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CONCORDANCE BETWEEN SELF-REPORTED AND PHYSIOLOGICAL MEASURES OF EMOTION DURING FEAR IMAGERY IN ANXIETY DISORDERS

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ABSTRACT

Lang (1979, 1985) stated that activation of fear and fear memory can be measured across multiple domains, including the verbal-cognitive and somato-visceral domains. He proposed that anxiety disorders vary along a continuum of the degree of agreement, or concordance, between these domains, with specific phobias associated with the greatest degree of concordance and the least degree of concordance is present in generalized anxiety states. Although existing evidence supports this continuum, lack of inclusion of generalized anxiety disorder (GAD) in the existing research prohibits the full support of Lang's theory. The purpose of the present study was to expand current understanding of the relationship between self-report and physiological emotional responses, particularly in regard to current understanding of emotion in specific phobia and generalized anxiety. Results showed that group membership could be predicted based upon emotional response for baseline and emotionally-neutral tasks, but not for emotionally-charged tasks. Long-term memory of emotional experience was related to self-reported arousal at the time of encoding, and the GAD group was slower in their recognition of emotional experiences. Results are discussed in relation to conceptual understanding of GAD, clinical implications and future directions.

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CHAPTER 1

INTRODUCTION

Self-report and physiological measures are two potential ways to measure emotion. Rather than choosing one type of measure over the other, use of both types of measures offers a more comprehensive assessment of emotion. Furthermore, a third dimension of assessment is the relationship between self-report and physiological measures. The agreement, or concordance, between self-reported and physiological activity during emotional experience is not well-understood, but has the potential to further the understanding of emotion. In fact, self-report and physiological measures do not necessarily produce concordant results, such that changes measured in self-report are not necessarily reflected in changes in visceral measures. The need to measure both self-report and physiological activity is reflected in Lang's (1971) statement that emotional behaviors occur across multiple domains, including the verbal-cognitive domain, somato-visceral domain and motor domain, and that emotional imagery should be assessed across these domains (Lang, 1985).

The examination of self-report and physiological activity in anxiety disorders is considered particularly relevant because anxiety disorders are conceptualized to be accompanied by some manner of subjective, heightened emotional experience. Given the multiple channels for assessing emotion, reliance upon a single channel calls into question the validity of conclusions about anxiety based solely upon self-report.

Furthermore, the additional dimension of concordance offers potential for even greater understanding of emotion in anxiety disorders. The present study sought to 1) build upon existing evidence suggesting discordance in GAD in relation to other anxiety disorders, and 2) explore the relationship of this discordance to explicit, long-term memory.

Measurement of emotion

Before further discussing emotion, it is worthwhile to clarify the term "emotion," as this guides the way in which emotion is quantified. For the purposes of this study, emotion is conceptualized to vary along the dimensions of 1) valence[1] and 2) arousal. Valence refers to the degree to which affect is negative, neutral or positive in nature, whereas arousal refers to the degree of activation. Therefore, an emotion such as intense fear would be characterized as high on negative affect and high on arousal (either perceived or actual physiological arousal). Both valence and arousal can be quantified using either self-report or physiological measures.

Self-report measures of emotion. A number of self-report measures of emotion exist. The Self-Assessment Manikin (SAM; Bradley & Lang, 1994; Hodes, Cook & Lang, 1985) is a nonverbal pictorial assessment that measures emotional response on the following three dimensions: pleasure (valence), arousal, and dominance (control). The pleasure dimension is anchored by "happy-unhappy," the arousal dimension is anchored by "excited-calm" and the dominance dimension is anchored by “controlled-in control.” Individuals are asked to rate their feelings in regard to these anchors using a 9-point Likert scale.

The Positive and Negative Affect Scale (PANAS; Watson, Clark & Tellegen, 1988) is an often-used self-report measure of valence, and it is based upon the theory that positive and negative affect can be viewed as orthogonal constructs. Individuals are given twenty adjectives that vary on positive and negative affect, and are then asked to rate themselves for the degree to which they feel the affect described by the adjectives.

Another self-report measure that is often used, particularly in clinical settings, is called Subjective Units of Distress (SUDs; Wolpe, 1973). SUDs is a widely-used, single-item measure of fear and anxiety intensity. As such, it is a measure that is a combination of negative valence and arousal. It can be quickly and easily administered by asking the following: “Think of the worst anxiety (fear) you have ever experienced, or can imagine experiencing, and assign to this the number 100. Now think of the state of being absolutely calm and call this zero. Now you have a scale of anxiety. On this scale, how do you rate yourself at this moment?” This measure is most commonly used on either a scale of 1-10 or 0-100.

Physiological measures of emotion. Physiological measures have also been shown to differentiate between valence and arousal dimensions, particularly when used in accordance with self-report measures. For example, Christie and Friedman (2004) examined self-report and physiological responses to film clips standardized to elicit discrete emotions (e.g., anger, fear, and sadness). Based upon self-report and physiological responses, they were able to categorize emotions along the valence and arousal dimensions using discriminant function analysis. Christie and Friedman found that the greatest factor loadings amongst the six physiological variables were cardiovascular measures (mean successive differences) and electrodermal response. Mean successive differences is considered to be an indicator of parasympathetic nervous system activity, whereas electrodermal response is considered to be an indicator of sympathetic nervous system activity. Given Christie and Friedman's results, use of cardiovascular and electrodermal response appear to be potentially good measures of emotion.

Concordance and Discordance of Self-report and Heart Rate

According to the Bio-Informational Theory of Emotion (Lang, 1977, 1979), emotion is stored in memory as a neural network of propositions. These propositions are small units or constructs about the world which are categorized either as stimulus, meaning, or response propositions. Stimulus propositions are representations of external or internal perceptual events that serve to activate the memory network. Meaning propositions are the semantic or declarative information about the significance of the input and output of the network. Finally, response propositions are behaviors or efferent activity associated with the stimulus, and include response types of verbal behavior (such as those measured by self-report), overt motor behavior (such as escape behavior), or physiological organ activation (such as increased heart rate).

The strength of Lang's approach to understanding emotion is that it offers an explanation for contrasting response types, such that activation of one type of response (e.g., self-report) does not also have to result in activation of another type of response (e.g., heart rate). Lang explains this discordance between response types as a result of partial activation of an emotional memory network, and the extent to which a network is activated is dependent upon the level of coherence, or strength, between the propositions. When accessed, a network of high coherence has a high probability of activation as a whole unit because all propositions are highly related. A highly coherent network is also described as having high stimulus specificity, such that a particular stimulus prototype serves to activate the network. Thus, the presentation of the stimulus prototype will result in collective activation of verbal behavior, motor behavior, and physiological response. In contrast, a network of low coherence does not have a strong relationship between propositions, and variable activation of propositions will occur with various stimuli. For example, a stimulus may activate response propositions only in the verbal-cognitive domain, while it does not activate other response types. The type of response activation or degree of network activation in a low coherent network, therefore, is proposed to vary depending upon the nature of the stimulus.

Lang (1985) later expanded the Bio-Informational Theory to include conceptualization of anxiety disorders along a continuum of network coherence. He proposed that anxiety disorders differ on their level of coherence within the fear memory network and thus, can be expected to differ on the level of concordance and discordance observed between response systems. At the high-coherence end of the continuum are specific phobias, which are characterized by an excessive or unreasonable fear that consistently occurs in response to exposure to a specific object or situation (American Psychiatric Association, *Diagnostic and statistical manual of mental disorders, text revision*, 2000). A network for specific phobia, therefore, is considered highly coherent because a single type of situation or object results in activation across response systems.

At the other end of the continuum of coherence are generalized anxiety states, which include generalized anxiety disorder (GAD). Generalized anxiety disorder is characterized by engagement in excessive anxiety and worry about a number of events or activities (APA, *DSM-IV-TR*, 2000). Several aspects of GAD contribute to its conceptualization as a disorder of low coherence. By definition, the worry and anxiety experienced in GAD are tied to multiple stimuli. Therefore, the specificity of the stimuli that activate the emotional network is low. Additionally, little overt motor behavior is activated because worry is focused on future or past events (and has very little present-moment focus). Thus, the emotional network of GAD is unlikely to contain response propositions tied to specific stimulus propositions. Given the theoretical low specificity of stimulus propositions and low strength of relationship between stimuli and response propositions, GAD can be considered to be low in coherence. Other anxiety disorders, such as posttraumatic stress disorder (PTSD) and social phobia, are hypothesized to exist between the extreme ends of the continuum in regard to coherence. Such disorders are considered to be associated with fear memory structures of a moderate level of coherence because multiple cues within a particular category of cues (i.e., interpersonal situations for social phobics and trauma-relevant stimuli for PTSD) may activate the fear response. Given the theoretical range of coherence between anxiety disorders, empirical evidence can also be examined for support for these variations in coherence.

Empirical evidence for the continuum of coherence in anxiety disorders

Evidence for Lang's (1985) conceptualization of anxiety disorders along a continuum of coherence has been found across several studies. One of the earliest examinations of coherence in anxiety disorders was performed by Lang, Melamed and Hart (1970). They demonstrated a very high level of consistency between self-report and physiological arousal in specific phobias. In Lang et al.'s study, speech and spider phobics created a hierarchy in which fear-specific situations were rank-ordered from lowest fear to highest fear. The participants were asked to imagine each of the situations on the hierarchy. Heart rate (HR) was measured during imagery, and self-report of anxiety (on a scale from 1 – 4) was taken immediately after imagery. Lang et al. found evidence for concordance between self-report and physiological response; a significant correlation between HR and self-report anxiety level (r = .65) was observed.

McNeil, Vrana, Melamed, Cuthbert, and Lang (1993) further explored the relationship between physiological and self-report responses during imagery through examination of dental phobia and social anxiety. All participants were guided through imagery of dental, social, and dental-social scenarios, as well as action and neutral scenarios. Self-report, HR and electrodermal responses were then rank-ordered and examined for linear trends between the self-report and physiological measures. McNeil et al. found that the dental phobics and "multiphobics" (who were both dental phobic and socially anxious) had significant linear trends for self-report with HR and for self-report with electrodermal response. In contrast, the socially anxious group did not show a significant linear trend between measures. The presence of significant linear trends selectively in the specific phobia group, even in the presence of comorbid anxiety disorders, provided further indication of a high level of concordance in specific phobia.

Cook, Melamed, Cuthbert, McNeil, and Lang (1988) also investigated HR and self-report in anxiety disorders. Participants with agoraphobia, social phobia, and specific phobia (dental) were instructed to imagine individualized scenes of a situation specific to their fear, as well as individualized relaxing, pleasant and physically dangerous scenes. Standard imagery scripts were also used to create speech, dental, exercise, and relaxing imagery scenarios. Emotional response was measured using HR and self-report. Although the greatest overall HR response and self-reported emotional response occurred during imagery of the phobic scenario particular to their identified fear, the concordance between measures was strongest for the specific phobic group. In the specific phobia group, HR correlated significantly in the expected directions with self-report assessment of emotion. Heart rate was negatively correlated with self-reported pleasure ($r = -.58$), and HR was positively correlated with self-reported arousal level ($r = .76$). In contrast to the specific phobic group, participants with social phobia did not show a clear pattern of concordance or discordance. The agoraphobic group showed self-reported emotional response that was similar to that of the other anxiety disorder groups, but HR response was significantly less than that associated with specific phobia. The authors concluded that the results of the study support the conceptualization of anxiety disorders on a continuum of coherence, with the greatest concordance in specific phobia.

Additional support for this conceptualization of anxiety disorders was found in a more recent study by Cuthbert et al. (2003). Participants with specific phobia, social phobia, panic disorder with agoraphobia, and PTSD were compared to non-anxious control participants during baseline and sentence recall of anxiety-provoking material. Sentences consisted of standard fear content (of fear-relevant situations), standard neutral content, and individualized fear content. Self-report results showed that personal fear content elicited the highest level of negative affect and arousal across the anxiety disorder groups. However, HR response for personally relevant fear sentences was different between groups: participants with panic disorder showed significantly less HR response than those with specific phobia and social phobia. Furthermore, the HR responses in panic disorder and PTSD were smaller than in non-anxious control participants, with the smallest response in PTSD. These results seem to demonstrate that specific phobia and social phobia had the highest level of concordance, whereas the small HR response in panic disorder and PTSD were discordant with the high level of self-reported fear. Therefore, conceptualization of anxiety disorders along a continuum of coherence was again supported in this study, with evidence that PTSD and panic disorder show a level of concordance lower than that associated with specific phobia.

This empirical evidence by Cuthbert et al. (2003) regarding PTSD is also consistent with the theoretical conceptualization of the disorder. Posttraumatic stress disorder can be considered to have less situational specificity than specific phobia because various environmental cues serve as reminders of the traumatic event. Nevertheless, PTSD is expected to have greater coherence than GAD because the conditioned nature of the initial traumatic event serves as a set of specific, trauma-related fear cues. Not surprisingly, empirical evidence shows support for placement of PTSD within the middle of the continuum of coherence with specific patterns of concordance.

A review of existing studies of PTSD in combat veterans published between 1990 to 2003 (Yamasaki, 2004) identified seventeen studies that had measured either self-report or HR during emotionally-evocative tasks (Amdur, Larsen & Liberzon, 2000; Beckham et al., 2000; Beckham et al., 2002; Casada et al., 1998; Davis, Adams, Uddo, Vasterling, & Sutker, 1996; Keane et al., 1998; Kinzie et al., 1998; Litz, Orsillo, Kaloupek, & Weathers, 2000; McFall, Murburg, Ko, & Veith, 1990; McFall, Veith, & Murburg, 1992; Muraoka, Carlson & Chemtob, 1998; Orr, Lasko, Metzger, & Pitman, 1998; Orr, Meyerhoff, Edwards & Pitman, 1998; Orr, Pitman, Lasko, & Herz, 1993; Orr, Soloman, Peri, Pitman & Shalev, 1997; Pitman et al., 1990). From this review, results showed that in response to combat-related stimuli, self-reported experience of negative emotionality was exaggerated in veterans with PTSD in terms of subjective measures of anxiety, arousal and negative valence. Heart rate responses to combat-related stimuli also showed evidence for exaggerated negative emotionality, as observed by greater HR responses in veterans with PTSD in comparison to veterans without PTSD. Given this evidence for exaggerated emotionality, it appears that PTSD is associated with a high level of concordance for emotional response to trauma-specific stimuli.

Although measures of self-report and HR show evidence of a pattern of concordance, use of both self-report and HR within the same experimental tasks provides more compelling support for concordance/discordance. Out of the 17 identified studies, six studies concurrently administered self-report and HR measures (Beckham et al., 2002; Keane et al., 1998; Litz et al., 2000; McFall et al., 1990; Orr et al., 1993; & Pitman et al., 1990). The results of these studies show a clear pattern of concordance and discordance. In response to combat-related tasks, which should serve to activate the existing fear memory network, self-report and HR were found to be concordant in 4 of 6 studies (Beckham et al., 2002; Keane et al., 1998; Litz et al., 2000; & McFall et al., 1990). Concordance was defined as an exaggerated response for the PTSD group in comparison to the non-PTSD group(s), with both elevated HR and exaggerated subjective negative emotionality in PTSD. The two studies that did not find evidence for concordance during heightened emotional response (Orr et al., 1993 & Pitman et al., 1990) had significant methodological considerations that could explain the results. For example, Orr et al. found that combat imagery resulted in self-reported arousal, valence and dominance ratings that were not significantly different between veterans with and without PTSD, whereas HR response was higher in PTSD veterans. Examination of the self-report scores of the PTSD and control group showed that valence ratings were limited by a floor effect, such that both groups' scores were nearly zero on a scale of 0 – 12 for level of pleasantness. This may explain the lack of difference in self-report between groups, such that rather than a lack of negative affect, both groups endorsed a high level of negative affect. In regard to Pitman et al., the results showed that combat imagery resulted in greater arousal, valence and dominance ratings in the PTSD group, but there was a trend for higher HR in the non-PTSD group. However, Pitman et al. used a control group consisting of mixed anxiety disorders. As concordance is described in terms of relationship to the referent group, the smaller degree of deviation from the control group in this study was likely to be due to the use of a mixed anxiety disorder sample, as the other studies used samples consisting of non-PTSD, non-anxious veterans.

Although Lang's theoretical framework is designed to explain emotional response across anxiety disorders, empirical work within Lang's theory has failed to include individuals with GAD. Lang (1985) describes GAD as having "maximum associative fluidity of affective response structures" (p. 167). Because GAD is placed at the extreme end of low coherence, examination of this end of the continuum is necessary to fully support Lang's conceptualization of anxiety disorders.

Research examining emotional response in GAD has shown inconsistent results in terms of self-report, HR, and concordance. Some evidence has shown a lack of difference between GAD and non-GAD control participants as measured by self-report (Lyonfields, Borkovec, & Thayer, 1995), whereas other evidence has shown elevated self-reported, negative emotional experience in GAD (Yamasaki, 2000). In regard to HR, studies have not found HR in GAD to be significantly different than non-anxious controls (Davis, Montgomery & Wilson, 2002; Lyonfields et al.; Thayer, Friedman, & Borkovec, 1996; Yamasaki). However, some have argued that the lack of HR findings are due to altered parasympathetic activity that is not captured by HR (Lyonfields et al.; Thayer et al.). Nevertheless, evidence for altered parasympathetic activity has also been mixed, with some support for lowered parasympathetic activity in GAD (Lyonfields et al.; Thayer et al.) and lack of support in other studies (Davis et al., 2002; Yamasaki). Finally, inconsistency in concordance between studies is also evident in GAD. For example, some evidence has shown exaggerated self-report of anxiety in the absence of exaggerated HR response during worry and non-worry-related tasks (Yamasaki), whereas other studies have shown concordance between HR and self-report with normal levels on each measure (Lyonfields et al.).

The high level of inconsistency of results in research in GAD is not surprising, as the existing studies have differed in the way that they have elicited emotionality. For example, in Lyonfields et al. (1995), participants engaged in both imagery and worry about a topic of worry. In contrast, Yamasaki (2000) had participants engage in worry without the imagery component. These differences in method prohibit comparison between the studies, as worry and imagery are distinct types of tasks. Worry is primarily a verbal-linguistic behavior (Borkovec & Inz, 1990) that is thought to inhibit emotionality (Borkovec & Hu, 1990), whereas imagery is a picture-based activity that is thought to facilitate emotionality (Vrana, Cuthbert & Lang, 1986). As such, studies which have used worrying to elicit emotional experience are not easily compared to studies which have used imagery of a worry topic. Furthermore, Lang's (1985) theory applies specifically to emotional imagery, rather than verbal-linguistic processes such as worry.

The lack of inclusion of GAD in studies of the continuum of coherence in anxiety disorders makes it primarily an assumption that GAD is a disorder of low coherence. Clearly, the current status of research and methodological differences between studies of emotion in GAD make it difficult to resolve inconsistencies in findings in GAD. The concept of imminence, nevertheless, may be one way to clarify findings in the existing research.

The concept of imminence

Although Lang's theoretical framework has been explored during overt exposure to the fear context, it is proposed that the conceptualization of anxiety disorders can be extended and applied to resting or emotionally-neutral situations. A major portion of the theory is that anxiety disorders differ according to the specificity of the fear cues. The relative presence of the fear cues at *any* given moment will also vary between anxiety disorders. For example, in GAD, a variety of cues chronically elicit worry. These cues may be either externally- or internally-driven. Thus, fear cues are likely to be consistently present in the environment or permeating the individual's thoughts, even in a state of rest. As a low coherent anxiety disorder, the activation of the fear network is likely to be only partial in nature, such as activation of verbal response (worry) without corresponding physiological activation.

At the other end of the continuum, individuals with a specific phobia have a highly coherent emotional network with a specific object predicted to act as a stimulus that will fully activate the network. Thus, the everyday environment is unlikely to contain cues that access the fear network, and concordance should also be high at baseline (with low self-reported fear and normal HR). Evidence for this proposed extension of Lang's work into baseline can be observed in a number of studies. For example, discordant self-report and HR have been demonstrated at baseline in GAD (Yamasaki, 2000) and in PTSD (Beckham et al., 2000; Beckham et al., 2002; Davis et al., 1996; Litz et al., 2000; McFall et al., 1990; Orr et al., 1993; Orr et al., 1997). Although studies of specific phobias tend not to examine baseline emotionality, Lang (1985) reported observation of stable cognitive and behavioral responses in specific phobias when threatening stimuli were not present.

The above evidence supports the possible extension of Lang's theory to include baseline conditions. An additional modification of Lang's theory is also proposed. Craske (1999) proposed that the primary influence upon physiological arousal and concordance is the level of imminence of the threat. She states that feelings of control and safety will be consistent with lower physiological activity when little threat is present, and reports of high levels of distress will be consistent with high levels of physiological activity when a threat is imminent. In Lang's terms, the level of activation of propositions can be viewed as a function of the imminence of a threat, where imminent threats are more likely to activate negative meaning propositions, which then lead to greater activation within a network, regardless of the coherence of the network. Therefore, self-report and physiological arousal should be concordant at both the extremely distal and extremely imminent ends of the continuum. Discordance should occur at the middle stages of threat imminence, such as when a person is aware of a possible threat, but the threat remains either psychologically or physically distal. This mildly threatening condition is not accompanied by physiological arousal, although self-report would indicate some level of detection of threat.

Evidence for discordance as a function of threat imminence is found in the PTSD literature and may explain differences in emotionality between standard combat scenes and personalized combat scenes. For example, individualized stimuli that are well-matched to memories of the traumatic event are more likely to be perceived as threatening, to have greater imminence and to lead to greater activation of meaning propositions. Therefore, a greater level of activation of memory networks is likely to occur in individualized scenes than in standard versions, where the stimulus may be less-threatening and have less imminence, leading to lower intensity of emotional experience.

For example, evidence for differences between standard and individualized imagery has been demonstrated in the enhanced elicitation of negative emotional response of individualized combat scenes over standard combat scenes (Orr et al., 1993). Imminence can also be used to explain findings of a study of PTSD by Keane et al. (1998), which showed that the HR response to standard imagery scripts differentiated veterans with a current PTSD diagnosis from veterans with a past PTSD diagnosis. In this situation, although both groups experienced trauma which resulted in PTSD (and therefore, possessed war-related fear memory), the differentiation between groups could be explained by a greater sense of imminence for those with active symptoms. This speculation is consistent with the finding that the peak HR of the veterans with current PTSD was significantly greater than for the veterans with a past diagnosis of PTSD. In contrast, the veterans without a past history of PTSD would be expected to experience little threat imminence, despite similar war experiences. Consistent with expectations, Keane et al. showed that the veterans without a past history of PTSD demonstrated low HR response which was concordant with self-report.

The concept of imminence of threat also helps to further explain the lack of consistency within the GAD literature. In GAD, anxiety is defined as engagement in worry about a future event. The distal nature of a future event removes the imminent quality of the threat. In fact, people identify one of the functions of worry as *prevention* of an event from occurring (Borkovec & Roemer, 1995). Thus, engagement in worry is likely to maintain psychological distance from the event. Evidence for worry as maintaining psychological distance has been demonstrated using physiological measures. For example, as mentioned earlier, worry involves primarily verbal-linguistic activity about negatively-valenced information, rather than imagery of such information (Borkovec & Inz, 1990). Such verbal-linguistic activity is associated with dampened physiological activity in comparison to engagement in imagery of the same content (Vrana et al., 1986; Borkovec & Hu, 1990). Therefore, worry serves to inhibit physiological activity. Furthermore, because physiological activity is considered to be an indicator of emotional processing (Foa & Kozak, 1986), worry serves to inhibit engagement in emotional processing of the information, and thus serves to maintain avoidance of this information (Avoidance theory of worry; Behar, Zuellig, & Borkovec, in press) and to maintain psychological distance from the threatening information.

Given the distal nature of the threat in GAD, in combination with its low coherence strength, it is likely that GAD is associated with a low degree of concordance between self-report and physiological measures of emotion. Nevertheless, the circumstances under which full activation of a low coherence network might occur are unclear. Craske's (1999) concept of imminence suggests that when a source of worry becomes physically or psychologically imminent, self-report and physiological activity should be concordant. The difficulty with exploring the circumstances under which a network of low coherence is activated is precisely the definition of a low coherence network; no single stimulus is representative of the source of fear. Therefore, it is difficult, if not impossible, to use a single stimulus to serve as a threat stimulus that is applicable to all GAD participants in an experimental investigation.

Additionally, it may be that even personally-relevant stimuli within low-coherent networks do not elicit concordance between self-report and physiological measures. For example, Lyonfields et al. (1995) examined cardiovascular activity during worry, as well as imagery related to worry content in GAD and non-GAD groups. They did not find differences between groups in self-reported anxiety, but found that the GAD group was different in cardiovascular response from the control group. The GAD group showed little cardiovascular response, as measured by heart rate and vagal tone, to worry and imagery tasks in comparison to the control group. Although it is difficult to examine concordance without correlational measures, these results suggest that the GAD group did not demonstrate concordance between self-report and cardiovascular response. The control group showed changes in cardiovascular response between tasks that were reflected in self-report, whereas the GAD group showed changes only in the self-report domain.

In summary, a significant body of evidence exists in support of a pattern of concordance and discordance between self-report and HR responses for particular anxiety disorders. Within this body of evidence, specific phobias show a pattern of strong coherence of emotional networks, GAD shows low coherence strength, and PTSD shows intermediate levels of coherence strength. Although Craske (1999) has presented her framework of the role of imminence as independent of Lang's theoretical approach (1977, 1979, & 1985), the potential application of the concept of imminence to explain the variation within a loosely associative emotional network seems to have merit. In combining these two theoretical approaches, HR and self-reported responses in anxiety disorders are neither bound strictly to a continuum of coherence, nor strictly to the imminence of the threat. To further understand the nature of emotion in anxiety disorders, future work should address the concordance and discordance for anxiety disorders at different levels of imminence and as associated with emotional experience outside of the fear network.

CHAPTER 2

EMOTION, CONCORDANCE AND MEMORY

As discussed thus far, the measurement of the concordance between self-reported and physiological activity may provide greater understanding of differences between anxiety disorders in the experience and manifestation of emotion. The concept of concordance, as mentioned previously, is based upon the idea that response types, such as self-report and physiological activity, are the result of storage of emotion in memory. If differences do exist between anxiety disorders in the storage of emotion in memory, then it follows that differences between anxiety disorders in memory performance should also be present.

A review of memory in anxiety disorders by Coles and Heimburg (2002) showed that memory in anxiety disorders is far from well-understood, but that preliminary conclusions allow for some distinctions between the disorders. Such conclusions are based upon the separation of explicit and implicit memory. Explicit memory requires the use of purposeful retrieval of material that has been previously learned. Implicit memory requires the retrieval or use of material that has been learned without conscious effort and is tested without direct instructions to retrieve the information. Explicit memory tests often include recall or recognition tasks, whereas implicit memory tests employ a variety of other approaches.

In regard to explicit and implicit memory in particular anxiety disorders, Coles and Heimburg (2002) made the following conclusions: 1) studies in panic disorder show evidence for enhanced explicit memory for threat-relevant information, rather than implicit memory differences in comparison to control groups; 2) Posttraumatic stress disorder tends to be associated with both explicit and implicit memory biases; and 3) generalized anxiety disorder tends to be associated with implicit memory biases, but not explicit biases. This breakdown of patterns in memory performance is reminiscent of Lang's (1985) continuum of coherence, such that specific phobias and panic are grouped similarly as having a high level of coherence, PTSD is a moderately coherent disorder, and GAD is the least coherent of the anxiety disorders. Given the overlap in distinction between anxiety disorders, it is possible that concordance may be an avenue for better understanding of differences in memory patterns of anxiety disorders.

As mentioned earlier, fear states are likely to have a high degree of imminence and concordance. During such states, self-reported emotion and physiological activity associated with emotional experience should be elevated. Interestingly, studies using normal samples have suggested that the level of self-reported emotion (Cahill & McGaugh, 1995) and physiological activity impact performance on memory tasks (Blake, Varnhagen, & Parent, 2001; Revelle & Loftus, 1992; McGaugh, 1992), such that greater emotional response (both self-report and physiological activity) is associated with facilitation of memory. If this relationship between emotion and memory exists in normal (randomly-selected) populations, then a similar process may explain memory biases in anxious populations. To further elucidate the relationship between emotion and memory in existing research, evidence for the emotion-memory relationship will first be discussed in randomly-selected populations and will then be reviewed in anxious populations.

Memory in normal populations

As mentioned earlier, emotion can be quantified on the dimensions of valence and arousal. Existing studies of the relationship between memory and emotion have primarily highlighted the importance of the arousal dimension. Emotion in the arousal domain, as measured by self-report, was used in a study of memory by Cahill and McGaugh (1995). Cahill and McGaugh used free-recall, cued recall and multiple choice tests to examine long-term, explicit memory. In their study, Experiment 1 served as a replication study of Huer and Reisburg (1990). Participants were given one of two versions of a story, with one emotionally arousing and the other emotionally neutral. Stories were accompanied by twelve slides. Participants were asked to rate the level of emotionality of each story. Two weeks after the initial presentation of the story, participants who viewed the high arousal story (and rated it as highly emotionally-arousing) showed greater free-recall and recognition than those who viewed the neutral content story. This finding of greater recall and recognition memory for high arousal information was replicated in Experiment 2. The second experiment used slides identical to those used in Experiment 1, but switched the arousal level with new narrations to accompany the slides to demonstrate that the effect of arousal was due to the emotional content of the story, rather than the slide content. Again, higher self-reported arousal was related to better memory performance. The consistency across multiple studies (Huer & Reisburg, Cahill & McGaugh) shows strong support for the relationship between memory and self-report of arousal.

In addition to measuring self-report of emotional arousal, physiological activity at presentation of an emotional stimulus has also been linked to memory. One physiological measure that has been used is electrodermal activity. In a review of memory and arousal by Revelle and Loftus (1992), twelve of the reviewed studies used electrodermal activity as a measure of arousal. Seven studies showed evidence for enhanced memory in association with electrodermal activity, two found evidence of impairment in memory associated with electrodermal activity, and three studies did not find any impact of arousal upon memory. In addition to the studies reviewed by Revelle and Loftus, another study (Bradley, Greenwald, Petry, & Lang, 1992) found that electrodermal responses were stronger in reaction to images that were rated as highly emotional arousing, and that high arousal was associated with greater recognition memory than low arousing images. Thus, the results from the review by Revelle and Lofus, as well as the results from the study by Bradley et al., suggest that high arousal is associated with greater memory. As electrodermal activity is considered a good measure of sympathetic activity, evidence suggests that arousal of sympathetic activity, as measured in the electrodermal response channel, is associated with increased memory. Further support for the arousal-memory relationship is provided through examination of blood glucose level, with circulating blood glucose level as an index of arousal. Blood glucose is considered a good index of arousal because of its role in the activation of the sympathetic nervous system in stressful, threatening situations. In such situations, the hypothalamus activates the release of epinephrine into the blood stream and the increase of HR. It also stimulates release of hormones to produce cortisol, which in turn, increases blood glucose to support the fight/flight response of the sympathetic nervous system (McGaugh, 2003).

Consistent with the relationship between blood glucose and the fight or flight response of the sympathetic nervous system, it is not surprising that blood glucose level has been shown to be related to enhanced memory for emotional information. For example, Blake et al. (2001) examined the relationship between blood glucose levels before and after presentation of either emotionally-arousing or emotionally-neutral pictures taken from the International Affective Picture System (IAPS, CSEA-NIMH, 1997). Participants viewed the pictures and made a self-report rating of the valence and arousal level for each of the pictures. Participants were then asked to take a free-recall memory test thirty minutes after viewing the last picture. Valence ratings were not found to be significantly different between groups who viewed the high arousal pictures and those who viewed the low arousal pictures. Nevertheless, at both 15 minutes and 30 minutes following picture presentation, blood glucose levels rose significantly from baseline for the group who viewed the high arousal pictures and did not rise for the group who viewed the low arousal pictures. The test of recall showed that participants who viewed the high arousal pictures recalled significantly more pictures than those who viewed the low arousal pictures. Therefore, the blood glucose levels differentiated groups in a situation when self-report was not sensitive to the influence of arousal upon short-term memory.

Facilitation of memory by arousal has also been found in studies of long-term memory. For example, Buchanan and Lovallo (2001) examined the influence of cortisol upon long-term memory. Participants were administered either cortisol or a placebo (20 mg) prior to presentation of emotion-eliciting images. One week later, they tested free-recall, cued-recall and recognition memory for the images and asked participants to rate their emotional responses (arousal, valence) using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). Slides rated as highly arousing were better remembered on free-recall, cued recall, and recognition tests. The group who was administered cortisol performed better on cued recall of the highly arousing slides rated than the placebo group. No effect for the valence of the images was found. These results suggest that arousal, as measured by physiological activity and self-report, facilitates long-term (1 week post-encoding) memory.

Across measures of self-report, EDA, blood glucose, and cortisol injections, arousal appears to be related to enhanced memory in normal populations. This link may be especially strong for long-term memory. Furthermore, this link between arousal and long-term memory is consistent with Revelle and Loftus' (1992) comprehensive review of thirty-four studies of the relationship between arousal and memory (using self-report, electrodermal response, electroencephalography, and body temperature as measures of arousal). Revelle and Loftus concluded that across the thirty-four studies utilizing various tools for assessing arousal, high arousal facilitated detection and encoding of long-term memory. Therefore, given the significant evidence for the link between arousal and memory in randomly-selected samples, it is possible that arousal in individuals with anxiety disorders is also associated with enhanced memory, particularly in tests of long-term memory.

Memory in anxiety disorder populations

Given the consistency of evidence in support of the relationship between arousal and enhanced memory, panic and fear states in anxiety disorders should be associated with enhanced memory when such states are accessed. Unfortunately, the relationship between physiological arousal, self-reported arousal and memory has not been extensively studied. Nevertheless, a large body of literature has attempted to explore memory biases in anxiety disorder populations. These findings across anxiety disorders will be discussed, as well as the potential for the combination of self-reported and physiological arousal measurements to enhance understanding in the field of memory and emotional arousal.

The majority of the existing literature on memory in anxiety disorders has been split into explicit and implicit memory. Due to the distinct nature of explicit and implicit memory, as well as the diverse body of literature that exists related to implicit memory, a focus upon explicit memory tests will be taken in the present review.

As mentioned earlier, specific phobia is an anxiety disorder that is theorized to have a high level of memory structure coherence. The majority of experiments examining memory in specific phobia have focused upon spider phobia. Several studies of explicit memory have attempted to identify patterns of memory performance that differ from non-phobics (Kindt et al., 1999; Rusted & Dighton, 1991; Watts & Coyle, 1992, 1993; Watts & Dalgleish, 1991; Watts, Trezise, & Sharrock, 1986). For example, Rusted and Dighton found that spider phobics performed better than non-phobics on a test of recall memory. Participants were presented with a passage that contained content suggesting the presence of spiders (but without explicit mention of the presence of spiders), as well as neutral content and content suggesting burglary. Participants were asked to engage in free recall details of the passage. Evidence showed that spider phobics recalled a greater level of detail of spider-related content than the non-phobics.

Watts and Coyle (1993) also found evidence for a bias toward memory for spider-related words. They recruited spider phobics and non-phobic controls toexamine memory for features of spiders (e.g., jaws, cobwebs) and anxiety response to spiders (e.g., sickening, scared), as compared to memory for features of babies (e.g., chubby, nursery) and response to babies (e.g., protective, comfort). All participants engaged in an exposure to a spider, as well as a baby. The results failed to show group differences in recall. For recognition memory, the control group showed significantly better overall performance. Although this finding may appear to support the argument that spider phobics show inhibited memory, there was a trend for an interaction of group membership with the category of words (spider, baby), such that there was a higher hit rate for spider words in phobics and a higher rate for baby words in controls. The authors argue that the anxiety in the phobics interfered with overall memory, but that a bias for enhanced memory for spider-related stimuli was present.

Although the above-mentioned studies show support for enhanced memory for phobic material in specific phobia, other evidence suggests impaired memory for phobic material. For example, Watts et al. (1986) examined memory differences between spider phobic and non-phobic groups. Participants were shown dead spiders for a period of five seconds and were then asked to complete a recognition task for the spiders. Spider phobics showed poorer recognition performance than non-phobics selectively for large spiders.

Evidence of poorer short-term memory in spider phobics was also found in two additional studies (Watts & Coyle, 1993; Watts & Dalgleish, 1991). Watts and Coyle exposed spider phobics and non-phobic controls to a live spider. Following the exposure session, all participants were presented with a list of words to recall in immediate and 20-minute delay recall. The list of words included stimulus words (e.g., run, lets, dark) and response words (e.g., dread, anxious, repelled). Evidence showed that memory impairment was greater in participants with specific phobia for the response words, but not for stimulus words, across both immediate and delayed trials.

Williams, Watts, MacLeod, and Mathews (1997) point out that the discrepancy in findings between studies may be due to differences in presentation of the feared object. For example, experiments by Watts and Dalgleish (1991), Watts & Coyle (1992), Watts and Coyle (1993), and Watts et al. (1986) presented participants with a live spider and were associated with memory impairment. In contrast, Rusted and Dighton (1991), who observed memory enhancement associated with spider phobia, did not use a live spider. It may be that the presence of spiders increased arousal to a level that actually interfered with memory, rather than facilitated memory. In fact, this explanation is consistent with Watts et al.'s (1986) finding that memory for small spiders (in contrast to large spiders) was better in spider phobics than in non-phobics, assuming that larger spiders elicited an extreme level of arousal in comparison to smaller spiders. Consistent with Williams et al., Watts et al. hypothesized that the difference between small and large spiders may be the effect of arousal, with greater arousal elicitation in response to the large spiders. It may be that memory interference is only associated with extremely arousing situations, and Rusted and Dighton's experiment, with only the suggestion of the presence of spiders, did not serve to elicit this level of extreme arousal.

This explanation for the discrepant results for specific phobias is consistent with neurobiological evidence, which has demonstrated the negative effects of extreme arousal upon memory (McGaugh, 1989; McGaugh, Weinberger, Lynch & Granger, 1985; Roozendal, 2000). For example, experiments investigating the effects of memory-enhancing drugs (McGaugh et al. 1985; McGaugh, 1989) have consistently shown an inverted-U relationship between memory and arousal. In other words, the greatest memory-enhancing effects reliably occur within moderate ranges of arousal, whereas memory deficits occur at very low and very high arousal levels. Further investigation, nevertheless, is necessary to fully clarify the relationship between arousal and explicit memory in specific phobias, as Watts et al. (1986) were not able to replicate their findings of memory for small versus large spiders in a follow-up experiment, and live spiders (which would presumably elicit very high arousal conditions in spider phobics) were associated with enhanced memory in a study by Watts and Coyle (1992).

One possible explanation for the seemingly discrepant and inconsistent results may be the inconsistency in the types of measures of emotion employed across studies. This confound due to measurement differences underscores the importance of measuring both self-reported and physiological arousal, rather than assuming arousal. A study by Kindt, Brosschot and Boiten (1999) measured arousal of both self-report and HR during a memory task for spider phobics. In this study, spider phobics were compared to non-phobics on their ability to remember material presented during an imagery induction. Imagery consisted of an encounter with a spider, and the dependent measures were self-reported anxiety and heart rate. The results showed that the spider phobics had greater self-reported anxiety to the imagery, as well as faster HR response to the imagery. It is noteworthy that the self-reported anxiety response was in the moderate range for the snake phobic group (spider phobic mean = 49, non-phobic mean = 3, on a scale of 20-80, with 20 = not anxious and 80 = extremely anxious). As would be predicted by the neurobiological evidence that arousal level is related to memory, the spider phobic group demonstrated greater ability to recognize imagery script content than the non-phobic group. Thus, the potential for interference of hyperarousal was not present in this study, and arousal was shown to be related to memory.

In addition to the measures of self-report and physiological arousal, another potential problem with the above studies is that none of them examined long-term memory. As evidence for randomly-selected groups suggests that arousal at encoding affects long-term memory performance, additional work should include examination of long-term memory.

Finally, another area to consider is that of the content of the material used in tests of memory. Most of the memory findings for specific phobia have examined memory of the feared stimulus content, rather than the emotions associated with exposure to the feared stimulus. As Lang has distinguished between memory for response information and stimulus information, it may be that memory for stimulus characteristics varies from memory for response characteristics. In fact, the study by Watts and Coyle (1993) found that the spider phobic group demonstrated greater impairment on recall of response words in comparison to stimulus words. Given this distinction between memory for fear stimulus characteristics and memory for emotional experience, examination of memory for emotional experience may provide potential clarification of conflicting results for memory in specific phobia.

Although discussion has primarily focused upon memory in specific phobia thus far, empirical findings examining panic disorder offer the opportunity to explore memory for emotional response information. Studies of panic disorder have examined both memory of anxiety-responses related aspects, as well as stimulus properties, due to the nature of the disorder. Panic disorder is associated with fear of panic attacks, which are characterized by perception of physiological arousal (*DSM-IV-TR*, APA, 2000). Therefore, the feared stimulus is arousal itself.

Memory ability in panic disorder has been examined in several studies and has supported the presence of an enhanced explicit memory for panic-related, threatening information. Coles and Heimburg (2002) reviewed 15 studies of panic disorder and found that 9 of 15 studies showed support for the presence of an explicit memory bias. For example, Becker, Roth, Andrich, and Margraf (1999) examined memory of panic symptom-related words. Participants with panic disorder were compared to non-panic control participants on their ability to recall words used in an imagery scenario involving themselves. Those with panic disorder recalled more physical symptoms (but not agoraphobic or catastrophic thoughts) in comparison to the control participants. These findings provided support for enhanced memory for physical responses, at least when physical responses are part of the feared stimulus, as they are in panic disorder.

Likewise, Becker, Rink and MarGrath (1994) compared patients with panic disorder with agoraphobia to non-anxious control participants in a test of free recall. All participants were shown words that were situational, symptom words, catastrophic cognitions, neutrally-valenced or positively-valenced. Results showed that patients diagnosed with panic disorder with agoraphobia recalled more anxiety symptom words (and not more situational or catastrophic cognitions) than the control participants, demonstrating that the memory enhancement of panic disorder patients was limited to anxiety symptom stimuli. Thus, results again demonstrated evidence for enhanced memory for the physical components of the emotional response.

Cloitre, Shear, Cancienne and Zeitlin (1994) also found support for enhanced explicit memory in panic disorder. In this study, participants were shown word pairs of positive, threat (fear-related) and neutral content. Word pairs were either similar or unrelated in content. For fear-related pairs, the first word contained a bodily-sensation word paired with a catastrophe word (e.g., palpitation – coronary). Following presentation, participants were given the first word of the pair and asked to complete the pair. The results showed that the participants with panic disorder, in comparison to participants without panic disorder, showed greater cued recall memory for the threat-related pairs. Interestingly, Cloitre et al. also tested a control group consisting of clinicians involved in cognitive-behavioral treatment for panic disorder. The clinician control group recalled fewer threat-related pairs than the panic disorder group, but recalled more than the non-anxious control group. These findings show support for enhanced fear-related memory associated with panic disorder, even beyond memory ability in clinicians who are highly familiar with the experience of panic disorder.

Despite these strong findings of enhanced memory for fear-related material, some studies have failed to show enhanced memory for threat in panic disorder (Pickles & van den Brock, 1988; Beck et al., 1992). For example, Pickles and van den Brock compared patients with agoraphobia, patients with high state anxiety, and normal controls in two tests of memory. In the first experiment, participants were asked to complete a test of free recall of passages with fear-related content and passages of neutral content. Results failed to show differences in memory between groups. In the second experiment, lists of words containing fear-related and neutral content were presented. Four trials of presentation of the lists and recall were administered. Again, no difference between groups was found. These two studies indicate evidence against enhanced memory for fear-related content in panic disorder. However, the results should be applied with caution, as the participants were selected for symptoms of agoraphobia, rather than panic disorder and no measures of arousal were employed to verify that actual arousal occurred. Nevertheless, a study by Beck et al. does show clearer evidence against enhanced memory.

Beck et al. (1992) compared psychiatric patients with panic disorder and non-anxious control participants on tests of attention and cued recognition. For the attention task, all participants were instructed to indicate whether or not a dot probe was shown during presentation of a word pair. The word pair consisted of a neutral word paired with an emotional word. Emotional words were of physical threat, social threat or positive emotional content. During the attention task, HR, electrodermal level and muscle tension were recorded. Beck et al. found that the panic disorder patients differed from the non-anxious participants in that they took longer to locate the dot probe for both physical threat and positive emotional content. Nevertheless, the groups did not differ in their physiological responses or memory performance. Although the lack of difference in memory between groups appears inconsistent with other studies of panic disorder, it is important to note that presentation of the stimuli was quite short in relation to other studies. Shorter presentation might not have allowed for sufficient arousal, which might have accounted for the lack of findings. Furthermore, as the groups experienced similar levels of physiological arousal at the time of the presentation of the stimuli, it was less likely that a memory bias would be elicited in this study. Unfortunately, due to the constraints of Beck et al.'s study, self-reported anxiety was not recorded during the attention task, so it is unknown whether or not self-reported emotional arousal would have differentiated the groups. Beck et al. did measure state anxiety prior to the experiment and found that the panic disorder group reported significantly greater state anxiety, as measured by the State-Trait Anxiety Inventory (Spielberger, Gorsuch & Lushene, 1970). It appears, therefore, that even significantly higher self-reported anxiety was not sufficient to elicit a memory bias, suggesting that physiological arousal must accompany the self-reported emotional arousal in order to elicit the bias in recognition memory.

As with specific phobias, the majority of emotional arousal research of panic disorder has lacked measurement of physiological measures of emotional arousal. In the single study which investigated the relationship between physiological arousal and memory (Beck et al., 1992), no memory differences were found between groups, but the groups also did not differ in their physiological responses. As with the studies of specific phobia, the need for measurement of a combination of physiological and self-reported arousal is imperative in differentiating results between studies.

Additionally, consistent with the phobia research, the addition of tests of long-term memory could clarify understanding of the relationship between arousal and memory.

As mentioned earlier, PTSD is one anxiety disorder that is hypothesized to fall within the moderate range of memory structure coherence. A number of studies show strong evidence for memory impairments in PTSD using neuropsychological assessment tools (see Buckley, Blanchard, & Neill, 2000 for a review), which do not include trauma-relevant stimuli within the memory assessment. In contrast, a number of studies have shown enhanced explicit memory in PTSD when tests include trauma-related material (Paunovic, Lundh, & Öst, 2002; Vrana, Roodman, & Beckman, 1995; Zeitlin & McNally, 1991).

A study by Zeitlin and McNally (1991) examined cued recall memory in Vietnam combat veterans who either met criteria for PTSD or who had not met criteria for PTSD within the last twenty years. All participants were presented with words from the categories of combat-related, social threat, positive and neutral in content. Following presentation of the words, participants engaged in a distraction task and were then asked to complete a cued recall test. The results for explicit memory indicated that all participants recalled more combat words than any other category of words, but that only the veterans with PTSD demonstrated a relative bias toward memory for the combat words when recall scores were corrected for the number of neutral words recalled.

Other studies have also shown evidence for explicit memory biases when words were viewed during a Stroop color-naming test (Paunovic et al., 2002; Vrana et al., 1995). In a study by Vrana and colleagues, words for the Stroop test were chosen from different categories: Vietnam-specific emotion words, general Vietnam-related words, general emotion words, and non-emotion/non-trauma words. Those with PTSD recalled a greater number of emotion/trauma words and also recognized more words across all categories. Although the findings indicated evidence for enhanced explicit memory associated with PTSD, the authors suggest that words across all categories were trauma-related, rather than just the single Vietnam-specific emotion word category and that this accounted for the overall facilitation of memory in the PTSD group.

A more recent study of explicit memory of PTSD in crime victims was conducted by Paunovic et al. (2002), who also used a Stroop color-naming task. Using the Stroop, participants were presented with three categories of words: trauma-related, positive and neutral. Participants were later asked to complete a free recall task of the words. The PTSD group showed a significant interaction between group (PTSD, non-PTSD) and word category (trauma-related, positive, neutral), such that the PTSD group showed better recall memory for trauma words than both positive and neutral words, whereas the non-PTSD participants only showed better recall for trauma words over neutral words. Overall, the PTSD group recalled more words in the trauma-related category than the controls, providing evidence for facilitation of memory in PTSD.

The findings from the studies by Vrana et al. (1995) and Paunovic et al. show strong support for a fear-related, explicit memory bias in PTSD. However, these studies have contained a mix of emotional response content (i.e., “grief”) with traumatic event content (i.e., “chopper”). As discussed above, evidence from studies of specific phobia (i.e., Watts & Coyle, 1993) and panic disorder (Beck et al., 1992; Becker et al., 1999) have shown differential memory performance for response versus stimulus content, and thus, investigation of these differences could further delineate the nature of memory in anxiety disorders. Furthermore, consistent with research of specific phobias and panic disorder, research in PTSD could also potentially benefit from measurement of arousal at encoding and the addition of long-term memory tasks, rather than the short-term tasks used by both the study by Vrana et al. and by Paunovic et al.

In contrast to high imminence and arousal states, GAD has already been discussed as an anxiety disorder associated with low coherence. In regard to memory performance in GAD, tests of memory have shown a lack of evidence for an explicit memory bias. In fact, a review of the literature by Coles and Heimburg (2002) found that only 1 of 9 studies found support for an explicit memory bias in GAD. The primary difficulty in studying memory biases in GAD appears to be akin to examination of concordance in GAD; it may be that the memory tasks utilized in studies of GAD have not been successful in using personally-relevant stimuli. This difficulty in selecting stimuli may have directly affected results, rather than the presence of a level of explicit memory in GAD that is inherently different from other anxiety disorders. In other words, the tasks selected by experimenters may not have had the same level of specificity to the feared object or situation as with other anxiety disorders, which may have obscured results.

Becker et al. (1999) attempted to compare GAD, speech phobia, and non-anxious controls. Participants were asked to imagine a scene that combined the content of a stimulus word and themselves, and then rate their emotional state during imagery. Ratings were made on a scale from 0 to 10 for excitement, tension, anxiety and avoidance. Words were selected so that they were GAD-related (e.g., "illness," "nervous,"), speech-related (e.g., "talk," "blush"), neutral (e.g., "chair," "walk") or positively-valenced (e.g., "baby," dreaming") in nature. Participants were then given a surprise test of recall in which they were asked to recall all of the words that they had imagined. Results showed neither group differences in ability to recall the words, nor differences in memory of emotional state during imagery of words. However, the authors noted that it was difficult to find GAD-relevant words; although the words used for their relevance to GAD were rated as highly relevant and unpleasant to the GAD group, the words were also rated similarly by the speech phobia group. Furthermore, a large standard deviation was observed for ratings of personal relevance for the GAD words in comparison to the speech-related words, revealing that the words were not consistently relevant across participants. Therefore, it appears that the particular set of words chosen for this experiment was not specific to GAD. In contrast, the words relevant to speech phobia were rated as more relevant and more unpleasant only to the speech phobia group, and the authors point this out as evidence that the lack of results was not easily explained by problems with the stimulus words. Although relevance and heightened self-reported arousal across anxious groups may not fully explain the results, concurrent physiological arousal was not present. This may account for the lack of findings and again underscores the necessity of including physiological measures to clarify results.

In contrast to Becker et al. (1999), Friedman, Thayer and Borkovec (2000) did find evidence for an explicit memory bias in GAD. However, their study had important methodological differences from other studies. First, participants were presented with words for an extended period of time, rather than imagining a scenario. The authors point out that presentation of words may be more consistent with the nature of worrying, as both reading and worrying, are verbal-linguistic behaviors. Additionally, participants were told that they would be tested on their memory prior to the test. Becker et al. (1999) tested incidental learning, while Friedman et al. tested purposeful learning. Both of these differences in protocol make it difficult to compare the findings of the study. It may be that one or both of the unique characteristics of the study by Friedman et al. need to be present in order to elicit an explicit memory bias in GAD.

Despite the inconsistent findings in GAD, the combined evidence for the relationship between arousal and memory in normal and in some anxiety disorder groups appears to be quite robust. However, as reviewed above, few studies have investigated the link between memory and arousal, as measured by physiological and self-report emotional arousal in combination. It remains to be determined whether or not emotional arousal, as measured by a combination of self-report and physiological approaches, offers further understanding of memory. Although evidence shows the relationship between physiological arousal and memory in normal populations, there is a relative lack of measurement of physiological arousal in anxious groups. Therefore, rather than seeking to clarify the presence or absence of explicit/implicit memory biases, research must first clarify the differences between the relationships of physiological arousal and memory versus self-reported arousal and memory, while using encoding tasks that sufficiently activate states of fear. If researchers are careful to provide what Coles and Heimburg (2002) describe as a "deep-encoding" process, it may be that understanding of the relationship between arousal and memory performance in anxiety disorders, including GAD, could be more clearly understood. Additionally, studies have not fully examined the impact of arousal upon long-term memory performance in anxiety disorders. As evidence suggests that arousal at encoding affects long-term memory, future work should include long-term memory tasks.

CHAPTER 3

THE HYPOTHESES

Hypotheses about emotional responses

The present study sought to address several hypotheses related to Lang's (1979, 1985) theory differentiating anxiety disorders according to coherence strength of the fear memory structure. The first set of hypotheses was related to the physiological and self-reported measures of emotion. It was expected that both physiological and self-report measures would differentiate between tasks of positive, neutral and negative valence, as well as between high and low arousal. As discussed earlier, Lang's (1985) theory of emotional imagery states that anxiety disorders which are highly coherent, such as specific phobias, will demonstrate a high level of concordance during imaginal exposure to the feared object. On the other hand, anxiety disorders that are not coherent, such as GAD, are expected to be associated with a low level of concordance during exposure to a relevant source of fear.

As mentioned in the above review, research in concordance of physiological and self-report measures in GAD is lacking. Therefore, investigation of concordance and the effect of imminence of threat in GAD was the primary purpose of the study. The main comparison group was specific phobia (snake), which is theorized to have a high degree of coherence strength. It was hypothesized that GAD would be associated with a lower level of concordance than snake phobia during neutral tasks. Specifically, during neutral tasks, the phobic group was expected to experience low levels of self-reported emotional arousal, whereas the GAD group was expected to experience elevated levels of self-reported emotional arousal (e.g., worry) without the physiological emotional arousal due to the lack of imminence of threat.

The second hypothesis served to investigate situations with highly imminent threat. It was predicted that personalized fear imagery would result in an increase in self-reported emotional arousal. This self-reported emotional arousal was hypothesized to be accompanied by physiological arousal across both the phobic and GAD groups relative to neutral imagery. Therefore, individuals with specific phobia and individuals with GAD were expected to demonstrate similar levels of concordance between self-report and physiological measures under imminently threatening circumstances, such as personalized fear imagery. This hypothesis was based upon Craske's (1999) idea of imminence, which suggests that under conditions of imminence, a high level of concordance will occur. As Lang's theory does not address positive emotional responses, no hypothesis was made in regard to concordance of positive emotional response.

Hypotheses about memory performance

The second set of hypotheses for the present study was related to memory. As discussed above, existing research in memory within anxiety disorders has failed to clearly differentiate the impact of self-reported arousal versus physiological arousal upon memory. Furthermore, it appears that studies of GAD have not succeeded in utilizing fear-relevant stimuli for the encoding task, and that this has impeded understanding of memory differences between anxiety disorders. The use of not only physiological measures, but a combination of self-report and physiological response could provide clarification of memory performance characteristics of anxiety disorders. To the extent that the GAD and phobic groups experienced similar levels of arousal at encoding (as predicted in the above hypotheses), the two groups were expected to show similar memory performance on tests of explicit memory. Both groups were predicted to show greater memory for high arousal material, rather than low arousal material. As the differences in impact upon memory between self-reported and physiological arousal are relatively unexplored, these differences were also examined. Furthermore, as an additional exploratory investigation, the relationship between memory and concordance of self-reported and physiological arousal was also examined.

The testing of the above hypotheses served to clarify existing theoretical understanding of emotion in anxiety disorders. This approach is especially necessary in relation to GAD, as it has not been included in tests of Lang's (1985) continuum. The use of the continuum could potentially allow for greater understanding of the relationship between self-reported and physiological arousal. Furthermore, it could provide an examination of the relationship between arousal and memory, extending the already-extensive research in normal populations to anxiety-disordered populations.

CHAPTER 4

METHOD

Participants

Participants in the study were 59 undergraduate students (9 males) with a mean age of 18.55 years (*SD* = 1.19). A large majority of the participants were enrolled in an introductory psychology course at The Pennsylvania State University and received credit toward their course in exchange for participation. Students were identified through a group screening session for the course in which they completed multiple self-report measures on a variety of topics. A small number of participants were also recruited through on-campus flyers and paid $15 dollars for their participation. The majority of the participants were Caucasian (*n* = 45). The rest of the participants were Alaskan (*n* = 1), Asian (*n* = 7), African American (*n* = 3), Hispanic (*n* = 1), or preferred not to answer (*n* = 2).

Participants for this study were included if they met diagnostic criteria for generalized anxiety disorder (*n* = 30) or for snake phobia (*n* = 29). They were selected for the GAD group according to their responses on the Generalized Anxiety Disorder Questionnaire – IV (GAD-Q-IV; Newman et al., 2002; see Appendix B). The GAD-Q-IV has been shown to have good internal consistency, test-retest reliability, strong convergent and discriminant validities (Newman et al.), as well as a specificity of .97 and sensitivity of .69 when compared to the Anxiety Disorder Interview Schedule (ADIS-IV; Brown, DiNardo, Lehman, & Campbell, 2001). The degree of concordance between the GAD-Q-IV and ADIS-IV diagnoses has been found to be equivalent to the reliability reported for GAD diagnoses from two independently administered ADIS-IV interviews (.67; Newman et al.). Participants were placed in the GAD group if they met all of the criteria for GAD according to the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV; American Psychiatric Association, 1994). Participants for the phobia group were selected if they scored highly on the Snake Questionnaire (SNAQ; Klorman, Weerts, Hastings, Melamed, & Lang, 1974; see Appendix C). The SNAQ is a 30-item self-report questionnaire that asks participants to rate their feelings, avoidance and escape behaviors regarding snakes. The SNAQ has been shown to have high internal consistency (Frederickson, 1983; Klorman et al.) and test-retest reliability (Frederickson). To prevent comorbidity of snake phobia and GAD, participants who met criteria for both groups were excluded. Participants were not invited to participate if they endorsed a known history of cardiovascular problems (e.g., heart arrhythmia). In total, exclusion of participants was made for the following reasons: comorbidity for both GAD and snake phobia ($n = 4$), missing questionnaire to test for comorbidity ($n = 1$), or lack of severity on either the SNAQ ($n = 7$) or GAD-Q ($n = 2$) to meet criteria[2]. All 7 of the excluded participants from the snake phobic group were from the group recruited from flyers.

Procedure

Each participant attended an initial 1.5-hour session (see Table 1 in Appendix A for a list of tasks in the experimental protocol) and a 15-minute follow-up session. The two sessions were conducted by either trained undergraduates research assistants or the principle investigator of the study, and were separated by a 1-week time period.

The participant was brought into the data recording room and asked to fill out consent forms. Following agreement to participate, the participant completed a questionnaire that asked for details of a personal, positively-valenced (described to participants as “happy”) past experience and a negatively-valenced scenario of his/her worst fear, as related to either snakes or a current worry/fear (for GAD group). The imagery construction was based upon the procedure described by Pitman, Orr, Forgue, de Jong, and Claiborn (1987), and has been used extensively in the study of emotional imagery in PTSD. The participant was asked to briefly describe the subject of the scenario, as well as visual, auditory, tactile, and olfactory experiences (see Appendices D through F for the positive, phobic, and worry imagery construction sheets given to the participant groups). Additionally, the participant was given a list of emotional words from the Positive and Negative Affect Scale (PANAS; Watson et al., 1988; see Appendix G) and a list of symptoms associated with panic disorder taken from the Anxiety Disorders Interview Schedule-Revised (ADIS-R; DiNardo and Barlow, 1988; see Appendix G). The participant identified and ranked his/her top five emotional experiences from each of the lists. The sensory and emotional information were then inserted into a standard imagery script (Appendix H) to create personalized imagery scripts. See Appendices I through K for examples of completed positive, worry, and phobic imagery scripts, respectively.

The participant also completed several other questionnaires which included the following: Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990; see Appendix L), PANAS (Watson et al., 1988; see Appendix M), the Self-Assessment Manikin (SAM; Bradley & Lang, 1994; see Appendix N), and a modified Beck Depression Inventory, 2nd edition (BDI-II; Beck, A.T., Steer, R.A., & Ball, & Ranieri, 1996; see Appendix O). The BDI-II was modified by removing the question regarding suicidality (question nine)[3].

Next, the participant was brought to an adjacent room containing recording equipment and seated in a comfortable sofa-chair. A brief description of the procedures was given to the participant. Electrodes for the electrocardiogram (ECG) were attached using two bilateral sites on the lower rib cage. The two ECG sites were prepped using a rubbing alcohol, and an Ag-AgCl 12-mm electrode (Med Associates) filled with Redux electrolyte paste (Electro-Cap, Inc.) was placed on each site. The ECG signals were sampled at 256 Hz with a 60 Hz notch filter, and amplified by a Neuroscan (Neurosoft) system. Electrodermal responses were also collected at the same sample rate and notch filter on the Neuroscan system. Electrodes were attached to the index and ring fingers of the participant's non-dominant hand. The participant was asked to wash his/her hands with non-abrasive soap prior to attachment of the electrodes.

Following attachment of the physiological equipment, the experimenter left the room and the participant was left alone in the room with the door closed. Throughout the experiment, an intercom remained on to give instructions to the participant and in the event that s/he needed to contact the experimenter. As posture and movement can significantly affect cardiovascular measures, the participant was comfortably seated in a sofa-chair and required to keep movement to a minimum with legs uncrossed. Furthermore, all participants were visually monitored through a video camera and reminded to sit quietly if excessive movement was detected.

First, the participant was asked to sit quietly for ten minutes. This served as the baseline measure. Following baseline, the participant was asked to complete SUDs ratings of their anxiety level, thoughts and muscle tension (see Appendix P), as well as the SAM and PANAS questionnaires. Next, the participant heard instructions to imagine a personalized positive scene for three minutes. The participant was then asked to again complete the SUDs, SAM and PANAS. Next, the participant was asked to imagine a neutral scene. The same neutral scene was used across all participants and consisted of imagining sitting and looking out onto the yard (see

Appendix Q). Following the 3-minute imagery period, the participant were asked to complete the vividness of imagery of rating scale (Appendix R), as well as the SUDs, SAM and PANAS questionnaires. This same procedure was used for the personalized fear imagery.

Following the last imagery task and completion of the respective questionnaires, the participant was instructed to engage in a 10-minute period of relaxation. The results of the relaxation period were part of another study and are not included in the results and discussion of the present paper.

One week following the initial physiological session, the participant returned to the laboratory to complete cued recall and recognition memory tasks. For the cued recall task, the participant was given a single key word from each of the imagery scripts and asked to recall the imagery scripts as closely as possible (for complete directions, see Appendix S). For the recognition task, the participant was shown a series of words and asked to respond whether or not s/he recognized the word from each of the inductions. The list of words consisted of all words from the original checklists during imagery construction. The recognition task was administered using E-Prime on a PC computer, which recorded the response and reaction time of the participant's responses.

Data reduction and scoring

All data reduction of cardiovascular activity took place on a PC-based computer. A Matlab program was used to identify R-spikes within the sampled data and to calculate cardiovascular measures (heart rate, HR; mean successive differences, MSD). Electrodermal responses were identified manually. Responses were counted when the following criteria were met: 1) the response reached a peak within five seconds, and 2) the amplitude of the peak was at least 4.0 microvolts from the most recent point of initiation.

In regard to the memory data, the accuracy of free recall responses was scored using the two checklists that the participants had used to construct their individual imagery scripts (adjectives and symptoms, Appendix G). Participants were required to identify the top 5 relevant descriptives from each of the two checklists. Each correctly recalled descriptive was worth 1 point. Therefore, a maximum score of 5 points per checklist was possible, with a possible total score of 10 points per imagery task (positively-valenced and negatively-valenced scenarios only, as the neutral scenario did not contain any checklist items).

CHAPTER 5

RESULTS

Preliminary analyses

Demographics. The GAD and snake phobic groups did not differ in mean age ($t(57) = -2.27$, *ns*), gender ($X^2 = .174$, $df = 1$, *ns*) or ethnicity ($X^2 = 5.33$, $df = 5$, *ns*).

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., PANAS), 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. All of these data points were converted to one unit above the next closest unit in accordance with the Windsor method. This method of detection of outliers yielded six outliers in the self-report data (out of 2301 data points; 0.2%), seven outliers in the physiological data (out of 944 data points; 0.7%), and four outliers in the memory data (out of 413 data points; 0.9%). Twelve out of the eighteen total outliers were from the GAD group.

Measures of psychopathology. Group differences in scores on measures of psychopathology (SNAQ, PSWQ, BDI) were examined using a between-subjects (Group: GAD, snake phobic) multivariate analysis of variance (MANOVA). A significant effect was found for group ($F(3, 55) = 82.87$, $p < .001$). As expected, the snake phobic group reported significantly greater fear of snakes, as measured by the

SNAQ, than the GAD group (GAD group: *M* = 7.13, *SD* = 5.14; Phobic group: *M* = 22.90, *SD* = 2.47). Likewise, the GAD group showed significantly greater scores on the PSWQ than the SNAQ group (GAD group: *M* = 64.53, *SD* = 8.96; Phobic group: *M* = 50.86, *SD* = 15.00). The two groups also differed on the BDI. The GAD group reported a higher level of depressive symptoms (GAD group: *M* = 20.335, *SD* = 8.13; Phobic group: *M* = 9.76, *SD* = 6.36).

Vividness of imagery. Group differences in vividness of imagery were also examined to verify that neither group exhibited greater imagery vividness than the other. A 2 (Group: GAD, snake phobic) x 3 (Task: Positive, Neutral, Negative) analysis of variance (ANOVA) with repeated measures on the second factor was conducted for vividness of imagery. No group differences emerged, but a significant effect for Task ($F(2,112) = 10.97$, $p < .001$) was found, with greater vividness of imagery associated with positive and negative imagery tasks than the neutral imagery task. The effect of vividness was not significantly different between the positive and negative imagery tasks, and the vividness did not interact with group status.

To follow up on the relationship of vividness to other dependent variables, correlations were conducted between vividness and physiological measures (HR, IBI, MSD, electrodermal responses), and between vividness and self-report measures (SUDs rating for amount of Anxiety, SUDs for amount of Thoughts, SUDs for amount of Tension, SAM item for Happiness, SAM item for Calmness, SAM item for Control, PANAS total score for positive affect, PANAS total score for negative affect). For physiological measures, the correlation matrix revealed only two significant correlations, which were between vividness and electrodermal responses for positive imagery (*r* = -.48, *p* < .01) and between vividness and MSD for neutral imagery (*r* = .39, *p* < .05). For self-report measures, the correlation matrix revealed only a significant correlation between vividness and SUDs calm-anxiety (*r* = .50, *p*< .01). As vividness of imagery was not consistently related to any particular measure or imagery task, and the focus of the present study was upon group differences, vividness of imagery was not included as a covariate in other analyses.

Manipulation of emotional experience. To verify that participants experienced imagery tasks (positive, neutral, negative) as emotionally different from each other in the intended manner, several measures were examined. First, to verify that the physiological variables were differently affected by the imagery tasks, a one-way (Task: positive, neutral, negative), within-subjects MANOVA for IBI, HR, MSD, and electrodermal responses was conducted. The MANOVA yielded a significant effect for task ($F(8, 228) = 3.69$, $p < .01$). Within-subjects contrasts were used to identify which dependent variable(s) explained the effect. The contrasts revealed a significant effect for task on IBI ($F(1, 58) = 4.35$, $p < .05$). See Figure 1 in Appendix A, which shows that the manipulations were in the expected directions, with the shortest IBI associated with negative imagery, and the longest IBI associated with neutral imagery. However, the effect sizes were quite small (e.g., Cohen's *d* = .08 for neutral vs. negative imagery task).

A significant effect for task was present for the number of electrodermal responses ($F(1, 58) = 6.42$, $p < .05$), with one-tailed tests revealing that, as expected, positive imagery task was associated with significantly more electrodermal responses than neutral imagery task ($t(116) = 1.85$, $p <.05$; Positive: $M = 9.86$, $SD = 11.97$; Neutral: $M = 6.21$, $SD = 9.32$). The difference between number of electrodermal responses for positive and negative imagery task was not significant. See Figure 2 in Appendix A for a graph of the number of electrodermal responses.

Finally, several of the self-report measures were examined as a manipulation check for Task. The PANAS yields separate total scores for positive affect and negative affect. It was expected that imagery of a positive experience would elicit a greater endorsement of positive affect than negative affect, and that the reverse would be true for imagery of a fearful experience. A one-way (Task: Positive, Neutral, Negative), within-subjects MANOVA for the PANAS total scores for positive and negative adjectives were conducted. The MANOVA revealed a significant effect for Task ($F(4, 232) = 66.19$, $p < .001$). Within-subjects contrasts identified that the significant effect on Task was present for PANAS totals of both the positive adjectives ($F(1,58) = 44.46$, $p < .001$) and the negative adjectives ($F(1,58) = 168.47$, $p <.001$). One-tailed *t*-tests revealed that all levels of the imagery task were significantly different from each other in the expected directions for the positive and negative adjective total scores (e.g., the positive imagery task was associated with greater endorsement of positive adjectives than negative adjectives). The only unexpected finding was in regard to neutral imagery. As neutral imagery was expected to have similar levels of positive and negative adjective totals, a two-tailed *t*-test was conducted; the neutral imagery task was associated with a significantly greater total score on the PANAS positive adjectives than on the PANAS negative adjectives, indicating that neutral imagery was associated with greater endorsement of positive adjectives.

To verify that the participants perceived greater arousal for positive and negative imagery than for neutral imagery, a one-way (Task: Positive, Neutral, Negative) ANOVA for the SAM item for Calmness was examined. This item asks the participant to rate themselves on a continuum from excited to calm. The ANOVA resulted in a significant effect for Task ($F(2, 116) = 49.27$, $p < .001$), with pairwise comparisons verifying that the levels were each significantly different from each other. The greatest level of excitement was associated with negative imagery (M = 3.93, SD = 1.79), with significantly less excitement associated with positive imagery (M = 4.84, SD = 2.09), and the least excitement associated with neutral imagery (M = 6.98, SD = 1.55).

Session #1: Concordance Between Physiological and Self-Report Variables

To examine the hypothesis that the groups would differ on their levels of concordance at baseline, but would be similar under conditions of imminent threat, a correlation matrix was run to identify significant correlations between all physiological and self-report dependent measures for each of the imagery tasks (e.g., IBI for positive, neutral and negative imagery tasks; PANAS total score for negative affect for positive, neutral, and negative imagery tasks). The results yielded significant correlations within the physiological variables (e.g., correlation between positive imagery IBI and neutral imagery IBI was $r = .97$) and within the self-report variables, but no significant correlations were found between the physiological and the self-report variables for either the GAD or the snake phobic group.

To further examine whether or not the groups could be differentiated by physiological and self-report responses, binary logistic regression was performed. Logistic regression computes the log odds that a particular outcome, such as anxiety disorder status, will occur (Brace, Kemp, & Snelgar, 2003). As discriminant analysis and logistic regression are similar analyses that can both be used to predict a categorical dependent variable, such as group status, based upon a number of predictor variables, logistic regression was chosen over discriminant analysis because it makes fewer assumptions about the dependent variables (Press & Wilson, 1978). In this particular data set, a Box's M test of the present dataset was significant, indicating that the assumption of homogeneity of variance was violated, potentially making the significance values of a discriminant function unreliable.

Baseline. To examine group membership using baseline measures, binary logistic regression was performed with group status (GAD, snake phobic) as the dependent variable and the following baseline predictor variables: BDI (entered into the first block to account for group differences in BDI), SUDs rating for amount of

Anxiety, SUDs for amount of Thoughts, SUDs for amount of Tension, SAM item for Happiness (vs. Unhappiness), SAM item for Calmness (vs. excitement), SAM item for Control (vs. lack of control), PANAS total score for positive affect, PANAS total score for negative affect, IBI[5], MSD, and number of electrodermal responses. The full model was significantly reliable (X^2 = 54.65, *df* = 12, *p* < .001). This model accounted for between 60.4% and 80.5% of the variance in group status, with the percentage of correctly identified participants of 84.7%. This percentage was an increase from 74.6% with the BDI as the single predictor of group status. See Table 2 in Appendix A for the Wald statistic to identify significant predictors and their coefficients.

Positive imagery. To examine group membership for the positive imagery task, binary logistic regression was performed with status (GAD, snake phobic) as the dependent variable and the following predictor variables for positive imagery: BDI (entered into the first block to account for group differences in BDI), SUDs rating for amount of Anxiety, SUDs for amount of Thoughts, SUDs for amount of Tension, SAM item for Happiness, SAM item for Calmness, SAM item for Control, PANAS total for positive affect, PANAS total for negative affect, IBI[5], MSD, and number of electrodermal responses. Although the full model was significantly reliable (X^2 = 33.65, *df* = 12, *p* < .01), BDI was the only significant predictor.

Neutral imagery. To examine group membership for the neutral imagery task, binary logistic regression was performed with group status (GAD, snake phobic) as the dependent variable and the following predictor variables for neutral imagery: BDI (entered into the first block to account for group differences in BDI), SUDs rating for amount of Anxiety, SUDs for amount of Thoughts, SUDs for amount of Tension, SAM item for Happiness, SAM item for Calmness, SAM item for Control, PANAS total for positive affect, PANAS total for negative affect, IBI[5], MSD, and number of electrodermal responses. The full model was significantly reliable ($X^2 = 35.92$, $df = 12$, $p < .001$). This model accounted for between 45.6% and 60.8% of the variance in group status, with 83.3% of the GAD participants correctly identified and 86.2% of the snake phobic participants correctly identified. The overall rate of correctly identified participants was 84.7%. See Table 3 in Appendix A for the Wald statistic and coefficients.

Negative imagery. To examine group membership based upon measures of emotion used for the negative imagery task, binary logistic regression was performed with group status (GAD, snake phobic) as the dependent variable and the following predictor variables for negative imagery: BDI (entered into the first block to account for group differences in BDI), SUDs rating for amount of Anxiety, SUDs for amount of Thoughts, SUDs for amount of Tension, SAM item for Happiness, SAM item for Calmness, SAM item for Control, PANAS total for positive affect, PANAS total for negative affect, IBI[5], MSD, and number of electrodermal responses. Although the full model was significantly reliable (X^2 = 35.77, *df* = 12, *p* < .001), BDI was the only significant predictor of group status.

In addition to the above analyses, further analyses were conducted to address concerns that the length of the tasks (ten minutes for baseline, three minutes for imagery tasks) contributed to the findings. Specifically, the baseline period might not have reflected a true resting baseline assessment, as physiological measures at baseline can be influenced by external factors (Hastrup et al., 1986). Although the present study utilized a 10-minute baseline in accordance with recommendations for the prevention of external confounds to baseline results (Manuck et al., 1989), the last 1.5 minutes of baseline IBI were compared to the average IBI for the 10-minute baseline period. The last 1.5 minutes were associated with significantly longer IBI than the 10-minute baseline (1.5 minute baseline: *M* = 824.61, *SD* = 126.68; 10-minute baseline: *M* = 813.43, *SD* = 123.00). However, when the logistic regression was re-run using the last 1.5 minutes, the results did not differ from the initial logistic regression.

To address concerns that the potency of the imagery may have decreased over time, the first 1.5 minutes of the average IBI data for each imagery task were substituted into the logistic regression in place of the 3-minute data. The results did not significantly differ from initial analyses.

As earlier analyses revealed that the neutral imagery task was associated with a lower level of vividness than the other tasks, vividness differences might have accounted for the task differences. Therefore, the logistic regressions were re-run and ratings of vividness were entered in the first block. This did not alter any of the above results.

Session #2: Memory data

Group differences. As the Session #1 analyses revealed that no self-report items or physiological measures differentiated the GAD group from the snake phobic group, it was predicted that the groups would also not differ in their memory performance. To compare the GAD and snake phobic groups in their memory performance, the recall and recognition memory data collected during the second session were analyzed using a 2 (Group: GAD, phobic) x 3 (Imagery task: Positive, Neutral, Negative), mixed-factors MANOVA, with repeated measures on the second factor. The dependent variables were cued recall, recognition accuracy and recognition reaction time. All follow-up tests were conducted using pairwise comparisons with a Bonferroni correction for multiple comparisons. The MANOVA revealed a significant effect for group status ($F(3,55) = 3.27$, $p < .05$). Pairwise comparisons revealed that the GAD group showed longer reaction times (M = 14263.97, SD = 500.23) than the snake phobic group (M = 12305.85, SD = 508.78). See Figure 3 in Appendix A for a graph of each groups' reaction times. No group differences emerged for cued recall or recognition accuracy.

Arousal. The 2 (Group: GAD, phobic) x 3 (Imagery task: Positive, Neutral, Negative), mixed-factors MANOVA, with repeated measures on the second factor revealed not only an effect for group status (as shown above), but also revealed an effect for imagery task on recognition accuracy ($F(1,57) = 7.20$, $p < .05$) and recognition reaction time ($F(1, 57) = 62.85$, $p < .001$). Pairwise comparisons revealed that greater recognition accuracy (positive imagery = 7.37, *SD* = 0.27; negative imagery = 8.093, *SD* = .237) and faster reaction time (positive imagery = 15342.93, *SD* = 502.79; negative imagery = 11226.88, *SD* = 369.50) were associated with the negative imagery task.

To investigate the hypothesis that high arousal material would be associated with greater memory than low arousal material, a correlation matrix was examined for the relationship of memory performance variables (recall memory, recognition accuracy, recognition reaction time) with physiological variables (HR, IBI, MSD, electrodermal responses). No significant correlations between memory performance and physiological variables were found. The correlation matrix of memory performance and self-report variables was also performed (for both positive and negative imagery tasks: SUDs rating for amount of anxiety, SUDs for amount of thoughts, SUDs for amount of tension, SAM item for happiness, SAM item for calmness, SAM item for control, positive adjectives on PANAS, negative adjectives on PANAS). Several significant, moderate correlations between memory performance and self-report variables were found (see Table 4 in Appendix A). To explore the potential for a quadratic relationship between memory performance and self-report variables, scatterplots with r-squared values were examined. See Figures 4 and 5 in Appendix A for linear and quadratic lines of fit, respectively, and for the r-squared values for the relationship between self-reported emotion and recognition reaction time.

Concordance. As concordance was not found between the physiological variables and self-report variables at Session #1 for either positive or negative imagery tasks, no analyses were performed to examine the relationship between concordance and memory.

CHAPTER 6

DISCUSSION

The present study sought to further understanding of emotion in anxiety disorders through the comprehensive measurement of emotional response. Participants with GAD and snake phobia were chosen as the focus of the investigation in order to maximize characteristic and theoretical (Lang, 1979, 1985) differences between anxiety disorders, with the GAD group representative of an anxiety disorder with a diffuse set of fears and the snake phobic group representative of an anxiety disorder with a single, focal source of fear. All participants engaged in imagery tasks designed to elicit an emotional response. One week following engagement in the imagery tasks, all participants were tested on their memory for their emotional responses during the initial imagery tasks. Physiological and self-report measures were used to assess emotional response at the time of the initial imagery tasks, and tests of explicit memory were used to assess memory performance at the one-week follow-up session. Examination of the concordance, or agreement, between the physiological and self-report measures served as the main focus of understanding emotionality and the storage of memory for fearful emotional experiences.

Emotion as measured by physiological responses

Based upon theoretical and empirical bases for emotionality in anxiety disorders, it was expected that physiological and self-report measures would be sensitive to differences between an emotionally-neutral task and an emotionally-charged task, with greater emotionality detected during the emotionally-charged tasks. The results indicated that physiological measures were sensitive to differences between the imagery tasks, with shorter IBIs and greater number of electrodermal responses associated with positive and negative imagery tasks than with the neutral imagery task. Whereas the physiological measures were sensitive to differences between emotionally-charged tasks (positive and negative imagery) versus the emotionally-neutral task (neutral imagery), the measures proved to be less-sensitive to differences between positive versus negative valence. Thus, the physiological measures used in this study were good indicators of the arousal dimension of emotion, but were not particularly good indicators of valence.

In regard to group differences, the physiological measures were not different between groups across all tasks, which demonstrated that the two anxiety groups were similar physiologically, at least in terms of cardiovascular and electrodermal measures. This finding was consistent with hypotheses, as groups were not expected to differ during emotionally-charged or neutral imagery tasks. The lack of group differences in one measure, MSD, is worth noting. Mean successive differences is a measure of parasympathetic activity, and as such, primarily works in reciprocal fashion to the sympathetic, or "fight or flight," nervous system. As mentioned earlier, the existing literature investigating autonomic nervous system activity in GAD has thus far been mixed. Some investigators have shown evidence for lowered parasympathetic activity in GAD (Lyonfields et al.; Thayer et al.), and others have failed to find support for lowered parasympathetic activity (Davis et al., 2002; Yamasaki, 2000). Although further study in this area should be pursued, the results of the present study do serve to provide support for the lack of presence of lowered parasympathetic activity in GAD.

Conclusions regarding physiological measurement of emotionality. The results demonstrated evidence of a high degree of similarity between GAD and snake phobia in regard to physiological measures of emotion, with physiological responses sensitive to differentiation between emotionally-charged versus emotionally-neutral tasks than between positive and negative valence.

Emotion as measured by self-report measures

In contrast to the physiological measures, which were only helpful in distinguishing differences between emotionally-charged versus emotionally-neutral tasks and were not sensitive to valence or differences between groups, self-report measures were quite able informative. First, differences between the tasks were readily distinguishable by self-report. The distinction between both the arousal and valence dimensions was evident in the self-report measures, with the greatest arousal associated with the negative imagery task and the greatest negative valence reported in the negative imagery task.

Whereas the differences between imagery tasks were easily distinguishable, the GAD and snake phobic groups were both similar and different in their emotional responses. The two groups were quite similar in terms of their responses for the emotionally-charged tasks; the two groups were not significantly different on any of the self-report measures of emotion for either the positive or the negative imagery tasks.

In contrast to the similarity between groups in emotionally-charged tasks, the GAD and snake phobic group showed clear differences in their responses at baseline and during neutral imagery. At baseline, the GAD group was predicted to respond with higher ratings of negative emotionality. However, the pattern of group differences was more complex than the hypotheses, and use of a variety of measures of emotion illuminated this complexity. Individuals with GAD were more likely to be characterized by higher levels of emotionality, as measured by level of tension and control, whereas individuals with snake phobia were more likely to be characterized by higher levels of anxiety and greater ratings of positive valence.

The finding of greater level of tension in the GAD group was not surprising, as it supports the inclusion of muscle tension as part of the diagnostic criteria for GAD (DSM-IV; APA, 2000). Although this finding was quite expected, the other results were not as straightforward.

The finding of the greater likelihood for elevated baseline anxiety in the snake phobic group was in contrast to the prediction that the GAD group would evidence the higher level of baseline anxiety. One potential explanation for this surprising result may be related to the nature of the experimental protocol. Prior to the experiment, participants were asked to complete questions about the nature of their fears (current worry or encounter with a snake for GAD and snake phobic groups, respectively). This may have triggered anticipatory anxiety selectively for the snake phobic group. As GAD is associated with chronic worry, attention drawn toward a source of current worry was not likely to have been a highly unusual experience for the participants with GAD. In contrast, individuals with snake phobia are unlikely to be faced with encounters with snakes on a daily basis and knowledge that the experiment included a portion with snakes would be likely to trigger fears of the upcoming experimental tasks. In fact, anecdotally, the members of the snake phobic group seemed to verbalize anticipatory fears (e.g., Will there be a live snake?) more often than members of the GAD group.

Support in favor of the initial hypotheses that the two groups would be different in their self-report at baseline was provided in the STAI. Although the groups did not differ following the resting baseline using the SUDs level of anxiety rating, the GAD group reported significantly greater state anxiety than the snake phobic group on the STAI. This difference between groups was present despite its administration after imagery script information had been collected. The seemingly contrasting findings between the STAI and SUDs rating of anxiety are likely to be due to the differences between the measures in content. Although both are measures of state anxiety, the STAI is a more comprehensive measure of anxiety (20 items), which could potentially tap into feelings of anxiety that are not consciously labeled as "anxiety." Therefore, it appears that the baseline ratings of anxiety, as measured by the SUDs rating, may have been skewed toward the snake phobic group due to the nature of the experimental protocol and could account for the lack of differences between the GAD and snake phobic groups.

In addition to the group differences in tension and state anxiety, higher ratings of positive valence in the individuals with snake phobia differentiated them from individuals with GAD. This was true even after level of depression was taken into account, suggesting the presence of a dampening of positive emotion at baseline in GAD. This finding is consistent with the information-processing literature in GAD. Much evidence demonstrates that GAD is associated with the interpretation of emotionally-neutral information as negative or threatening in nature. For example, individuals with GAD have been found to be more likely to make threatening interpretations of ambiguous scenarios (Butler & Mathews, 1983) and to complete ambiguous sentence stems in a threatening manner (Mogg et al., 1994). This literature suggests that the baseline task in the present study could have been experienced as more threatening to the GAD group than to the snake phobic group. Furthermore, it provides support for the accuracy of the STAI as a measure of state anxiety over the SUDs rating of anxiety.

The last self-report measure which distinguished the GAD group from the snake phobic group at baseline was that of control (also referred to as dominance), with greater ratings of control associated with GAD. Before interpreting this finding in the area of control, differentiation between the perception of increased control and actual execution of greater control was explored after the planned analyses had been performed.

In the experimental protocol, the neutral imagery task differed from the positive and negative imagery tasks in that it did not contain any reference to emotional response. Only content of the senses (sight, sound, smell, and touch) were included. With this lack of emotional cues in the neutral imagery task, one way to examine exertion of control within the present study was to examine whether or not participant groups differed in their rate of insertion of their own emotional experience.

Although it is impossible to gain access to the actual imagery content of the participants while they were engaged in the imagery, the memory data were examined for the number of false positives in the neutral task as an approximation of the imagery content. False positives were adjectives or symptoms that the participant identified as being heard during the imagery script, but were not actually read to the participant. It was assumed that the false positives were likely to be congruent with the participant's experience during the initial imagery task; as no emotional cues were included in the imagery script, these emotional states would have been projected onto the neutral scenario by the participant and would suggest greater exertion of control. Examination of the number of false positives showed that the groups did not differ in their rate of false positives, indicating that the GAD group's greater sense of control did not appear to be due to greater actual interjection of their own emotional experiences or actual exertion of control of emotion than the snake phobic group. Rather, the greater rating of control in the GAD group appears to be reflective of the group's greater perceptions of control.

The greater level of perceived control associated with GAD at baseline is consistent with existing theoretical and empirical work indicating that the issue of control is an important feature of GAD. For example, Borkovec and Roemer (1995) found that individuals with GAD cite reasons for worry such as to "prevent bad things from happening" or to "distract from more emotional topics," suggesting that an overarching reason for worry could be to exert control over one's life or one's emotions. More recent work in GAD also supports attempts to control one's emotions, as worry and GAD are associated with attempts to control internal experiences (Roemer, Salters, Raffa, & Orsillo, 2005).

Attempts to exert control through the use of worry are likely to be related to the high degree of intolerance of uncertainty that is present in GAD (Dugas, Gagnon, Ladouceur, & Freeston, 1998). That is, if an individual has a low perceived sense of control, any uncertain or unpredictable situations serve to increase a sense of vulnerability, thereby triggering the individual with GAD to employ worry strategies to exert control. The individual with GAD is subjected to many unpredictable stimuli in everyday situations that are potentially sources of worry, whereas the snake phobic individual's environment is relatively predictable, with minimal likelihood that a snake will present itself unexpectedly. Therefore, the snake phobic individual has little reason to attempt to exert control over his/her environment in daily life, whereas the individual with GAD has ample reason (whether rational or not) to attempt to exert control. Unfortunately, the environment is ultimately unpredictable on some level, and individuals with GAD may have difficulty coping with this level of uncertainty. In fact, intolerance of uncertainty has been shown to be highly related to worry and GAD (Dugas et al., 1998), with intolerance of uncertainty found to be a strong risk factor for the development of worry (Norton, Sexton, Walker, & Norton, 2005). Furthermore, treatment designed to decrease intolerance of uncertainty in GAD has shown good results through 12-month follow-up assessment of GAD symptoms (Ladouceur, Dugas, Freeston, & Léger, 2000), providing evidence that intolerance of uncertainty is related to GAD symptomatology.

Understanding the area of control in GAD may also offer greater understanding of the development of GAD. Barlow (2000) has argued for the strong role of control in the development of GAD, proposing that sense of control is central to the vulnerability for development of anxiety and related disorders. He cites much evidence indicating that circumstances of unpredictability and a diminished sense of control contribute to the development of anxiety, with a low degree of control as the mediating factor between limited control within the family environment and negative affect, which ultimately leads to negative affect and interpretation of all stimuli as uncontrollable (see Barlow's model in Figure 6).

The finding of greater perceived control associated with GAD in the present study was not only present in response to the baseline task, but also for the neutral imagery task. These findings are consistent with the existing literature and suggest that control may be a distinguishing characteristic of GAD. In fact, in the present study, all other differences between groups in self-reported emotionality that were present during baseline dropped out for neutral imagery. The nature of the neutral imagery task demonstrated confirmation that without emotional cues, increased control emerges as a characteristic that clearly differentiates a group with a set of diffuse fears from a group with a single, focal source of fear.

Evidence has begun to emerge to suggest that the area of control, especially as related to intolerance of uncertainty, may be an essential feature of GAD. The presence of the self-reported increased sense of control over the snake phobic group in the present study suggests that individuals with GAD may overestimate their sense of control in situations with minimal emotional cues. Thus, although the present evidence is consistent with Barlow's model that control is central to understanding anxiety, the present study also suggests that Barlow's model could be modified to include differentiation between types of anxiety and between types of stimuli in a model for GAD. Rather than a general stimulus interpreted as uncontrollable across any situation, it appears that for GAD, the response may differ for neutral stimuli;

when individuals with GAD are presented with neutral situations, an elevated sense of control is perceived, rather than an automatic perception of low control. Perhaps this represents a rebound effect for the GAD group, whose intolerance of the lack of control in emotional situations results in an overestimation of control when emotional cues are lacking. Regardless, GAD appears to be characterized by disruptions in perception of control, with an elevated sense of control when emotional cues are lacking.

Conclusions about self-reported measures of emotionality. The self-report measures of emotion used in this study were quite able to distinguish between imagery tasks in regard to both valence and arousal. Group differences were also found, although the picture was more complex than originally hypothesized. The GAD and snake phobic group showed similar responses to positive and negative imagery in the expected directions. Differences between groups emerged at resting baseline and neutral imagery. Unexpectedly, the snake phobic group reported greater levels of anxiety at baseline, but this could be explained by a potential confound in the experimental protocol and was unsupported by the STAI, which showed higher levels of state anxiety in the GAD group. The GAD group showed greater tension and perceived control in response to resting baseline and neutral imagery. Although the level of higher tension in the GAD group was consistent with expectations, the higher level of control was surprising and is not readily explained. Based upon some existing evidence for the importance of feelings of lack of control in the development and maintenance of GAD, this finding needs to be pursued further in future research.

Memory

In the present study, the positive and the negative imagery tasks not only provided a mode for the investigation of emotional response in the physiological and self-report domains, but also served as encoding tasks for long-term memory. Existing experimental evidence has shown strong support for the relationship between arousal and memory; arousal, as measured by self-report and physiological response, has been shown to be related to memory performance, with moderate anxiety associated with the greatest facilitation of memory. Therefore, it was hypothesized that memory performance in the GAD and snake phobic groups in the present study would be related to arousal at encoding.

The use of personalized imagery was chosen to address concerns that existing research in GAD has been confounded by the lack of easily identified "deep-encoding" tasks for GAD. The personalized imagery in the present study appears to have been successful in achieving "deep-encoding" across both the GAD and snake phobic groups for several reasons. First, the manner in which the imagery was created served to facilitate the intensity of the imagery and to create a vivid, realistic scenario that elicited emotional arousal. This was achieved by giving the participants a list from which to choose the most relevant descriptors for their emotional state during the imagery scenario. The list served to maximize personal relevance, while maintaining some degree of standardization across participants. Furthermore, the word list from which the participant had to choose was created from a list of symptoms from an existing assessment measure of symptoms during a panic attack. This served to maximize the imminent quality of the imagery scenarios.

The second reason that "deep-encoding" appears to have occurred was based upon the observed self-report and physiological responses at the time of encoding. Both groups reported at least a moderate level of arousal in response to positive and negative imagery, and the negative imagery task was associated with significantly greater arousal than the positive imagery task. Both groups also responded to positive and negative imagery with physiological arousal across positive and negative imagery, as measured by sympathetic activity, in comparison to physiological response for neutral imagery. Given the differences between the self-report and physiological findings, predictions based upon the self-report measures suggested that memory differences between tasks could be expected, while physiological measures indicated that memory differences between positive and negative encoding tasks should not be expected.

One week after the encoding session, participants were given tests of cued recall, recognition accuracy and recognition reaction time. Examination of cued recall and recognition accuracy provided a mixed picture. In accordance with the prediction of memory performance based upon physiological measures, cued recall did not differ between positive and negative imagery tasks. In contrast, recognition accuracy was consistent with predictions based upon self-reported arousal; greater recognition accuracy was associated with the negative imagery task than the positive imagery task, providing evidence that recognition accuracy was facilitated by arousal.

The difference in findings between the two measures of memory highlights the influential role in which the type of measure of memory can play. Despite that both cued recall and recognition accuracy are of the explicit, long-term type, the measures provided different results. One potential explanation is that cued recall may require a greater level of arousal than recognition to facilitate memory performance. Arousal that was only experienced in the physiological domain (at least as measured by electrodermal responses) may not be sufficient to facilitate memory, particularly when arousal as measured by electrodermal responses was not accompanied by strong arousal differences between tasks as measured by other physiological indicators. Recognition accuracy, in contrast, may be sensitive to small, non-conscious changes in physiological arousal, with facilitation of recognition accuracy occurring with non-conscious changes in arousal. Therefore, not only is the importance of choice of measures of memory performance important, but it is also extremely important to take measures of both physiological and self-reported arousal when examining memory in anxiety disorders. It appears that if existing findings are to be clarified, future research will need to use a comprehensive assessment approach which includes a combination of multiple measures of memory and multiple measures of arousal, as this study utilized. Only with this type of comprehensive measurement approach will the relationships between arousal and the specific memory tasks be clearly understood and be useful in furthering knowledge about the influence of arousal upon memory.

In addition to the presence of memory differences between the imagery tasks, comparisons between the GAD and snake phobic groups also provided further understanding of memory of emotional experiences in anxiety. With evidence of at least moderate arousal in both the self-report and physiological domains across groups, it was expected that memory would be facilitated equally across the groups. Therefore, the lack of difference between groups in cued recall and recognition accuracy was not surprising. Although no experiments have compared GAD with specific phobia in memory performance, existing research suggested that explicit memory would to be facilitated in snake phobia, but not in GAD. Nevertheless, as mentioned earlier, Coles and Heimburg (2002) have criticized the lack of "deep-encoding" tasks in the GAD research which may have confounded results and obstructed the identification of explicit memory biases in GAD. Their criticism appears to be well-founded, as use of a deep-encoding task in the present study resulted in similar, rather than different, explicit memory performance in cued recall and recognition accuracy across groups.

Although one might be tempted to conclude that explicit memory does not appear to be dependent upon the presence (or lack thereof) of a single source of fear (as in snake phobia) or multiple sources of fear (as in GAD), the lack of findings could be dependent upon the types of measures used. In fact, recognition reaction time was used in the present study as an exploratory measure and yielded interesting findings. In this study, participants were not told that reaction time was being measured and were not given instructions with regard to time, as not to induce overt time pressure and to minimize performance anxiety in participants. Under these circumstances, the groups differed significantly in their reaction time. The GAD group showed longer reaction time than the snake phobic group across encoding tasks. These group differences could be interpreted as either memory interference in the GAD group, facilitation of memory in the snake phobic group, or a combination of both. Although no studies with similar protocol could be identified to make comparisons, several explanations for these group differences exist.

In an attempt to further understand the presence of longer reaction time in the GAD group, the relationship between self-reported arousal at encoding and reaction time in the two participant groups was examined. Across both groups, little relationship was present between self-reported emotion and reaction time for the positive imagery encoding. For the negative imagery encoding task, the PANAS total score for negative adjectives was the only score to be significantly correlated with reaction time across both groups. Examination of the relationship revealed that while the linear relationship was significant, the relationship was actually better captured as a quadratic relationship, with the fastest reaction times associated with a moderate endorsement of negative emotion. This finding supported expectations of an inverted-U relationship between memory and arousal, but did not reveal clear differences between groups. The lack of group differences was consistent with the lack of differences in physiological and self-reported emotionality between groups at the time of encoding, suggesting that the GAD group's longer reaction time was not due to any bias created by experience at encoding.

One potential explanation for longer reaction time is that the evolutionary basis of snake phobias is a hard-wired response and is likely to result in greater facilitation of memory than in GAD. However, this would not explain the lack of cued recall and recognition accuracy differences. A second possibility could be related to comorbid depression. It is well-established that depression impacts cognitive functioning, and as the GAD group endorsed a significantly higher degree of depression than the snake phobic group, this could have accounted for the differences between the two groups. To address this concern, analyses were re-run with depression as a covariate. However, the effect of longer reaction time for the GAD group was still present.

As previous work has demonstrated that worriers show longer reaction times during ambiguous tasks (Metzger, Miller, Cohen, Sofka & Borkovec, 1990), a third explanation is that the longer reaction times in the present study were due to the ambiguity of the task. Similar to the present study, both groups performed with similar levels of accuracy when asked to make a forced decision, but worriers showed longer reaction times. Ambiguity in the present study could have been created through the presentation of the long, consecutive presentation of possible correct answers, with some overlap of the words. For example, both “racing heart” and “pounding heart” appeared on the list presented during the recognition task. Likewise, “chest pain” and “chest discomfort” also appeared on the list. As it was possible for the participant to have only chosen one of the two symptoms originally, the task of deciphering whether or not the symptom had been heard at the initial session during the previous week could have created significant ambiguity. Furthermore, no feedback was given to the participants as they performed the recognition task, which could have served to create even greater ambiguity. Metzger et al. explain the increase in reaction time in worriers in their study as related to a fear of failure in which the worriers’ fear of making an error was traded against the fear of failing to respond. Certainly, the laboratory environment in the present study could have served to facilitate an evaluative situation and to active fears of making an error.

Yet another explanation for the longer reaction time in the GAD group may be the presence of limited cognitive resources in GAD. Worry is a verbal-linguistic activity that is primary based in thought activity, rather than imaginal activity (Borkovec & Inz, 1990). Given that GAD is characterized by worry, it is possible that the cognitive resources of individuals with GAD are limited by their worries. The presence of these worries could serve to interfere with concentration upon the task which would be behaviorally manifested in slowed reaction time. Thus, rather than differences in the actual content of memory, the slowed reaction time could reflect the extra time that is required to focus cognitive resources upon the task at hand. Furthermore, presence of triggers, such as the emotional words associated with a source of worry, could serve to differentially affect the negative imagery task over the positive imagery task.

Conclusions regarding memory. In light of the findings in memory performance of the two groups, it appears that a moderate level of arousal is related to facilitation of memory in anxiety disorders. This is consistent with evidence from randomly-selected samples. Furthermore, traditional measures of explicit memory did not differentiate the two groups, suggesting that despite the difference in the nature of their fears, GAD and snake phobia are not associated with any characteristic impairment or facilitation of memory for their emotional experiences. However, slower recognition reaction time characterized GAD, which might be explained by several possibilities, including that possibility that interference of the cognitive load created by chronic worries in the GAD group or difficulty with decision-making in ambiguous tasks. Therefore, it appears that rather than impairment in actual memory ability, symptoms characteristic of GAD interfere with efficiency in recognition of past emotional experiences.

Although the findings for memory performance appear to be consistent with existing literature and expectations, several precautions are worthwhile noting. First, one cannot rule out the possibility of order effects at the time of encoding. All participants were given the original imagery tasks (positive, neutral, and negative) in the same order. This protocol was chosen for several reasons. First, the positive and negative imagery tasks were designed to elicit intense emotional experience and there was concern that back-to-back presentation of positive and negative emotional experiences might have a carry-over effect that would confound emotional reactions. The neutral imagery task was therefore placed in-between the positive and negative emotional experiences, as there was no theoretical or empirical reason to believe that the positive imagery task would significantly affect the neutral task. Second, the present study also served as part of another study investigating the impact of relaxation upon negative emotional experience and required that the negative imagery be performed last in the protocol. Future experiments should include randomized order of encoding tasks and could utilize resting baseline periods between imagery tasks to minimize carry-over effects. Another limitation of the memory portion of the present study is that the content of the neutral imagery encoding task differed from the other encoding tasks, as described earlier in regard to the control findings, with no inclusion of symptom response material in the neutral task. This prohibited examination of memory performance of the neutral imagery in comparison to the positive and negative imagery tasks. Although the method used in the study was designed to minimize any positive or negative emotionality, use of explicit cues of neutrality could be used in future studies. This would provide the opportunity to fully assess the relationship between emotion and memory, without the exclusion of memory of neutral information. Based upon the findings in the present study and past evidence, it would be expected that neutral imagery would be associated with poorer memory performance than for emotionally-charged information. However, if the neutral task contained neutral valence combined with high arousal, one could argue that a moderate level of arousal would result in memory performance similar to that of positive and negative encoding tasks. Clearly, more work could be done to clarify the relationship between neutral encoding tasks and memory.

Finally, the use of a non-anxious control group is necessary to fully validate the conclusions made from the results of the present study. In regard to the memory results, inclusion of a non-anxious control group would serve to clarify whether or not memory performance was facilitated or impaired in the GAD and snake phobic group. Although the results of the present study provide strong evidence for the relationship between moderate arousal and facilitation of memory, it is unclear as to whether the overall memory performances of the GAD and snake phobic group were better or worse than what would be expected for a non-anxious individual under similar arousal conditions. Based upon the reviewed existing evidence and Lang's theoretical model, the GAD and snake phobic groups would be expected to have facilitation of memory in comparison to non-anxious individuals, as long as conditions were moderately arousing. Nevertheless, the study by Friedman et al. (2000) suggested that imaginally-based encoding tasks might not facilitate explicit biases in GAD. Although the similarity in performance between the GAD and phobic group (which has more typically shown explicit memory biases) suggests that the GAD group did show a memory bias, the inclusion of a non-anxious control group would allow further exploration of this matter.

Concordance

Although group differences in emotionality and memory, as discussed above, were of interest to further understanding about differences in emotionality between groups of broad fears versus a specific fear, the cornerstone of the study was the idea of concordance. The GAD and snake phobic groups were proposed to differ in the degree to which the self-report and physiological measures would be related, with lower concordance expected in the GAD group than the snake phobic group.

Concordance was also expected to increase with tasks presenting an imminent level of threat in contrast to resting or emotionally-neutral tasks. The results partially supported the hypotheses about concordance. First, although the GAD and snake phobia groups were expected to show different levels of concordance, correlational analyses failed to reveal evidence for the presence of significant relationships between self-report and physiological variables for either of the groups. Nevertheless, the second planned approach to investigating concordance, logistic regression, revealed that the two groups were distinguishable based upon concordance of measures of emotion.

As expected, the GAD and snake phobic groups were equivalent in their physiological responses and self-reported emotionality during the emotionally-charged tasks of positive and negative imagery tasks. The results indicated that when faced with emotionally-arousing tasks, both physiological and self-report measures of emotionality were largely unable to differentiate between the members of the two anxiety groups. Thus, there was strong evidence for concordance of measures during imminent, emotional experiences.

The contrast between the presence of emotional cues versus the absence of emotional cues highlights that the GAD group was able to fully experience both positive and negative emotional imagery, at least to the degree that the snake phobics did. The imagery tasks aimed to create an imminent emotional experience, and both groups appeared to engage in the tasks as such. Therefore, although conceptual understanding and empirical work in GAD has emphasized the avoidance of emotional experience in GAD, the GAD group appeared unable to avoid the emotional experience while engaging in personalized imagery.

In contrast to the concordance observed during the positive and negative imagery tasks, discordance was present for the baseline and neutral imagery tasks. Although groups were similar in their physiological responses, the differences in self-reported levels of control indicated that the GAD group was characterized by discordance. The discordance between self-reported emotionality and physiological responses at baseline was not surprising, as it is consistent with previous findings of elevated self-reported negative emotionality with a relative lack of physiological activation in GAD at baseline (Yamasaki, 2000). The results of the present study are also consistent with the theoretical notion that individuals with GAD develop this behavioral pattern (self-reported emotionality without corresponding physiological response) as a result of social constraints: a fight or flight response is not socially acceptable, and the individual learns to inhibit physiological response over time (Riskind, 2005).

Conclusions about concordance. Investigation of self-reported and physiological emotional response in the present study provided important information regarding the elicitation of strong emotional response, with solid evidence that both GAD and specific phobia are capable of experiencing concordance between self-report and physiological responses. The differentiation of anxiety disorders was the main focus of the present study. However, one of the limitations of the study was the lack of inclusion of a non-anxious control group. Inclusion of a non-anxiety control group would provide a reference group and would serve to verify several conclusions from the results of the present study. For example, the conclusion that the group differences in level of control were due to heightened control in GAD rather than lowered level of control in snake phobia could be verified. The inclusion of a non-anxious control group would additionally serve to examine whether or not physiological responses in the anxiety groups were greater or less than a normal sample, providing a reference for understanding the similarities in the GAD and snake phobic groups' physiological responses.

An additional limitation of the present examination of concordance was related to the manipulation of the physiological responses. Ideally, the physiological responses would have differentiated between the positive, neutral and negative imagery tasks. However, as mentioned earlier, the effect size for differences between positive/negative imagery tasks and the neutral task were small for IBI. Furthermore, the tasks did not differ in MSD. This lack of difference between tasks was surprising, as it was expected that a task of neutral imagery would be less physiologically arousing than the highly-emotional imagery. The lack of task effect for MSD suggests that either the neutral task was not truly neutral in nature (e.g., participants were anxious about upcoming aspects of the experiment), or the participants were imagining a neutrally-valenced scenario with significant activity in the arousal dimension. Future work would benefit from differentiating between these two possibilities, as this has implications for understanding concordance. Furthermore, although it is unclear whether or not one of these explanations accounts for the minimal physiological effects based upon the present study, future experiments could benefit from exploration and identification of other physiological measures that are sensitive to the arousal and valence dimensions of emotionality.

As mentioned earlier, order effects may also have affected concordance results and should be explored further in future investigations. It is important to acknowledge, nevertheless, that the order may have actually served to weaken the findings in concordance, rather than to facilitate them. For example, electrodermal response is well-known to habituate over time, and habituation of these responses has even been studied as a method for understanding differences between anxiety disorders (Rabavilas, 1989). For this experiment, electrodermal responses at the end of the experimental session would be expected to be fewer in number than at the beginning. As negative imagery was expected to be associated with the greatest number of electrodermal responses, habituation would have worked against the hypotheses. Also, if positive imagery effects carried over to neutral imagery, they would have been likely to minimize anxiety for the neutral imagery and thus decrease the likelihood of finding discordance.

Finally, another limitation of the study of concordance was the difference between the timing of physiological measures versus self-report measures. Physiological measures were taken during the actual imagery task, whereas the self-report measures were taken immediately after the imagery task. Although participants were instructed to respond regarding their emotional experiences during the imagery, it would have been preferable to assess self-reported emotional response during the imagery, similar to recent investigations of emotion and physiological response which have utilized continuous self-report ratings (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005). Unfortunately, the highly comprehensive nature of the self-report measures in the present study prohibited administration of self-report measures during the imagery. Nevertheless, the differences in concordance found in the present experiment provide reason to narrow the focus of measures and suggest that insertion of a brief measure of control during imagery should be further investigated in future experiments.

Overall conclusions

In summary, the present study yielded many fruitful findings that provide both confirmation of existing research and suggestions for future research. In particular, the study clarified several methodological issues, including the importance of imminence in both concordance and memory research, and the potential for personalized imagery to elicit imminence. The results confirmed that imminent tasks elicit similar responses between individuals with a broad set of fears and individuals with a specific set of fears. As such, this similarity clarified that Lang's theory of emotional imagery does not hold in situations of imminent threat.

Although anxiety disorders do not appear to differ in the level of concordance when the source of fear is imminent in its presence, the results did confirm that the concordance differences are present between individuals with diffuse fears and individuals with a specific fear in resting or neutral conditions. Thus, it appears that when allowed to manifest fears or anxiety in their usual manner and consistent with anxiety disorder type (e.g., worry in GAD), Lang's continuum is useful in differentiating disorders.

The results of the present study also supported previous evidence that arousal at encoding is related memory, with the greatest facilitation present at moderate levels of arousal. Additionally, the lack of differences between groups in arousal level at encoding was consistent with the lack of differences between groups in memory performance, as measured by cued recall and recognition accuracy performance. In contrast to the lack of differences between groups in cued recall and recognition accuracy, the GAD and phobic groups were different in recognition reaction time. The GAD group showed slowed recognition reaction time in comparison to the phobic group. Multiple plausible explanations for this finding exist, which strongly suggested that the slowed reaction time in the GAD group was a behavioral manifestation of GAD symptomatology, rather than a result of actual memory impairment. Two possibilities include that worries depleted cognitive resources needed to perform the memory task or that the ambiguity of the recognition task contributed to difficulty making a decision.

The conceptual picture of GAD that is created by the results in emotionality and memory is one of the following: although GAD is characterized by avoidance and efforts to control internal experiences, emotionality is not fundamentally impaired or excessive in an individual with GAD. Likewise, memory of emotional experiences for an individual with GAD is neither impaired nor facilitated. When provided with a clear method for experiencing emotion, such as imagery, an individual with GAD will engage in both positive and negative emotion in a manner that is consistent with someone who has a focused source of fears, such as in snake phobia. However, when left to his/her own inclinations, the individual with GAD is characterized by a unique response set which differentiates the individual with GAD from an individual with fear that is limited to a specific object. Specifically, the individual with GAD may experience cognitive interference for emotional memory that results in slowed behavior. This slowing could be caused by his/her chronic worries or difficulty in decision-making in ambiguous situations. Furthermore, discordance of emotional response occurs in situations when there is a lack of emotional cues, with physiological responses that are consistent with specific phobia but elevated in self-reported level of state anxiety and an overestimation of control. This overestimation of control may be rooted in early experiences of lack of control and may be a rebound effect due to a general lack of ability to tolerate internal experiences.

Future directions. The results of the present study provided the groundwork for future directions in both research and clinical applications in the area of emotion in GAD. Future examination of emotionality in GAD could benefit from addressing the methodological limitations outlined in the above discussion, as well as further exploration of the area of control in GAD. For example, conditions in which either overestimation or underestimation of control are elicited in GAD should be further investigated, as Barlow's (2000) model suggests that chronic lack of perceived control is present in GAD, while the results of the present suggest otherwise. Regardless of the specific direction of research, the results of this study highlight the necessity of careful consideration of the measures employed to assess emotion and memory. The results also strongly argue for comprehensive measurement of emotion, as this type of approach can provide opportunity to bring together apparently discrepant existing research, such as the existing literature on memory in anxiety disorders.

In regard to clinical applications, the confirmation that control is an important area in understanding GAD provides further support for the necessity of incorporation of the issue of control into the treatment of GAD. The results of the present study provide information about GAD that could be adapted into current treatment. For example, within a cognitive-behavioral framework, provision of a rationale for treatment is a necessary component. As evidence suggests that individuals with GAD make attempts to exert control emotional experiences and overestimate the utility of worry (Roemer et al., 2005), the results suggesting slowed reaction time in present study could be incorporated into treatment as explanation of the negative consequences of chronic worry. Finally, the results of the present study could also be used to disconfirm beliefs of the dangers of internal experiences, as the therapist could use the results of the present study to provide evidence that GAD is not associated with impairment or excessive emotionality, but rather the coping mechanisms used.

These are just a few of the possible directions that might be taken from the present study. Clearly, much room exists for future development of the understanding of emotion and memory in GAD and other anxiety disorders. With continued effort to use a comprehensive measurement approach and refining of this approach, research can continue to inform clinical practice in the area of anxiety.

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FOOTNOTES

[1] Emotion is also separated into the "Approach-Withdrawal" dimension to reflect the finding that emotions can be separated by the degree to which they elicit approach and withdrawal behavior. As the present study will focus upon elicitation of happy and fearful situations, this will reflect both the approach/positive valence (happy) and withdrawal/negative valence (fear) continua, without the confound of approach-withdrawal behavior.

[2] Summary of participants: 73 participants were recruited for the study. Of those, 63 were recruited through group screening process and received course credit for participant. Ten were recruited through flyers and paid $15 for participation. The total number of exclusions from the original 73 participants was 14. List of excluded participants:

107: No SNAQ administered

112: SNAQ high (18) - comorbid

124: GAD-Q does not qualify

128: SNAQ high (19) - comorbid

130: PSWQ low (36)

509: Not engaged in task; laughing during fear imagery

510: Comorbid

521: Recruited through paid participation; comorbid

523: Recruited through paid participation; SNAQ score too low

524: Recruited through paid participation; SNAQ score too low

526: Recruited through paid participation; SNAQ score too low

528: Recruited through paid participation; SNAQ score too low

529: Recruited through paid participation; SNAQ score too low

531: SNAQ score too low

[3] BDI-II question #9 was removed due to complications in the protocol. Question #9 asks the respondent to rate their level of suidical thoughts or wishes, on the following scale: "0" "I don't have any thoughts of killing myself," "2" "I have thoughts of killing myself, but I would not carry them out.", and "3" "I would kill myself if I had the chance."

[4] Three participants in the snake phobia group were missing physiological data, due to excessive movement during the experiment (n = 1) and technical problems (n = 2). These data were replaced using mean substitution.

[5] Heart rate was dropped as a predictor because it is primarily the inverse of IBI, and IBI is considered the more accurate of the two measures.

APPENDIX A: Tables and Figures

TABLE 1. Experimental protocol

1. Complete initial questionnaires
2. Sit quietly (10 minutes)
3. Complete questionnaire packet
4. Imagine personalized positive imagery (3 minutes)
5. Complete questionnaire packet
6. Imagine standardized neutral imagery (3 minutes)
7. Complete questionnaire packet
8. Imagine personalized negative imagery (3 minutes)
9. Complete questionnaire packet
10. Relaxation (10 minutes)

TABLE 2. Baseline Discriminant Analysis

Measures	B	S.E.	Wald	df	Sig.	Exp(B)
BDI	-.986	.485	4.139	1	.042	.373
Anxiety	.138	.065	4.492	1	.34	1.148
Thoughts	.231	.148	2.449	1	.118	1.260
Tension	-.200	.104	3.790	1	.054	.819
Happiness	5.133	2.623	3.828	1	.050	169.468
Excitement	-1.527	.960	2.842	1	.092	.217
Control	-1.537	.805	3.643	1	.056	.215
Pos. adj.	-.371	.224	2.736	1	.098	.690
Neg. adj.	.109	.145	.566	1	.452	1.115
IBI	.008	.006	1.549	1	.213	1.008
MSD	.001	.001	1.243	1	.265	1.000
EDR	.131	.075	3.114	1	.078	1.141

Note. BDI, Happiness, Tension (trend) and control (trend) predicted group membership. Coefficients indicate the factor by which the likelihood of membership in the snake group increases with each increase in unit of the measure.

TABLE 3. Neutral imagery discriminant analysis

Measures	B	S.E.	Wald	df	Sig.	Exp(B)
BDI	-.222	.078	8.103	1	.004	.801
Anxiety	-.017	.052	.108	1	.743	.983
Thoughts	.036	.026	1.873	1	.171	1.036
Tension	-.044	.036	1.515	1	.218	.957
Happiness	.658	.413	2.537	1	.111	1.930
Excitement	-.020	.317	.004	1	.949	.980
Control	-.544	.246	4.876	1	.027	.580
Pos. adj.	-.034	.067	.263	1	.608	.966
Neg. adj.	.146	.185	.621	1	.431	1.157
IBI	-.002	.004	.171	1	.679	.998
MSD	.0001	.0001	.214	1	.643	1.00
EDR	.004	.040	.009	1	.926	1.004

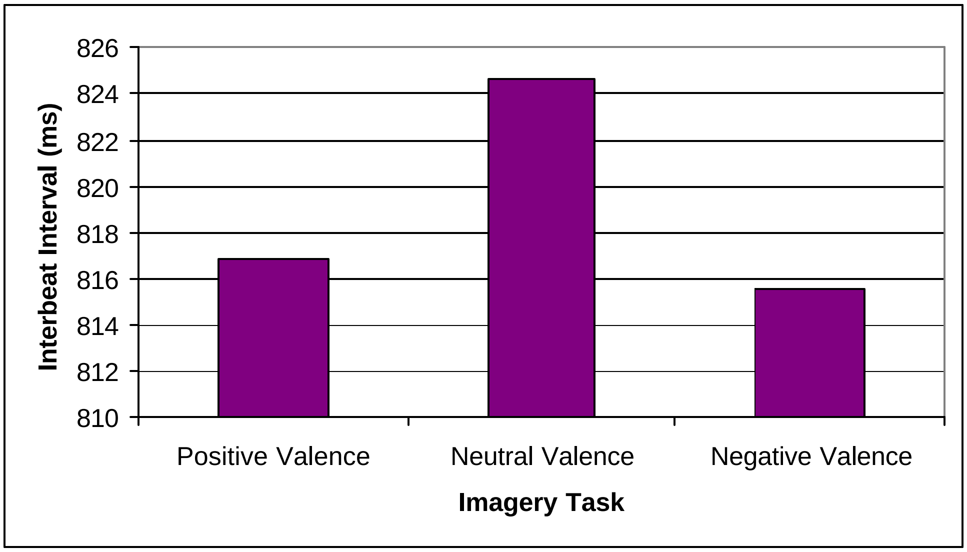
Note. Only ratings of control reliably predicted group status. Coefficient values indicate that each unit of increase in rating of control is associated with an increase in being GAD by a factor of .580.

TABLE 4. Correlations between self-reported arousal level and memory for negative imagery

Group	SUDs-Anxiety	SUDs-Thoughts	SUDs-Tension	SAM-Happiness	SAM-Excitement	SAM-Control	PANAS-Positive	PANAS-Negative
GAD								
Recall	-.36*	-.32	-.091	.34	-.052	.34	.26	-.25
Recog. ACC	-.16	-.053	.09	-.017	-.23	.13	-.11**	.28**
Recog. RT	-.41*	-.53**	-.47**	.56**	.19	.31	.20	-.55**
Snake phobic								
Recall	.20	.33$_b$	.18	-.22	-.25	-.35	.12	.42*
Recog ACC	.15	.26	.38*	-.48**	-.37*	.28	.38	.45
Recog RT	-.23	-.22	-.31	.31	.33	.12	-.35	-.58**

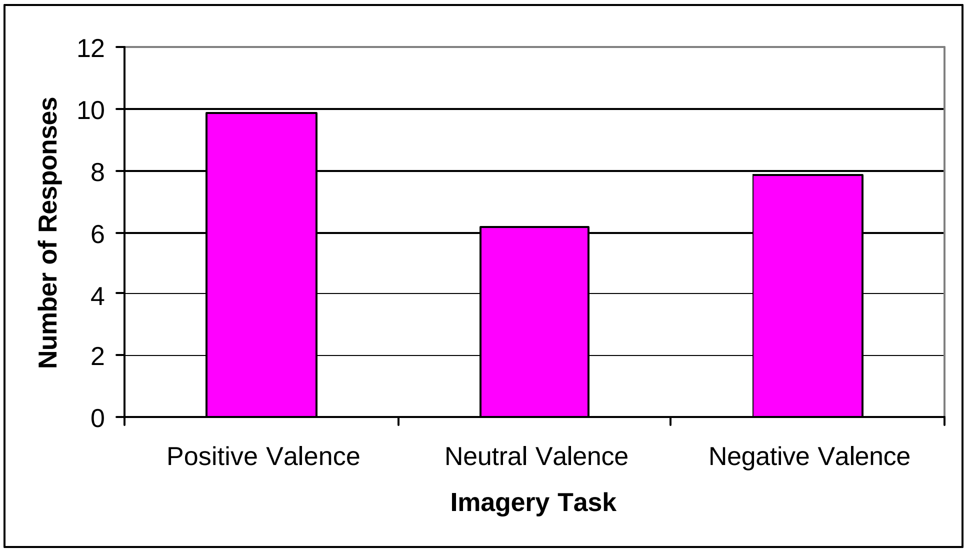
Note. “Recall” = cued recall, “Recog ACC” = recognition accuracy, “Recog RT” = recognition reaction time. Significant correlations are denoted * if $p < .05$, and ** if $p < .01$.

FIGURE 1. Interbeat Interval



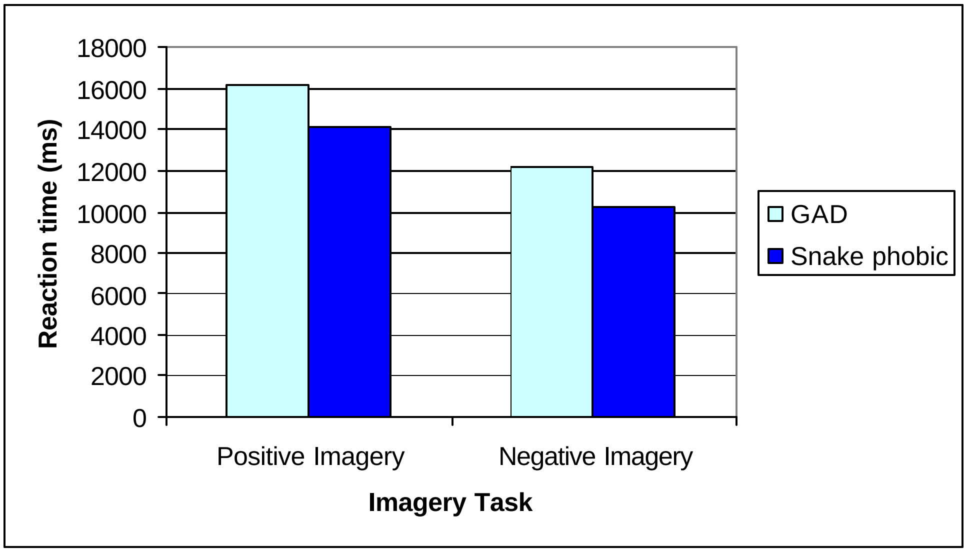
The effect for task was significant for IBI ($F(1, 58) = 4.35$, $p < .05$). Neutral imagery was significantly longer than negative and positive imagery.

FIGURE 2. Number of electrodermal responses



The effect for task was significant for electrodermal response ($F(1,58) = 6.42$, $p < .05$). Positive imagery was associated with greater number of electrodermal responses than neutral imagery. Negative imagery was associated with greater number of electrodermal responses than neutral imagery. Positive and negative imagery were not different.

FIGURE 3. Recognition memory: Reaction time



The effect for group was significant ($F(3,55) = 3.27$, $p < .05$). The GAD group showed slower overall reaction times than the snake phobic group. The negative imagery task was associated with significantly faster reaction time (ms) than the positive imagery task ($F(3,55) = 24.80$, $p < .001$).

FIGURE 4. Recognition reaction time and PANAS total negative adjective score: R-squared values for a linear relationship

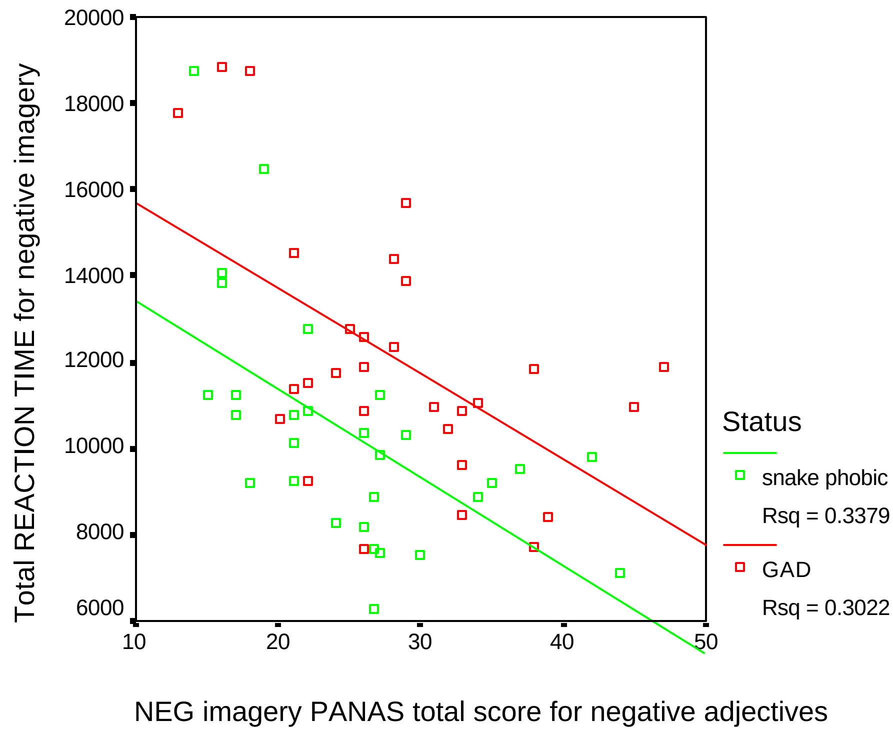


FIGURE 5. Recognition reaction time and PANAS total negative adjective score: R-squared values for a quadratic relationship

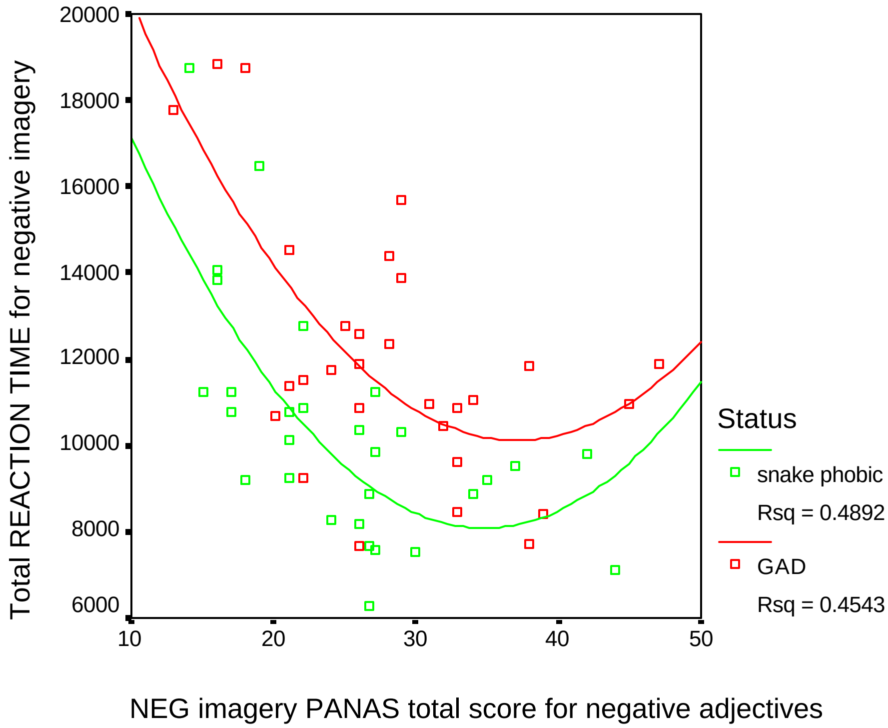
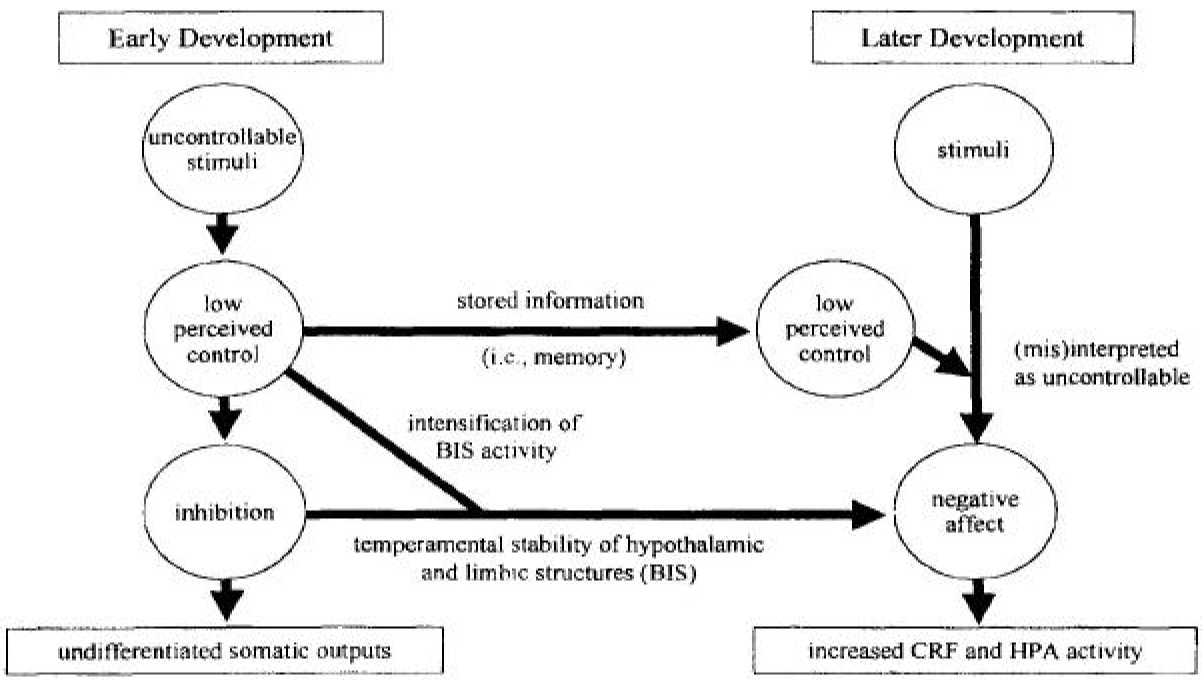


FIGURE 6. Developmental model of anxiety

Model of the Development of Vulnerability for Anxiety and Depression



Note. BIS = behavioral inhibition system; CRF = corticotropin releasing factor; HPA = hypothalamic pituitary adrenocortical. From "The Development of Anxiety: The Role of Control in the Early Environment," by B. F. Chorpita and D. H. Barlow, *Psychological Bulletin, 124*, p. 16. Copyright 1998 by the American Psychological Association. Adapted with permission of the authors.

APPENDIX B:

GAD-Q-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 <u>minor things</u> such as being late for an appointment, minor repairs, homework, etc.?…………	NO =	0	YES =	1

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

APPENDIX C:

SNAQ

Answer each of the following statements either True or False as you feel they generally apply to you. If the statement is true most of the time or mostly true for you, you should answer **true**. If it is mostly false or false most of the time, mark it **false**.

1. I avoid going to parks or on camping trips because there may be snakes about.
2. I would feel some anxiety holding a toy snake in my hand.
3. If a picture of a snake appears on the screen during a motion picture, I turn my head away.
4. I dislike looking at pictures of snakes in a magazine.
5. Although it may not be so, I think of snakes as slimy.
6. I enjoy watching snakes at the zoo.
7. I am terrified by the thought of touching a harmless snake.
8. If someone says that there are snakes anywhere about, I become alert and on edge.
9. I would not go swimming at the beach if snakes had ever been reported in the area.
10. I would feel uncomfortable wearing a snakeskin belt.
11. When I see a snake, I feel tense and restless.
12. I enjoy reading articles about snakes and other reptiles.
13. I feel sick when I see a snake.
14. Snakes are sometimes useful.

15. I shudder when I think of snakes.

16. I don't mind being near a non-poisonous snake if there is someone there in whom I have confidence.

17. Some snakes are very attractive to look at.

18. I don't believe anyone could hold a snake without some fear.

19. The way snakes move is repulsive.

20. It wouldn't bother me to touch a dead snake with a long stick.

21. If I came upon a snake in the woods I would probably run.

22. I'm more afraid of snakes than any other animal.

23. I would not want to travel "down south" or in tropical countries because of the greater prevalence of snakes.

24. I wouldn't take a course like biology if I thought I might have to dissect a snake.

25. I have no fear of non-poisonous snakes.

26. Not only am I afraid of snakes, but worms and most reptiles make me feel anxious.

27. Snakes are very graceful animals.

28. I think that I'm no more afraid of snakes than the average person.

29. I would prefer not to finish a story if something about snakes was introduced into the plot.

30. Even if I was late for a very important appointment, the thought of snakes would stop me from taking a shortcut through an open field.

APPENDIX D:

Positive imagery construction sheet

Instructions: Please complete the following items with a BRIEF phrase or sentence.

1. Please identify a past situation in which you felt extremely happy on the following lines: ____

   ____

2. Identify what you see in this situation.

   ____

   ____

3. Identify sensations of touch in this situation.

   ____

   ____

4. Identify what you smell in this situation.

   ____

   ____

5. Identify what you hear in this situation.

   ____

   ____

APPENDIX E:

Snake phobia imagery construction worksheet

Instructions: Please complete the following items with a BRIEF phrase or sentence.

1. Please identify a situation that would be one of your greatest fears involving a snake on the following lines: ____

   ____

2. Identify what you see in this situation.

   ____

   ____

3. Identify sensations of touch in this situation

   ____

   ____

4. Identify what you smell in this situation.

   ____

   ____

5. Identify what you hear in this situation.

   ____

   ____

APPENDIX F:

GAD imagery construction worksheet

3. Please identify a situation that is of your greatest current worry of an upcoming event on the following lines:____

____

4. Identify what you see in this situation.

____

____

5. Identify sensations of touch in this situation

____

____

6. Identify what you smell in this situation.

____

____

7. Identify what you hear in this situation.

____

____

APPENDIX G:

Affect and symptoms checklist taken from PANAS and ADIS-R, respectively

Select 5 adjectives from the list that describe your feelings in the situation you have identified. Rate the adjectives from 1 – 5, with "1" being the most prominent feeling and "5" being the least prominent.

___interested	___irritable
___distressed	___alert
___excited	___ashamed
___upset	___inspired
___strong	___nervous
___guilty	___determined
___scared	___attentive
___hostile	___jittery
___enthusiastic	___active
___proud	___afraid

Select 5 symptoms you would be likely to be experiencing in this situation. Rate them from 1 – 5, with "1" being the most prominent feeling and "5" being the least prominent.

___Racing heart	___Lightheaded
___Pounding heart	___Feeling as if things around you are unreal
___Sweating	___Feeling as if you are detached from yourself
___Shaking	___Feeling as if you are losing control
___Short of breath	___Feeling as if you are going crazy
___Choking	___Feeling as if you are dying
___Chest pain	___Numb
___Chest discomfort	___Tingling
___Nausea	___Chills
___Dizziness	___Hot flashes

APPENDIX H:

Standard Imagery Script

You are __(*ITEM #*1)__. You notice that you are feeling __(*PANAS #5*)__ and __(*PANAS #4*)___. As you look around, you see ___(*ITEM #2*)___. You smell __(*ITEM* #3)__. You feel __(*ITEM* #3)__. As you are noticing all of the sights, sounds, and smells you are experiencing, you notice that you are also feeling __(*PANAS #3*)__, __(*PANAS #2*)__ and __(*PANAS #1*)__. You notice that __(*SENSATION #5)*__, __(*SENSATION #4)*__, __(*SENSATION #3)*__. You also notice that you __(*SENSATION #2)*__ *and*__(*SENSATION #1)*__. For the next several minutes, please continue to imagine, as intensely and as vividly as possible, that you are __(*ITEM #1*)__.

APPENDIX I:

Example of a positive imagery script

You are standing on the stage waiting to receive your diploma. You notice that you are feeling alert and attentive. As you look around, you see other students around you. You hear other students talking happily. You smell fresh air of the outdoors. You feel that you are clasping your hands. Noticing all of the sights, sounds and smells, you feel proud, attentive and inspired. You notice that your heart is racing, and that your palms are sweaty. Your heart is pounding, you are short of breath, and shaking. For the next several minutes, please continue to imagine, as intensely and as vividly as possible, that you are standing on stage waiting to receive your diploma.

APPENDIX J:

Example of a GAD imagery script

You are sitting in the room for your exam. You notice that you are feeling alert and attentive. As you look around, you see other students around you. You hear other students shuffling their papers. You smell the stale air of the classroom. You feel that you are holding your notes in your hands. Noticing all of the sights, sounds and smells, you feel distressed, nervous and afraid. You notice that your heart is racing, and that your palms are sweaty. You are nauseous, short of breath, and lightheaded. For the next several minutes, please continue to imagine, as intensely and as vividly as possible, that you are sitting in the room for your exam.

APPENDIX K:

Example of a snake phobia imagery script

You are in a forest at night. You notice that you are feeling alert and attentive. As you look around, you see a snake among the plants. You hear slithering and leaves moving . You smell the damp leaves on the ground. You feel the flashlight in your hand. Noticing all of the sights, sounds and smells, you feel distressed, nervous and afraid. You notice that your heart is racing, and that you have chills. You are shaking, sweating, and feeling as if you are detached from yourself. For the next several minutes, please continue to imagine, as intensely and as vividly as possible, that you are in a forest at night.

APPENDIX L:

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 LINE in front of each item.

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

____1. If I don't have enough time to do everything, I don't worry about it.

____2. My worries overwhelm me.

____3. I 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.

APPENDIX M:

Positive and negative affective scale

Directions: This scale consists of a number of words that describe different feelings and emotions. Read each item and then circle the appropriate answer next to that word. Indicate to what extent you feel this way at the current moment.

Use the following scale to record your answers.

(1) = Very slightly or not at all (2) = A little (3) = Moderately (4) = Quite a bit (5) = Extremely

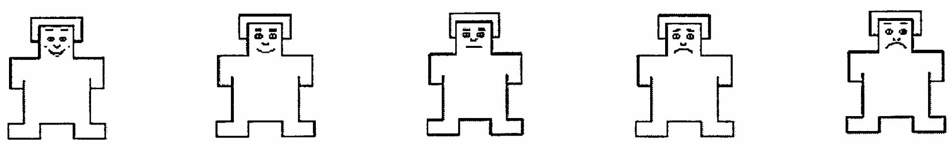
	Very slightly or not at all	**A little**	**Moderately**	**Quite a bit**	**Extremely**
1. Interested	1	2	3	4	5
2. Distressed	1	2	3	4	5
3. Excited	1	2	3	4	5
4. Upset	1	2	3	4	5
5. Strong	1	2	3	4	5
6. Guilty	1	2	3	4	5
7. Scared	1	2	3	4	5
8. Hostile	1	2	3	4	5
9. Enthusiastic	1	2	3	4	5
10. Proud	1	2	3	4	5
11. Irritable	1	2	3	4	5
12. Alert	1	2	3	4	5
13. Ashamed	1	2	3	4	5
14. Inspired	1	2	3	4	5
15. Nervous	1	2	3	4	5
16. Determined	1	2	3	4	5
17. Attentive	1	2	3	4	5
18. Jittery	1	2	3	4	5
19. Active	1	2	3	4	5
20. Afraid	1	2	3	4	5

APPENDIX N:

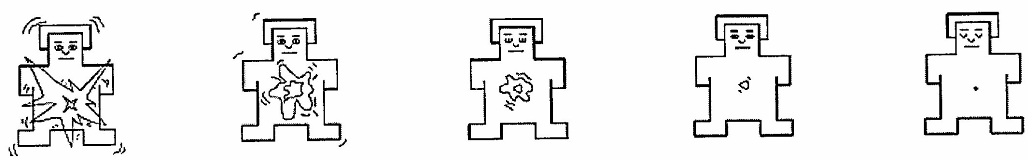
Self-assessment manikin

Please mark an "X" on the figure that best describes how you are currently feeling on each of the 3 scales. Remember, you may place an "X" either directly on top of one of the SAMs or between two of the SAMs.

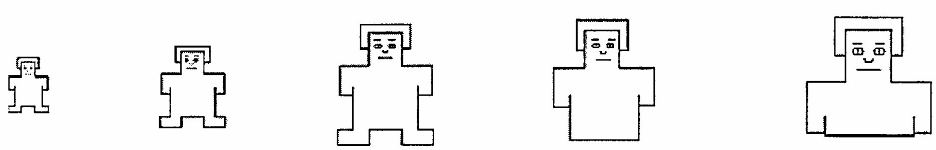
1. Happy-Unhappy



2. Excited-Calm



3. Controlled-In control



APPENDIX O:

Beck Depression Inventory – II

(modified to exclude question regarding suicidality)

This questionnaire consists of 20 groups of statements. Please read each group of statements carefully, and then pick out the ONE STATEMENT in each group that bests describes the way you have been feeling during the PAST TWO WEEKS, INCLUDING TODAY. Mark the number beside the statement you have picked. If several statements in the group seem to apply equally well, mark the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in sleeping patter) or Item 18 (Changes in Appetite).

1. Sadness

0 I do not feel sad.
1 I feel sad much of the time.
2 I am sad all the time
3 I am so sad or unhappy that I can't stand it

2. Pessimism

0 I am not discouraged about my future.
1 I feel more discouraged about my future than I used to be.
2 I do not expect things to work out for me.
3 I feel that my future is hopeless and will only get worse.

3. Past Failure

0 I do not feel like a failure.
1 I have failed more I should have.
2 As I look back, I see a lot of failures.
3 I feel I am a total failure as a person.

4. Loss of Pleasure

0 I get as much pleasure as I ever did from the things I enjoy.
1 I don't enjoy things as much as I used to.
2 I get very little pleasure from the things I used to enjoy.
3 I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings

0 I don't feel particularly guilty.
1 I feel guilty over many things I have done or should have done.
2 I feel quite guilty most of the time.

3 I feel guilty all of the time.

6. Punishment Feelings

0 I don't feel I am being punished.
1 I feel I may be punished.
2 I expect to be punished.
3 I feel I am being punished.

7. Self-Dislike

0 I feel the same about myself as ever.
1 I have lost confidence in myself.
2 I am disappointed in myself.
3 I dislike myself.

8. Self-Criticalness

0 I don't criticize or blame myself more than usual.
1 I am more critical of myself than I used to be.
2 I criticize myself for all of my faults.
3 I blame myself for everything bad that happens

9. Crying

0 I don't cry any more than I used to.
1 I cry more than I used to
2 I cry over every little thing.
3 I feel like crying, but I can't.

10. Agitation

0 I am no more restless or wound up than usual.
1 I feel more restless or wound up than usual.
2 I am so restless or agitated that it's hard to stay still.
3 I am so restles or agitated that I have to
keep moving or doing something.

11. Loss of Interest.

0 I have not lost interest in other people or activities
1 I am less interested in other people or things than before.
2 I have lost most of my interest in other people or things
3 It's hard to get interested in anything.

12. Indecisiveness

0 I make decisions about as well as ever.
1 I find it more difficult to make decisions than usual.
2 I have much greater difficulty in making decisions

than I used to.
3 I have trouble making any decisions.

13. Worthlessness
0 I don't feel I am worthless.
1 I do not consider myself as worthwhile and useful as I used to.
2 I feel more worthless as compared to other people.
3 I feel utterly worthless.

14. Loss of Energy
0 I have as much energy as ever.
1 I have less energy than I used to have.
2 I don't have enough energy to do very much.
3 I don't have enough energy to do anything.

15. Changes in Sleeping Pattern
0 I have not experienced any change in my sleeping pattern.
1 Either I sleep somewhat more OR less than usual.
2 Either I sleep a lot more OR less than usual.
3 Either I sleep most of the day OR wake up 1-2 hours early and can't get back to sleep.

16. Irritability
0 I am no more irritable than usual.
1 I am more irritable than usual.
2 I am much more irritable than usual.
3 I am irritable all the time.

17. Changes in Appetite.
0 I have not experienced any change in my appetite
1 Either my appetite is somewhat less OR greater than usual.
2 Either my appetite is much less OR greater than usual.
3 Either I have no appetite at all OR crave food all the time.

18. Concentration Difficulty
0 I can concentrate as well as ever.
1 I can't concentrate as well as usual.
2 It's hard to keep my mind on anything for very long.
3 I find I can't concentrate on anything.

19. Tiredness or Fatigue

0 I am no more tired or fatigued than usual.
1 I get more tired or fatigued more easily than usual.
2 I am too tired or fatigued to do a lot of the things I used to do.
3 I am too tired or fatigued to do most of the things I used to do.

20. Loss of interest in Sex

0 I have not noticed any recent change in my interest in sex.
1 I am less interested in sex than I used to be.
2 I am much less interested in sex now.
3 I have lost interest in sex completely.

APPENDIX P:

Subjective Units of Distress ratings

On a scale of 0 – 100, with “0” representing the state of being absolutely calm and “100” representing the worst anxiety that you can imagine, how would you rate yourself at this moment? Circle your response below.

On a scale of 0 – 100: _________

On a scale of 0 – 100, with “0” representing the state of having a blank mind and “100” representing having an excessive amount of thoughts that you can imagine, how would you rate yourself at this moment? Circle your response below.

On a scale of 0 – 100: _________

On a scale of 0 – 100, with “0” representing the state of being absolutely no muscle tension or bodily arousal and “100” representing the worst muscle tension or bodily arousal that you can imagine, how would you rate yourself at this moment?

On a scale of 0 – 100: _________

APPENDIX Q:

Neutral imagery script

Please close your eyes. Now, imagine that you are sitting in a lawn chair, looking out onto the yard. You are noticing all of the sights, sounds, and smells around you. You notice that the lawn is green and you can smell the freshly cut grass. Your arms are resting on the arms of the lawn chair, while you listen to the sounds of others who are also outside in yard. For the next several minutes, please continue to imagine, as intensely and as vividly as possible, that you are sitting in a lawn chair, looking out onto the yard.

APPENDIX R:

Vividness of imagery rating scale

Please rate the level of vividness of your imagery on a scale of 1 – 5, with “1” being little or no vividness and “5” being extremely vivid as if you were living the imagined experience.

On a scale of 1 – 5: _________

APPENDIX S:

Cued recall task

At the first session, you imagined 3 scenarios. Before engaging in imagery of each of the scenarios, you heard the scenario described over the intercom. As accurately as possible, using the same words that you heard, please write down the words describing the _____________ scenario on the lines below:

Please do the same with the lawn scenario.

Please do the same with the__________ scenario.

ALISSA S. YAMASAKI
Curriculum Vitae

EDUCATION

Ph.D. in Psychology (Clinical), The Pennsylvania State University 2002-2006

Dissertation topic: The concordance between self-reported and physiological measures of emotion during fear imagery in anxiety disorders

M.S. in Psychology (Clinical), The Pennsylvania State University 1999-2002

B.S. in Psychology, B.S. in Kinesiology, University of Illinois at Urbana 1994-1998

RESEARCH FOCUS AND CLINICAL INTERESTS

Research focus is in the psychophysiology of emotion and anxiety, with an emphasis on generalized anxiety disorder (GAD). Clinical focus is in the treatment of chronic mental illness in adults with an integration of psychodynamic and cognitive-behavioral orientations.

REPRESENTATIVE RESEARCH

Schut, A.J., Castonguay, L.G., Bedics, J.D., Smith, T.L., Barber, J.P., Flanagan, K.M., & Yamasaki, A.S. (accepted for publication). Therapist interpretation, patient-therapist interpersonal process, and outcome in psychodynamic psychotherapy for avoidant personality disorder. *Psychotherapy*

Bowes, J.D., Yamasaki, A.S., & Ray, W.J. (2005, November). *A Comparison of Meditation and Relaxation Effects on GAD*. Poster presented at the annual meeting of the Association for the Advancement of Behavior Therapy, Washington DC.

Yamasaki, A.S., Behar, E., Borkovec, T.D., & Ray, W.J. (2004, November). Parasympathetic and sympathetic nervous system activity as an index of emotional processing following imaginal exposure in GAD. In, S. Hayes (Chair), *New Advances in Emotional Processing and Exposure-based Treatments*. Symposium presented at the annual meeting at the Association for the Advancement of Behavior Therapy, New Orleans, LA.

Behar, E., Yamasaki, A.S., Borkovec, T.D., & Ray, W.J. (2003, November). Physiological processing of emotional material following imaginal exposure for GAD. In, E. Behar and A. Przeworski (Chairs), *An Examination of Moderating Variables, Mediating Variables, and Therapeutic Techniques in the Treatment of GAD.* Symposium presented at annual meeting at the Association for the Advancement of Behavior Therapy, Boston, MA.

Yamasaki, A.S., Behar, E., & Ray, W.J. (2002, November). Is there a Processing Bias Toward General Emotionality, Regardless of Valence in Generalized Anxiety Disorder? In, M.G. Newman (Chair), *Emotion, Emotional Expression, and Emotional Processing in GAD*. Symposium presented at the meeting of the Association for the Advancement of Behavior Therapy, Reno, NV.

REPRESENTATIVE CLINICAL EXPERIENCE

Pre-doctoral Intern, *Albany Medical Consortium* 2005 – 2006

Conducted psychotherapy treatment/assessment at the Capital District Psychiatric Center, Stratton VA Medical Center and Albany Medical Center inpatient unit

Staff Therapist, *Pennsylvania State University Psychological Clinic* 2000 – 2005

Completed over 800 hours of direct client contact in a community mental health setting and supervised beginning graduate students