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IMAGINAL EXPOSURE FOR CHRONIC WORRY: THE ROLE OF ANXIOUS AROUSAL
AND IMAGINAL SENSORY INFORMATION

by

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ABSTRACT

This study examined the effect of exposure script references to anxious physiological sensations and the five senses upon anxious arousal during a single 30-minute imaginal exposure. Forty-five high worriers were randomized to two conditions: Comprehensive (all reference types included) or Limited (only visual and auditory references included). Anxious arousal was measured via heart rate (HR), skin conductance level (SCL) and self-report. Both conditions exhibited increased arousal patterns from baseline. SCL did not significantly decrease in either condition during exposure. For self-reported anxiety, Comprehensive participants exhibited significant decreases throughout exposure; but Limited participants demonstrated significant *increases*. Comprehensive participants reported significantly greater anticipated ability to cope after exposure. Results are discussed in the context of emotional processing theory.

Keywords: generalized anxiety disorder; worry; imaginal exposure; vividness; autonomic arousal; heart rate; skin conductance

Table of Contents

Introduction	The Nature of Worry, Psychological Treatments for GAD, and Imaginal Exposure	1
	Previous Imaginal Exposure Research	3
	Theoretical Considerations in Imaginal Exposure	6
	Imaginal Exposure and Imaginative Ability	10
	Objectives of the Current Study and Hypotheses	14
	Research Importance	17
Method	Participants	18
	Materials	21
	Procedure	25
Results	Data Screening and Missing Value Analysis	29
	Scale Reliability, Diagnostic Status, and Effectiveness of Random Assignment	32
	Manipulation Check and Exposure Script Data Integrity	38
	Differences in Skin Conductance Level between Conditions	44
	Differences in Heart Rate between Conditions	51
	Differences in Self-Reported Anxious Arousal between Conditions	54
	Postexposure Differences in Self-Reported Momentary Worry between Conditions	61

Table of Contents (continued)

Results	Individual Differences in Imaginative Vividness and Anxious Arousal	63
	Absorption, Anxious Arousal, and Individual Differences in Imaginative Vividness	65
	Individual Differences in Imaginative Vividness and Self-Reported Peak Vividness	66
	Differences in Self-Reported Vividness between Conditions	67
Discussion	Brief Summary and Interpretation of Findings	70
	Limitations	80
	Future Directions	82
	Conclusion	83
Appendices		85
References		92

List of Tables

Table 1.	Diagnostic Status Frequency According to Condition	33
Table 2.	Questionnaire Mean Differences According to Condition	35
Table 3.	QMI Subscale Mean Differences According to Condition	36
Table 4.	Categorical Variable Differences According to Condition	37
Table 5.	Correlations (Significance) According to Condition between Individual Difference Measures of Imaginative Vividness and Peak Anxious Arousal during Exposure	64

List of Figures

Figure 1.	Mean Skin Conductance Level by Condition from Baseline to First Exposure Measurement	46
Figure 2.	Adjusted Mean Skin Conductance Level by Condition during 30-Minute Exposure	50
Figure 3.	Mean Heart Rate by Condition from Baseline to First Exposure Measurement	53
Figure 4.	Mean SAM Arousal Ratings by Condition from Baseline to First Exposure Measurement	56
Figure 5.	Adjusted Mean SAM Arousal Ratings by Condition during 30-Minute Exposure	60
Figure 6.	Mean Vividness Ratings by Condition during 30-Minute Exposure	69

List of Appendices

Appendix A.	Exposure Scenario Construction Protocol: Comprehensive Condition	85
Appendix B.	Exposure Scenario Construction Protocol: Limited Condition	87
Appendix C.	Prompts for Exposure Scenario Editing: Comprehensive Condition	89
Appendix D.	Prompts for Exposure Scenario Editing: Limited Condition	91

Imaginal Exposure for Chronic Worry: The Role of Anxious Arousal and Imaginal Sensory Information

According to the Diagnostic and Statistical Manual of Mental Disorders (fourth edition, text revision; *DSM-IV-TR*; American Psychiatric Association, 2000), generalized anxiety disorder (GAD) is characterized primarily by excessive, chronic worry that is difficult to control. Research into the nature of worry has demonstrated that worry is characterized by future-oriented cognition regarding feared negative outcomes that consists primarily of negative verbal/linguistic material (Borkovec, Alcaine, & Behar, 2004). Although verbal/linguistic material of this nature has not typically been shown to elicit physiological arousal (Borkovec, et al., 2004), fearful mental imagery has been shown to cause a marked increase in physiological arousal (Vrana, Cuthbert, & Lang, 1989), and this has led some theorists to conclude that worry may serve as a strategy to avoid or suppress threatening mental imagery and the resulting anxiety-based physiological arousal (Borkovec, et al., 2004). If this assertion is correct, then the avoidance of threatening mental imagery through worry might be conceptualized as a maintaining factor in GAD. As such, worry could then be targeted for change during treatment by prolonged and repeated exposure in one's imagination to these avoided anxiety-provoking mental images (imaginal exposure) to facilitate more complete processing of the images, thereby reducing the need for worry cognition post-emptively (Borkovec, et al., 2004).

Psychological Treatments for GAD

Cognitive behavioural therapy (CBT), delivered in group or individual format has consistently demonstrated posttreatment results superior to waitlist or treatment as usual, across a number of randomized controlled trials, in the treatment of GAD (Hunot, Churchill, Teixeira, & Silva de Lima, 2007; Covin, Ouimet, Seeds, & Dozois, 2008). There is also evidence supporting

positive long-term treatment outcomes (up to 24 months posttreatment) for GAD treated with CBT in both individual and group formats (Dugas et al., 2003).

A typical CBT treatment package for GAD consists of several components. For instance, Dugas and Robichaud (2007) include six components in their CBT treatment package for GAD: 1) psychoeducation and worry awareness training, 2) uncertainty recognition and behavioural exposure, 3) re-evaluation of the usefulness of worry, 4) problem-solving training, 5) imaginal exposure, and 6) relapse prevention.

Another commonly used CBT treatment package for GAD (Borkovec & Costello, 1993) consists of: 1) applied relaxation, 2) self-control desensitization, and 3) brief cognitive therapy. Applied relaxation consists of teaching clients to notice early cues of worry and anxiety and to apply relaxation techniques (e.g., progressive relaxation, diaphragmatic breathing) as soon as anxiety is detected. Self-control desensitization consists of imaginal exposure to threatening future-oriented situations. This includes the mental rehearsal of coping methods within the imagined scenario to facilitate quicker acquisition of more adaptive coping strategies as well as fuller processing of threatening mental imagery. Finally, brief cognitive therapy is used to challenge maladaptive beliefs that maintain worry and anxiety (Borkovec & Costello, 1993).

Imaginal Exposure for GAD and Worry

Imaginal exposure, a component that is common to both of the aforementioned CBT treatment packages (Dugas & Robichaud, 2007; Borkovec & Costello, 1993), involves exposure to one's worst fear (an exaggerated and typically future-oriented concern) by repeatedly evoking a vivid and concrete mental image of one's worst fear as if it were occurring in the present. In practice, clients are commonly instructed to write a script in the present-tense and from the first-person point of view that describes in great detail what it would be like for the client's worst fear

to come true in real life. The client is usually also instructed to include a rich array of relevant information from the five senses (i.e., not just visual information, but also relevant sounds, smells, etc.) as well as one's own anxiety-based physiological reactions (e.g., sweaty palms, tachycardia, etc.). The inclusion of a full array of sensory and physiological information is believed to enhance the vividness and concreteness of the scenario pictured in the mind's eye of the client during imaginal exposure. Although imaginal exposure is a component of CBT for GAD, there have been few empirical investigations of the core assumptions that underlie the procedure commonly used in clinical practice. These core assumptions include: 1) repeated exposure to threatening mental imagery of one's worst fear (i.e., imaginal exposure) leads to reductions in anxiety and worry, 2) imaginal exposure leads to cognitive change, and 3) imaginal exposure is most effective when the exposure scenario is rich in sensory and affective information and not simply a "picture in the mind's eye."

Previous Imaginal Exposure Research

Provencher, Dugas, and Ladouceur (2004) tested the individual components of problem-solving training and imaginal exposure taken from the CBT treatment package for GAD described by Dugas and Robichaud (2007). Participants ($N = 18$) with a principal diagnosis of GAD were assigned to receive twelve 1-hour sessions of either problem-solving training or imaginal exposure. Those whose primary worry content consisted of realistic concerns were assigned to the problem-solving training condition ($n = 8$) and those whose primary worries were largely hypothetical and unlikely to occur were assigned to the imaginal exposure condition ($n = 10$). Both groups demonstrated statistically and clinically significant posttreatment change (defined as no longer meeting ADIS-IV [Di Nardo, Brown, & Barlow, 1994] diagnostic criteria for GAD as well as presenting scores below clinical cutoffs for at least three of the four anxiety

and worry measures), and these gains were maintained at 6-month follow-up. A total of 15 participants completed the entire treatment protocol and 12 of these participants were available at 6-month follow-up (Provencher, et al., 2004). Although the sample size is small, this study provides preliminary evidence for the efficacy of the individual treatment components of problem-solving training (for realistic concerns) and imaginal exposure (for exaggerated concerns) derived from a popular CBT protocol for the treatment of GAD (Dugas & Robichaud, 2007).

Goldman, Dugas, Sexton, and Gervais (2007) have more recently explored the efficacy of a written exposure procedure for reducing worry in a nonclinical sample of high worriers (determined via self-report questionnaires). Imaginal exposure scripts recorded to a media device (e.g., loop tape, mp3 player) rely on technology and do not change over time (i.e., the details of the recorded script do not change upon repeated listening). The researchers hypothesized that repeated written exposure may lead to superior generalization of the exposure procedure to real life (as compared to a static, prerecorded imaginal exposure scenario that is played repeatedly) if clients were allowed to explore new aspects of the worry scenario at each subsequent session (i.e., write a slightly different version of the exposure scenario each time). Participants were asked to engage in daily writing for a period of 30 minutes over five days. Those in the written exposure condition were asked to write about what it would be like if their worst worry were to come true in real life and to include as much detail as possible (including physical sensations, relevant information from the five senses, reactions, etc.). Participants in the control condition were asked to follow the same procedure except they were asked to write about their reaction if they had learned that they had been given the day off at work. Results demonstrated significant reductions in worry and GAD somatic symptoms in the written

exposure condition. However, significant reductions occurred only in GAD somatic symptoms in the control condition. Although the observed reduction in somatic symptoms in the control group was an unexpected finding, significant reduction in worry was only observed in the experimental condition and this provides preliminary evidence for the efficacy of written exposure for worry reduction.

Imaginal exposure is often included in CBT treatment packages for a number of other anxiety disorders. The largest body of imaginal exposure research is contained within the Posttraumatic Stress Disorder (PTSD) literature. There is a sufficiently large body of research supporting the efficacy of CBT treatment for PTSD, and such protocols commonly include cognitive restructuring combined with imaginal and/or in vivo exposure (Solomon & Johnson, 2002).

Tarrier et al. (1999) compared imaginal exposure with cognitive restructuring in the treatment of PTSD and found that both treatments yielded significant improvements. A later study (Tarrier & Sommerfield, 2004) examined the same sample at five-year follow-up and found that more participants in the imaginal exposure condition (29%) still met criteria for PTSD than those in the cognitive restructuring condition (0%).

To a lesser degree, imaginal exposure has been studied in the treatment of other anxiety disorders. In the treatment of obsessive-compulsive disorder, the combination of imaginal and in vivo exposure has been found to be more effective in reducing anxiety than in vivo exposure alone (Abramowitz, 1996). Rentz, Powers, Smits, Cougle, and Telch (2003) compared two variations of imaginal exposure with in vivo exposure in the treatment of dog phobia and found that all three conditions yielded significant improvements with no statistically significant differences between conditions. Imaginal exposure has also been included in at least one CBT-

oriented treatment package for social anxiety disorder that has demonstrated treatment efficacy (Turner, Beidel, Cooley, Woody, & Messer, 1994).

Theoretical Considerations in Imaginal Exposure

According to well-established theory in the exposure literature, emotional processing must occur in order to counteract pathological fear (in this case, chronic worry). This theory of emotional processing (Foa & Kozak, 1986) posits that pathological fear structures (the association between feared stimuli, one's reaction to the stimuli, and the meaning derived therein) must be activated by confrontation of the feared stimuli in the context of a situation in which new, nonpathological associations may be learned (i.e., the therapeutic setting). More recent research has demonstrated that in exposure therapy, a new kind of learning takes place that does not replace old associations, but competes with older fear structures for activation. These findings have led theorists to conclude that experiences that more closely match one's feared scenario are likely to produce greater activation of one's fear structures and provide greater opportunity for new learning (Foa, Huppert, & Cahill, 2006).

In keeping with the theory of emotional processing, one might expect that confrontation of feared stimuli would result in physiological arousal and that this arousal may abate as new learning takes place. That is, one might expect that successful exposure would be marked by a marked increase of anxious arousal at the beginning of the exposure (signifying that the stimuli is indeed fear provoking) and a gradual decrease in arousal as new learning occurs (signifying that the individual is less afraid of the stimuli as a result of new learning that has occurred). This pattern of arousal has been demonstrated across a number of studies concerning exposure therapy for a variety of anxiety disorders. Antony, McCabe, Leeuw, Sano, and Swinson (2001) observed this pattern of arousal in heart rate (HR) measured during in vivo exposure with

individuals with a specific phobia of spiders. Behavioural approach tests (BATs) conducted before and after exposure confirmed a significant elevation of anxious arousal (in both HR and subjective units of distress) from baseline and a significant reduction in arousal after exposure. Individuals were also able to move significantly closer to the spider after exposure. These results indicate that new learning had taken place.

A similar pattern of arousal was observed with skin conductance level (SCL) and self-reported anxious arousal in a study of virtual reality exposure for specific phobia of flying (Mühlberger, Herrmann, Wiedemann, Ellgring, & Pauli, 2001), although significant changes in HR were only observed across multiple exposures rather than within each exposure. A pattern of increased HR from baseline has also been observed in a study of written disclosure for students with symptoms of posttraumatic stress (Sloan, Marx, Epstein, and Lexington, 2007), although this study only examined mean HR change from baseline throughout three 20-minute exposures. Sloan's research group also reported the same pattern of HR change from baseline in an earlier study of written disclosure in which undergraduates wrote about their most distressing experiences using the same procedure (Epstein, Sloan, & Marx, 2005).

Although there is considerable previous research affirming the significant association between physiological anxious arousal and fearful mental imagery (typically in the context of the earlier technique of systematic desensitization to phobic stimuli; Mathews, 1971), there is little (if any) research that directly examines the pattern of physiological arousal during prolonged imaginal exposure to fearful images associated with chronic worry. The closest approximation is a recent study that investigated physiological arousal with individuals with Panic Disorder (PD) during a number of different tasks including brief imaginal exposure (four minutes) to the most anxiety provoking item on his or her exposure hierarchy (Bystritsky, Maidenberg, Craske,

Vapnik, & Shapiro, 2000). Control participants imagined the most anxiety provoking event that had occurred in their lives during imaginal exposure. The purpose of the study was to investigate the theory that autonomic dysfunction is one of the mechanisms of PD and that individuals with PD display unusually high autonomic reactivity. A number of standard tests of autonomic reactivity (e.g., hyperventilation, aerobic exercise) were also conducted in order to allow for comparison of the degree of psychophysiological arousal between these tasks and imaginal exposure.

Both PD participants and control participants demonstrated a pattern of increased arousal from baseline during imaginal exposure (Bystritsky et. al, 2000). Self-reported anxiety was significantly greater for the PD group during imaginal exposure as was systolic blood pressure. Although the PD group was higher than the control group in heart rate and skin conductance, these differences were not statistically significant. However, other autonomic tests were completed consecutively *before* the imaginal exposure including hyperventilation, squeezing hand grip apparatus, mental arithmetic, and knee bends. No attempt was made to counterbalance the order of these tasks and so order and carryover effects cannot be ruled out. The imaginal exposure portion of the procedure was also extremely brief (and was likely intended more as an assessment of autonomic reactivity than a treatment, *per se*) and was carried out with a group of individuals with a markedly different diagnosis than GAD. It is also uncertain whether any reduction in physiological arousal was observed throughout the brief imaginal exposure as these data were not reported (Bystritsky et. al, 2000). Nonetheless, this study indicates that an increase in physiological arousal from baseline is likely to occur during imaginal exposure. This tentative conclusion is further supported by the data from the aforementioned studies that demonstrated

physiological arousal increases from baseline and either within or between exposure session decreases in physiological arousal.

Although studies typically demonstrate that in vivo exposure is superior to imaginal exposure in eliciting fearful responding across a number of anxiety disorders (e.g., Armfield, 2008), this is almost always not an option in the treatment of GAD. Worries are often hypothetical scenarios that the individual fears may come true in real life. Therefore, in vivo exposure may be impractical or impossible to conduct precisely because the feared scenario has not occurred and may never occur in real life. In vivo exposure for other anxiety disorders typically involves confronting concrete and easily accessible objects and situations in real life and learning that one can cope more effectively in these situations than previously believed. In contrast, imaginal exposure allows exposure to the feared images associated with less concrete and accessible future-oriented worries, and their potential consequences, in a controlled and prolonged manner (Dugas & Robichaud, 2007).

Since in vivo exposure is not always possible, practical, or relevant, it seems important to determine what factors may render imaginal exposure more or less effective. Certainly, for imaginal exposure to be effective, it seems reasonable to assume that the exposure script should be as concrete and vivid as possible. As such, imaginal exposure protocols typically instruct clients to include as much information from the five senses as possible (i.e., relevant sounds, smells, etc.) including their own expected physiological reactions to the scenario if it were to occur in real life (e.g., Dugas & Robichaud, 2007). However, it is uncertain whether the inclusion of anxiety-based physiological reactions (e.g., nausea, tachycardia) and sensory information beyond the visual and auditory domains (e.g., relevant smells, tastes, etc.) yields a more effective imaginal exposure scenario. Presumably, anxious arousal (measured both

objectively and by self-report) should be greater within an imaginal exposure session, when these are included, if the inclusion of such information does indeed create a more vivid and concrete script. However, this has never been formally tested in any of the anxiety disorders (although the literature has demonstrated both physiological and subjective anxious arousal in reaction to imaginal exposure; e.g., Bystritsky, et. al, 2000; Vrana, Cuthbert, & Lang, 1989). Nonetheless, when considered in the context of Foa and Kozak's (1986) model, it seems likely that the incorporation of more complete sensory information and references to one's physiological anxious arousal into an imaginal exposure script may activate fear structures more completely and provide greater opportunity for learning new associations.

Imaginal Exposure and Imaginative Ability

At the level of individual differences, it seems likely that one's imaginative abilities would also be a significant determining factor in the amount of anxiety-based arousal elicited by imaginal exposure. If one is unable to conjure a particularly vivid and concrete scenario in one's mind, it seems unlikely that imaginal exposure would yield much in the way of anxiety-based arousal. Conversely, an individual with an extremely vivid imagination would have less difficulty conjuring a concrete and vivid scenario and might be expected to experience a great degree of anxiety-based arousal during imaginal exposure.

Two commonly utilized measures of imagination vividness are the *Vividness of Visual Imagery Questionnaire* (VVIQ; Marks, 1973) and the shortened form of the *Betts' Questionnaire upon Mental Imagery* (QMI; Sheehan, 1967). The VVIQ assesses only visual imagination vividness, whereas the QMI measures imaginative abilities across several modalities (visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, and organic; Sheehan, 1967). These questionnaires have been utilized in previous in vivo exposure research. For example, Mohlman

and Zinbarg (2000) used the VVIQ to verify successful randomization with respect to imaginative vividness (i.e. that no significant between group differences existed in mean imaginative vividness). During in vivo exposure, participants were also asked to mentally picture the most prototypical version of their feared stimulus (in this case, the most prototypically fear-invoking spider one could mentally picture) or a neutral stimulus (a plant) while maintaining visual focus on either a neutral stimulus (a real plant) or the phobic stimulus (a live spider). This addition to the in vivo exposure protocol was intended to elucidate the role of cognitive focus (or distraction) during in vivo exposure and Mohlman and Zinbarg (2000) did not test the relationship between individual differences in imaginative vividness and any of the outcome variables. Unfortunately, there is little, if any, previous research investigating the relationship between imaginative ability and anxious arousal in the context of *imaginal exposure*.

Dadds et al. (2004), in a correlational study, found that imagery vividness (as measured by the QMI) was positively associated with the number of specific fears or aversions reported by participants (e.g., aversions to foods, avoidance of places, etc.). Rauch, Foa, Furr, and Filip (2004) found that mental image vividness was positively associated with subjective anxiety ratings in the treatment of PTSD (among females who had been assaulted) with imaginal exposure. This relationship was strongest during early sessions and became nonsignificant by session six. Ultimately, Rauch et al. (2004) found that imagery vividness was not related to treatment outcome.

However, it is important to note that Rauch et al. (2004) asked participants to rate the vividness of their specific intrusive memories and it is difficult to imagine a situation where an intrusive memory would be rated as not particularly vivid. This line of reasoning highlights possible issues with range restriction that are acknowledged by Rauch et al. (2004). It also

means that vividness ratings in this context of this experiment do not refer to participants' global imaginative abilities, but merely to the vividness of their specific trauma memory. While this is useful and important information, it is not sufficient to successfully elucidate the relationship between the individual difference of imaginative ability and anxious arousal in imaginal exposure. To answer this question, imaginative ability should be assessed by a separate experimental task utilizing neutral images that are unrelated to the exposure scenario.

It is also important to note that imaginal exposure is used with GAD to expose the client to imagery related to future oriented worries *that have not yet occurred and may never occur*. In the context of imaginal exposure for GAD, the role of imaginative ability may be much more important since the clients are asked to generate a realistic and impactful *hypothetical* scenario in their imagination rather than merely calling to mind the memory of an event that has already occurred. Given the limited research available, further investigation is warranted to investigate the possible relationship between imaginative ability and anxious arousal in the context of imaginal exposure.

A related construct that is frequently mentioned in the virtual reality psychological treatment literature is that of *presence*. Presence is defined by Witmer and Singer (1998) as "the subjective experience of being in one place or environment even when one is physically situated in another" (p. 225). In the context of virtual reality-based psychological treatment or research, presence is the experience of feeling like one is embedded in the virtual environment rather than the actual physical environment (i.e., the laboratory or treatment facility; Witmer & Singer, 1998). A related construct to presence is immersion (also known as absorption), which is characterized by Witmer and Singer (1998) as an individual difference in the ability of individuals to lose themselves in an imagined situation and, therefore, experience presence.

Research has demonstrated that the efficacy of virtual reality based psychological treatment for a number of anxiety disorders is directly related to the amount of presence (and, by implication, immersion) experienced by the client (Wiederhold & Wiederhold, 2005).

A commonly utilized measure of immersion (absorption) is the *Tellegen Absorption Scale* (TAS; Tellegen & Atkinson, 1974). This scale was designed to measure stable individual differences in the ability to become mentally absorbed in one's experiences.

It is likely that previously mentioned studies in which participants were asked to rate the vividness of their imaginal exposure mental images (e.g., Rauch et al., 2004) were attempting to indirectly tap into the degree to which participants were immersed or absorbed in their imaginal exposure scenarios. This also indirectly implicates the concept of presence, albeit one more step removed.

It seems reasonable to predict that more vivid mental images will be more engaging and create a greater sense of being absorbed in the imaginal exposure scenario than unclear or dim mental images. Likewise, a tendency towards high absorption might result in more vivid mental images during imaginal exposure. However, Wiederhold and Wiederhold (2005) state that it is difficult to verify the construct validity of measures of presence as no reliable psychophysiological measures have yet been discovered that could be used to more objectively measure presence. Therefore, the best solution may be to measure individual differences in immersion/absorption ability (via the TAS; Tellegen & Atkinson, 1974) and ask participants to rate the vividness of their imaginal exposure scenario throughout the exposure session.

Objectives of the Current Study and Hypotheses

Although many experts in the field would suggest that multiple exposure sessions are preferable to maximize the learning of new associations (e.g., Dugas & Robichaud, 2007), undertaking a project involving multiple exposures seemed premature in this case. Because there is a dearth of literature specifically investigating physiological arousal during imaginal exposure as well as the effect of imaginal exposure alone (apart from other treatment components) on pathological worry, it seemed pertinent to begin with an investigation of the effects of a single exposure session.

The exposure length chosen was based on recent research findings. van Minnen and Foa (2006) found that although within-session anxious arousal reduction was significantly less for shorter exposure sessions, there was no difference in final treatment outcomes for PTSD patients when they received either 30 or 60-minute imaginal exposure sessions throughout a complete course of treatment that included nine exposure sessions. The authors stated that this indicates that complete return to baseline of within-session anxious arousal may not be necessary for successful exposure treatment in PTSD in the context of a complete treatment regimen (van Minnen & Foa, 2006). Although the current research was not intended as a treatment study *per se*, it was deemed important to choose an exposure length that would provide enough time for at least some reduction in anxious arousal to take place since Foa and Kozak's (1986) theory of emotional processing suggests that arousal should decrease as new learning occurs. However, it was also necessary to make the procedure as time-efficient as possible and to avoid unnecessarily fatiguing participants. In light of van Minnen and Foa's (2006) findings, an exposure length of 30 minutes seemed like an appropriate compromise between these objectives.

Therefore, the current research was designed to address three main objectives in the context of a single 30-minute exposure session. The first objective was to determine whether the inclusion of references to physiological anxious arousal (e.g., sweaty palms, tachycardia, nausea, etc.) and sensory information beyond the visual and auditory domains (e.g., relevant tastes, smells, etc.) increases the amount of anxious arousal elicited by imaginal exposure throughout a single session. This research question necessitated two conditions: a) a Comprehensive condition where participants were instructed to include references to all relevant information from the five senses as well as physiological anxious arousal, and b) a Limited condition where participants were instructed *explicitly* with regards to the inclusion of visual information *only* in the exposure scenario. The inclusion of information from the other four senses as well as physiological anxious arousal was not specifically mentioned in the instructions for the Limited condition.

H1a: It was hypothesized that, for both conditions, anxious arousal would increase significantly from baseline to the first measurement time period. *H1b*: However, it was hypothesized that a significantly greater increase would be observed in the Comprehensive condition. *H1c*: It was also hypothesized that significantly higher peak anxious arousal during exposure (both psychophysiological and subjective measures) would be observed in the Comprehensive condition as compared to the Limited condition. *H1d*: Finally, it was hypothesized that the slope of anxious arousal over time for the two conditions would significantly differ, creating a significant interaction between time and condition, such that a greater reduction of anxious arousal from beginning to end of the exposure would be observed in the Comprehensive condition.

A second objective of this research was to provide preliminary information regarding the effect of a single 30-minute imaginal exposure on momentary worry. As stated previously, it was hypothesized that the Comprehensive condition would elicit greater anxious arousal than the Limited condition. If this hypothesis were confirmed, increased anxious arousal might be attributed to greater activation of fear structures in the imaginal exposure experience facilitated by the enhanced elements of the Comprehensive condition. As such, an exposure scenario that more fully activates fear structures might be expected to be more effective in reducing momentary worry, anxiety, and perceptions of likelihood of occurrence and severity of the feared outcome.

H2: Therefore it was hypothesized that at posttest, participants in the Comprehensive condition (when compared to participants in the Limited condition) would report: (*H2a*) lower perceived likelihood of their feared scenario coming true in real life, (*H2b*) lower self-reported worry in the present that the feared scenario will occur in real life, (*H2c*) less distress if the feared scenario were to come true, and (*H2d*) greater anticipated ability to cope if the feared scenario were to occur.

The final objective of this research was to determine whether imaginative vividness is directly related to the amount of anxious arousal that can be elicited by imaginal exposure. To test this research question, it is important to measure participants' imaginative abilities using neutral images that are unrelated to their worries, in the context of a separate procedure from the exposure. Using participant ratings of the vividness of their imaginal exposure session for this purpose would confound imaginative ability with anxious arousal.

H3: It was hypothesized that greater imaginative ability (measured via questionnaires completed before the imaginal exposure session) would be positively associated with peak

anxious arousal regardless of condition. It was also determined that the relationship between individual differences in absorption and peak anxious physiological arousal should be examined. Previous research has found a moderate positive association between individual differences in absorption and imaginative vividness (Minakowska-Gruda, 2006). *H4*: Therefore, it was also anticipated that greater absorption tendencies, regardless of condition, would be associated with: (*H4a*) greater imaginative ability (measured via self-report questionnaires), (*H4b*) greater peak physiological arousal, and, (*H4c*) greater self-reported peak vividness ratings during exposure. *H5*: Finally, it was predicted that there would be a significant, positive association between individual differences in imaginative ability and self-reported peak vividness during exposure regardless of condition.

Research Importance

This research addresses a significant gap in the anxiety disorder literature regarding imaginal exposure. First, it provides an empirical test of whether the inclusion of rich sensory information and references to anxious physiological arousal in an imaginal exposure script makes a significant difference in the pattern of anxious arousal experienced during exposure. Although the addition of such references in fearful mental imagery is known to generally elicit increased anxious arousal (Mathews, 1971), the resulting pattern and trajectory of anxious arousal that should be expected during imaginal exposure is unclear.

Treatment package components originally tested with and created for the treatment of a particular disorder are often later included in treatment packages for other disorders. While this may result in innovative new approaches to treatment, the research literature typically lags behind in demonstrating the efficacy of specific components in their new applications. Such is the case with imaginal exposure used in the treatment of GAD, and the present research seeks to

begin to explore the effect of imaginal exposure on momentary worry. If imaginal exposure alone results in a reduction in momentary worry as some previous research suggests (Provencher et al., 2004), then autonomic activation may be the mechanism through which cognitive change and momentary worry reduction occur.

Finally, the role of imaginative ability in the context of imaginal exposure for GAD is currently poorly understood. If imaginative ability significantly predicts exposure scenario vividness and treatment outcome, this has important implications that will potentially direct the flow of GAD treatment according to client individual differences. For instance, if clients with poor imaginative abilities experience little anxious arousal in the context of imaginal exposure, therapists may need to allot time to aid clients in training their imaging abilities. If such training proves unsuccessful, therapists might select alternate treatment methods less heavily based on mental imaging that will prove more effective for these clients.

Method

Participants

Participants were recruited from the community via online advertisements (e.g., Craigslist) and through the undergraduate psychology participant pool at Ryerson University. Eligible participants were initially identified through the completion of a battery of online questionnaires. Gillis, Haaga, and Ford (1995) reported a mean score of 42.2 and a standard deviation of 11.5 on the *Penn State Worry Questionnaire* (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) in a community sample. Therefore, those who scored 54 or higher on the PSWQ (one standard deviation above the aforementioned mean) were considered to be *high worriers* for the purposes of this study and were invited to participate in a subsequent session to take place at the laboratory (this cut score method was taken directly from Goldman et al., 2007).

Ryerson undergraduate participants completed the entire battery of questionnaires online during an initial session. Those who scored above the cutoff were invited to the subsequent laboratory session. Community participants initially accessed the PSWQ as a prescreener via online advertisement (e.g., Craigslist). Those who scored above the cutoff were contacted via telephone and invited to participate in the laboratory session. Community participants who agreed to participate in the laboratory session were sent a web link via email to complete the balance of the online questionnaires before their laboratory session. All participants in the laboratory session were paid \$25 for their time. All participants who completed questionnaires, regardless of whether they were invited to participate in the laboratory session, were entered into a raffle for a \$100 gift certificate in exchange for their participation.

One hundred participants (84 women and 16 men) between the ages of 17 and 59 years ($M = 26.51$ years, $SD = 10.12$) completed the online questionnaire package. Those who completed the questionnaires were of diverse ethnic backgrounds including Caucasian ($n = 48$), Asian ($n = 9$), Multiethnic ($n = 8$), East Indian ($n = 7$), West Indian ($n = 8$), Latin American/Hispanic ($n = 5$), Middle Eastern ($n = 4$), and African ($n = 2$). Ten individuals provided no answer regarding their ethnic background and one individual indicated that he or she preferred not to provide this information. The marital status of the majority of questionnaire completers was single ($n = 69$), followed by married/living common law ($n = 23$), and divorced/separated ($n = 7$). One participant indicated that he or she preferred not to provide this information.

Eighty nine of the 100 participants who completed the online questionnaires scored 54 or greater on the PSWQ and were invited to participate in the laboratory session. Of those invited, 50 chose to participate. The laboratory session data of five of these participants were excluded

due to a variety of issues including poor effort (as observed by the experimenter), inability to generate an imaginal exposure script, and attention difficulties that significantly interfered with the ability to complete experimental tasks.

This yielded a final sample of 45 participants (35 women and 10 men) between the ages of 18 and 59 years ($M = 29.89$ years, $SD = 11.98$) who completed both online questionnaires and the laboratory session. The final sample participants were also of diverse ethnic backgrounds including Caucasian ($n = 28$; 62.22%), Asian ($n = 8$; 17.77%), Multiethnic ($n = 4$; 8.89%), Latin American/Hispanic ($n = 3$; 6.67%), and Middle Eastern ($n = 2$; 4.44%). The marital status of the final sample was also primarily single ($n = 29$; 64.44%), followed by married/living common law ($n = 11$; 24.44%), and divorced/separated ($n = 5$; 11.1%). These participants were randomly assigned to condition.

Random assignment yielded 22 Comprehensive condition participants (18 women and 4 men) between the ages of 18 and 58 years ($M = 28.09$ years, $SD = 11.71$). Twenty-three participants (17 women and 6 men), between the ages of 19 and 59 years ($M = 31.61$ years, $SD = 12.24$), were assigned to the Limited condition.

Participants from both conditions were of diverse ethnic backgrounds. In the Comprehensive condition, ethnic backgrounds included Caucasian ($n = 11$; 50.0%), Asian ($n = 5$; 22.7%), Latin American/Hispanic ($n = 3$; 13.6%), Multiethnic ($n = 2$; 9.1%), and Middle Eastern ($n = 1$; 4.5%). In the limited condition, ethnic backgrounds included Caucasian ($n = 17$; 73.9%), Asian ($n = 3$; 13.0%), Multiethnic ($n = 2$; 8.7%), and Middle Eastern ($n = 1$; 4.3%).

The marital status of participants in both conditions was primarily single. In the Comprehensive condition, 72.7% were single ($n = 16$), 13.6% were married ($n = 3$), 9.1% were living common law ($n = 2$), and 4.5% were divorced ($n = 1$). In the Limited condition, 56.5%

were single ($n = 13$), 13.0% were married ($n = 3$), 13.0% were living common law ($n = 3$), 8.7% were separated ($n = 2$), and 8.7% were divorced ($n = 2$).

The final sample consisted primarily of community participants. Thirty-four participants (75.56%) were recruited from the community through online advertisement (17 Comprehensive condition participants and 17 Limited condition participants). Eleven participants (24.44%) were recruited via the undergraduate participant pool at Ryerson University (5 Comprehensive condition participants and 6 Limited condition participants).

The final sample was also primarily far above the cutoff of 54 on the PSWQ that was used to identify potential participants for the subsequent laboratory session (see Table 2). Behar, Alcaine, Zuellig, and Borkovec (2003) determined via receiver operating characteristic analysis that a cut score of 62 on the PSWQ maximized sensitivity and specificity in identifying likely GAD cases in a student population. Thirty-five participants (71.1%) out of the final sample of 45 scored above 62 on the PSWQ. Although this cutoff (Behar et al., 2003) was derived from a student sample and therefore may not generalize well to the current mixed sample of student and (primarily) community participants, the high percentage of participants scoring above this cutoff speaks to the general severity of self-reported worry that characterized the current sample.

Materials

The Penn State Worry Questionnaire (PSWQ; Meyer, et al., 1990) is a 16-item self-report questionnaire that was constructed from a factor analysis of a large pool of items tested extensively with a student population initially. It was designed to measure the frequency and intensity of general worry. It has since been tested with several large clinical populations (e.g., Brown, Antony, & Barlow, 1992) and has demonstrated excellent internal consistency and acceptable test-retest reliability in both clinical and student samples (Meyer et al., 1990; Brown

et al., 1992). As previously stated, this measure was used as a screener to recruit *high worriers* for the study.

The *Structured Clinical Interview for DSM-IV* (SCID-IV; First, Spitzer, Gibbon, & Williams, 1996) is a well-known semi-structured diagnostic interview that possesses good psychometric properties. A full administration can take up to two hours, but for the purposes of this study, only the GAD and Mood Disorder sections were administered.

The *Self-Assessment Manikin* (SAM) rating system (Bradley & Lang, 1994) measures affective responses to stimuli utilizing a rating system consisting of manikin cartoons displaying a range of affective responses across three domains: pleasure, arousal, and dominance. For each of the three domains there are five manikins and participants may place an 'x' directly on a manikin or between two manikins. This yields a nine-point scale for each of the domains. The SAM rating system is a well-respected measure and has been used extensively in the emotion literature where it has demonstrated strong correlations with physiological and behavioural measurements of pleasure and arousal (Bradley & Lang, 1994). For the purposes of this research, only the *arousal* series of manikins were used as a means of reporting subjective units of distress (SUDS) throughout the exposure procedure. This is likely to yield more accurate and meaningful participant arousal ratings since a SUDS rating of 50 (on a scale of 0 to 100) may represent a slightly different level of arousal to different participants; but a manikin rating of 5, on a scale of 1 (not at all aroused) to 9 (maximum arousal), will be tied to the same manikin depiction for all participants.

The *Vividness of Visual Imagery Questionnaire* (VVIQ; Marks, 1973) is a measure of visual imaginative vividness. It consists of 16 experimenter administered items and has demonstrated acceptable psychometric properties for research purposes. Participants are asked

to visually imagine different people or situations and rate the mental image on a scale of 1 (perfectly clear) to 5 (no image) with respect to its vividness (Marks, 1973).

The shortened form of the *Betts' Questionnaire upon Mental Imagery* (QMI; Sheehan, 1967) measures imaginative abilities across several modalities (visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, and organic). It consists of 35-items rated on a scale of 1 (perfectly clear) to 7 (no image/experience), takes approximately ten minutes to administer (the original version is 150-items and is very time-consuming), and has been shown to possess acceptable reliability and validity in a number of experimental settings. Participants are asked to imagine different experiences across each of the sensory modalities (e.g., visual, gustatory, cutaneous) and rate the vividness of their imagination of each experience.

The *Tellegen Absorption Scale* (TAS; Tellegen & Atkinson, 1974) measures the dispositional ability of individuals to become immersed or absorbed in experience, characterized by focused attention that enables a greater sense of reality of the object focused upon and heightened resistance to distraction. The TAS is a self-report questionnaire containing 34 items in which participants are asked to indicate whether they experience different aspects of absorption. Although the original questionnaire was presented in true/false format, items are now commonly rated on a scale of 0 (never) to 4 (always); and this is thought to produce a more fine-grained measurement of the construct (Glisky, Tataryn, Tobias, Kihlstrom, & McConkey, 1991).

Psychophysiological Recording

Psychophysiological measures collected during the procedure included heart rate (HR) and skin conductance level (SCL), which were acquired and amplified using a *Biopac MP150* system and *AcqKnowledge 3.9.1* software connected to a Windows PC. HR data were acquired

using three pregelled Biopac 35mm disposable electrodes (EL503). An electrode was placed on the inside of each wrist and an additional electrode was placed on the inside of the left forearm as a ground. SCL was recorded using two pregelled Biopac 2.5cm x 4.5 cm disposable electrodes that were placed on the palmar region of the distal phalanges of the first and second fingers of the right hand.

Participants were asked to wash their hands and wrists with soap and water and dry them thoroughly before the psychophysiological equipment was connected to ensure consistent recording quality. Deep breath tests were performed and waveforms of the recorded HR and SCL data were visually inspected to ensure that the equipment was functioning properly. Electrodes were connected for a minimum of five minutes before recording of baseline data began to ensure adequate stabilization. Baseline data were recorded for a period of six minutes. Data from the first minute (during which deep breath tests were performed) were discarded to ensure that participants had reached a state of relaxation before the beginning of retained baseline measurements.

Both HR and SCL were sampled continuously at a rate of 200 Hz. HR recordings were converted to beats per minute (bpm) by the AcqKnowledge software via the detection of cardiac R-waves. HR values below 40 bpm and above 160 bpm occurred infrequently as a result of participants moving their arms excessively. These occurrences were extremely brief (a fraction of a second) and clearly resulted from loss of electrode contact due to participant movement. After visually screening data for these (relatively infrequent) instances and removing them, mean HR and SCL values for each 10-minute section of the imaginal exposure procedure were calculated using AcqKnowledge software.

Procedure

Participants initially completed questionnaires online. The VVIQ and the QMI were completed first. These scales were presented before the PSWQ to prevent any effect upon imaginative vividness scores that might result from reminding participants about their worries. The order of these two scales was also counterbalanced to control for potential order effects. Participants then completed the PSWQ followed by the TAS. After initial eligibility for the laboratory session was established via the online questionnaire package (i.e., a PSWQ score equal to or greater than 54), those who agreed to participate completed a single 150-minute experimental session at the laboratory. Participants were first given a brief explanation regarding what participation in the study would entail. They were informed that they would be asked a series of questions regarding common mood and anxiety related concerns, and then would be asked to imagine a distressing worry occurring in real life while psychophysiological and self-report measures of anxiety are collected. Participants were also briefed regarding the confidentiality and anonymity of the data provided and were informed of their rights as participants to ensure informed consent.

After the consent forms were signed, the session continued with a brief structured clinical interview utilizing an abbreviated administration of the *Structured Clinical Interview for DSM-IV* (SCID-IV; First, Spitzer, Gibbon, & Williams, 1996) to determine whether diagnostic criteria were met for either GAD or a mood disorder. Participants were not excluded on the basis of whether they qualified for a diagnosis of GAD or a mood disorder, but this information was recorded for the purpose of describing the clinical status of the sample.

After completion of the clinical interview, participants were asked to wash their hands and wrists with soap and water to ensure consistent psychophysiological recordings. Participants

were then seated and the psychophysiological equipment measuring heart rate and skin conductance level was connected and adjusted for baseline measurement. After testing to ensure that the equipment was recording properly, baseline readings were obtained for a period of six minutes (as mentioned previously, the first minute was discarded to be certain that participants were completely relaxed during the retained baseline measurement time period).

After baseline measurements were obtained, participants were given instructions, according to experimental condition (Comprehensive condition, or Limited condition), regarding the construction of an imaginal exposure scenario, based on the procedure outlined by Dugas and Robichaud (2007), in a domain of worry identified as being prominent for each individual participant during the clinical interview. The experimenter aided the participant in fine tuning the imaginal exposure scenario regarding length and content utilizing acceptable prompts according to experimental condition as needed (see Appendices C and D). It immediately became apparent that it would be unnatural to ask participants in the Limited condition not to include references to the auditory domain (e.g., it would be odd for an individual to receive a phone call informing them that a loved one had been injured and be unable able to hear the content of the phone call). Therefore, the procedure was immediately amended such that participants in the Limited condition were not prompted to focus exclusively on the visual domain if they included relevant auditory references in their exposure scripts. Participants were asked to aim for an exposure script length that would be between 2-3 minutes when the script was read aloud at a moderate pace. The scenario was entered into a word processing program by the experimenter as the participant dictated it, and then it was printed and saved to the computer for later analysis. The participant then recorded the audio narrative of their imaginal exposure scenario using a handheld digital recorder. The audio recordings were then transferred to

computer and edited by the experimenter to remove reading mistakes, long pauses, coughing, etc. to ensure that the quality of the recording did not detract from the exposure.

Before beginning the imaginal exposure, participants were briefly instructed as to the use of the *Self-Assessment Manikin* (SAM) rating system (Bradley & Lang, 1994) for reporting subjective units of distress throughout the exposure procedure. For the purposes of this research, only the *arousal* manikins were used. Participants were also briefly instructed regarding rating the vividness of the imaginal exposure scenario throughout the exposure procedure (on a scale of 1 to 7 similar to the VVIQ and QMI). Participants were asked to report their preexposure SAM arousal ratings at this time.

The audio narrative of the imaginal exposure scenario was then played to the participant repeatedly for 30 minutes while the participant closed his or her eyes and imagined the scenario. Audio playback of the recorded scenario was stopped and participants were asked to briefly open their eyes and provide *Self-Assessment Manikin* ratings (arousal manikins only) and exposure vividness ratings at the 10-minute, 20-minute, and 30-minute mark (end of session) during the exposure. Participants were asked to rate the highest level of arousal and vividness they experienced during each 10-minute section of the exposure (peak arousal; peak exposure vividness) as well as the level of arousal or vividness at the end of each 10-minute period.

The aforementioned imaginal exposure procedure was used instead of the written exposure procedure described by Goldman et al. (2007) because it more closely resembles current clinical practice in the treatment of GAD. Since the procedure described by Goldman et al. (2007) is relatively new, its use is unlikely to be widespread among clinicians currently. Also, despite some of the possible limitations or challenges with traditional imaginal exposure methods raised by Goldman et al. (2007), there is little if any empirical evidence to indicate that

written exposure is superior to traditional imaginal exposure for GAD as the two methods have never been directly compared in the literature.

Immediately after the exposure session, participants were asked to rate (on a Likert scale from 1 to 5) the objective probability that the imagined worry scenario would occur in real life in the future. Participants were also asked to rate how worried they were immediately after the imaginal exposure that the worry scenario would come true in the future, how distressing it would be if the worry were to come true, and to what degree the participant believed he or she could cope with the situation if it were to occur. These four items comprised the Post Exposure Questionnaire.

Finally, participants were asked if they had any remaining questions before the conclusion of the session. They were then formally debriefed (the purpose of the study was briefly explained), thanked for their participation in the study, and given the opportunity to receive a report of the aggregated findings of the study upon its conclusion. Participants then were given their remuneration (\$25). Finally, participants were also offered a list of print resources for overcoming worry. Information was also provided to participants regarding counselling resources available at Ryerson University (for Ryerson University students) or in the community (for community participants).

Exposure scripts were analyzed after experimental sessions were concluded to facilitate a planned manipulation check and analysis of consistency in scripts across conditions. The text analysis was performed using Linguistic Inquiry and Word Count software (LIWC; Pennebaker, Booth, & Francis, 2007). The proportion of references to physiological sensations of anxious arousal, emotional reactions, and the full range of the five senses were calculated for each individual exposure script. Length in seconds (obtained from the computer audio files of

imaginal exposure scripts that participants were exposed to), total word count, and the proportion of references to past, present, and future tenses were also calculated for each script.

Results

Data Screening

The data were initially screened for normality and the presence of outliers. Outliers greater than three standard deviations from the mean were considered problematic and were removed from the data. Scores on a limited number of subscales of the QMI for three participants were deemed problematic outliers and the scores from these subscales *only* were deleted from the dataset to protect against the possibility of resulting Type I or Type II errors. There were no problematic outliers for any other measures.

All data approximated normal distributions with the exception of Skin Conductance Level (SCL), Exposure Vividness Ratings, Postexposure Questionnaire items, and Participant Age. A number of transformations were performed to attempt to normalize the distributions of SCL and Exposure Vividness Ratings, but none were uniformly successful. Therefore, the decision was made to leave them untransformed. The decision was made to also leave Participant Age, Postexposure Questionnaire items, and Exposure Script Sensation Reference Frequencies untransformed since the discussion of transformed variables (e.g., the square root of age) may not be particularly meaningful or intuitive with respect to these variables. Despite departures from distribution normality for some variables, sample size was likely large enough to ultimately preclude the necessity of transformations.

Missing Value Analysis

Missing values were extremely infrequent although they occurred in all self-report questionnaires except for the *Penn State Worry Questionnaire* (PSWQ). For the *Vividness of Visual Imagery Questionnaire* (VVIQ), a maximum of three missing values occurred for 10 of the 16 individual items in the scale (maximum of 3% missing data). A total of 15 participants did not provide an answer for at least one scale item on the VVIQ. For participants randomized to condition, a maximum of two missing values occurred for six individual items in the scale (maximum of 2% missing data). A total of eight participants did not provide an answer for at least one scale item.

For the *Bett's Questionnaire upon Mental Imagery* (QMI), a maximum of five responses were missing for 34 of the 35 items (maximum of 5% missing data). Twenty-five participants did not provide an answer for at least one scale item on the QMI. For participants randomized to condition, a maximum of two missing values occurred for 14 items in the scale (maximum of 2% missing data). A total of eight participants did not provide an answer for at least one scale item. The relatively large amount of missing data on this scale may have been a result of some participants not understanding some of the less common or more obscure vocabulary used in the QMI (e.g., *tepid* bath). It also may have been an indicator of participant fatigue due to the length of the questionnaire or difficulty with imaginative vividness within a particular domain. Nonetheless, there did not seem to be any discernable pattern in which data was missing.

For the *Tellegen Absorption Scale* (TAS), a maximum of three responses were missing for 23 of the 34 items (maximum of 3% missing data). Twenty-three participants did not provide an answer for at least one item on the TAS. For participants randomized to condition, a single

missing value occurred for ten individual items in the scale (maximum of 1% missing data). A total of nine participants did not provide an answer for at least one scale item.

For the three aforementioned scales, the largest percentage of *within-scale* missing data at the level of the *individual participant* was 14.71% (with the exception of one participant who answered only two of the 35 items of the QMI). On a *per-item* basis, *across participants*, the largest amount of missing data was 5.00%. On a *per-scale* basis, *across participants*, the largest amount of missing data was 1.00%. For participants randomized to condition, the largest percentage of *within-scale* missing data at the level of the *individual participant* was 12.5% (again, with the exception of one participant who answered only two of the 35 items of the QMI – see below). On a *per-item* basis, *across participants*, the largest amount of missing data was 2.00%. On a *per-scale* basis, *across participants*, the largest amount of missing data was 1.00%.

Missing values for individual items were imputed by calculating the mean of the individual's responses to the items from the same scale for which responses were provided. These imputed values were used in the calculation of total scale scores. QMI scores could not be calculated for a single participant because of an unusually low percentage of items answered (2 of 35 items, 5.71%). This participant's limited QMI data were excluded from the analysis. Heart rate (HR) data were also unavailable for a single participant due to an equipment malfunction.

Although mean imputation is generally considered an older and less desirable method for imputing missing values, Tabachnick and Fidell (2007) have noted that, in cases where less than 5% of the sample is missing data, different methods of missing value imputation produce very similar results. Therefore, since the amount of missing data was very small, mean imputation was used for the sake of simplicity.

Scale Reliability

All scales demonstrated excellent internal consistency reliability. Both the QMI ($\alpha = .94$) and the TAS ($\alpha = .92$) exceeded $\alpha = .90$, which is considered to be superior by convention (Murphy & Davidshofer, 2005). The PSWQ ($\alpha = .89$) and VVIQ ($\alpha = .89$) also demonstrated internal consistency in the high range.

Diagnostic Status

The diagnostic status of the sample of participants who completed both online questionnaires and the laboratory session ($n = 45$) are presented in Table 1.

Table 1

Diagnostic Status Frequency According to Condition

Condition	GAD	ADNOS [†] (Subthreshold GAD)*	Subclinical GAD**	Mood with Prominent Worry	No Diagnosis
Comprehensive	8	2	4	1	7
Limited	9	4	1	2	7

[†] *Anxiety Disorder Not Otherwise Specified*

* *Participants meeting all DSM-IV criteria for GAD, but fewer than three somatic symptoms were reported*

** *Participants meeting all DSM-IV criteria for GAD with the exception of significant distress or impairment*

Effectiveness of Random Assignment

A number of independent samples *t*-tests were conducted to examine between-group differences on online questionnaire scores obtained before the laboratory session. There were no statistically significant differences between groups after random assignment (i.e., random assignment was successful). These results are presented in Table 2. To examine the possibility of preexisting group differences in different facets of imaginative vividness, independent *t*-tests were also carried out for each of subscales of the QMI. Results are presented in Table 3. Chi square tests were also conducted to examine between group differences on categorical variables. In some cases, categorical variable groupings had to be collapsed in order to compensate for frequency counts less than five in some individual cells (which violates an assumption of the chi square test). Ethnicity, marital status, and diagnostic status were simplified in this manner. Again, nonsignificant results indicate that statistically significant differences between groups did not exist after random assignment. These results are presented in Table 4.

Table 2

Questionnaire Mean Differences According to Condition

Questionnaire	Comprehensive		Limited		<i>t</i>	<i>p</i>
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>		
QMI total	2.53	.68	2.66	.47	.78	.44
VVIQ	2.17	.47	2.46	.59	1.83	.07
TAS	54.36	17.20	50.17	15.98	-.85	.40
PSWQ	66.50	7.14	68.52	7.25	.94	.35

Table 3

QMI Subscale Mean Differences According to Condition

QMI Subscale	Comprehensive		Limited		<i>t</i>	<i>p</i>
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>		
Visual	2.70	1.14	2.91	.85	.71	.48
Auditory	2.64	.80	2.48	.78	.67	.50
Cutaneous	2.51	.99	2.64	.68	.52	.61
Kinaesthetic	2.26	.70	2.66	.69	1.93	.06
Gustatory	2.38	.83	2.39	.82	.06	.95
Olfactory	3.01	1.18	3.05	.88	.08	.94
Organic	2.19	.87	2.49	.80	1.23	.23

Table 4

Categorical Variable Differences According to Condition

	Frequency		X^2	p
	Comprehensive	Limited		
Sex				
Female	18	17		
Male	4	6	.41	.52
Ethnicity				
Caucasian	11	17		
Other	11	6	2.74	.10
Marital Status				
Single	16	13		
Other	6	10	1.29	.26
Diagnostic Status				
GAD	8	9		
Other	14	14	.04	.98

An independent samples *t*-test was conducted to determine whether significant age differences existed between conditions. No significant age differences between Comprehensive ($M = 28.09$ years, $SD = 11.71$) and Limited condition participants ($M = 31.61$ years, $SD = 12.24$) were observed, $t = .98$, $p = .33$.

Manipulation Check

As a manipulation check, imaginal exposure scripts were analyzed using the Linguistic Inquiry and Word Count program (LIWC; Pennebaker, Booth, & Francis, 2007) to verify that Comprehensive condition exposure scripts contained a greater portion of physiological sensation descriptors (calculated as a percentage out of the total word count of the script) than Limited condition scenarios. The percentage of physiological sensation descriptors was compared between conditions utilizing an independent samples *t*-test. The scripts of Comprehensive condition participants contained a significantly greater percentage of words referring to physiological sensations ($M = 1.75\%$, $SD = .85$) than scripts of the Limited condition participants ($M = .55\%$, $SD = .56$), $t(43) = 5.60$, $p < .001$, indicating that the experimental manipulation functioned as intended.

Although the percentage of references to physiological sensations in both conditions appears extremely low initially (.55% and 1.75%, respectively), this occurs as a result of the analysis method used by the text analysis software. Although custom dictionaries can be created by the end user to analyze phrases, the included dictionaries analyze single words only. However, anxious physiological sensations tend to be represented in language in phrases (e.g., “My hands start to shake, my mouth feels dry, and I feel like I’m going to faint”). Therefore, due to an inability of the software to directly infer meaning from complete phrases or sentences, the total proportion of words in exposure scripts used to describe anxious physiology is

significantly underestimated. For instance, in the sentence, “My *hands* start to shake, my *mouth* feels dry, and I feel like I’m going to *faint*”, LIWC only identifies the three italicized words as physiological references. However, it should be clear to the reader that the entire sentence refers to anxious physiological arousal. It is also difficult for text analysis software to capture the relative importance of individual phrases in an entire script. For instance, the inclusion of a three-word-phrase such as “I want to die” would be extremely important to notice despite its small contribution with respect to total word count. It is important to note that, although LIWC tends to underestimate proportionality with respect to physiological references, it does so consistently. That is, the pattern of significant differences observed between conditions in physiological references is real, but equally underestimated in *both conditions* regarding total proportion.

Exposure scripts were also examined via computer text analysis to verify that Comprehensive condition scenarios contained a greater percentage of references to senses beyond the visual and auditory domains than the Limited condition scenarios. Relevant *t*-tests were conducted accordingly. As expected, no significant difference was observed between the Comprehensive ($M = .96\%$, $SD = .89$) and Limited conditions ($M = .96\%$, $SD = .65$) in the mean percentage of visual references contained in exposure scripts, $t(43) = .01$, $p > .99$. With respect to auditory references, Levene’s test was significant, $F = 4.58$, $p = .04$, indicating that the assumption of equality of variances between groups had been violated. Degrees of freedom were adjusted to compensate for this violation. No significant difference was observed between the Comprehensive ($M = 1.35\%$, $SD = 1.24$) and Limited conditions ($M = 1.21\%$, $SD = .71$) in the mean percentage of auditory references contained in exposure scripts, $t(33.16) = .50$, $p = .62$. Regarding references to touch, Levene’s *HOV* test was significant, $F = 22.08$, $p < .001$,

indicating that the assumption of equality of variances between groups had been violated. Degrees of freedom were adjusted to compensate for this violation. The exposure scripts of Comprehensive condition participants ($M = 1.41\%$, $SD = .83$) contained a significantly greater percentage of cutaneous references than those of the Limited condition participants ($M = .44\%$, $SD = .30$), $t(26.36) = 5.14$, $p < .001$. No significant differences were observed between Comprehensive condition participants ($M = 1.41\%$, $SD = .83$) and Limited condition participants ($M = 1.41\%$, $SD = .83$) in the percentage of olfactory references, $t(43) = .24$, $p = .81$. There were also no significant differences between Comprehensive condition participants ($M = 1.41\%$, $SD = .83$) and Limited condition participants ($M = 1.41\%$, $SD = .83$) in the percentage of gustatory references, $t(43) = .003$, $p > .99$. Therefore, the attempted experimental manipulation of exposure script references to senses beyond the visual and auditory domains was largely ineffective (with the exception of the significant difference observed in cutaneous references). References to additional senses in the exposure scripts of participants in either condition were relatively rare. Although several participants included cutaneous references, only two participants (one in each condition) made reference to the sense of smell (corresponding to the olfactory subscale of the QMI); and only six participants (two in the Comprehensive condition, and four in the Limited condition) included references to taste (QMI gustatory subscale). Only two of the exposure scripts (both in the Limited condition) made reference to organic sensations (e.g., hunger; QMI organic subscale) or the sensation of moving one's body through space (QMI kinaesthetic subscale).

Exposure Script Data Integrity

To ensure that exposure scripts were consistent, it was necessary to investigate whether exposure script length (in both seconds and word count) was consistent when collapsed across conditions as well as between conditions. Once again, LIWC software (Pennebaker et. al, 2007) was used for this purpose. As stated previously, participants were asked to generate a script that would take 2-3 minutes to read out loud at a moderate pace. Collapsed across condition, the mean length of exposure scripts after editing to remove pauses, reading errors, etc. was 154.69 seconds ($SD = 30.22$), which fell within the time span specified by the procedure. The minimum observed script length was 104 seconds (1m44s) and the maximum observed length was 219 seconds (3m39s). The mean word count of scripts collapsed across conditions was 500.58 words ($SD = 102.38$). The minimum observed script word count was 300 words and the maximum observed length was 707 words.

To verify that mean exposure script length (in seconds) did not differ according to condition, an independent samples *t*-test was conducted. Mean script length in the Comprehensive condition ($M = 149.05$ seconds, $SD = 27.98$) did not significantly differ from that of the Limited condition ($M = 160.09$ seconds, $SD = 31.88$), $t(43) = -1.23$, $p = .22$.

To verify that exposure script word count also did not differ according to condition, an independent samples *t*-test was conducted. Mean script word count in the Comprehensive condition ($M = 485.68$ words, $SD = 94.57$) did not significantly differ from that of the Limited condition ($M = 522.48$ words, $SD = 109.39$), $t(43) = -1.21$, $p = .24$.

To verify that participants adhered to the instruction that scripts be written primarily in the present tense, a 2 (condition: comprehensive, limited) x 3 (tense: past, present, future) Mixed ANOVA was conducted on the output of the text analysis software. Box's test of equality of

covariance matrices was nonsignificant, *Box's* $M = 8.38$, $F(6, 13319.26) = 1.29$, $p = .26$, indicating that the assumption of homogeneity of variance-covariance matrices was not violated. Mauchly's test of sphericity was significant, $W = .75$, $\chi^2(2) = 11.90$, $p < .01$, indicating that the assumption of sphericity had been violated. Greenhouse-Geisser adjusted values are reported below to compensate for this violation.

The main effect of condition was nonsignificant, $F(1, 43) = .30$, $p = .59$. Mean percentage of references to tense collapsed across tense type (past, present, future) for the Comprehensive group ($M = 5.37\%$, $SD = 1.04$) did not significantly differ from that of the Limited condition group ($M = 5.49\%$, $SD = 1.33$). However, the main effect of tense was significant, $F(1.60, 69.98) = 1296.32$, $p < .001$. The mean percentage of references collapsed across condition for the past tense ($M = 1.49\%$, $SD = .95$) and future tense ($M = 1.03\%$, $SD = .76$) did not significantly differ, $t(43) = 2.26$, $p = .09$. However, the percentage of references to the present tense ($M = 13.77\%$, $SD = 1.88$) was significantly greater than both the past tense, $t(43) = 37.33$, $p < .001$, and the future tense, $t(43) = 42.05$, $p < .001$. The interaction between tense and condition was nonsignificant, $F(1.60, 69.98) = .88$, $p = .40$ (between subjects $MSE = 1.42$). Therefore, these results confirmed that the vast majority of references to tense contained in exposure scripts, regardless of condition, referred to the present.

It was also necessary to determine whether the instruction to include emotional reactions in exposure scripts was adhered to in both conditions and to examine whether the proportion of emotional words in the scripts differed between conditions. The percentage of references to emotional reactions in the Comprehensive condition ($M = 4.49\%$, $SD = 1.39$) did not significantly differ from that of the Limited condition ($M = 4.02\%$, $SD = 1.36$), $t(43) = 1.14$, $p = .26$. The relative percentage of these references indicated that they were relatively plentiful in

both conditions. There were no significant between group differences in the proportion of references to emotional reactions included by participants in their exposure scripts.

References to emotional reactions in exposure scripts were also examined in greater detail by comparing the proportion of references to anxiety, anger, and sadness between conditions. These groupings in the LIWC software (Pennebaker, et al., 2007) refer not just to emotion (e.g., sad), but also to cognition (e.g., worried) and behaviour (e.g., crying). Levene's *HOV* test was significant for anxiety references, $F = 7.89, p = .01$. Degrees of freedom were adjusted for anxiety references to compensate for this violation. The mean percentage of references to anger in Comprehensive condition scripts ($M = .57\%, SD = .45$) did not significantly differ from that of the Limited condition ($M = .48\%, SD = .45$), $t(43) = .67, p = .51$. There also was no significant difference between the Comprehensive condition ($M = .63\%, SD = .43$) and the Limited condition ($M = .63\%, SD = .43$) in the mean proportion of references to sadness in exposure scripts, $t(43) = -.01, p > .99$. However, the mean percentage of references to anxiety in the Comprehensive condition ($M = 1.02\%, SD = .72$) was significantly greater than that of the Limited condition ($M = .65\%, SD = .28$), $t(26.98) = 2.30, p = .03$.

Since Comprehensive condition participants were specifically instructed to write about anxious physiological sensations (and Limited condition participants were not specifically instructed in this manner), it is not surprising that the Comprehensive condition scripts contained a greater proportion of anxiety references. One might expect that physiological sensations attributed to anxiety within an exposure script would often be referenced as such. Therefore, the significant differences in anxiety references observed between conditions further underscore the success of the manipulation. However, the finding that the proportion of emotional references in general did not significantly differ between conditions demonstrates that participants in both

conditions complied with instructions to include emotional reactions in the exposure script. This finding bolsters confidence that overall script quality was consistent between conditions.

Differences in Skin Conductance Level between Conditions during Exposure

To test the hypotheses that (*H1a*) both conditions would significantly increase but that (*H1b*) there would be a significantly greater increase in SCL in the Comprehensive condition from baseline to the first time period during the exposure, a 2(time) x 2(condition) mixed-ANOVA was conducted. Box's test of equality of covariance matrices was also nonsignificant, $\text{Box's } M = 1.06, F(3, 357043.83) = .34, p = .80$, indicating that the assumption of homogeneity of variance-covariance matrices was not violated.

There was a significant main effect of time, $F(1, 43) = 105.99, p < .001$ (*Between Subjects MSE* = .04), which accounted for approximately 71% of the variance in SCL between baseline and the first measurement time period ($\text{partial } \eta^2 = .711$). Collapsed across conditions, a significant increase in mean SCL was observed from baseline ($M = .69, SD = .34$) to the first measurement time period during the exposure ($M = 1.14, SD = .30$). The main effect of condition was not significant, $F(1, 43) = 2.45, p = .13$, and accounted for approximately 5.4% of additional variance ($\text{partial } \eta^2 = .054$). Collapsed across time, mean SCL did not significantly differ between the Comprehensive ($M = .85, SD = .31$) and Limited conditions ($M = .98, SD = .33$). The interaction between time and condition was also not significant, $F(1, 43) = 1.40, p = .24$, and accounted for approximately 3.2% of additional variance in mean SCL from baseline to the first measurement time period ($\text{partial } \eta^2 = .032$). Mean SCL from baseline to the first measurement time period according to condition is displayed below in Figure 1. As hypothesized (*H1a*), a significant increase in mean SCL was observed across both conditions.

However, the hypothesis that (*H1b*) a significantly greater increase in mean SCL would be observed in the Comprehensive condition was not supported.

Figure 1. Mean SCL (Y-axis) versus Time (X-axis) for the Comprehensive condition (solid line) and the Baseline condition (dashed line). Error bars represent standard error of the mean. The SCL values are reported below the X-axis.

Mean SCL collected at time 0 ($M = 5.5, SD = 1.0, 75.85^{\text{th}} = 10, p = .33$). Mean SCL collected across exposure during the Comprehensive condition ($M = 1.40, SD = .70$), the Baseline condition ($M = 1.41, SD = .66$), and the 50% exposure period of the exposure ($M = 1.42, SD = .67$) did not significantly differ when baseline SCL was not statistically controlled. The interaction effect was also non-significant ($F(1, 76, 75.55) = .43, p = .51$). Mean SCL collected across the 50% exposure period of the exposure ($M = 1.40, SD = .66$) did not significantly differ from the Comprehensive condition ($M = 1.40, SD = .70$) when baseline SCL was not statistically controlled ($F(1, 76, 75.55) = 1.14, p = .32$ (between subjects $MSE = 1.71$)). The interaction between time and condition was also non-significant when baseline SCL was not statistically controlled, $F(1, 76, 75.55) = 1.14, p = .32$ (between subjects $MSE = 1.71$)).

Figure 1. Mean Skin Conductance Level by Condition from Baseline to First Exposure Measurement

To test the hypothesis that peak skin conductance level (SCL) would be significantly greater in the Comprehensive condition, an independent t -test was conducted. Contrary to the hypothesis ($H1c$), peak SCL in the Comprehensive group ($M = 1.50$, $SD = .66$) did not significantly differ from the Limited condition group ($M = 1.62$, $SD = .75$), $t(43) = -.57$, $p = .57$.

To test the hypothesis that there would be a greater reduction in anxious arousal over time in the Comprehensive condition with respect to SCL, a 3(time) x 2(condition) mixed-ANOVA was first conducted to determine the effect of time according to condition *without* statistically controlling for baseline SCL measurements. Box's test of equality of covariance matrices was nonsignificant, $Box's M = 11.30$, $F(6, 13319.26) = 1.74$, $p = .11$, indicating that the assumption of homogeneity of variance-covariance matrices was not violated. Mauchly's test of sphericity was significant, $W = .87$, $\chi^2(2) = 6.04$, $p = .05$, indicating that the assumption of sphericity had been violated. Greenhouse-Geisser adjusted values are reported below to compensate for this violation.

The main effect of time was not significant, $F(1.76, 75.85) = .10$, $p = .88$. Mean SCL collapsed across condition during the first 10 minutes ($M = 1.40$, $SD = .70$), the second 10 minute period ($M = 1.41$, $SD = .66$), and the third 10 minute period of the exposure ($M = 1.39$, $SD = .65$) did not significantly differ when baseline SCL was not statistically controlled. The main effect of condition was also nonsignificant, $F(1, 43) = .43$, $p = .51$. Mean SCL collapsed across time for the Comprehensive group ($M = 1.33$, $SD = .64$) did not significantly differ from that of the Limited condition group ($M = 1.46$, $SD = .70$) when baseline SCL was not statistically controlled. The interaction between time and condition was also nonsignificant when baseline SCL was not statistically controlled, $F(1.76, 75.85) = 1.14$, $p = .32$ (*between subjects MSE* = 1.28).

Since the mixed-ANOVA was nonsignificant, a 3(time) x 2(condition) mixed-ANCOVA was conducted to determine the effect of time according to condition on mean SCL when baseline SCL was statistically controlled. Mean baseline SCL was determined to be significantly, positively associated with measurements at each of the three time periods (all $r_s > .36$, all $p_s < .02$). To satisfy the assumption that there were no significant differences between groups on the covariate (baseline SCL), an independent t -test was conducted. There was no significant difference between the Comprehensive ($M = .45$, $SD = .47$) and Limited conditions ($M = .73$, $SD = .68$) in baseline SCL, $t(43) = -1.60$, $p = .12$. Finally, the interaction between group assignment and the covariate (baseline SCL) at each time period was nonsignificant (all $p_s > .43$), indicating that the assumption of homogeneity of regression had been satisfied.

When statistically controlling for baseline SCL, the main effect of time remained nonsignificant, $F(1.80, 75.52) = 2.91$, $p = .07$, and accounted for approximately 6.5% of the variance in SCL during the 30-minute exposure ($\text{partial } \eta^2 = .065$). Collapsed across conditions, there was no significant difference in mean SCL between the first 10-minute period ($M = 1.40$, $SD = .70$), the second 10-minute period ($M = 1.41$, $SD = .66$) and the final 10-minute period ($M = 1.39$, $SD = .65$) of the exposure. The main effect of condition was also not significant, $F(1, 43) = .01$, $p = .94$, and accounted for less than 1% of additional variance ($\text{partial } \eta^2 < .001$). Collapsed across time, mean SCL did not significantly differ between the Comprehensive ($M = 1.41$, $SD = .64$) and Limited conditions ($M = 1.39$, $SD = .70$). The interaction between time and condition was also not significant, $F(1.80, 75.52) = 1.19$, $p = .31$ (*between subjects MSE* = .04), and accounted for approximately 2.7% of additional variance in mean SCL throughout the exposure ($\text{partial } \eta^2 = .027$). Mean (adjusted) SCL values at each measurement time period according to condition are presented in Figure 2. No significant reduction in mean SCL was

observed in either condition. The hypothesis (*H1d*) that a greater reduction in SCL over time would be observed in the Comprehensive condition (as compared to the Limited condition) was not supported.

To HR between baseline and the first measurement time period, the main effect of condition ($F(1, 41) = 1.17, p = .286$) was not significant. The main effect of time ($F(1, 41) = 1.17, p = .286$) was also not significant. The interaction between condition and time ($F(1, 41) = 1.17, p = .286$) was also not significant. The main effect of condition accounted for approximately 2.7% of additional variance in mean SCL from baseline to the first measurement time period ($\eta^2 = 0.027$). Mean HR from baseline to the first measurement time period is displayed in Figure 3. Contrary to the predicted significant increase from baseline to the first measurement time period, no significant increase in mean HR was observed in either condition. The main effect of condition accounted for approximately 2.7% of additional variance in mean SCL from baseline to the first measurement time period. Since the predicted significant increase in

Figure 2. Adjusted Mean Skin Conductance Level by Condition during 30-Minute Exposure^a

^aMean values adjusted for ANCOVA to control for baseline measurement are reported here.

Differences in Heart Rate between Conditions during Exposure

To test the hypothesis that there would be significant increases in both conditions, but that a greater increase in HR would occur in the Comprehensive condition from baseline to the first time period during the exposure, a 2(time) x 2(condition) mixed-ANOVA was conducted. Box's test of equality of covariance matrices was also nonsignificant, $\text{Box's } M = 1.24, F(3, 444257.94) = .39, p = .76$, indicating that the assumption of homogeneity of variance-covariance matrices was not violated.

The main effect of time was not significant, $F(1, 42) = .37, p = .55$ (between subjects $MSE = 301.55$), which accounted for less than 1% of the variance in HR between baseline and the first measurement time period ($\text{partial } \eta^2 = .009$). Collapsed across conditions, there was no significant difference in mean HR observed from baseline ($M = 75.36, SD = 13.18$) to the first measurement time period during the exposure ($M = 74.87, SD = 11.57$). The main effect of condition was also not significant, $F(1, 42) = .21, p = .65$, and accounted for less than 1% of additional variance ($\text{partial } \eta^2 = .005$). Collapsed across time, mean HR did not significantly differ between the Comprehensive ($M = 74.24, SD = 12.85$) and Limited conditions ($M = 75.92, SD = 12.13$). The interaction between time and condition was also not significant, $F(1, 42) = 3.18, p = .08$, and accounted for approximately 7.0% of additional variance in mean SCL from baseline to the first measurement time period ($\text{partial } \eta^2 = .070$). Mean HR from baseline to the first measurement time period according to condition is displayed in Figure 3. Contrary to the hypotheses, a significant increase from baseline HR was not observed in either condition ($H1a$) nor was there a greater increase from baseline in the Comprehensive condition ($H1b$). A significantly greater increase in mean HR was not observed in the Comprehensive condition from baseline to the first measurement time period. Since the predicted significant increase in

HR from baseline to the first measurement time point during the exposure was not observed in either condition (*H1a*, *H1b*), analyses to compare reductions in heart rate according to condition throughout the exposure (*H1d*) were deemed irrelevant and were not conducted.

Figure 3. Mean Heart Rate by Condition from Baseline to First Exposure Measurement

To test the hypothesis that peak heart rate (HR) would be significantly greater in the Comprehensive condition, an independent *t*-test was conducted. Contrary to the hypothesis (*H1c*), peak HR in the Comprehensive group ($M = 75.86$, $SD = 11.60$) did not significantly differ from the Limited condition group ($M = 77.30$, $SD = 11.10$), $t(42) = -.42$, $p = .68$.

Differences in Self-Reported Anxious Arousal between Conditions during Exposure

To test the hypothesis that significant increases would be observed in both conditions, but that there would be a significantly greater increase in SAM ratings in the Comprehensive condition from preexposure to the first exposure time period, a 2(time) x 2(condition) mixed-ANOVA was conducted. Mean SAM ratings (the mean of peak and end SAM arousal ratings for each 10-minute section of the exposure) were used for this analysis to be consistent with the method with which values for psychophysiological variables were derived. Box's test of equality of covariance matrices was also nonsignificant, *Box's* $M = .47$, $F(3, 357043.83) = .15$, $p = .93$, indicating that the assumption of homogeneity of variance-covariance matrices was not violated.

The main effect of time was significant, $F(1, 43) = 103.65$, $p < .001$ (*between subjects* $MSE = 3.44$), and accounted for approximately 70.7% of the variance in SAM ratings between preexposure and the first measurement time period (*partial* $\eta^2 = .707$). Collapsed across conditions, mean SAM ratings significantly increased from preexposure ($M = 2.38$, $SD = 1.41$) to the first measurement time period during the exposure ($M = 4.46$, $SD = 1.57$). The main effect of condition was not significant, $F(1, 43) = 1.61$, $p = .21$, and accounted for approximately 3.6% of additional variance (*partial* $\eta^2 = .036$). Collapsed across time, mean SAM ratings did not significantly differ between the Comprehensive ($M = 3.67$, $SD = 1.54$) and Limited conditions

($M = 3.17$, $SD = 1.42$). The interaction between time and condition was also not significant, $F(1, 43) = 1.58$, $p = .22$, and accounted for approximately 3.5% of additional variance in mean SAM ratings from baseline to the first measurement time period ($\text{partial } \eta^2 = .035$). Mean SAM ratings from baseline to the first measurement time period according to condition are displayed below in Figure 4. As predicted, a significant increase from baseline to the first exposure time period occurred in both conditions (*H1a*). However, contrary to the hypothesis (*H1b*), a significantly greater increase in SAM ratings was not observed in the Comprehensive condition.

Figure 4. Mean SAM Arousal Ratings by Condition from Baseline to First Exposure Measurement

To test the hypothesis that peak Self Assessment Manikin (SAM) ratings would be significantly greater in the Comprehensive condition, an independent t -test was conducted. Contrary to the hypothesis ($H1c$), peak SAM ratings in the Comprehensive group ($M = 5.77$, $SD = 1.54$) did not significantly differ from the Limited condition group ($M = 5.57$, $SD = 1.97$), $t(43) = .39$, $p = .70$.

To test the hypothesis that there would be a greater reduction in anxious arousal over time in the Comprehensive condition with respect to SAM ratings, a 3(time) x 2(condition) mixed-ANOVA was first conducted to determine the effect of time according to condition *without* statistically controlling for preexposure SAM arousal ratings. Box's test of equality of covariance matrices was nonsignificant, $Box's M = 2.35$, $F(6, 13319.26) = .36$, $p = .90$, indicating that the assumption of homogeneity of variance-covariance matrices was not violated. Mauchly's test of sphericity was not significant, $W = .88$, $\chi^2(2) = 5.16$, $p = .08$, indicating that the assumption of sphericity had not been violated.

The main effect of time was not significant, $F(2, 86) = .13$, $p = .88$. Mean SAM ratings collapsed across condition during the first 10 minutes ($M = 4.46$, $SD = 1.57$), the second 10 minute period ($M = 4.36$, $SD = 1.74$), and the third 10 minute period of the exposure ($M = 4.43$, $SD = 1.91$) did not significantly differ when preexposure SAM ratings were not statistically controlled. The main effect of condition was also nonsignificant, $F(1, 43) = .06$, $p = .82$. Mean SAM ratings collapsed across time for the Comprehensive group ($M = 4.47$, $SD = 1.65$) did not significantly differ from that of the Limited condition group ($M = 4.36$, $SD = 1.80$) when preexposure SAM ratings were not statistically controlled. The interaction between time and condition was significant when preexposure SAM ratings were not statistically controlled for, $F(2, 86) = 5.34$, $p = .006$ (between subjects $MSE = 7.06$).

A 3(time) x 2(condition) mixed-ANCOVA was conducted to determine whether the effect of time according to condition on mean SAM ratings would be significantly altered when preexposure SAM ratings were statistically controlled. Mean preexposure SAM ratings were determined to be significantly, positively associated with measurements at each of the three time periods (all $r_s > .50$, all $p_s < .001$). To satisfy the assumption that there were no significant differences between groups on the covariate (preexposure SAM ratings), an independent t -test was conducted. There was no significant difference between the Comprehensive ($M = 2.50$, $SD = 1.47$) and Limited conditions ($M = 2.26$, $SD = 1.36$) in preexposure SAM ratings, $t(43) = .57$, $p = .57$. Finally, the interaction between group assignment and the covariate (preexposure SAM ratings) at each time period was nonsignificant (all $p_s > .50$), indicating that the assumption of homogeneity of regression had been satisfied.

When statistically controlling for preexposure SAM ratings, the main effect of time remained nonsignificant, $F(2, 82) = .82$, $p = .44$, and accounted for approximately 1.9% of the variance in mean SAM ratings during the 30-minute exposure ($partial \eta^2 = .019$). The main effect of condition also remained nonsignificant, $F(1, 43) = .03$, $p = .86$, and accounted for less than 1% of additional variance ($partial \eta^2 = .001$). The interaction between time and condition remained significant when controlling for preexposure SAM ratings, $F(1, 43) = 5.39$, $p = .006$ (between subjects $MSE = 4.11$), and accounted for approximately 11.4% of additional variance in mean SAM ratings throughout the exposure ($partial \eta^2 = .114$). Therefore, the hypothesis ($H1$) that there would be a significant reduction of self-reported arousal collapsed across conditions was not supported. Mean (adjusted) SAM ratings at each measurement time period according to condition are presented in Figure 5.

Planned contrasts (simple effects) were conducted for each condition between the first and last measurement time period during the exposure to explain the nature of the interaction (i.e., assess the degree of mean SAM rating reduction in each condition). A significant reduction in mean SAM ratings from the first ten minutes of the exposure ($M = 4.76, SD = 1.61$) to the final ten minutes of the exposure ($M = 4.03, SD = 1.70$) was observed in the Comprehensive condition, $t(42) = 2.08, p = .02$ (1-tailed). However, an unexpected *increase* in mean SAM ratings was observed in the Limited condition from the first ten minutes ($M = 4.16, SD = 1.47$) to the final ten minutes ($M = 4.82, SD = 2.07$) of the exposure, $t(42) = -1.91, p = .03$ (1-tailed). As hypothesized (*H1d*), greater reduction in mean SAM ratings was observed in the Comprehensive condition. However, rather than observing a decrease in SAM ratings in the Limited condition from beginning to end of the 30-minute exposure, an *increase* in SAM ratings was observed. This increase in self-reported anxiety would have been statistically significant in the context of a 1-tailed t -test (in the opposite tail of the distribution) if an increase had been predicted.

Figure 5. Adjusted Mean SAM Arousal Ratings by Condition during 30-Minute Exposure^a

^aMean values adjusted for ANCOVA to control for baseline measurement are reported here.

Postexposure Differences in Self-Reported Momentary Worry between Conditions

To test the hypothesis that Comprehensive participants would report significantly less postexposure momentary worry (as assessed by the 4-item Post Exposure Questionnaire) than Limited condition participants, a series of Independent *t*-tests were conducted. Each of these items was rated on a 5-point Likert scale. Lower scores indicate lower likelihood, worry, anticipated distress, or anticipated ability to cope. Higher scores indicate greater likelihood, worry, anticipated distress, or anticipated ability to cope. Levene's *HOV* test was significant for Postexposure Questionnaire Item 3 ($F = 4.21, p = .04$). Degrees of freedom were adjusted for Item 3 to compensate for this violation.

Contrary to hypotheses (*H2a*, *H2b*, and *H2c*), participants in the Comprehensive group did not rate the objective likelihood of their feared worry scenarios coming true in real life ($M = 2.27, SD = .88$) significantly lower than the Limited condition group ($M = 2.35, SD = .93$), $t(43) = -.28, p = .78$. Comprehensive participants also did not report less subjective worry that their worry scenarios would occur in real life ($M = 2.84, SD = 1.04$) as compared with the Limited condition group ($M = 3.00, SD = 1.09$), $t(43) = -.50, p = .62$. (*H2c*) Significant differences also were not observed between (*H2c*) the Comprehensive ($M = 4.72, SD = .63$) and Limited condition groups ($M = 4.87, SD = .34$) in predictions of the degree of distress that would be experienced if the feared scenarios were to occur in real life, $t(32.17) = -.93, p = .36$. However, as predicted (*H2d*), Comprehensive participants did report significantly greater anticipated ability to cope ($M = 3.00, SD = .93$) than the Limited condition group ($M = 2.42, SD = .84$) if the feared scenarios were to occur, $t(43) = -2.20, p = .03$.

Since heightened anxious arousal might be interpreted as a sign of fuller activation of fear structures, anxious arousal was investigated as a possible mechanism of new learning during

exposure (specifically, one's anticipated ability to cope if one's worst worry were to come true in real life). Therefore, a number of exploratory correlational analyses were conducted to determine whether anxious arousal during imaginal exposure was associated with postexposure anticipated ability to cope. Difference scores were used for variables of anxious arousal to control for baseline level of activation. Anticipated ability to cope was not significantly associated with peak self-reported anxiety ($r = -.21, p = .17$) or peak SCL ($r = -.01, p = .98$). The association between anticipated ability to cope and peak HR approached significance in the expected direction ($r = .29, p = .054$). There was no significant association between anticipated ability to cope and the degree of change from beginning to end of the exposure in self-reported anxiety ($r = .03, p = .83$), SCL ($r = -.21, p = .18$), or HR ($r = -.18, p = .25$).

There was a positive association between postexposure anticipated ability to cope and peak HR that approached significance. However, this finding should be interpreted with caution since no significant differences in HR emerged between conditions in earlier analyses and only a small number of participants in each condition demonstrated HR increases during exposure. Also, a similar correlational pattern was clearly not reproduced with the other measures of peak anxious arousal. Postexposure anticipated ability to cope was also not significantly associated with the degree of change from beginning to end of the exposure in any of the measures of anxious arousal (both self-report and psychophysiological). Therefore, anxious arousal likely does not account for observed differences between conditions in anticipated ability to cope in this sample.

Anxious Arousal during Exposure and Individual Differences in Imaginative Vividness

To test the hypothesis that individual difference measures of imaginative vividness (VVIQ, QMI) would be positively associated with peak anxious arousal during the imaginal exposure (both self-report and psychophysiological measures), a number of correlational analyses were conducted according to condition. Difference scores were used for psychophysiological variables (peak minus baseline) to control for individual differences in baseline heart rate and skin conductance level. Since it was determined that exposure scripts contained very few references to gustatory and olfactory sensations and participants had not been specifically instructed to include kinaesthetic references, corresponding QMI subscales were not examined in the analyses since any observed correlation between these subscales and the outcome variables would almost certainly be spurious. Because analyses indicated that participants included visual, auditory, cutaneous, and organic sensations where appropriate, only these corresponding QMI subscales were included in the correlational analyses. For scores on both the QMI and the VVIQ, lower scores indicate greater imaginative vividness and higher scores indicate less imaginative vividness. These correlations are presented in Table 5.

Table 5

Correlations (Significance) According to Condition between Individual Difference Measures of Imaginative Vividness and Peak Anxious Arousal during Exposure

Measure	Comprehensive			Limited		
	SAM	HR	SCL	SAM	HR	SCL
VVIQ	.06 (.79)	.37 (.10)	.28 (.20)	-.32 (.14)	-.04 (.88)	-.04 (.84)
QMI Visual	-.04 (.88)	.44 (.053)	-.02 (.94)	-.06 (.78)	.15 (.50)	-.30 (.16)
QMI Auditory	-.31 (.17)	.20 (.41)	-.35 (.12)	.11 (.61)	-.15 (.50)	.33 (.13)
QMI Cutaneous	-.34 (.14)	.26 (.28)	-.06 (.79)	.39 (.06)	.06 (.80)	.08 (.73)
QMI Organic	.16 (.50)	.16 (.50)	-.07 (.75)	.28 (.20)	.01 (.98)	-.10 (.66)

Although a few correlations approached statistical significance, the hypothesis (H3) that individual differences in imaginative ability would be positively related to peak anxious arousal during the exposure (both self-report and psychophysiological measures) in both conditions was not supported.

Imaginative Vividness and Absorption

It was expected that measures of imaginative vividness and absorption would be significantly correlated with each other. Although measures of imaginative vividness (VVIQ, QMI) were significantly correlated with each other, $r = .37, p = .02$, the strength of the correlation was not as strong as anticipated considering that the two scales measure similar constructs. The strength of correlation between the VVIQ (which measures visual imagination only) and the QMI visual subscale was stronger, $r = .54, p < .001$, but still not as high as might be expected. Contrary to the hypothesis (H4a), the TAS was not significantly correlated with either the QMI, $r = .18, p = .24$, or the VVIQ, $r = .14, p = .35$.

Anxious Arousal during Exposure and Individual Differences in Absorption

To test the hypothesis that individual differences in absorption (the tendency or ability to become deeply absorbed in experience; as measured by the TAS) would be positively correlated with peak anxious arousal (both self-report and psychophysiological measures) during the exposure, several correlational analyses were conducted according to condition. Difference scores were used for psychophysiological variables (peak – baseline) to control for individual differences in baseline heart rate and skin conductance level.

For Limited condition participants, none of the measures of peak anxious arousal obtained during the exposure (SCL, HR, SAM arousal manikin ratings) were significantly associated with TAS scores (all r s $< \pm .13$, all p s $> .57$). Therefore, the hypothesis (H4b) that

absorption would be significantly associated with peak anxious arousal during the exposure was not supported. The hypothesis (*H4c*) that TAS scores would be significantly, positively associated with peak self-reported vividness ratings during the exposure was also not supported, $r = .02, p = .94$.

For Comprehensive condition participants, peak anxious arousal measures obtained during the exposure also were not significantly associated with the TAS scores (all r s $< \pm .23$, all p s $> .15$). Therefore, the hypothesis (*H4b*) that absorption would be significantly associated with peak anxious arousal during the exposure was not supported. The hypothesis (*H4c*) that TAS scores would be significantly, positively correlated with peak vividness ratings during the exposure was also not supported, $r = -.11, p = .63$.

Although individual differences in absorption were not significantly related to peak self-reported vividness ratings in either condition, this may be explained by the ceiling effect that was observed in peak exposure vividness ratings. Because participants' self-reported peak exposure vividness ratings were uniformly at or near the ceiling of the scale, there was little room for variance and this may have masked significant relationships.

Imaginative Vividness and Self-Reported Peak Vividness during Exposure

To determine whether individual differences in imaginative ability were related to the degree of self-reported vividness of imagery during exposure, a number of correlational analyses were conducted. For the Limited condition, peak exposure vividness was significantly correlated with the VVIQ ($r = -.46, p = .03$). However, peak exposure vividness in the Limited condition was not significantly correlated with the visual ($r = -.22, p = .31$), auditory ($r = -.03, p = .88$), cutaneous ($r = .34, p = .12$), or organic ($r = .12, p = .59$) subscales of the QMI. For the Comprehensive condition, peak exposure vividness was not significantly correlated with the

VVIQ ($r = -.10, p = .66$), or the visual ($r = -.38, p = .09$), auditory ($r = -.28, p = .22$), cutaneous ($r = -.06, p = .80$), or organic ($r = -.20, p = .38$) subscales of the QMI. Although one correlation out of a possible four (VVIQ and the QMI visual subscale for each condition) concerning the visual sensory domain achieved statistical significance in the Limited condition only, the findings lacked consistency since the three remaining correlations were nonsignificant. Therefore, contrary to the hypothesis ($H5$), individual differences in imaginative ability also did not appear to be significantly predictive of participants' self-reported peak vividness ratings during the exposure. However, it is important to note that there was a clear ceiling effect in self-reported exposure vividness ratings and this may explain the lack of consistency in the findings.

Differences in Self-Reported Vividness between Conditions during Exposure

To determine whether peak exposure vividness significantly differed between conditions, an independent t -test was conducted. Levene's HOV test was nonsignificant, $F(43) = 2.04, p = .16$, indicating that the assumption of homogeneity of variance had not been violated. Peak vividness ratings in the Comprehensive group ($M = 6.27, SD = .70$) did not significantly differ from the Limited condition group ($M = 6.13, SD = 1.10$), $t(42) = .52, p = .61$.

To determine whether significant differences occurred between groups in exposure vividness ratings throughout the exposure, a 3(time) x 2(condition) mixed-ANOVA was conducted. As previously mentioned, exposure vividness was rated by participants on a scale of 1 to 7 after each of the three time points during the 30-minute exposure. Lower values indicate less vividness and higher scores indicate greater vividness. Box's test of equality of covariance matrices was nonsignificant, $Box's M = 10.03, F(6, 13319.26) = 1.54, p = .16$, indicating that the assumption of homogeneity of variance-covariance matrices was not violated. Mauchly's test of sphericity was significant, $W = .72, \chi^2(2) = 13.79, p = .001$, indicating that the assumption of

sphericity had been violated. Greenhouse-Geisser adjusted values are reported below to compensate for this violation.

The main effect of time was not significant, $F(1.56, 67.19) = .26, p = .71$, and accounted for less than 1 % of the variance in mean vividness ratings during the 30-minute exposure ($\text{partial } \eta^2 = .006$). Mean vividness ratings collapsed across condition during the first 10 minutes ($M = 5.54, SD = .77$), the second 10 minute period ($M = 5.51, SD = 1.06$), and the third 10 minute period of the exposure ($M = 5.46, SD = 1.30$) did not significantly differ. The main effect of condition was also nonsignificant, $F(1, 43) = .02, p = .90$, and accounted for less than 0.1% of additional variance ($\text{partial } \eta^2 < .001$). Mean vividness ratings collapsed across time for the Comprehensive group ($M = 5.49, SD = 1.07$) did not significantly differ from that of the Limited condition group ($M = 5.52, SD = 1.12$). The interaction between time and condition was also nonsignificant, $F(1.56, 67.19) = 1.99, p = .15$ (between subjects $MSE = 2.95$), and accounted for approximately 4.4% of additional variance ($\text{partial } \eta^2 = .044$). Mean exposure vividness ratings at each measurement time period according to condition are presented in Figure 6.

As noted earlier, a marked ceiling effect was observed in participants' self-reported exposure vividness ratings (see Figure 6). Since there was little room for increase and little variability due to this effect, significant findings may have been obscured. This is especially true of peak ratings since these ratings reflect the highest value reported by each participant throughout the entire exposure.

Figure 6. Mean Vividness Ratings by Condition during 30-Minute Exposure

Discussion

Brief Summary of Findings

With respect to psychophysiological measurement of participants' anxious arousal, heart rate (HR) displayed no significant increase from baseline to the first measurement time period in either condition. There also were no significant differences between conditions either at the first measurement time point or in peak HR during the 30-minute exposure. For skin conductance level (SCL), both conditions exhibited a significant increase from baseline, but there was no difference in magnitude of the increase between conditions. Peak SCL during the 30-minute exposure did not differ between conditions, nor was there any significant decrease in SCL throughout the exposure in either condition.

Participants' self-reported anxiety increased significantly from baseline to the first measurement time point in both conditions, but there were no significant differences in the magnitude of the increase. Peak self-reported anxiety during the exposure did not differ according to condition. However, from beginning to end of the 30-minute exposure, Comprehensive participants reported a statistically significant decrease and Limited participants reported a significant increase of self-reported anxiety.

With respect to variables assessed by the Post-Exposure Questionnaire, there were no significant differences between conditions in participants' reports of the likelihood of the feared scenario coming true in real life, the degree of worry that the feared scenario may come true, or the amount of anticipated distress if the scenario were to come true. However, participants in the Comprehensive condition reported significantly greater anticipated ability to cope than Limited condition participants if the feared scenario were to come true in real life. Exploratory analyses revealed that there were no significant associations between anticipated ability to cope and peak

anxious arousal or the degree of reduction of arousal during the exposure (for both self-report and psychophysiological measures of arousal).

Finally, individual differences in imaginative ability were not significantly correlated with peak anxious arousal (both psychophysiological and self-report). Significant associations were also not observed between individual differences in absorption and individual differences in imaginative ability, peak anxious arousal, or peak self-reported exposure vividness. Imaginative ability was not significantly predictive of peak self-reported exposure vividness.

Interpretation of Results

The current research set out to clarify a number of questions regarding imaginal exposure methodology. The first of these questions is whether the inclusion of references to anxious physiology in the exposure script results in greater peak arousal and greater reduction of arousal over time throughout the exposure. The general pattern that emerged was one of significantly increased anxious arousal from baseline across both conditions that did not differ as to the magnitude of peak anxiety, but sometimes differed with respect to the pattern of anxious arousal over time. However, it is important to note that it is impossible to determine whether the change from baseline in measures of anxious arousal was caused by the construction of the imaginal exposure script, imaginal exposure to the script, or a combination of both. That is, the process of script construction *alone* may have had an exposure effect.

While the lack of significant findings with respect to HR was unexpected, research findings that led to recent changes in the diagnostic criteria of GAD may explain this finding. Brown, Marten, and Barlow (1995) note that GAD criteria in *DSM-III-R* (American Psychiatric Association, 1987) originally included a cluster of symptoms of autonomic hyperactivity (which included accelerated heart rate). However, these symptom criteria were dropped in later editions

of the *DSM* because research demonstrated that they were not frequently endorsed by those with a diagnosis of GAD. The autonomic hyperactivity cluster was also found to be of limited utility in discriminating between GAD and other anxiety disorders as compared to the symptoms retained in *DSM-IV* (Brown, Marten, & Barlow, 1995). In light of these previous research findings, it may not be unexpected that significant elevations in HR were not observed in this sample during imaginal exposure.

However, significant elevations from baseline in SCL observed in both conditions rules out the interpretation that participants did not find the imaginal exposure procedure to be particularly activating. Since GAD is most readily distinguished from other anxiety disorders by symptoms such as feeling restless or on edge (Brown, et al., 1995), it seems logical that SCL would be a better measure of anxiety of this nature. HR is known to be a reflection of both the sympathetic and parasympathetic branches of the autonomic nervous system (Berntson et al., 1994) whereas SCL is generally regarded as a measure of sympathetic activation only; and this has led some anxiety researchers to conclude that SCL may be a more specific measure of general activation than HR (e.g. Mohlman & Zinbarg, 2000). As such, SCL may be more well suited to capturing subtle symptoms of generalized anxiety (e.g., restlessness) and HR may be more well suited to capturing more overt fear responses (e.g., racing heart).

With respect to self-reported anxiety, when references to anxious physiology were not included in the script, arousal was elevated from baseline initially and continued to rise and peak near the end of the 30-minute exposure such that a statistically significant *increase* in anxiety was observed from beginning to end of the 30-minute exposure. When these references were included, peak arousal was reached near the beginning of the exposure, and a statistically significant decrease in self-reported arousal was observed between the beginning and end of the

exposure. However, SCL revealed a pattern of general arousal throughout the exposure that did not differ according to condition and remained elevated with only minor fluctuations throughout the exposure.

Although this difference between psychophysiological measures and self-reported anxiety seems initially contradictory, it may be a result of the long intervals (10 minutes) used to calculate mean SCL. The longer mean intervals may have masked subtle but important differences between conditions in SCL that occurred during smaller metrics of time. However, using shorter time intervals would have necessitated comparisons between a greater number of time points, which would have made finding significant effects increasingly difficult under ANOVA/ANCOVA (due to required corrections to alpha for multiple comparisons). Notably, other studies examining psychophysiological measures of anxious arousal during imagery exposure (Bystritsky et al., 2000) and virtual reality exposure (Mühlberger, Herrmann, Wiedemann, Ellgring, & Pauli, 2001) have used markedly smaller time intervals to calculate mean SCL.

The slope of reduction in anxious arousal across a larger number of time points could have alternately been tested using Multilevel Linear Modeling or Latent Growth Curve Modeling, but this would have required a significantly larger number of participants. Another alternate approach would have been to use polynomial contrasts to test the effect of time across a greater number of measurement time points in the context of ANOVA/ANCOVA. However, this would have required markedly more specific hypotheses regarding the slope of anxious arousal decline and would have drastically increased the possibility of Type II error. Although there is a reasonable amount of research regarding the progression of anxious arousal during in vivo exposure (e.g., Antony et al, 2001; Telch et al., 2004; Alpers & Sell, 2008), there is little

research investigating the phenomena in the context of imaginal exposure to guide the formation of hypotheses. This necessitated caution regarding the statistical approach to test hypothesized effects. Therefore, using relatively long time periods to calculate mean values for psychophysiological variables to reduce the number of follow up tests constituted a reasonable compromise.

The current study also sought to answer whether the inclusion of references to senses beyond the visual and auditory domains in the exposure script would lead to increased peak arousal and a greater decrease in arousal throughout the exposure. The failure of participants to include these references could indicate that additional sensory domains were often not relevant to participants' exposure scenarios or that participants did not consider them important enough to include. A statistically significant difference between groups was observed in the frequency of cutaneous references in the expected pattern. However, the frequency of references beyond the visual and auditory sensory domains were infrequent in both conditions overall. Clearly, the manipulation was not successful and therefore no conclusions can be drawn regarding the effect of the inclusion of supplementary sensory domain information on anxious arousal during exposure.

The second question this study set out to answer is whether the addition of references to senses beyond the auditory and visual domains and the addition of references to anxious physiology into the exposure script results in differences in momentary worry. The answer to this question seems to be a qualified yes. As stated earlier, the manipulation of additional sensory domain references in the scripts of Comprehensive participants failed, and so this portion of the question cannot be addressed by these results. However, the manipulation of the inclusion of references to physiological anxious arousal into the scripts of Comprehensive participants was

clearly successful and it appears that this inclusion resulted in a noteworthy difference between conditions in momentary worry. Although null results were observed regarding objective likelihood, subjective worry, and anticipated distress of worry scenarios occurring in real life, participants in the Comprehensive condition reported significantly greater anticipated ability to cope than Limited condition participants if their feared scenarios were to occur in real life. This difference between conditions might be explained in the context of Foa and Kozak's (1986) model of fear processing. The inclusion of references to physiological anxious arousal in the scripts of Comprehensive condition participants may have led to fuller activation of cognitive fear structures, thus making a greater portion of fear structures available for new learning during the exposure. This interpretation seems to be reflected in the observed postexposure difference between groups in anticipated coping ability.

Considering that the treatment of GAD would normally take place over several months and include multiple exposures, it is interesting that this difference was observed after only a single 30-minute exposure. It is noteworthy that the observed difference between groups occurred solely from exposure, apart from the cognitive restructuring portion of typical CBT treatment of GAD, which lends credence to the assertion that imaginal exposure may be an important component of CBT treatment for GAD in its own right. However, a greater number of imaginal exposures combined with skills training, psychoeducation, and cognitive restructuring might be required to produce cognitive differences between groups across the other three momentary worry variables. Although this finding is promising and warrants further research, it is important to note that it is difficult to generalize results from a single exposure to an entire treatment package containing several exposures and multiple treatment components. It is

uncertain whether these differences would be clinically meaningful when compared with other treatment components throughout an entire treatment package for GAD.

The observed difference between conditions in anticipated ability to cope observed in the current research may loosely correspond to differences in what Dugas and Robichaud (2007) term *negative problem orientation* (which is normally addressed through psychoeducation and problem solving training in their treatment package). Dugas and Robichaud (2007) define this as a mindset that clients with GAD commonly exhibit that is marked by doubt regarding one's ability to solve problems, a view of problems as threatening rather than as a challenge, and marked pessimism regarding the outcome of one's attempts at solving a given problem. However, it is important to note that the entire construct of problem orientation was not assessed and anticipated coping was not measured before exposure. Although unlikely, the difference observed between conditions could have been a failure of random assignment (i.e., participants who possessed unusually positive attitudes concerning coping ability were assigned to the Comprehensive condition while participants who possessed markedly less confidence in their ability to cope were assigned to the Limited condition). It might be expected that random assignment would distribute differing levels of anticipated coping ability in participants approximately evenly between conditions, but the lack of preexposure measurement of anticipated coping ability (and other variables of momentary worry) made this impossible to verify.

Although between-group differences were observed in anticipated ability to cope, exploratory analyses revealed that there was no association between anticipated coping and anxious arousal (self-report or psychophysiological). Therefore, it would seem that the degree or pattern of anxious arousal is not the primary mechanism that facilitated these observed

differences. Again, it is important to note that no baseline measurements of anticipated coping ability were taken and so change cannot be assessed. However, these results seem to contradict Foa and Kozak's (1986) theory of emotional processing, which implies that anxious arousal should covary with the activation of fear structures and abate as new learning occurs. Although extremely tentative, one logical conclusion is that the model does not apply in the same way to emotional processing of generalized anxiety (i.e., protracted, low intensity) as it does to the emotional processing of fear (acute, high intensity). In the case of generalized anxiety, perhaps the cessation of avoidance is more fundamentally important than the degree or pattern of anxious arousal experienced. If worry does function primarily as a strategy to avoid fearful mental imagery as some theorists believe (Borkovec et al., 2004), then imaginal exposure to fearful mental images associated with one's primary worry content may have its most powerful effect upon worry by blocking avoidance. Exposure to previously avoided *concrete* images of one's worst worries occurring in real life along with feared consequences and associated meaning may provide opportunity for cognitive processing that is normally short-circuited due to the *indistinct* and *diffuse* nature of linguistic-based worry.

The current study also examined whether individual differences in imaginative vividness were related to the amount of anxious arousal elicited by the exposure regardless of condition. Although null results were found, the two measures of imaginative vividness (VVIQ, QMI) were clearly problematic in this study and this casts considerable doubt on the findings. The measures of imaginative vividness should have been more strongly correlated considering that they are regarded as measuring the same construct. Campos (1998) reported a correlation between these measures of $r = .48$ and Burton and Fogarty (2003) reported a correlation of $r = .57$, both of which are markedly greater than was observed here. Both measures demonstrated high internal

consistency reliability in this sample and order effects were controlled for through counterbalancing the measures. However, online presentation of these questionnaires may have led to results that were reliable but of questionable validity for any number of reasons (e.g., systematic failure to follow directions). Although the measures themselves have been criticized by some theorists as generally lacking in predictive and construct validity (e.g., Kihlstrom, Glisky, Peterson, Harvey, & Rose, 1991), the results reported here must be considered inconclusive, regardless of these concerns, due to the low correlations observed in the current research between measures of imaginative vividness.

It was also investigated whether individual differences in absorption are significantly related to the degree of anxious arousal experienced during exposure regardless of condition. No relationship was found between absorption and any of the psychophysiological measures or self-report measures of anxious arousal. Absorption was also not significantly related to either of the measures of imaginative ability in this sample, which is unusual since other research has found a relationship between these measures (e.g., Minakowska-Gruda, 2006). This finding likely underscores the problems noted earlier with the measures of imaginative ability in the current research rather than indicating any problems with the measure of absorption. There is little if any research examining the hypothesized link between absorption tendencies and anxious arousal during exposure. The most analogous research available may be a study conducted by Zachariae, Jørgensen, Bjerring, and Svendsen (2000) that explored psychophysiological responses to an experimental stressor task. The study found that individuals high in absorption displayed greater autonomic reactivity as measured by heart rate variability. However, the stressor task involved playing a video game that administered electric shocks when mistakes were made by players during the game, and while this could certainly be expected to evoke

anxiety, it is a drastically different procedure than imaginal exposure. Imaginal exposure does not provide external visual stimuli as it must be created by the participant in their mind's eye, and it does not involve the administration of punishment (i.e., electric shock).

In the current research, TAS scores were normally distributed in the sample and there was no evidence of range restriction. One possible explanation for the null results is that the creation of an audio recording of the exposure script resulted in an exposure that was engaging enough on its own to make the influence of absorption tendencies irrelevant. The significant elevations in psychophysiological and self-report measures of anxiety from baseline seem to support the assertion that the exposure was engaging enough to produce a significant amount of anxiety in participants. Therefore, it might be postulated that participants unilaterally were immersed (absorbed) in their respective imaginal exposure experiences.

Null results regarding the hypothesized association between individual differences and imaginative ability might also be explained in a similar manner. Perhaps the creation of an audio recording of the exposure script resulted in a description of the scenario that was detailed enough in and of itself to produce highly vivid mental images regardless of individual differences in imaginative vividness. This seems to be supported by the ceiling effects observed across both conditions. Regardless of condition, participants almost uniformly reported their exposure experiences as being highly vivid such that variance was extremely limited. As such, this pronounced ceiling effect may have masked significant associations between imaginative ability and other variables of interest.

Limitations

There are a number of key limitations to the current research. Since a small percentage of participants (40%) actually reported symptoms meeting diagnostic criteria for GAD and the sample as a whole might be best characterized as consisting primarily of nonclinical high worriers, it is difficult to determine how these results might generalize solely to those with a diagnosis of GAD. However, it is likely that the significant results observed would have been even more pronounced in a homogenous sample of participants with GAD since they might be likely to be more unilaterally worried and anxious than nonclinical high worriers. While it would have been useful to be able to repeat the analyses with only those participants with GAD, the resulting sample size would have been very small and these analyses would have been extremely underpowered.

It might also have been useful to know the diagnostic status of the sample with regards to other anxiety disorders. Although the results of the current research might still be largely applicable to imaginal exposure for other anxiety disorders, it would have been useful to be able to control for a wider variety of comorbidity in the sample and this information was unavailable because only the Mood Disorder and GAD sections of the semistructured clinical interview were used. Also, information regarding participants' use of anxiolytic medication or other substances (e.g., alcohol, cannabis) was not obtained and therefore could not be controlled. Use of anxiolytic medication or other substances that affect one's ability to experience anxiety might have been important to control for and might have even been a suitable exclusion criterion for the study.

Another limitation of this research was the mixed sample of student and community participants. This mixture makes it difficult to draw firm conclusions regarding either

population. However, because the majority of the sample was drawn from the community, it could be argued that the disadvantage of this potential ambiguity is outweighed by the advantage of having a more heterogeneous sample that may generalize (with some caution) more widely across a variety of populations.

Finally, the failure of the manipulation of the inclusion of sensory information beyond the visual and auditory domains and the difficulties with the measures of imaginative vividness made it impossible to draw conclusions regarding the role of these factors. It still remains unclear whether individual differences in imaginative vividness plays a role in the magnitude or pattern over time of anxiety experienced during imaginal exposure. The administration of questionnaires used to assess imaginative vividness was clearly problematic in the current study as evidenced by the lack of correlation between the two measures (VVIQ and QMI). It also remains unclear whether the inclusion of additional sensory information in the exposure script plays a role in anxious arousal during imaginal exposure. According to Foa and Kozak's (1986) model of emotional processing, it might be predicted that the inclusion of a more complete array of information from the five senses might more completely activate fear structures, and this might be expected to result in greater anxious arousal during exposure. However, the inclusion of references beyond the visual and auditory domains in exposure scripts was extremely infrequent in both conditions, making it impossible to investigate this research question with the current sample.

Future Directions

The current research should be replicated with a number of modifications to clarify findings. First, it would be important to conduct a study of imaginal exposure with an entire sample of participants for whom GAD diagnostic criteria are met. This would remove any lack of variability in anxious arousal in the current sample that could have been a result of the inclusion of participants who did not demonstrate clinically significant levels of worry. Future research might also calculate mean scores for psychophysiological variables over shorter segments of time and utilize statistical tests that can more elegantly analyze growth curves with numerous time points (e.g., Multilevel Linear Modeling), although this would require a significantly larger sample size. A full diagnostic interview might also be employed in future research for a more complete picture of comorbidity and questionnaires of imaginative vividness should be administered during the interview to ensure the validity of their administration.

An appropriate extension of the current research might be to conduct a series of imaginal exposures while tracking changes in momentary worry between exposures to examine whether cognitive change accumulates and whether changes in patterns of anxious arousal are observed over subsequent exposures. Many experts (e.g., Dugas & Robichaud, 2007) recommend multiple exposures that are spaced closely together because this is believed to facilitate greater opportunity for new learning. This approach could be contrasted with a psychoeducation/skills training condition and a condition that includes both components in order to assess the degree of change that takes place according to condition. This method would help determine the degree to which each treatment component contributes to the observed cognitive and anxious arousal pattern changes. The procedure could also include follow-up assessments to determine the degree to which these changes are maintained after treatment.

Traditional imaginal exposure utilizing recorded scripts should also be contrasted with the more recent procedure of written exposure (as described in Goldman et al., 2007). There are apparent advantages to both procedures and both have demonstrated efficacy (Goldman et al., 2007), but it is unclear whether both are equally effective in less rigidly controlled therapeutic contexts. Written exposure is less technology-dependent and allows the exposure script to be dynamically altered between sessions to incorporate further explorations of the worry subject matter. However, it is impossible for the therapist to verify that the client is adhering to guidelines (e.g., including a rich array of sensory information, writing from the first person point of view, etc.) during self-directed exposure homework. On the other hand, scripts that are recorded do not have the flexibility to incorporate further exploration of worry subject matter during self-directed exposure homework. However, they have the advantage of being composed with the therapist's assistance. This means that the therapist can ensure that the recorded script contains all of the appropriate elements of a high quality script. It is important to determine if both are equally effective in everyday practice or if one demonstrates superior clinical effectiveness in everyday psychological practice.

Conclusion

The results of the current study demonstrate that the inclusion of references to one's physiological arousal in an imaginal exposure script leads to greater anticipated ability to cope with the worrisome situation imagined if it were to occur in real life. However, the mechanism of action remains unknown. Although increased anxious arousal, both self-reported and physiologically measured (with the exception of heart rate), was observed in both conditions, the pattern and degree of anxious arousal did not predict differences in anticipated ability to cope. It may be speculated that the cessation of avoidance of fearful imagery is the mechanism of action

of imaginal exposure for chronic worry. Perhaps anxious arousal may be necessary but not sufficient in and of itself to facilitate the learning of new associations in the case of generalized anxiety.

Future research should investigate anxious arousal during imaginal exposure using smaller measurement time periods. This would help determine whether calculating mean arousal across relatively large time periods masks meaningful changes occurring at smaller metrics of time. If anxious arousal calculated across smaller metrics of time still is not significantly associated with the degree of anticipated ability to cope, this may add weight to the tentative conclusion drawn in the current research that within-session anxious arousal during imaginal exposure does not predict cognitive variable outcomes with respect to chronic worry. Pre and post measurements of cognitive variables should also be incorporated to further elucidate the nature and degree of cognitive change after imaginal exposure.

Appendix A – Exposure Scenario Construction Protocol: Comprehensive Condition

“I’d like you to think of a *future oriented* concern or worry now in the domain we previously identified as an area of frequent worry for you (**Experimenter mentions the Participant’s dominant worry domain as identified during GAD section of SCID-I**). If you have several worries related to this area, try to identify the one that you find the most upsetting. It should be something that you are concerned may happen in the future *but that has not yet happened*. What would that be for you? (**Experimenter pauses here for Participant to respond**).

In a few minutes, I’ll have you dictate to me a hypothetical scenario describing a situation where this worry actually comes true in real life. But first, I’d like to give you some further instructions about what the scenario should contain. It should include the setting of your fearful situation, your physical and emotional reactions to the situation, and the meaning that you take from both the situation and your reactions. It should be written in present tense from the first person (your) perspective. It should also contain any relevant information from your five senses (sight, smell, hearing, taste, and touch) so as to make the scenario as concrete and vivid as possible. You don’t have to include information from all the senses – just that which is relevant to your worry and how you would experience it in real life. Your scenario should also include any physical sensations (i.e., ways that your body reacts to or manifests your anxiety) that would occur if your worry came true in real life. Finally, your scenario should not contain any neutralization. Try to make the scenario two to three minutes in length if you were to read it slowly with expression. I’ll type your scenario into the word processing program as you dictate it to me. We’ll look at the scenario together and edit the content further if necessary to make it

as concrete and vivid as possible. Then I'll have you read it aloud while I record you. Finally, I'll have you listen to the recording repeatedly for 30 minutes while you imagine the described worrisome situation coming true in real life. Do you have any questions? **(Experimenter waits for Participant to respond and provides further clarification if required. Experimenter then types worry script as Participant dictates.)**"

(After script has been typed and edited appropriately according to condition, Experimenter records exposure script as Participant reads it aloud). "Thinking intensely over a protracted period of time about our worries can be somewhat uncomfortable, but I'd like you to try to stay focused on the scenario in your mind's eye and bring your attention back to the scenario if your mind wanders. I'll be asking you for subjective ratings of your anxiety, using the self-assessment manikins I showed you earlier, every ten minutes throughout the thirty minute session. I'll also ask you to rate the sharpness/clarity of what you are imagining (on a scale from 1 to 7, as discussed earlier) every ten minutes through the course of the session. Do you have any further questions before we begin? **(Experimenter waits for Participant to respond and answers any questions).** Now please close your eyes and I'll start the exposure scenario playback. **(Experimenter starts playback).**"

Appendix B – Exposure Scenario Construction Protocol: Limited Condition

“I’d like you to think of a *future oriented* concern or worry now in the domain we previously identified as an area of frequent worry for you (**Experimenter mentions the Participant’s dominant worry domain as identified during GAD section of SCID-I**). If you have several worries related to this area, try to identify the one that you find the most upsetting. It should be something that you are concerned may happen in the future *but that has not yet happened*. What would that be for you? (**Experimenter pauses here for Participant to respond**).

In a few minutes, I’ll have you dictate to me a hypothetical scenario describing a situation where this worry actually comes true in real life. But first, I’d like to give you some further instructions about what the scenario should contain. It should include the setting of your fearful situation, your emotional reactions to the situation, and the meaning that you take from both the situation and your reactions to it. It should be written in present tense from the first person (your) perspective. Try to describe what you see in your mind’s eye with a great amount of detail so as to make the scenario as concrete and vivid as possible. Finally, your scenario should not contain any neutralization. Try to make the scenario two to three minutes in length if you were to read it slowly with expression. I’ll type your scenario into the word processing program as you dictate it to me. We’ll look at the scenario together and edit the content further if necessary to make it as concrete and vivid as possible. Then I’ll have you read it aloud while I record you. Finally, I’ll have you listen to the recording repeatedly for 30 minutes while you imagine the described worrisome situation coming true in real life. Do you have any questions?

(Experimenter waits for Participant to respond and provides further clarification if required. Experimenter then types worry script as Participant dictates.)."

(After script has been typed and edited appropriately according to condition, Experimenter records exposure script as Participant reads it aloud). "Thinking intensely over a protracted period of time about our worries can be somewhat uncomfortable, but I'd like you to try to stay focused on the scenario in your mind's eye and bring your attention back to the scenario if your mind wanders. I'll be asking you for subjective ratings of your anxiety, using the self-assessment manikins I showed you earlier, every ten minutes throughout the thirty minute session. I'll also ask you to rate the sharpness/clarity of what you are imagining (on a scale from 1 to 7, as discussed earlier) every ten minutes through the course of the session. Do you have any further questions before we begin? **(Experimenter waits for Participant to respond and answers any questions).** Now please close your eyes and I'll start the exposure scenario playback. **(Experimenter starts playback)."**

Appendix C - Prompts for Exposure Scenario Editing: Comprehensive Condition

- 1) If elements of scenario are not in present tense or the first person: “Please ensure that all of your script is in the first person (present tense) as this will make it more realistic. For instance, use phrases such as ‘I am driving down the road’ instead of ‘I was driving down the road’ or ‘I would be driving down the road’ so the scenario will read as if it is happening to you presently.”
- 2) If neutralization is present in sections of the scenario: “It looks as though you may have some neutralization in your script. How might you rephrase this section (**Experimenter points to appropriate section**) so that it is as realistic as possible? (**Experimenter may explain more if Participant does not see why the section is neutralization**).” ***(**A similar prompt may be used if Participant’s scenario ending is unrealistically positive**)***
- 3) If content is generally impoverished and lacking in detail: “This is an excellent start, but can you add some more detail? Try to provide more descriptive detail about the setting, your physical and emotional reactions to it, and the meaning you take away from both the scene and your reactions to it.”
- 4) If there is poverty of detail regarding relevant information from the five senses: “Your scenario could use some more details regarding relevant information from the five senses. What else might you be seeing (hearing/smelling/tasting/touching) if this situation came true in real life?”
- 5) If there is poverty of detail regarding physiological anxious arousal: “A little more detail about any physical sensations of anxiety in your body would make your scenario more

realistic. If you can't think of anything, it may be helpful to think of how your body reacts to anxiety in the context of a more familiar situation such as writing an important exam, going for a job interview, going on a date you are particularly nervous about, etc.”

Appendix D - Prompts for Exposure Scenario Editing: Limited Condition

- 1) If elements of scenario are not in present tense or the first person: “Please ensure that all of your script is in the first person (present tense) as this will make it more realistic. For instance, use phrases such as ‘I am driving down the road’ instead of ‘I was driving down the road’ or ‘I would be driving down the road’ so the scenario will read as if it is happening to you presently.”
- 2) If neutralization is present in sections of the scenario: “It looks as though you may have some neutralization in your script. How might you rephrase this section (**Experimenter points to appropriate section**) so that it is as realistic as possible? (**Experimenter may explain more if Participant does not see why the section is neutralization**).” ***(**A similar prompt may be used if Participant’s scenario ending is unrealistically positive**)***
- 3) If content is generally impoverished and lacking in detail: “This is an excellent start, but can you add some more detail? Try to provide more descriptive detail about the setting, your reactions to it, and the meaning you take away from both the scene and your reactions to it.”
- 4) If there is poverty of detail regarding relevant visual information: “Your scenario could use more detail regarding what you see in your environment. Try to imagine in your mind’s eye what other relevant visual information from the environment you might take note of if this situation came true in real life.”

References

- Abramowitz, J. S. (1996). Variants of exposure and response prevention in the treatment of obsessive-compulsive disorder: A meta-analysis. *Behavior Therapy*, 27, 583-600.
- Alpers, G. W., & Sell, R. (2008). And yet they correlate: Psychophysiological activation predicts self-report outcomes of exposure therapy in claustrophobia. *Journal of Anxiety Disorders*, 22, 1101-1109.
- American Psychiatric Association. (1987). *Diagnostic and statistical manual of mental disorders* (3rd ed., rev.). Washington, DC: Author.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Antony, M. M., McCabe, R. E., Leeuw, I., Sano, N., & Swinson, R. P. (2001). Effect of distraction and coping style on in vivo exposure for specific phobia of spiders. *Behaviour Research and Therapy*, 39, 1137-1150.
- Armfield, J. M. (2008). An experimental study of the role of vulnerability related perceptions in spider fear: Comparing an imaginal and in vivo encounter. *Journal of Anxiety Disorders*, 22, 222-232.
- Behar, E., Alcaine, O., Zuellig, A. R., & Borkovec, T. D. (2003). Screening for generalized anxiety disorder using the Penn State Worry Questionnaire: A receiver operating characteristic analysis. *Journal of Behavior Therapy and Experimental Psychiatry*, 34, 25-43.
- Berntson, G. G., Cacioppo, J. T., Binkley, P. F., Uchino, B. N., Quigley, K. S., & Fieldstone, A. (1994). Autonomic cardiac control. III. Psychological stress and cardiac response in

autonomic space as revealed by pharmacological blockades. *Psychophysiology*, 31, 599-608.

Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The Self-Assessment Manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, 25, 49-59.

Borkovec, T. D., Alcaine, O. M., & Behar, E. (2004). Avoidance theory of worry and generalized anxiety disorder. In R. G. Heimberg, C. L. Turk, & D. S. Mennin (Eds.), *Generalized anxiety disorder: Advances in research and practice* (pp. 77-108). New York: Guilford.

Borkovec, T. D., & Costello, E. (1993). Efficacy of applied relaxation and cognitive-behavioral therapy in the treatment of generalized anxiety disorder. *Journal of Consulting and Clinical Psychology*, 61, 611-619.

Brown, T. A., Antony, M. M., & Barlow, D. H. (1992). Psychometric properties of the Penn State Worry Questionnaire in a clinical anxiety disorders sample. *Behaviour Research and Therapy*, 30, 33-37.

Brown, T. A., Marten, P. A., & Barlow, D. H. (1995). Discriminant validity of the symptoms constituting the DSM-III-R and DSM-IV associated symptom criterion of Generalized Anxiety Disorder. *Journal of Anxiety Disorders*, 9, 317-328.

Burton, L., & Fogarty, G. (2003). The factor structure of visual imagery and spatial abilities. *Intelligence*, 31, 289-318.

Bysritsky, A., Maidenberg, E., Craske, M. G., Vapnik, T., & Shapiro, D. (2000). Laboratory psychophysiological assessment and imagery exposure in panic disorder patients. *Depression and Anxiety*, 12, 102-108.

- Campos, A. (1998). A measure of visual imaging capacity: A preliminary study. *Perceptual and Motor Skills*, 87, 1012-1014.
- Covin, R., Ouimet, A. J., Seeds, P. M., & Dozois, D. J. A. (2008). A meta-analysis of CBT for pathological worry among clients with GAD. *Journal of Anxiety Disorders*, 22, 108-116.
- Dadds, M. R., Hawes, D., Schaefer, B., & Vaka, K. (2004). Individual differences in imagery and reports of aversions. *Memory*, 12, 462-466.
- Di Nardo, P. A., Brown, T. A., & Barlow, D. H. (1994). *Anxiety Disorders Interview Schedule for DSM-IV (ADIS-IV)*. New York: Oxford.
- Dugas, M. J., Ladouceur, R., Léger, E., Freeston, M. H., Langlois, F., Provencher, M. D., & Boisvert, J. (2003). Group cognitive-behavioural therapy for generalized anxiety disorder: Treatment outcome and long-term follow-up. *Journal of Consulting and Clinical Psychology*, 71, 821-825.
- Dugas, M. J., & Robichaud, M. (2007). *Cognitive-behavioral treatment for generalized anxiety disorder: From science to practice*. New York: Routledge.
- Epstein, E. M., Sloan, D. M., & Marx, B. P. (2005). Getting to the heart of the matter: Written disclosure, gender, and heart rate. *Psychosomatic Medicine*, 67, 413-419.
- First, M.B., Spitzer, R.L., Gibbon, M., & Williams, J.B.W. (1996). *Structured Clinical Interview for DSM-IV Axis I Disorders – Patient edition (SCID-I/P, Version 2.0)*. New York: New York Psychiatric Institute, Biometrics Research Department.
- Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin*, 99, 20-35.

- Foa, E. B., Huppert, J. D., & Cahill, S. P. (2004). Emotional processing theory: An update. In B. O. Rothbaum (Ed.), *Pathological anxiety: Emotional processing in etiology and treatment* (pp. 3-24). New York: Guilford.
- Gillis, M. M., Haaga, D. A. F., & Ford, G. T. (1995). Normative values for the Beck Anxiety Inventory, Fear Questionnaire, Penn State Worry Questionnaire, and Social Phobia and Anxiety Inventory. *Psychological Assessment*, 7, 450-455.
- Glisky, M. L., Tataryn, D. J., Tobias, B. A., Kihlstrom, J. F., & McConkey, K. M. (1991). Absorption, openness to experience, and hypnotizability. *Journal of Personality and Social Psychology*, 60, 263-272.
- Goldman, N., Dugas, M. J., Sexton, K. A., & Gervais, N. J. (2007). The impact of written exposure on worry: A preliminary investigation. *Behavior Modification*, 31, 512-538.
- Hunot, V., Churchill, R., Teixeira, V., & Silva de Lima, M. (2007). *Psychological therapies for generalised anxiety disorder* (Cochrane Database of Systematic Reviews 2007, Volume 1). Chichester, UK: Wiley.
- Kihlstrom, J. F., Glisky, M. L., Peterson, M. A., Harvey, E. M., & Rose, P. M. (1991). Vividness and control of mental imagery: A psychometric analysis. *Journal of Mental Imagery*, 15, 133-142.
- Marks, D. F. (1973). Visual imagery differences in the recall of pictures. *British Journal of Psychology*, 64, 17-24.
- Mathews, A. M. (1971). Psychophysiological approaches to the investigation of desensitization and related procedures. *Psychological Bulletin*, 76, 73-91.

- Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the Penn State Worry Questionnaire. *Behaviour Research and Therapy*, 28, 487-495.
- Minakowska-Gruda, I. (2006). Relations and differences among three kinds of imagery related traits: Visual cognitive style, imagery vividness and imagination immersion. *Imagination, Cognition and Personality*, 26, 43-63.
- Mohlman, J., & Zinbarg, R. E. (2000). What kind of attention is necessary for fear reduction? An empirical test of the emotional processing model. *Behavior Therapy*, 31, 113-133.
- Mühlberger, A., Herrmann, M. J., Wiedemann, G., Ellgring, H., & Pauli, P. (2001). Repeated exposure of flight phobics to flights in virtual reality. *Behavior Research and Therapy*, 39, 1033-1050.
- Murphy K. R., & Davidshofer, C. O. (2005). *Psychological testing: Principles and applications* (6th Ed.). Upper Saddle River, NJ: Pearson.
- Pennebaker, J. W., Booth, R. J., & Francis, M. E. (2007). Linguistic Inquiry and Word Count: LIWC2007 (Computer software). Austin, TX: LIWC Incorporated.
- Provencher, M. D., Dugas, M. J., & Ladouceur, R. (2004). Efficacy of problem-solving training and cognitive exposure in the treatment of generalized anxiety disorder: A case replication series. *Cognitive and Behavioral Practice*, 11, 404-414.
- Rauch, S. A. M., Foa, E. B., Furr, J. M., & Filip, J. C. (2004). Imagery vividness and perceived anxious arousal in prolonged exposure treatment for PTSD. *Journal of Traumatic Stress*, 17, 461-465.

- Rentz, T. O., Powers, M. B., Smits, J. A. J., Coughle, J. R., & Telch, M. J. (2003). Active-imaginal exposure: Examination of a new behavioural treatment for cynophobia (dog phobia). *Behaviour Research and Therapy*, 41, 1337-1353.
- Sheehan, P. W. (1967). A shortened form of Betts' questionnaire upon mental imagery. *Journal of Clinical Psychology*, 23, 386-389.
- Sloan, D. M., Marx, B. P., Epstein, E. M., & Lexington, J. M. (2007). Does altering the writing instructions influence outcome associated with written disclosure? *Behavior Therapy*, 38, 155-168.
- Solomon, S. D., & Johnson, D. M. (2002). Psychosocial treatment of posttraumatic stress disorder: A practice-friendly review of outcome research. *Psychotherapy in Practice*, 58, 947-959.
- Tabachnick B. G., & Fidell, L. S. (2007). *Using Multivariate Statistics* (5th Ed.). Boston, MA: Pearson.
- Tarrier, N., Pilgrim, H., Sommerfield, C., Faragher, B., Reynolds, M., Graham, E., & Barrowclough, C. (1999). A randomized trial of cognitive therapy and imaginal exposure in the treatment of chronic posttraumatic stress disorder. *Journal of Consulting and Clinical Psychology*, 67, 13-18.
- Tarrier, N., & Sommerfield, C. (2004). Treatment of chronic PTSD by cognitive therapy and exposure: 5-year follow-up. *Behavior Therapy*, 35, 231-246.
- Telch, M. J., Valentiner, D. P., Ilai, D., Young, P. R., Powers, M. B., & Smits, J. A. J. (2004). Fear activation and distraction during the emotional processing of claustrophobic fear. *Journal of Behavior Therapy and Experimental Psychiatry*, 35, 219-232.

- Tellegen, A., & Atkinson, G. (1974). Openness to absorbing and self-altering experiences ("absorption"), a trait related to hypnotic susceptibility. *Journal of Abnormal Psychology*, 83, 268-277.
- Turner, S. M., Beidel, D. C., Cooley, M. R., Woody, S. R., & Messer, S. C. (1994). A multicomponent behavioural treatment for social phobia: Social effectiveness therapy. *Behaviour Research and Therapy*, 32, 381-390.
- van Minnen, A., & Foa, E. B. (2006). The effect of imaginal exposure length on outcome of treatment for PTSD. *Journal of Traumatic Stress*, 19, 427-438.
- Vrana, S. R., Cuthbert, B. N., & Lang, P. J. (1989). Processing fearful and neutral sentences: Memory and heart rate change. *Cognition and Emotion*, 3, 179-195.
- Wiederhold, B. K., & Wiederhold, M. D. (2005). *Virtual reality therapy for anxiety disorders: Advances in evaluation and treatment*. Washington, DC: American Psychological Association.
- Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence: Teleoperators and Virtual Environments*, 7, 225-240.
- Zachariae, R., Jørgensen, M. M., Bjerring, P., & Svendsen, G. (2000). Autonomic and psychological responses to an acute psychological stressor and relaxation: The influence of hypnotizability and absorption. *The International Journal of Clinical and Experimental Hypnosis*, 48, 388-403.