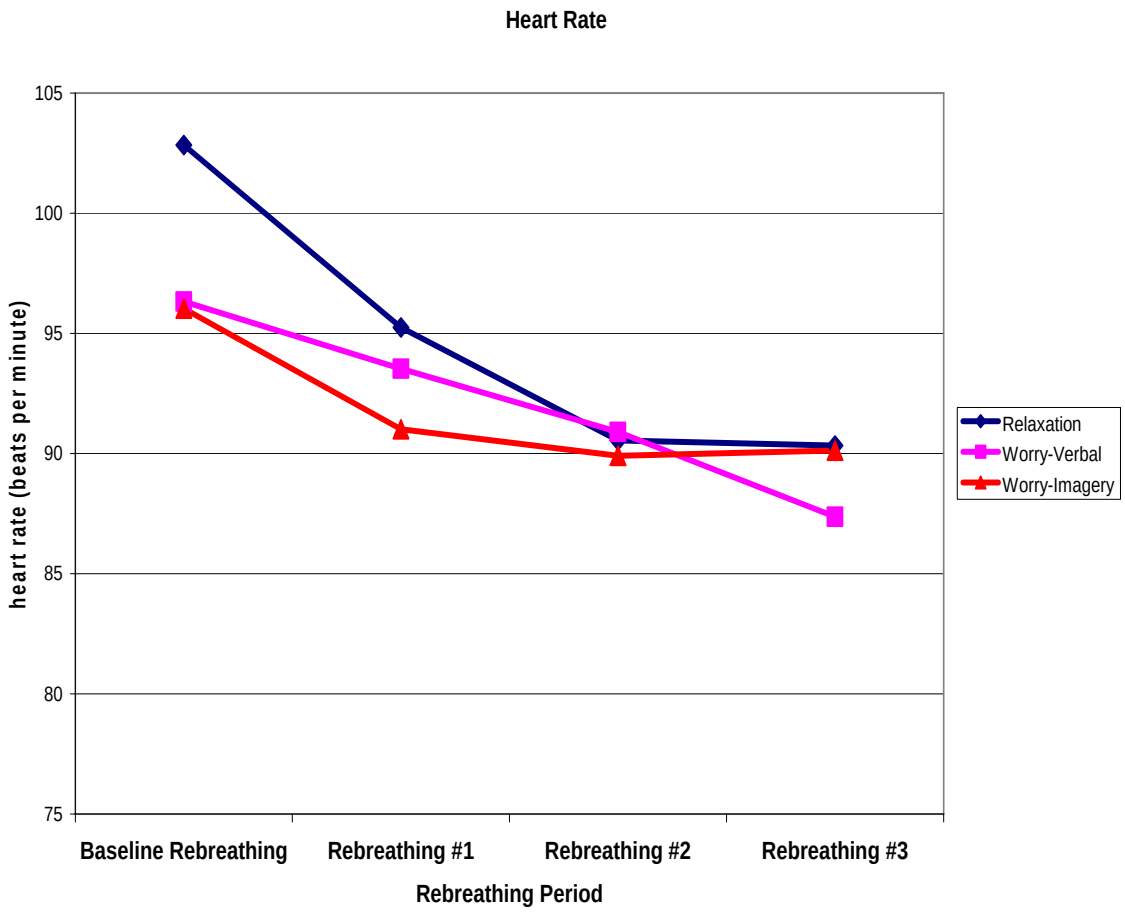


Figure 3.

Heart rate during the rebreathing tasks following periods of relaxation, verbal worry, or imaginal worry.



Appendix B: Telephone Screening Form

Hello, my name is _____ and I am calling from Dr. Borkovec's lab at Penn State. We received your name from the list of Psy002 students interested in being contacted for research and I'm calling to tell you about a study that is being run in Dr. Borkovec's lab.

The title of the study is the "Breathing Study," and it's examining the relationship between breathing patterns and cardiovascular activity. It involves being hooked up to some equipment – we would be placing 2 electrodes on your torso area, just over each rib cage. We would also place two small electrodes on two of your fingertips. The electrodes are just small round stickers, so they do not hurt and are non-invasive.

After being hooked up to the equipment, we would ask you to spend a few minutes breathing quickly and deeply into a paper bag. After repeating this procedure a few times and filling out a few questionnaires, we would remove the sticker electrodes and you would be finished for that session. The entire session should last about an hour and a half.

Then, a week later, we would ask you to come in to fill out some more questionnaires. This part of the study would not involve the use of electrodes, and it would be much shorter (about 10 minutes).

In all, you would receive two hours of research credit for your Psy002 class.

Assess person's willingness to participate in the study. If person is interested, go on. If not, thank the person for his/her time and proceed to the next name on your list. Keep

good notes on what people say if they don't want to participate, so that we can comment on this in the final report.

If not interested: thank the person for his/her time and wish him/her luck with the remainder of his/her semester.

If interested: go on to the Medical Condition Screening Form.

If history of medical condition, explain that we will not be able to include person in the study, and wish person luck with the remainder of his/her semester.

If <u>no</u> history of medical condition and person still interested, schedule a 1.5-hour appointment with the participant. Ask female participants not to wear a dress on the day of the appointment (due to placement of electrodes on torso).

Appendix C: Medical Condition Screening Form

On the telephone, assess for the following medical conditions for each person contacted. If person meets criteria for any of the following four problems, he/she cannot participate in the study. In such a case, explain that participant safety is our primary concern and we do not wish to risk endangering anyone in our experiment.

Respiratory Problems

No

Yes (Please describe here:_____)

Heart Problems

No

Yes (Please describe here:_____)

Epilepsy

No

Yes (Please describe here:_____)

Stroke

No

Yes (Please describe here:_____)

Are you currently taking any medications?

Name of Medication (if feel comfortable sharing): _____

Has your dosage changed at all over the past 8 weeks? Yes No

(*if dosage has changed, person cannot be a participant)*

Appendix D: Measures of Psychopathology

Anxiety Sensitivity Index (Original & Revised)

Please circle the number that best corresponds to how much you agree with each item. If any of the items concern something that is not part of your experience (for example, "It scares me when I feel shaky" for someone who has never trembled or felt shaky), answer on the basis of how you expect you might feel <u>if you had</u> such an experience. Otherwise, answer all items on the basis of your own experience.

0	1	2	3	4
Very Little	**A little**	**Moderate**	**Much**	**Very much**

1. It is important to 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 I feel "shaky" (trembling).
4. It scares me when I feel faint.
5. It is important to me to stay in control of my emotions.
6. It scares me when my heart beats rapidly.
7. It embarrasses me when my stomach growls.
8. It scares me when I am nauseous.
9. When I notice my heart is beating rapidly, I worry that I might have a heart attack.
10. It scares me when I become short of breath.
11. When my stomach is upset, I worry that I might be seriously ill.
12. It scares me when I am unable to keep my mind on a task.
13. Other people notice when I feel shaky.
14. Unusual body sensations scare me.
15. When I am nervous, I worry that I might be mentally ill.
16. It scares me when I am nervous.
17. When my head is pounding, I worry I could have a stroke.

0	1	2	3	4
Very Little	**A little**	**Moderate**	**Much**	**Very much**

18. When I tremble in the presence of others, I fear what people might think of me.
19. When I feel like I'm not getting enough air, I get scared that I might suffocate.
20. When I get diarrhea, I worry that I might have something wrong with me.
21. When my chest feels tight, I get scared that I won't be able to breathe properly.
22. When my breathing becomes irregular, I fear that something bad will happen.
23. It frightens me when my surroundings seem strange or unreal.
24. Smothering sensations scare me.
25. When I feel pain in my chest, I worry that I'm having a heart attack.
26. I believe it would be awful to vomit in public.
27. It scares me when my body feels strange or different in some way.
28. I worry that other people will notice my anxiety.
29. When I feel "spacey" or spaced out, I worry that I may be mentally ill.
30. It scares me when I blush in front of people.
31. When I feel a strong pain in my stomach, I worry that it could be cancer.
32. When I have trouble swallowing, I worry that I could choke.
33. When I notice my heart skipping a beat, I worry that there is something seriously wrong with me.
34. It scares me when I feel tingling or pricking sensations in my hands.
35. When I feel dizzy, I worry there is something wrong with me.
36. When I begin to sweat in social situations, I fear people will think negatively of me.
37. When my thoughts seem to speed up, I worry that I might be going crazy.
38. When my throat feels tight, I worry that I could choke to death.
39. When my face feels numb, I worry that I might be having a stroke.

0	1	2	3	4
Very Little	**A little**	**Moderate**	**Much**	**Very much**

40. When I have trouble thinking clearly, I worry that there is something wrong with me.
41. I think it would be horrible for me to faint in public.
42. When my mind goes blank, I worry that there is something terribly wrong with me.

Panic Disorder Severity Scale – Self Report Version

Before responding, please read the instructions in the box carefully!!!

Several of the following questions refer to panic attacks and limited symptom attacks. For this questionnaire, we 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	Dizziness or Faintness
Sweating	Feelings of Unreality
Trembling or Shaking	Numbness or Tingling
Breathlessness	Chills or Hot Flashes
Feeling of Choking	Fear of Losing Control or Going Crazy
Chest Pain or Discomfort	Fear of Dying
Nausea	

1. **How many panic attacks (as defined above) have you experienced in your life (total number)? _____**
2. **How many panic attacks (as defined above) have you experienced in the past week (total number)? _____**

For each of the following questions, please indicate the answer that best describes your experience during the past month.

3. **How many panic and limited symptoms attacks did you have during the past week?**

   0—No panic or limited symptom episodes
   1—Mild: no full panic attacks and no more than 1 limited symptom attack/day
   2—Moderate: 1 or 2 full panic attacks and/or multiple limited symptom attacks/day
   3—Severe: more than 2 full attacks but not more than 1/day on average
   4—Extreme: full panic attacks occurred more than once a day, more days than not

4. **If you had any panic attacks during the past week, how distressing (uncomfortable, frightening) were they while they were happening? (If you had more than one, give an average rating. If you didn't have any panic attacks but did have limited symptom attacks, answer for the limited symptom attacks.)**

   0—Not at all distressing, or no panic or limited symptom attacks during the past week
   1—Mildly distressing (not too intense)

2—Moderately distressing (intense, but still manageable)
3—Severely distressing (very intense)
4—Extremely distressing (extreme distress during all attacks)

5. **During the past week, how much have you worried or felt anxious <u>about when your next panic attack would occur, or about fears related to the attacks</u> (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 or only mildly
   2—Frequently or moderately
   3—Very often or to a very disturbing degree
   4—Nearly constantly and to a disabling extent

6. **During the past week, were there any <u>places or situations</u> (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), <u>because of fear of having a panic attack</u>? Are there any other situations that you would have avoided or been afraid of if they had come up during the week, for the same reason? If yes to either question, 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. There was little or no modification of my lifestyle due to this.
   2—Moderate: noticeable fear and/or avoidance, but still manageable. I avoided some situations but I could confront them with a companion. There was some modification of my lifestyle because of this, but my overall functioning was not impaired.
   3—Severe: extensive avoidance. Substantial modification of my life style was required to accommodate the avoidance, making it difficult to manage usual activities.
   4—Extreme: pervasive disabling fear and/or avoidance. Extensive modification in my lifestyle was required, such that important tasks were not performed.

7. **During the past week, were there any <u>activities</u> (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 (uncomfortable doing, wanted to avoid or stop), <u>because they caused physical sensations like those you feel during panic attacks or that you were afraid might trigger a panic attack</u>? Are there any other activities that you would have avoided or been afraid of if they had come up during the week, for that reason? If yes to either question, 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, but usually I could confront or endure

with little distress activities that cause physical sensations. There was little modification of my lifestyle due to this.

2—Moderate: noticeable avoidance, but still manageable. There was definite, but limited, modification of my lifestyle, such that my overall functioning was not impaired.

3—Severe: extensive avoidance. There was substantial modification of my life style or interference in my functioning.

4—Extreme: pervasive and disabling avoidance. There was extensive modification in my lifestyle due to this, such that important tasks or activities were not performed.

8. **During the past week, how much did the above symptoms altogether (panic and limited symptom attacks, worry about attacks, and fear of situations and activities because of attacks), interfere with your <u>ability to work or carry out your responsibilities at home</u>? (If your work or home responsibilities were less than usual this past week, answer how you think you would have done if the responsibilities had been usual.)**

0—No interference with work or home responsibilities

1—Slight interference with work or home responsibilities, but I could do nearly everything I could if I didn't have these problems

2—Significant interference with work or home responsibilities, but I still could manage to do the things I needed to do

3—Substantial impairment in work or home responsibilities; there were many important things I couldn't do because of these problems

4—Extreme, incapacitating impairment, such that I was essentially unable to manage any work or home responsibilities

9. **During the past week, how much did panic and limited symptom attacks, worry about attacks, and fear of situations and activities because of attacks, interfere with your <u>social life</u>? (If you didn't have many opportunities to socialize this past week, answer how you think you would have done if you did have opportunities.)**

0—No interference

1—Slight interference with social activities, but I could do nearly everything I could if I didn't have these problems

2—Significant interference with social activities, but I could manage to do most things if I made the effort

3—Substantial impairment in social activities; there are many social things I couldn't do because these problems

4—Extreme, incapacitating impairment, such that there was hardly anything social I could do

Agoraphobic Cognitions Questionnaire

Below are some thoughts or ideas that may pass through your mind <u>when you are nervous or frightened.</u> Please indicate <u>how often each thought occurs when you are nervous</u>. Rate from 1-5 using the scale below.

	*Thought **never** occurs when I am nervous*	*Thought **rarely** occurs when I am nervous*	*Thought occurs **during half of the times** when I am nervous*	*Thought **usually** occurs when I am nervous*	*Thought **always** occurs when I am nervous*
1. I am going to throw up	**1**	**2**	**3**	**4**	**5**
2. I am going to pass out	**1**	**2**	**3**	**4**	**5**
3. I must have a brain tumor	**1**	**2**	**3**	**4**	**5**
4. I will have a heart attack	**1**	**2**	**3**	**4**	**5**
5. I will choke to death	**1**	**2**	**3**	**4**	**5**
6. I am going to act foolish	**1**	**2**	**3**	**4**	**5**
7. I am going blind	**1**	**2**	**3**	**4**	**5**
8. I will not be able to control myself	**1**	**2**	**3**	**4**	**5**
9. I will hurt someone	**1**	**2**	**3**	**4**	**5**
10. I am going to have a stroke	**1**	**2**	**3**	**4**	**5**
11. I am going crazy	**1**	**2**	**3**	**4**	**5**
12. I am going to scream	**1**	**2**	**3**	**4**	**5**
13. I am going to babble or talk funny	**1**	**2**	**3**	**4**	**5**

	Thought ***never*** *occurs when I am nervous*	*Thought* ***rarely*** *occurs when I am nervous*	*Thought occurs* ***during half of the times*** *when I am nervous*	*Thought* ***usually*** *occurs when I am nervous*	*Thought* ***always*** *occurs when I am nervous*
14. I am going to be paralyzed by fear	**1**	**2**	**3**	**4**	**5**
15. Other ideas not listed (please describe and rate them)	**1**	**2**	**3**	**4**	**5**

Body Sensations Questionnaire

Below is a list of specific body sensations that may occur when you are nervous or in a feared situation. Please mark down how afraid you are of these feelings. Rate from 1-5 using the scale below.

	Not at all afraid	*Some-what afraid*	*Moder-ately afraid*	*Very afraid*	*Extremely afraid*
1. heart palpitations	**1**	**2**	**3**	**4**	**5**
2. pressure or a heavy feeling in chest	**1**	**2**	**3**	**4**	**5**
3. numbness in arms or legs	**1**	**2**	**3**	**4**	**5**
4. tingling in the fingertips	**1**	**2**	**3**	**4**	**5**
5. numbness in another part of your body	**1**	**2**	**3**	**4**	**5**
6. feeling short of breath	**1**	**2**	**3**	**4**	**5**
7. dizziness	**1**	**2**	**3**	**4**	**5**
8. blurred or distorted vision	**1**	**2**	**3**	**4**	**5**
9. nausea	**1**	**2**	**3**	**4**	**5**
10. having "butterflies" in your stomach	**1**	**2**	**3**	**4**	**5**
11. feeling a knot in your stomach	**1**	**2**	**3**	**4**	**5**
12. having a lump in your throat	**1**	**2**	**3**	**4**	**5**
13. wobbly or rubber legs	**1**	**2**	**3**	**4**	**5**
14. sweating	**1**	**2**	**3**	**4**	**5**
15. a dry throat	**1**	**2**	**3**	**4**	**5**

	Not at all afraid	*Some-what afraid*	*Moder-ately afraid*	*Very afraid*	*Extremely afraid*
16. feeling disoriented and confused	**1**	**2**	**3**	**4**	**5**
17. feeling disconnected from your body: only partly present	**1**	**2**	**3**	**4**	**5**
18. other (please describe and rate)	**1**	**2**	**3**	**4**	**5**

State Trait Anxiety Inventory – Trait Version

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number on the answer sheet to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but **give the answer which seems to describe how you generally feel.**

	Almost Never	Sometimes	Often	Almost Always
1. I feel pleasant	1	2	3	4
2. I feel nervous and restless	1	2	3	4
3. I feel satisfied with myself	1	2	3	4
4. I wish I could be as happy as others seem to be	1	2	3	4
5. I feel like a failure	1	2	3	4
6. I feel rested	1	2	3	4
7. I am "calm, cool, and collected"	1	2	3	4
8. I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
9. I worry too much over something that really doesn't matter	1	2	3	4
10. I am happy	1	2	3	4
11. I have disturbing thoughts	1	2	3	4
12. I lack self-confidence	1	2	3	4
13. I feel secure	1	2	3	4
14. I make decisions easily	1	2	3	4
15. I feel inadequate	1	2	3	4
16. I am content	1	2	3	4
17. Some unimportant thought runs through my mind and bothers me	1	2	3	4
18. I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
19. I am a steady person	1	2	3	4
20. I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

Generalized Anxiety Disorder Questionnaire – IV

1. Do you experience excessive worry?…….…….	No =	0	Yes =	1
2. Is your worry excessive in intensity, frequency, or amount of distress it causes?.....	No =	0	Yes =	1
3. Do you find it difficult to control your worry (or stop worrying) once it starts?.....	No =	0	Yes =	1
4. Do you worry excessively and uncontrollably about minor things such as being late for an appointment, minor repairs, homework, etc.?…….	No =	0	Yes =	1

5. How many separate topics do you worry about excessively and uncontrollably?
a. One topic
b. Two topics
c. Three topics
d. Four topics
e. Five topics
f. Six or more topics

6. During the last six months, have you been bothered by excessive and uncontrollable worries more days than not? …….	No =	0	Yes =	1
7. During the past six months, have you been bothered by restlessness or feeling keyed up or on edge more days than not?…….	No =	0	Yes =	1
8. During the past six months, have you been bothered by difficulty falling/staying asleep or restless/unsatisfying sleep more days than not? …	No =	0	Yes =	1
9. During the past six months, have you been bothered by difficulty concentrating or your mind going blank more days than not? ……...	No =	0	Yes =	1
10. During the past six months, have you been bothered by irritability more days than not?.....	No =	0	Yes =	1
11. During the past six months, have you been bothered by being easily fatigued more days than not? ……...	No =	0	Yes =	1
12. During the past six months, have you been bothered by muscle tension more days than not? ….…….……	No =	0	Yes =	1

13. How much do worry and these physical symptoms interfere with your life, work, social activities, family, etc.?

0	1	2	3	4	5	6	7	8
Not at All		Mildly		Moderately		Severely		Very Severely

14. How much are you bothered by worry and these physical symptoms (how much distress do they cause you)?

0	1	2	3	4	5	6	7	8
No distress		Mild distress		Moderate distress		Severe distress		Very Severe distress

15. How frequently do you experience worry?

0	1	2	3	4	5	6	7	8
Never Worry		Worry Occasionally		Worry a Moderate Amount		Worry quite A Bit		Worry all The time

16. How intensely do you worry?

0	1	2	3	4	5	6	7	8
Not at All		A little		Moderately		Quite A Bit		Very much so

17. To what extent is your worry distressing?

0	1	2	3	4	5	6	7	8
Not at All		A little		Moderately		Quite A Bit		Very Much so

18. How difficult is it to control your worry (or stop worrying) once it starts?

0	1	2	3	4	5	6	7	8
No Difficulty		Slight Difficulty		Moderate Difficulty		Marked Difficulty		Extreme Difficulty

19. How often can you control your worry (or stop worrying) once it starts?

0	1	2	3	4	5	6	7	8
Always in Control		Frequently in Control		Occasionally in Control		Rarely in Control		Never in Control

20. How often do you worry about things that others might see as minor such as being late for an appointment, minor repairs, homework, etc.?

0	1	2	3	4	5	6	7	8
Never		Occasionally		A Moderate Amount		Quite A Bit		All The time

Please Answer the next two questions based on the list below

a. Punctuality, or being late for an appointment
b. Small repairs
c. Household chores or errands
d. Your competence
e. Work (e.g., getting fired, how you are evaluated, responsibilities)
f. Finances
g. School (doing poorly on tests, flunking out)
h. Family members
i. Interpersonal relationships
j. Your health or safety
k. The health or safety of significant others
l. Community or world affairs
m. Your ability to cope
n. Others ability to cope
o. Other

21. About how many of the above topics do you worry frequently (more days than not)?

0	1	2	3	4	5	6	7	8 or More

22. About how many of the above topics do you worry uncontrollably (e.g., have difficulty stopping once you start worrying about the topic?)

0	1	2	3	4	5	6	7	8 or More

23. How often during the <u>last six months</u>, have you been bothered by worries?

0	1	2	3	4	5	6	7	8
Never		Once a Week		3-4 times per week		More days than not		Almost Every day

24. How often during the <u>last six months</u>, have you had trouble stopping your worry once it started?

0	1	2	3	4	5	6	7	8
Never		Once a Week		3-4 times per week		More days than not		Almost Every day

25. How often during the <u>last six months</u>, have you felt restless, keyed up, or on edge?

0	1	2	3	4	5	6	7	8
Never		Once a Week		3-4 times per week		More days than not		Almost Every day

26. How often during the <u>last six months</u>, have you felt irritable?

0	1	2	3	4	5	6	7	8
Never		Once a Week		3-4 times per week		More days than not		Almost Every day

27. How often during the <u>last six months</u>, have you had difficulty falling/staying asleep or restless/unsatisfying sleep?

0	1	2	3	4	5	6	7	8
Never		Once a Week		3-4 times per week		More days than not		Almost Every day

28. How often during the <u>last six months</u>, have you been easily fatigued?

0	1	2	3	4	5	6	7	8
Never		Once a Week		3-4 times per week		More days than not		Almost Every day

29. How often during the <u>last six months</u>, have you had difficulty concentrating or noticed your mind going blank?

0	1	2	3	4	5	6	7	8
Never		Once a Week		3-4 times per week		More days than not		Almost Every day

30. How often during the <u>last six months</u> have you had muscle tension or soreness?

0	1	2	3	4	5	6	7	8
Never		Once a Week		3-4 times per week		More days than not		Almost Every day

Penn State Worry Questionnaire

Choose the number that best describes how typical or characteristic each item is of you. PLEASE MAKE ALL RESPONSES ON THE FORM

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

_____1. If I don't have enough time to do everything, I don't worry about it.

_____2. My worries overwhelm me.

_____3. I don't tend to worry about things.

_____4. Many situations make me worry.

_____5. I know I shouldn't worry about things, but I just can't help it.

_____6. When I am under pressure I worry a lot.

_____7. I am always worrying about something.

_____8. I find it easy to dismiss worrisome thoughts.

_____9. As soon as I finish one task, I start to worry about everything else I have to do.

_____10. I never worry about anything.

_____11. When there is nothing more I can do about a concern, I don't worry about it any more.

_____12. I've been a worrier all my life.

_____13. I notice that I have been worrying about things.

_____14. Once I start worrying, I can't stop.

_____15. I worry all the time.

_____16. I worry about projects until they are all done.

Posttraumatic Stress Disorder Checklist

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

The event you experienced was _____ on _____.
(event) (date)

	Not At all	*A little bit*	*Moder-ately*	*Quite a bit*	*Extremely*
1. Repeated, disturbing *memories, thoughts, or images* of the stressful experience?	**0**	**1**	**2**	**3**	**4**
2. Repeated, disturbing *dreams* of the stressful experience?	**0**	**1**	**2**	**3**	**4**
3. Suddenly *acting or feeling* as if the stressful experience *were happening again* (as if you were reliving it)?	**0**	**1**	**2**	**3**	**4**
4. Feeling *very upset* when *something reminded you* of the stressful experience?	**0**	**1**	**2**	**3**	**4**
5. Having *physical reactions* (e.g., heart pounding, trouble breathing, sweating) when *something reminded you* of the stressful experience?	**0**	**1**	**2**	**3**	**4**
6. Avoiding *thinking about or talking about* the stressful experience or avoiding *having feelings* related to it?	**0**	**1**	**2**	**3**	**4**
7. Avoiding *activities or situations* because *they reminded you* of the stressful experience?	**0**	**1**	**2**	**3**	**4**

	Not At all	*A little bit*	*Moder-ately*	*Quite a bit*	*Extremely*
8. Trouble *remembering important parts* of the stressful experience?	**0**	**1**	**2**	**3**	**4**
9. *Loss of interest* in activities that you used to enjoy?	**0**	**1**	**2**	**3**	**4**
10. Feeling *distant or cut off* from other people?	**0**	**1**	**2**	**3**	**4**
11. Feeling *emotionally numb* or being unable to have loving feelings for those close to you?	**0**	**1**	**2**	**3**	**4**
12. Feeling as if your *future* somehow will be *cut short*?	**0**	**1**	**2**	**3**	**4**
13. Trouble *falling or staying asleep*?	**0**	**1**	**2**	**3**	**4**
14. Feeling *irritable* or having *angry outbursts*?	**0**	**1**	**2**	**3**	**4**
15. Having *difficulty concentrating*?	**0**	**1**	**2**	**3**	**4**
16. Being "*superalert*" or watchful or on guard?	**0**	**1**	**2**	**3**	**4**
17. Feeling *jumpy* or easily startled?	**0**	**1**	**2**	**3**	**4**

Appendix E: Baseline Self-Report Measure

On a scale of 0 – 100, how much anxiety do you feel <u>right now?</u>

In forming your response, please use the following scale:

0	10	20	30	40	50	60	70	80	90	100
/	/	/	/	/	/	/	/	/	/	/
Complete Relax-ation	Very slight anxiety	Slight anx-iety		Some anx-iety	Moderate anxiety	Definite anxiety		Much anx-iety	Very much anx-iety	Worst anx-iety imag-inable

Your anxiety rating: _____
(can be any number between 0-100)

<u>PANAS</u>

This scale consists of a number of words that describe different feelings and emotions. Please read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you felt this way **RIGHT NOW, AT THIS MOMENT.** Use the following scale to indicate your answers:

1	2	3	4	5
very slightly or not at all	**a little**	**moderately**	**quite a bit**	**extremely**

_____interested
_____distressed
_____excited
_____upset
_____strong
_____guilty
_____scared
_____hostile
_____enthusiastic
_____proud

_____irritable
_____alert
_____ashamed
_____inspired
_____nervous
_____determined
_____attentive
_____jittery
_____active
_____afraid

Appendix F: Relaxation Condition Tape-Recorded Instructions

Resting Baseline (2 minutes)

"Thank you for participating in our study, which looks at the impact of heavy breathing on heart rate activity. Please sit quietly for a few moments and relax. Remember to keep movement to a minimum and to keep your legs and feet uncrossed. We will begin shortly."

Rebreathing Baseline (3 minutes)

"We will now begin the first breathing task. I would like you to begin the fast breathing procedure. As you were shown earlier, you will begin the metronome as soon as you are ready. Once the metronome begins, complete one breathing cycle for every other beep. In other words, you will inhale at one beep, and then exhale at the next beep. You should breathe in and out as hard as you can, like you are blowing up a balloon. It is important that you breathe deeply and that you breathe at the rate of the metronome. Position the paper bag so that it completely covers your mouth, and use only your non-dominant hand to hold the bag to your mouth. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next set of questions. If you have any questions, please ask the experimenter now. Otherwise, you may begin."

Rebreathing BL Questionnaire

"Please pick up the next questionnaire and fill it out. When you are done, please put it aside and await further instructions."

Period 1

Pre-ReBreathing Induction #1 (3 minutes). "In a little while, I will ask you to complete this breathing task again. Please close your eyes now and try to relax as deeply as possible. One of the best ways to achieve deep relaxation is to breathe through your diaphragm as opposed to your chest. In other words, breathe so that your stomach moves up and down as opposed to your chest. Let all of the muscles in your body relax as you breathe deeply and slowly. Please do this for the next several minutes, allowing yourself to relax as deeply as possible. You do not need to do any heavy breathing yet. I will let you know when to stop. You may begin."

Manipulation Check #1. "Please pick up the next questionnaire and fill it out."

Rebreathing Task #1 (3 minutes). "We will now return to the fast breathing portion of our study. When you are ready, begin the metronome and breathe as you did before, inhaling at one beep and exhaling at the next. Position the paper bag so that it completely covers your mouth. You should breathe in and out as hard as you can, like you are blowing up a balloon. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next questionnaire. Please begin."

Symptom Questionnaire #1. "Please stop. Pick up the next questionnaire and fill it out. When are you done, please put it aside and await further instructions."

Period 2

Pre-Rebreathing Induction #2 (3 minutes). "In a little while, I will ask you to complete this breathing task again. Just as you did before, please spend the next few

minutes relaxing as deeply and as slowly as possible. Remember, breathe from your diaphragm as opposed to your chest, breathing so that your stomach moves up and down as opposed to your chest. Let all of the muscles in your body relax as you breathe deeply and slowly. Please do this for the next several minutes, allowing yourself to relax as deeply as possible. You do not need to do any heavy breathing yet. I will let you know when to stop. You may begin."

Manipulation Check #2. "Please pick up the next questionnaire and fill it out."

Rebreathing Task #2 (3 minutes). "We will now return to the fast breathing portion of our study. When you are ready, begin the metronome and breathe as you did before, inhaling at one beep and exhaling at the next. Position the paper bag so that it completely covers your mouth. You should breathe in and out as hard as you can, like you are blowing up a balloon. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next questionnaire. Please begin."

Symptom Questionnaire #2. "Please stop. Pick up the next questionnaire and fill it out. When are you done, please put it aside and await further instructions."

Period 3

Pre-Rebreathing Induction #3 (3 minutes). "In a little while, I will ask you to complete this breathing task again. Just as you did before, please spend the next few minutes relaxing as deeply and as slowly as possible. Remember, breathe from your diaphragm as opposed to your chest, breathing so that your stomach moves up and down as opposed to your chest. Let all of the muscles in your body relax as you breathe deeply

and slowly. Please do this for the next several minutes, allowing yourself to relax as deeply as possible. You do not need to do any heavy breathing yet. I will let you know when to stop. You may begin."

Manipulation Check #3. "Please pick up the next questionnaire and fill it out."

Rebreathing Task #3 (3 minutes). "We will now return to the fast breathing portion of our study. When you are ready, begin the metronome and breathe as you did before, inhaling at one beep and exhaling at the next. Position the paper bag so that it completely covers your mouth. You should breathe in and out as hard as you can, like you are blowing up a balloon. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next questionnaire. Please begin."

Symptom Questionnaire #3. "Please stop. Pick up the next questionnaire and fill it out. When are you done, please put it aside and await further instructions."

Relaxation Induction (5 minutes)

"You are finished with the experiment. Please sit and relax for a few moments, breathing slowly and deeply, until the experimenter comes in to remove the equipment."

Appendix G: Worry-Imagery Condition Tape-Recorded Instructions

Resting Baseline (2 minutes)

"Thank you for participating in our study, which looks at the impact of heavy breathing on heart rate activity. Please sit quietly for a few moments and relax. Remember to keep movement to a minimum and to keep your legs and feet uncrossed. We will begin shortly."

Rebreathing Baseline (3 minutes)

"We will now begin the first breathing task. I would like you to begin the fast breathing procedure. As you were shown earlier, you will begin the metronome as soon as you are ready. Once the metronome begins, complete one breathing cycle for every other beep. In other words, you will inhale at one beep, and then exhale at the next beep. You should breathe in and out as hard as you can, like you are blowing up a balloon. It is important that you breathe deeply and that you breathe at the rate of the metronome. Position the paper bag so that it completely covers your mouth, and use only your non-dominant hand to hold the bag to your mouth. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next set of questions. If you have any questions, please ask the experimenter now. Otherwise, you may begin."

Rebreathing BL Questionnaire

"Please pick up the next questionnaire and fill it out. When you are done, please put it aside and await further instructions."

Period 1

Pre-Rebreathing Induction #1 (3 minutes). **"**In a little while, I will ask you to complete this breathing task again. Please close your eyes now and worry about the upcoming breathing task using vivid imagery. Please do so by creating vivid pictures in your mind as you worry about the upcoming task – imagine yourself actively engaged in the heavy breathing through the paper bag, and imagine the sensations and emotions that you will be feeling. If you find yourself using thought or verbal activity, simply replace these with vivid pictures. Please do this for the next several minutes, replaying the images in your mind. You do not need to do any heavy breathing yet. I will let you know when to stop worrying. You may begin."

Manipulation Check #1. "Please pick up the next questionnaire and fill it out."

Rebreathing Task #1 (3 minutes). "We will now return to the fast breathing portion of our study. When you are ready, begin the metronome and breathe as you did before, inhaling at one beep and exhaling at the next. Position the paper bag so that it completely covers your mouth. You should breathe in and out as hard as you can, like you are blowing up a balloon. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next questionnaire. Please begin."

Symptom Questionnaire #1. "Please stop. Pick up the next questionnaire and fill it out. When are you done, please put it aside and await further instructions."

Period 2

Pre-Rebreathing Induction #2 (3 minutes). "In a little while, I will ask you to complete this breathing task again. Please close your eyes now and worry about the upcoming breathing task using vivid imagery. Please do so by creating vivid pictures in your mind as you worry about the upcoming task – imagine yourself actively engaged in the heavy breathing through the paper bag, and imagine the sensations and emotions that you will be feeling. If you find yourself using thought or verbal activity, simply replace these with vivid pictures. Please do this for the next several minutes, replaying the images in your mind. You do not need to do any heavy breathing yet. I will let you know when to stop worrying. You may begin."

Manipulation Check #2. "Please pick up the next questionnaire and fill it out."

Rebreathing Task #2 (3 minutes). "We will now return to the fast breathing portion of our study. When you are ready, begin the metronome and breathe as you did before, inhaling at one beep and exhaling at the next. Position the paper bag so that it completely covers your mouth. You should breathe in and out as hard as you can, like you are blowing up a balloon. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next questionnaire. Please begin."

Symptom Questionnaire #2. "Please stop. Pick up the next questionnaire and fill it out. When are you done, please put it aside and await further instructions."

Period 3

Pre-Rebreathing Induction #3 (3 minutes). "In a little while, I will ask you to complete this breathing task again. Please close your eyes now and worry about the upcoming breathing task using vivid imagery. Please do so by creating vivid pictures in your mind as you worry about the upcoming task – imagine yourself actively engaged in the heavy breathing through the paper bag, and imagine the sensations and emotions that you will be feeling. If you find yourself using thought or verbal activity, simply replace these with vivid pictures. Please do this for the next several minutes, replaying the images in your mind. You do not need to do any heavy breathing yet. I will let you know when to stop worrying. You may begin."

Manipulation Check #3. "Please pick up the next questionnaire and fill it out."

Rebreathing Task #3 (3 minutes). "We will now return to the fast breathing portion of our study. When you are ready, begin the metronome and breathe as you did before, inhaling at one beep and exhaling at the next. Position the paper bag so that it completely covers your mouth. You should breathe in and out as hard as you can, like you are blowing up a balloon. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next questionnaire. Please begin."

Symptom Questionnaire #3. "Please stop. Pick up the next questionnaire and fill it out. When are you done, please put it aside and await further instructions."

Relaxation Induction (5 minutes)

"You are finished with the experiment. Please sit and relax for a few moments, breathing slowly and deeply, until the experimenter comes in to remove the equipment."

Appendix H: Worry-Verbal Condition Tape-Recorded Instructions

Resting Baseline (2 minutes)

"Thank you for participating in our study, which looks at the impact of heavy breathing on heart rate activity. Please sit quietly for a few moments and relax. Remember to keep movement to a minimum and to keep your legs and feet uncrossed. We will begin shortly."

Rebreathing Baseline (3 minutes)

"We will now begin the first breathing task. I would like you to begin the fast breathing procedure. As you were shown earlier, you will begin the metronome as soon as you are ready. Once the metronome begins, complete one breathing cycle for every other beep. In other words, you will inhale at one beep, and then exhale at the next beep. You should breathe in and out as hard as you can, like you are blowing up a balloon. It is important that you breathe deeply and that you breathe at the rate of the metronome. Position the paper bag so that it completely covers your mouth, and use only your non-dominant hand to hold the bag to your mouth. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next set of questions. If you have any questions, please ask the experimenter now. Otherwise, you may begin."

Rebreathing BL Questionnaire

"Please pick up the next questionnaire and fill it out. When you are done, please put it aside and await further instructions."

Period 1

Pre-Rebreathing Induction #1 (3 minutes). **"**In a little while, I will ask you to complete this breathing task again. Please close your eyes now and worry about the upcoming breathing task using thought activity. Please do so by using words in your mind as you normally do when worrying. I would like you to worry about the upcoming breathing task as intensely as you can. If you find yourself using imagery, simply replace these with words in your mind. Please do this for the next several minutes, replaying the words in your mind. You do not need to do any heavy breathing yet. I will let you know when to stop worrying. You may begin."

Manipulation Check #1. "Please pick up the next questionnaire and fill it out."

Rebreathing Task #1 (3 minutes). "We will now return to the fast breathing portion of our study. When you are ready, begin the metronome and breathe as you did before, inhaling at one beep and exhaling at the next. Position the paper bag so that it completely covers your mouth. You should breathe in and out as hard as you can, like you are blowing up a balloon. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next questionnaire. Please begin."

Symptom Questionnaire #1. "Please stop. Pick up the next questionnaire and fill it out. When are you done, please put it aside and await further instructions."

Period 2

Pre-Rebreathing Induction #2 (3 minutes). **"**In a little while, I will ask you to complete this breathing task again. Please close your eyes now and worry about the

upcoming breathing task using thought activity. Please do so by using words in your mind as you normally do when worrying. I would like you to worry about the upcoming breathing task as intensely as you can. If you find yourself using imagery, simply replace these with words in your mind. Please do this for the next several minutes, replaying the words in your mind. You do not need to do any heavy breathing yet. I will let you know when to stop worrying. You may begin."

Manipulation Check #2. "Please pick up the next questionnaire and fill it out."

Rebreathing Task #2 (3 minutes). "We will now return to the fast breathing portion of our study. When you are ready, begin the metronome and breathe as you did before, inhaling at one beep and exhaling at the next. Position the paper bag so that it completely covers your mouth. You should breathe in and out as hard as you can, like you are blowing up a balloon. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next questionnaire. Please begin."

Symptom Questionnaire #2. "Please stop. Pick up the next questionnaire and fill it out. When are you done, please put it aside and await further instructions."

Period 3

Pre-Rebreathing Induction #3 (3 minutes). **"**In a little while, I will ask you to complete this breathing task again. Please close your eyes now and worry about the upcoming breathing task using thought activity. Please do so by using words in your mind as you normally do when worrying. I would like you to worry about the upcoming breathing task as intensely as you can. If you find yourself using imagery, simply replace

these with words in your mind. Please do this for the next several minutes, replaying the words in your mind. You do not need to do any heavy breathing yet. I will let you know when to stop worrying. You may begin."

Manipulation Check #3. "Please pick up the next questionnaire and fill it out."

Rebreathing Task #3 (3 minutes). "We will now return to the fast breathing portion of our study. When you are ready, begin the metronome and breathe as you did before, inhaling at one beep and exhaling at the next. Position the paper bag so that it completely covers your mouth. You should breathe in and out as hard as you can, like you are blowing up a balloon. At the end of 3 minutes I will stop you, and at that point you should begin breathing as you normally do and fill out the next questionnaire. Please begin."

Symptom Questionnaire #3. "Please stop. Pick up the next questionnaire and fill it out. When are you done, please put it aside and await further instructions."

Relaxation Induction (5 minutes)

"You are finished with the experiment. Please sit and relax for a few moments, breathing slowly and deeply, until the experimenter comes in to remove the equipment."

Appendix I : Manipulation Check Questionnaires

Manipulation Check Questionnaire (Worry Conditions)

You were just asked to spend a few moments actively worrying about the upcoming breathing task. What percentage of the time were you *actually* worrying about the upcoming task?

_____% of the time

For purposes of this questionnaire, we are defining ***thoughts*** *as "words you say to yourself,"* ***images*** *as "pictures in your mind," and* ***other*** *as anything that is neither thoughts nor images.*

During the period of worrying you underwent, what percentage of the time did you notice thoughts, images, or neither?

_____% thoughts

_____% images

_____% neither

Total = 100%

Manipulation Check Questionnaire (Relaxation Condition)

You were just asked to spend a few moments engaged in deep relaxation. What percentage of the time were you *actually* engaged in deep relaxation?

_____% of the time

For purposes of this questionnaire, we are defining ***thoughts*** *as "words you say to yourself,"* ***images*** *as "pictures in your mind," and* ***other*** *as anything that is neither thoughts nor images.*

During the period of relaxation you underwent, what percentage of the time did you notice thoughts, images, or neither?

_____% thoughts

_____% images

_____% neither

Total = 100%

Appendix J: Symptom Questionnaire Administered Following Rebreathing Tasks

Below is a list of physical sensations people sometimes experience in response to breathing tasks such as this one. Please read each sensation and indicate HOW MUCH YOU WERE BOTHERED BY THAT SENSATION <u>DURING THE BREATHING TASK YOU JUST UNDERWENT</u>.

Please circle the number corresponding to your response for each item.

At any point during this breathing task, did you suddenly feel more frightened, anxious, or extremely uncomfortable?
Please circle one: **NO** **YES**

	Not at all Noticed									***Very Intensely Felt***
1. Palpitations, pounding heart, or accelerated heart rate	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
2. Sweating	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
3. Trembling or shaking	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
4. Sensations of shortness of breath or smothering	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
5. Feeling of choking	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
6. Chest pain or discomfort	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
7. Nausea or abdominal distress	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
8. Feeling dizzy, unsteady, lightheaded, or faint	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
9. Feeling of unreality or being detached from yourself	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
10. Fear of losing control or going crazy	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

11. Fear of dying	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
12. Numbness or tingling sensations	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
13. Chills or hot flushes	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

On a scale of 0 – 100, how much anxiety do you feel <u>right now?</u>

In forming your response, please use the following scale:

0 /	**10** /	**20** /	**30** /	**40** /	**50** /	**60** /	**70** /	**80** /	**90** /	**100** /
Complete Relaxation	Very slight anxiety	Slight anx-iety		Some anx-iety	Moderate anxiety	Definite anxiety		Much anx-iety	Very much anx-iety	Worst anx-iety imag-inable

Your anxiety rating: _____

(can be any number between 0-100)

Please turn the page for additional questions ➡

Please indicate whether you experienced any of the following <u>thoughts</u> DURING THE BREATHING TASK.		
"I am going to throw up"	**Yes**	**No**
"I am going to pass out"	**Yes**	**No**
"I must have a brain tumor"	**Yes**	**No**
"I will have a heart attack"	**Yes**	**No**
"I will choke to death"	**Yes**	**No**
"I am going to act foolish"	**Yes**	**No**
"I am going blind"	**Yes**	**No**
"I will not be able to control myself"	**Yes**	**No**
"I will hurt someone"	**Yes**	**No**
"I am going to have a stroke"	**Yes**	**No**
"I am going crazy"	**Yes**	**No**
"I am going to scream"	**Yes**	**No**
"I am going to babble or talk funny"	**Yes**	**No**
"I am going to be paralyzed by fear"	**Yes**	**No**
Other:	**Yes**	**No**

Please turn the page for additional questions ➡

PANAS

This scale consists of a number of words that describe different feelings and emotions. Please read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you felt this way **RIGHT NOW, AT THIS MOMENT.** Use the following scale to indicate your answers:

1	2	3	4	5
very slightly or not at all	**a little**	**moderately**	**quite a bit**	**extremely**

_____interested	**_____irritable**
_____distressed	**_____alert**
_____excited	**_____ashamed**
_____upset	**_____inspired**
_____strong	**_____nervous**
_____guilty	**_____determined**
_____scared	**_____attentive**
_____hostile	**_____jittery**
_____enthusiastic	**_____active**
_____proud	**_____afraid**

Appendix K: Follow-Up Memory Task Questionnaire – Recall

PANAS

This scale consists of a number of words that describe different feelings and emotions. Please read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you felt this way **RIGHT NOW, AT THIS MOMENT.** Use the following scale to indicate your answers:

1	2	3	4	5
very slightly or not at all	**a little**	**moderately**	**quite a bit**	**extremely**

_____interested	**_____irritable**
_____distressed	**_____alert**
_____excited	**_____ashamed**
_____upset	**_____inspired**
_____strong	**_____nervous**
_____guilty	**_____determined**
_____scared	**_____attentive**
_____hostile	**_____jittery**
_____enthusiastic	**_____active**
_____proud	**_____afraid**

Please turn the page for additional questions ➡

Last week, you were asked to breathe heavily and deeply into a paper bag several times. On this form, please try to recall the physical symptoms you experienced during those procedures. In the left column, record the symptom you experienced; in the right column, record the intensity with which you experienced that symptom. Try to recall as many of your symptoms as possible. If these instructions are not clear, please ask the experimenter.

List Physical Symptoms Here *(list as many as you can remember)*	***Not at all Noticed***									***Very Intensely Felt***
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Please turn the page for additional questions ➡

Now, please try to recall the thoughts that were going through your mind last week as you breathed through the paper bag. In the left column, record the thought you experienced. Try to recall as many of your thoughts as possible. If these instructions are not clear, please ask the experimenter.

List Thoughts you Experienced Here ***(list as many as you can remember)*:**

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.

The experimenter will now give you "Form B" of the questionnaire. Please ask him/her for that form.

Appendix L: Follow-Up Memory Task Questionnaire – Recognition

Now, please answer the following questions based on the symptoms you experienced <u>last week during the breathing tasks</u>.

At any point during the breathing tasks last week, did you suddenly feel more frightened, anxious, or extremely uncomfortable?
Please circle one: **NO YES**

	Not at all Noticed									***Very Intensely Felt***
1. Palpitations, pounding heart, or accelerated heart rate	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
2. Sweating	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
3. Trembling or shaking	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
4. Sensations of shortness of breath or smothering	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
5. Feeling of choking	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
6. Chest pain or discomfort	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
7. Nausea or abdominal distress	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
8. Feeling dizzy, unsteady, lightheaded, or faint	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
9. Feeling of unreality or being detached from yourself	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
10. Fear of losing control or going crazy	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
11. Fear of dying	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
12. Numbness or tingling sensations	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
13. Chills or hot flushes	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

On a scale of 0 – 100, how much anxiety do you feel <u>right now?</u>

In forming your response, please use the following scale:

0 /	**10** /	**20** /	**30** /	**40** /	**50** /	**60** /	**70** /	**80** /	**90** /	**100** /
Complete Relaxation	Very slight anxiety	Slight anx-iety		Some anx-iety	Moderate anxiety	Definite anxiety		Much anx-iety	Very much anx-iety	Worst anx-iety imag-inable

Your anxiety rating: _____

(can be any number between 0-100)

Please indicate whether you experienced any of the following <u>thoughts</u> DURING THE BREATHING TASK LAST WEEK.		
"I am going to throw up"	**Yes**	**No**
"I am going to pass out"	**Yes**	**No**
"I must have a brain tumor"	**Yes**	**No**
"I will have a heart attack"	**Yes**	**No**
"I will choke to death"	**Yes**	**No**
"I am going to act foolish"	**Yes**	**No**
"I am going blind"	**Yes**	**No**
"I will not be able to control myself"	**Yes**	**No**
"I will hurt someone"	**Yes**	**No**
"I am going to have a stroke"	**Yes**	**No**
"I am going crazy"	**Yes**	**No**
"I am going to scream"	**Yes**	**No**
"I am going to babble or talk funny"	**Yes**	**No**
"I am going to be paralyzed by fear"	**Yes**	**No**
Other:	**Yes**	**No**

PANAS

This scale consists of a number of words that describe different feelings and emotions. Please read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you felt this way **RIGHT NOW, AT THIS MOMENT.** Use the following scale to indicate your answers:

1	2	3	4	5
very slightly or not at all	**a little**	**moderately**	**quite a bit**	**extremely**

_____interested	**_____irritable**
_____distressed	**_____alert**
_____excited	**_____ashamed**
_____upset	**_____inspired**
_____strong	**_____nervous**
_____guilty	**_____determined**
_____scared	**_____attentive**
_____hostile	**_____jittery**
_____enthusiastic	**_____active**
_____proud	**_____afraid**

Evelyn Behar
Curriculum Vitae

Academic Background

2001-2005	Ph.D.	Penn State University	Clinical Psychology
1998-2001	M.S.	Penn State University	Clinical Psychology
1995-1998	B.A.	University of Virginia	Psychology

Grants

National Research Service Award (NRSA) from the National Institute of Mental Health (Grant 1 F31 MH068167-01 to Evelyn Behar, P.I.). Title: "The Effects of Worry on Panic Symptoms." Priority Score = 181, 13.3rd percentile. Funding period June 1, 2003 through September 1, 2004. (Total awards = $26,299).

Representative Awards & Distinctions

Winner, Best Poster at the Society for a Science of Clinical Psychology poster session at the American Psychological Society conference, New Orleans, LA, June 2002.

Penn State University Bunton-Waller Graduate Fellowship Recipient for 1998-1999 and 2002-2003 academic years (declined for 2002-2003 in favor of NIMH grant).

Representative Publications

Newman, M.G., Groff, M., Zuellig, A.R., Kachin, K.E., & Behar, E. (in press). The reliability and validity of the Panic Disorder Self-Report (PDSR): A new diagnostic screening measure of panic disorder. *Psychological Assessment.*

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