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The Impact of Mindfulness on Exposure and Extinction Processes in Social Anxiety

Michael Treanor
University of Massachusetts Boston

THE IMPACT OF MINDFULNESS ON EXPOSURE AND EXTINCTION PROCESSES IN SOCIAL ANXIETY

A Dissertation Presented

by

MICHAEL TREANOR

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Approved as to style and content by:

_____

Lizabeth Roemer, Professor
Chairperson of Committee

_____

Sarah Hayes-Skelton, Assistant Professor
Member

_____

Laurel Wainwright, Senior Lecturer
Member

_____

Alice S. Carter, Program Director
Clinical Psychology Program

_____

Carol Smith, Acting Chairperson
Psychology Department

ABSTRACT

THE IMPACT OF MINDFULNESS ON EXPOSURE AND EXTINCTION PROCESSES IN SOCIAL ANXIETY

June 2012

Michael Treanor, B.A., Loyola Marymount University
M.A., University of Massachusetts Boston
Ph.D., University of Massachusetts Boston

Directed by Professor Lizabeth Roemer

The present study sought to examine the potential impact of brief mindfulness inductions to enhance exposure and extinction processes in social anxiety. Mindfulness may enhance extinction through increased awareness of multiple conditioned excitors (thereby "overpredicting" the occurrence of an aversive outcome) or by acting as a retrieval cue to mitigate return of fear. Twenty-two participants high in social anxiety were recruited to participate in a series of massed exposures. Latent growth curve analyses revealed that participants who received mindfulness inductions prior to exposure procedures demonstrated enhanced extinction learning as measured by expectancy ratings, but not when measured by distress, state anxiety or willingness. In Study 2, participants who received mindfulness inductions were invited back between 1 and 3 weeks later to examine the potential of mindfulness to act as a retrieval cue to mitigate

return of fear. There appeared to be a non-significant return of fear, thereby limiting our ability to examine mindfulness as a retrieval cue. Results are discussed in terms of the basic science of conditioning and extinction.

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CHAPTER 1

SPECIFIC AIMS

As a group, anxiety disorders represent some of the most prevalent mental health difficulties today (Kessler, Chiu, Demler, & Walters, 2005). Fortunately, cognitive-behavioral therapies (CBT) have been established as efficacious for the treatment of anxiety disorders (Barlow, 2002; Chambless et al., 1996), and are often considered a first line treatment option for these disabling conditions. At the core of many cognitive-behavioral treatments for anxiety disorders is exposure, or repeatedly confronting a feared stimulus while simultaneously abstaining from engaging in any avoidance behavior (Craske, 1999). Although the mechanisms behind exposure procedures are largely predicated upon models of extinction learning (discussed more fully below), many have argued that clinical researchers have not adequately taken into consideration advances in our understanding of extinction processes derived from basic science (e.g., Craske, Kircanski, Zelikowsky, Mystkowski, Chowdury, & Baker, 2008). A more thorough understanding of the basic science underlying extinction may help to improve current behavioral treatments for anxiety disorders.

In addition to traditional forms of cognitive and behavioral therapy, behavioral approaches that incorporate mindfulness and acceptance-based strategies have shown promise in the treatment of various anxiety disorders (Batten & Hayes, 2005; Dalrymple

& Herbert, 2007; Roemer, Orsillo, & Salters-Pedneault, 2008). Derived from Eastern traditions such as Buddhism, mindfulness refers to a process of focusing on experiences in the present moment in an open, non-judgmental, curious, and accepting manner (Kabat-Zinn, 1990, 2005). Although these approaches have demonstrated promising results, further research is needed to more precisely elucidate the ways in which mindfulness practice may enhance treatment for anxiety. One area that has yet to be fully explored is the manner in which mindfulness interventions might facilitate exposure processes. This is surprising, given the centrality of exposure and extinction processes in the treatment of anxiety disorders. However, numerous findings in both basic and clinical science point to the possibility that mindfulness interventions might facilitate exposure and extinction processes although no studies to date have directly examined this possibility.

Based on research in the basic science of conditioning and extinction, the overall aim of the present study was to examine the potential impact of brief mindfulness inductions on exposure and extinction processes in social anxiety disorder. Social anxiety disorder represents a prime candidate for this type of research given its a) high prevalence and disability (Kessler et al., 2005), b) amenability to laboratory-based examinations (Moscovitch & Hoffman, 2004), and c) focus as a treatment target for successful exposure-based anxiety disorder treatments (Gould, Buckminster, Pollack, Otto, & Yap, 1997; Hope, Heimberg, & Bruch, 1995).

In undertaking this type of research, it is important to distinguish between the interventions themselves and the mechanisms of action underlying these interventions. For the purposes of this study, exposure or exposure-based procedures will refer to the

process of confronting a feared stimulus while abstaining from avoidance behavior. Extinction, or extinction learning, will refer to one of the mechanisms thought to underlie the efficacy of these approaches. The aims of the current study were to:

1. **Apply findings from basic science to the examination of the effect of a brief mindfulness manipulation on exposure and extinction processes.** For example, we examined whether mindfulness inductions enhanced extinction learning, and whether or not mindfulness inductions during exposure procedures acted as a retrieval cue to mitigate the return of fear.
2. **Assess the feasibility of examining the effects of brief mindfulness manipulations on extinction learning.** Given that this was one of the first studies to examine the effect of a mindfulness manipulation on extinction learning in anxiety disorders, it was important to assess the feasibility of conducting laboratory based assessments of this type.

CHAPTER 2

BACKGROUND AND SIGNIFICANCE

Conditioning and Anxiety

Although various theoretical orientations have provided explanations for the development, maintenance, and treatment of pathological anxiety, this study operated from within a behavioral or learning theory framework. Although a full examination of the research underlying both behavioral and learning theory is beyond the scope of the present study, a basic understanding of certain core principles, particularly those related to classical conditioning, will be helpful as we proceed to explore extinction processes.

The behavioral model of anxiety disorders is based on the assumption that anxiety is a learned or conditioned response. A particular cue comes to elicit a fearful or anxious response because of its association with an aversive consequence. This type of associative learning is most easily exemplified by examining Pavlov's (1927) seminal series of experiments in which a previous neutral stimulus (a bell) came to elicit the same response in a canine (salivation) as an unlearned stimulus (food). This occurred because the sound of the bell often preceded the delivery of food. In short, the animal responded with salivation to the sound of the bell because it was a good predictor that food would be delivered. This process of learning has come to be known as either classical or Pavlovian conditioning, and it is a core processes in associative learning.

Many researchers initially argued that the association formed during classical conditioning was between the conditioned stimulus and unconditioned response (known as a stimulus-response or S-R relationship; Bouton, 2006). However, numerous findings from basic science point to the formation of a different association. In one seminal experiment, Rescorla (1973) conditioned rats to fear a light by pairing it with a klaxon (a device that produces a loud noise). Following conditioning, one group of rats received exposure to the klaxon alone (i.e., without the light) until their fear habituated. These rats were less afraid of the light when tested once again. If the initial relationship that had formed were between the stimulus and response (the light and the fear), the animals would have still responded fearfully when presented with the light in a subsequent experiment. Rescorla (1973) argued that the initial relationship that formed was between the light and the klaxon (a stimulus-stimulus, or S-S relationship). Several studies have confirmed this finding (Holland, 1990; Holland & Rescorla, 1975). This does not mean that stimulus-response relationships do not form. These are the norm in operant conditioning, and can form in classical conditioning as well. In the latter case, this usually occurs after numerous pairings. However, the primary relationship in classical conditioning remains a S-S relationship (Bouton, 2006).

This model of conditioning can be applied to clinical disorders as well. In the case of anxiety disorders, an individual may respond with anxiety or fear to certain cues because of their association with an aversive outcome. For example, in social phobia an individual may respond with fear when presented with the possibility of giving a speech in front of others. This is because the act of giving a speech is assumed to be a good predictor of an aversive outcome such as social exclusion or humiliation (i.e., an S-S

relationship). Of course, the development and maintenance of anxiety disorders is a complex process, with factors such as second order conditioning, stimulus generalization, latent inhibition, and interoceptive conditioning playing important roles (Bouton, Mineka, & Barlow, 2001; Mineka & Zinbarg, 2006). Nevertheless, a wealth of research from basic science and clinical studies point to the explanatory power of learning theory and classical conditioning in regards to the etiology and treatment of anxiety disorders (Acheson, Forsyth, Prenoveau, & Bouton, 2007; Mineka & Zinbarg, 2006).

Given that classical conditioning represents a core process in the behavioral account of anxiety disorders, and formed the foundation upon which this study was based, it is important to explore it in more detail. Rescorla and Wagner (1972) proposed the following theory to explain many of the mechanisms underlying classical conditioning. They suggested that the strength of conditioning was governed by several factors including the salience of the conditioned and unconditioned stimuli (CS and US respectively), in addition to the magnitude and surprisingness of the US. They provided the following equation (a modified version of the learning curve) to illustrate the connection between these various factors and their affect on associative learning:

$$\Delta V = \alpha\beta(\lambda - \sum V)$$

where ΔV is the change in associative strength (or predictive value) for a given stimulus, α and β are the salience of the CS and US respectively, λ is the upper magnitude of the US, and $\sum V$ represents the sum of the associative strength of all stimuli present during the trial.

Although this is an equation, it is not meant to illustrate precise numbers or changes in associative strength, but merely to illustrate the importance of the various factors governing associative learning. One simply inserts numbers greater than or equal to zero in order to determine how various factors affect learning. Although it is beyond the scope of the present study to summarize all of the evidence in favor of the Rescorla-Wagner model, it is important to note that the model, and its subsequent derivations, has been an important force in the basic science of conditioning and extinction. Its ability to parsimoniously explain and predict numerous findings (such as blocking, deepened extinction, etc.) has allowed it to remain relevant to discussions of associative learning for the past several decades (Bouton, 2006). Although it is presented briefly here, it will be important when discussing mechanisms of extinction in subsequent sections.

Behavioral Treatments for Anxiety Disorders: Exposure and Extinction

From a behavioral perspective, learned or conditioned anxiety is treated by having the individual repeatedly confront a feared conditioned stimulus while simultaneously abstaining from any avoidance behavior (Craske, 1999). Within the clinical literature these interventions are collectively known as exposure or exposure-based procedures, and they form the core component of many behavioral and cognitive-behavioral treatments for anxiety disorders (Barlow, 2002). Indeed, several studies comparing treatments solely comprised of exposure-based interventions to those containing exposure plus additional elements (e.g., cognitive restructuring) have yielded no additional benefit to the combined treatment package (e.g., Foa et al., 2005; Hope, Heimberg, & Bruch, 1995). This has prompted some researchers to argue that exposure represents the primary

component responsible for change in the treatment of anxiety disorders (Foa, Rothbaum, & Furr, 2003).

By repeatedly presenting a given cue in the absence of the US, a new inhibitory association is formed. The organism comes to view the conditioned stimuli as no longer the best predictor of the occurrence of the unconditioned stimuli. As a result, conditioned responding is mitigated. For example, in social anxiety disorder, by repeatedly having the individual confront cues previously associated with social rejection or exclusion in the absence of these aversive consequences, the individual learns that the presence of these cues (e.g., giving a speech) is no longer a strong predictor of the negative outcome. The individual is then likely to display less fear in social situations. This process is known as extinction learning and is thought to be a core mechanism of action underlying these interventions (Vansteenwegen, Dirikx, Hermans, Vervliet, & Eelen, 2006)[1].

By returning once again to the Rescorla-Wagner model, one can gain a better understanding of the precise process of extinction learning. Once again, this model postulates that associative learning is governed by several factors including the salience of the CS and US, the magnitude of the US, and the sum of the associative strength of all the conditioned stimuli present on any given trial [$\Delta V = \alpha\beta(\lambda - \sum V)$]. Bouton (2006)

[1] Many researchers have argued that habituation is another important mechanism of action in the treatment of anxiety disorders (e.g., Foa & Kozak,1986). However, habituation is most commonly explained as a decrease in responding to a stimulus that elicits an innate or unlearned response (e.g., orienting to a particular stimulus, startle reaction, etc.). Yet rarely do clinicians expose clients to a stimulus that elicits an innate response in the context of therapy. Clients are exposed to conditioned stimuli that are thought to predict the occurrence of an aversive event (e.g., traumatic memory in post traumatic stress disorder, social interaction in social phobia), but not to the actual US itself (actual trauma, social rejection, etc.).

provides the following example in order to illustrate the process of extinction. Let us assume, for a given conditioned stimulus (X) an excitatory strength of 1 and a salience of .2. Inasmuch as extinction trials involve the non-occurrence of the US, we will place a value of 0 for λ.

$$\Delta V_x = .2(0-1) = -.2$$

Therefore, the Rescorla-Wagner model predicts a decrease in the associative strength of stimulus X.

A wealth of research in both animal and human populations lends support to process of extinction learning and the decrease in associative strength underlying it. For example, when conditioning fear in human samples, it is standard to measure an individual's expectancy that a particular CS will result in the delivery of a US. During extinction training these expectancy ratings, along with sympathetic arousal, often decrease, indicating a decrease in the associative strength between a particular cue (CS) and an aversive outcome (US;Vansteenwegen et al., 2005). Bouton (2004) has also summarized the evidence for various processes that may underlie extinction learning and has concluded that the evidence is most consistent with changes in associative strength instituted by violations in the expectancy that a US will occur. This is precisely what is implied by error-correction models such as those outlined by Rescorla and Wagner (1972).

Although this change in associative strength and prediction of aversive consequences is a prime candidate for the efficacy of extinction procedures, it is important to note that not all clinical studies of exposure procedures attempt to measure

this type of learning. Clinical researchers often use changes in symptom ratings, levels of distress, fear of aversive outcomes, and willingness to approach feared situations or objects (e.g. behavioral approach tasks) as indicators of successful exposure treatment (e.g., Hofmann & Barlow, 2002). However, given that exposure procedures are modeled closely on extinction procedures, and that extinction has been found to result in changes in the expectancy of aversive outcomes, it is highly probable that exposure procedures function by similar processes. Future research with clinical samples would be served by more direct measures of changes in associative strength and expectancy of aversive outcomes.

In summary, behavioral models and learning theories have provided a solid basis for understanding conditioning and extinction, as well as the mechanisms underlying these processes. In regards to extinction, these mechanisms include decreases in associative strength and expectancy of harm as explained by the Rescorla-Wagner model. However, in order to elucidate the ways in which mindfulness may positively impact exposure and extinction processes, it will be necessary to first examine conditions for enhancing as well as retaining extinction learning, while simultaneously considering alternative theories on the mechanisms underlying exposure. These subjects are considered in the following sections.

Enhancing Extinction Learning: Multiple Excitors

An interesting finding in early conditioning studies was that by reinforcing two or more conditioned excitors (i.e., stimuli that predict the occurrence of the US) together during conditioning, the stimuli actually decreased in associative strength. In these

studies, two stimuli (e.g., A and B) are both paired with an unconditioned stimulus separately. Although both were strongly conditioned predictors on their own, when presented together in conjunction with the US, they actually lost associative strength. That is, even though the US was delivered, conditioning actually decreased (Kremer, 1978; Rescorla, 1970). The Rescorla-Wagner model actually predicts this, as it emphasizes the sum of all the stimuli present on a given trial ($\sum V$). In essence, the combined excitatory strength of both conditioned stimuli actually *overpredicted* the strength or occurrence of the US. This became known as the overexpectation effect (Bouton, 2006). When the strength of the US is less than that predicted by the conditioned stimuli, conditioned associations weaken (i.e., conditioning decreases) whether or not the US is actually delivered.

This finding points to the importance the Rescorla-Wagner's model emphasis on the summation of all conditioned stimuli present on any given trial. It also points to a unique possibility in regards to extinction. As discussed previously, extinction learning implies a loss of associative strength as an organism learns that a given conditioned stimulus is no longer a strong predictor that the unconditioned stimulus will be delivered. Therefore, what would happen if one extinguished two or more excitatory stimuli simultaneously? Similar to the overexpectation effect, the Rescorla-Wagner model predicts a greater decrease in associative strength (i.e., heightened extinction). For example, whereas our previous extinction equation obtained a decrease in associative strength of -.2, the following equation, combining the excitatory strength of two conditioned stimuli, results in the following decrease:

$$\Delta V_x = .2[0-(1 + .7)] = -.34$$

As in the overexpectation effect, the combined excitatory strength of the two conditioned stimuli create a heightened expectation that the US will occur. When the US does not occur, as in extinction, there is a greater loss in associative strength precisely because of the large discrepancy between what was predicted and what actually occurred. Learning, or in this case extinction learning, is affected by discrepancies between what is predicted and what actually occurs (Bouton, 2006).

Despite the possibility of enhanced extinction implicated in the Rescorla-Wagner model, very few experimental studies have examined this possibility. However, in a series of experiments, Rescorla (2000) examined extinction of a stimulus (A) alone, in conjunction with another excitatory stimulus (X), in conjunction with a neutral stimulus (i.e., a non-excitatory stimulus; B), or the stimulus itself was spared extinction. The subjects' reactions to the target stimulus (i.e., stimulus A) were then examined during a test the following day. Consistent with the predictions of the Rescorla-Wagner model, extinction learning was greatest in those subjects receiving extinction to the compound excitatory stimuli (AX).

Thomas and Ayres (2004) also examined the possibility of heightened extinction of multiple conditioned excitors using an ABA study design. In an ABA design, subjects are conditioned in one context (A), extinction is undertaken in another context (B), and subjects are returned to the original context in order to test for fear to the target stimulus. This is a powerful test of extinction learning, as extinction is often highly context dependent (discussed more fully below). As in the Rescorla (2000) study, the authors found heightened extinction to the target stimulus when it was combined with other conditioned excitors (Thomas & Ayres, 2004)

As with many experiments in the basic science of conditioning and extinction, the preceding experiments were conducted with animal subjects. There have been relatively few studies examining extinction with multiple conditioned excitors in human subjects. However, combining multiple feared stimuli during a given exposure is a common element in many behavioral treatments for anxiety disorders. During treatment for panic disorder, an individual may be encouraged to enter a previously avoided situation (in vivo exposure) while simultaneously being exposed to multiple physiological cues for panic (elevated heart rate, dizziness, etc.; Craske et al., 2008, Craske & Barlow, 2008). It is possible that the presence of multiple cues actually enhances these exposure procedures.

Recent findings from experimental manipulations of exposure procedures in human anxiety disorders are also relevant to this discussion. Wolitzky and Telch (2009) compared exposure alone to exposure plus "oppositional action" in a sample of eighty-eight individuals with acrophobia. Individuals in both conditions were gradually exposed to a series of heights in a stairwell. Individuals proceeded up to next level on the stairwell when their reported distress had decreased by thirty points (out of a 0-100 scale). Individuals in the exposure plus oppositional action condition were exposed to the same cues, but were simultaneously asked to engage in several "oppositional actions" while conducting the exposure. These included stepping closer to the edge of the railing, placing their hands behind their back, inducing dizziness while standing at the edge of the railing, and even running towards the edge of the railing with their hands behind their back (with the therapist present to ensure safety). In essence, the participants in this condition were exposed to multiple cues related to their fear simultaneously (e.g., standing close to the edge while dizzy, etc.). Participants in the exposure plus

oppositional action condition demonstrated enhanced extinction learning as assessed through behavioral approach tasks and questionnaires compared to the exposure only condition, with some of these differences maintained when assessed one month later.

Similarly, Nelson, Deacon, Lickle, and Sy (2010) compared the efficacy of probability-based exposures versus cost-based exposures in individuals high in public speaking anxiety. Probability-based exposures are standard in cognitive-behavioral treatments for social phobia and entail confronting feared situations and violating expectancies that a particular US will occur (thereby altering an individual's probability bias). Individuals in the cost-based exposure condition where asked to deliberately engage in embarrassing behaviors during their exposure (e.g., stuttering, pausing for 10 secs, making foolish statements), thereby altering the perceived cost of performing "foolishly". Participants in the cost-based condition demonstrated significantly greater improvements on measures of social anxiety than those in the other condition. Once again, it is possible that this enhanced extinction was due to the presence of multiple conditioned excitors during a given exposure (e.g., the speech task in conjunction with embarrassing behaviors).

Although these studies raise interesting questions in regard to the use of multiple conditioned excitors in the treatment of anxiety disorders, it is important to note that the authors did not intend to directly manipulate or examine the effects of multiple conditioned excitors. These studies therefore do not provide direct evidence for the role of multiple conditioned excitors in extinction learning. For example, Wolitzky and Telch (2009) noted that participants in the oppositional action group displayed greater peak fear levels than individuals in the exposure only group. It is possible that the between-group

differences were a result of differing degrees of difficulty. The oppositional action group may have performed more difficult exposures (i.e., exposures that would be towards the higher end of a fear hierarchy), and this may have resulted in greater violation of expectancies (Wolitzky & Telch, 2009) whether or not the subjects were aware of multiple conditioned excitors. Moreover, some reports have indicated that greater initial fear levels are associated with improved outcomes (Foa, Riggs, Massie, & Yarczower, 1995; Kozak, Foa, & Steketee, 1988).

Despite the promise of heightened extinction through the use of multiple conditioned excitors, not all of the experimental evidence is consistent in this regard. In fact, at least two studies examining extinction of conditioned fear in human samples have failed to find that extinction learning to a target cue benefited from the presence of multiple fear related cues (Lovibond, Davis, & O'Flaherty, 2000; Vervliet, Vansteenwegen, Hermans, & Eelen, 2007). Lovibond et al. (2000) suggest that this failure to demonstrate enhanced extinction may have been due to either external inhibition or a context effect. In external inhibition, the presence of additional, usually novel, cues disrupts attention to the target stimulus. Therefore, the individual fails to learn that the target cue was not associated with non-occurrence of the US. The authors also suggest that the presence of both cues represented a unique context during extinction training that failed to generalize to the test of the target stimulus on its own (Lovibond et al., 2000). That is, the individuals associated the non-occurrence of the US with the combined presence of both cues rather than with the cues individually.

It is important to note that in both the Lovibond et al. (2000) and Vervliet et al., (2007) studies the conditioned stimuli underwent extinction simultaneously. Rescorla

(2006) has summarized evidence suggesting that simultaneous extinction, rather than sequential followed by combined extinction, can actually result in less associative change. This largely has to do with the salience of each of the conditioned stimuli. When both conditioned stimuli are equally salient, they "compete" for the associative change that results from either conditioning or extinction. However, if one stimulus is more salient than the other, it will retain the larger share of associative change. This can be achieved in various ways. If one first conducts extinction with one variable (A), and then later combines this variable with the target variable (X), one can enhance the extinction of the target variable. This is because "A" will still retain some excitatory strength, thereby enhancing extinction when combined with X, but will also decrease in salience. This may occur naturally during exposure therapy as a client proceeds up her/his fear hierarchy. As the client proceeds up her/his hierarchy towards increasingly anxiety provoking stimuli, s/he is likely to encounter other stimuli that were previously extinguished as part of previous exposure sessions. Unfortunately, there is a dearth of research examining this possibility in clinical samples.

In addition, one could only conduct a few extinction trials with the combined stimuli. Rescorla (2006) argues that merely conducting a few extinction trials will enhance extinction through combined excitatory prediction, before the additional stimulus has time to overshadow attention to the target cue.

In sum, both theoretical and experimental evidence points to the possibility of enhanced extinction learning through the presence of multiple conditioned excitors, although not all of the evidence is consistent with this hypothesis. However, despite the efficacy of extinction procedures, either to a single stimulus or in combination with

multiple conditioned excitors, a wealth of evidence points to the difficulty in retaining this learning. The following section will explore research explaining this process, with an emphasis on ways to maintain extinction learning in various contexts.

Enhancing Extinction Learning: Retaining Inhibitory Associations

Despite the use of the term extinction, a wealth of evidence indicates that conditioned associations are not erased or "extinguished" completely. Under the right circumstances the individual or organism will once again display fear or other conditioned responding despite having undergone extinction. For example, in reinstatement, simply presenting the US on its own after extinction can cause conditioned responding to reoccur to the CS (Rescorla & Heath, 1975). In renewal, the organism once again responds with fear to the CS after fear had been extinguished in another context (Bouton, 2002). This is often demonstrated through the ABA design mentioned previously, in which conditioning occurs in one context, extinction in another, and then the organism is tested for conditioned responding to the CS in the original context. The original observation of recovery of conditioned responding was termed spontaneous recovery. In spontaneous recovery, conditioned responding returns simply after the passage of time (Pavlov, 1927). Within the clinical literature on anxiety disorders, the renewal of fear following exposure treatment has been described as the "return of fear" (Rachman, 1989).

In summarizing the evidence on the return of conditioned responding following extinction, Bouton and colleagues (Bouton, 2002; 2004; Bouton, Westbrook, Corcoran, & Maren, 2006) have convincingly argued that these renewal effects are a result of the context dependent nature of extinction learning. According to this viewpoint, during

extinction training certain contextual cues, in addition to any explicit cues such as conditioned stimuli, come to be associated with the non-occurrence of the US. However, the original CS-US association remains intact. In essence, the organism is left with two associations: the CS predicts the US, and the CS does not predict the US. The organism relies on contextual cues to determine which relationship is operating at any given point in time. These contextual cues can be related to the physical location of the extinction training or even the internal state of the organism (Bouton et al., 2006). In the absence of contextual cues related to extinction learning, the organism once again resorts to the original conditioned association (e.g., fear). This learning does not seem to be unique to extinction training, but rather to most secondarily learned associations (Bouton, 2004). The decrease in associative strength as outlined in the Rescorla-Wagner model above is likely to still be operative, but is also highly context dependent.

Fortunately, there are methods for enhancing retrieval of this context dependent learning in order to mitigate renewal or return of fear. One could conduct exposure and extinction in multiple contexts in order to increase the number of cues that are associated with extinction (Vansteenwegen et al., 2006). However, experimental evidence suggests that this does not always mitigate renewal of conditioned responding, and it still may leave the individual subject to a return of fear if they encounter the stimulus in a novel context (Bouton, García-Gudtiérrez, Zilski, & Moody, 2006). Other promising evidence relates to the use of retrieval cues, present both during extinction and in the new context.

In a series of experiments, Brooks and Bouton (1994) conducted conditioning and extinction training with rats. Following extinction, the rats were then tested for renewal of conditioned responding to the CS in a different context. As expected, the rats once

again displayed conditioned responding when tested in this new context. However, this responding was mitigated if a cue was presented at re-test (e.g., a light) that was also present during extinction training. The cue appeared to "retrieve" the memory of extinction training, thereby indicating that the CS was unlikely to result in the delivery of the US. A novel cue, as well as a cue that was present during conditioning, did not have the same effect. It also appears that the cue did not develop a direct relationship with the US (e.g., an inhibitory relationship). Rather it seemed to function as a negative occasion setter in that it "set the occasion" for which CS-US relationship would be operating at that time (Brooks & Bouton, 2004).

Similar results demonstrating the efficacy of retrieval cues have been obtained in human subjects. Mystkowski, Craske, Echiverri, and Labus (2006) conducted a series of exposures with forty-eight spider fearful individuals. Following exposure procedures, several individuals were tested for a return of fear to the spiders 1-week later in a different context. Prior to the re-test, half of the sample was asked to recall the treatment procedures from their exposure training (retrieval cue condition), whereas the other participants were merely asked to focus on another memory. Participants in the retrieval cue condition reported significantly less return of fear than participants in the non-retrieval cue condition with large effect sizes. It is important to note that this effect was seen in self-reported levels of distress, and did not extend to all measures of fear (e.g., behavioral avoidance, catastrophic cognitions).

In summary, behavioral models have provided several mechanisms for understanding the conditioning and extinction of fear. Research in both animal and human populations have demonstrated the validity and efficacy of these approaches, and

have even suggested ways for enhancing extinction learning (e.g., through the use of multiple excitors). However, current conceptualizations of extinction learning also suggest that the original conditioned association is neither extinguished nor erased. Rather, it appears that an individual forms a second inhibitory association. This association tends to be highly context specific, and a return of conditioned responding (e.g., fear) is often seen when the individual confronts the CS in a context that differs from the one in which exposure or extinction occurred. Fortunately, this return of fear can be mitigated by presenting a retrieval cue during re-test that was associated with the extinction context. With this foundation in place, it is now possible to explore the various ways in which mindfulness interventions may enhance exposure and extinction processes.

Mindfulness

Drawn from eastern spiritual traditions such as Buddhism, mindfulness refers to a process of focusing on experiences in the present moment in an open, non-judgmental, curious, and accepting manner (Kabat-Zinn, 1990, 2005). As mindfulness interventions have gained greater popularity in psychological discussions, numerous attempts have been made to more formally operationalize it as a construct, as well as to elucidate its precise mechanisms of action (e.g., Baer, 2003; Bishop et al., 2004; Shapiro, Carlton, Astin, & Freedman, 2006). While it is beyond the scope of this paper to explore these discussions in depth, it is important to briefly examine the construct of mindfulness, along with its potential mechanisms of action, in order to more precisely situate our current discussion.

As implied by the definition above, mindfulness refers to a particular type of awareness of one's present experience. The goal of this awareness is increased contact with the present moment, and all that entails, without attempts at labeling, judging, avoiding, or attaching to one's thoughts and emotions (Bishop et al., 2004; Kabat-Zinn, 1990). Several mechanisms have been posited to underlie the efficacy of mindfulness-based approaches in the treatment of psychopathology. These include increased awareness, along with the ability to see one's thoughts and emotions from a decentered perspective (i.e., as transitory experiences rather than never ending states or indications of absolute truth; Teasdale et al., 2002). In addition, mindfulness may function as a form of exposure as numerous clinical problems stem from rigid attempts to avoid aversive internal experiences (Baer, 2003; Hayes, Strosahl, & Wilson, 1999). Mindfulness may also reduce the added distress that results from rigid attempts to control or suppress one's thoughts and emotions (Roemer & Orsillo, 2009).

While the construct of mindfulness is often thought of within the confines of meditation, it need not be. The skill of mindfulness can be cultivated through both formal (e.g., meditation) and informal practices (Roemer & Orsillo, 2009). It is also important to note that the emphasis in mindfulness practice is on the process as opposed to any particular state (either cognitive, emotional, or physiological; Bishop et al., 2004). To the extent that one is engaging in the process of mindful attention to the present moment, she/he is engaging in mindfulness. For example, during exercises that emphasize mindful awareness of the breath, an individual might find her/his attention continually pulled away from the breath by other thoughts. The process of noticing this, and gently returning

one's attention to the breath in a non-judgmental manner, is mindfulness (Roemer & Orsillo, 2009).

Mindfulness or mindfulness-based interventions have shown promise in the treatment of numerous disorders, including chronic pain (Kabat-Zinn, 1990, for a review) and depression (Teasdale et al., 2002). However, its function as an intervention for anxiety disorders is of most relevance to the present discussion. Several researchers have sought to examine how mindfulness-based or acceptance-based therapies may function in the treatment of anxiety disorders. These include Acceptance and Commitment Therapy (ACT) as a unified protocol for various anxiety disorders (Eifert & Forsyth, 2005; Eifert, Forsyth, Arch, Espejo, Keller, & Langer, 2009), as well as studies of ACT for specific disorders such as social anxiety disorder (Dalrymple & Herbert, 2007), obsessive-compulsive disorder (Twohig, Hayes, Masuda, 2006) and post-traumatic stress disorder (Orsillo & Batten, 2005). ACT is a multifaceted approach to behavior change that argues that attempts at control of one's internal experiences (thoughts, emotions) can paradoxically increase distress. ACT incorporates various mindfulness strategies to foster acceptance of one's internal experience while encouraging behavioral action in valued domains regardless of one's level of distress (Hayes et al., 1999). While these studies demonstrated promising results, all of them were reports on case studies (e.g., Eifert et al., 2009; Orsillo & Batten, 2005; Twohig et al., 2006), or open trials (Dalrymple & Herbert, 2007) rather than controlled outcome studies, which limits the ability to conclude that ACT itself was responsible for any observed changes. In addition, ACT is a multifaceted treatment approach. Dismantling studies and process research may help to shed light on the precise role of mindfulness in client change.

Roemer and Orsillo (2005, 2009) have also developed an acceptance-based behavioral therapy (ABBT) for generalized anxiety disorder that employs numerous mindfulness-based interventions. This ABBT employs mindfulness interventions in order alter one's relationship to their internal experience, thereby reducing attempts at experiential avoidance. This is based on the theory that rigid attempts at altering or avoiding one's internal state lie at the heart of psychopathology, and often paradoxically increases one's level of distress (Hayes et al., 1999; Roemer & Orsillo, 2009). In addition, mindfulness practice may help to bring greater awareness and clarity to the client's emotional experience, which helps to facilitate value guided action (Roemer & Orsillo, 2009). Thus far, this ABBT has demonstrated promising results in the treatment of GAD (Roemer et al., 2008), although further exploration of the process and mechanisms of change is underway (e.g., Hayes, Orsillo, & Roemer, 2010).

Although mindfulness-based interventions have shown promise in the treatment of anxiety disorders, there has been a dearth of research on how precisely mindfulness may impact exposure and extinction processes. This is surprising, given the centrality of exposure-based procedures for the treatment of anxiety disorders, and the promise of mindfulness and acceptance-based interventions. Although many mindfulness researchers have acknowledged that mindfulness may act as a form of exposure, in that it encourages contact with avoided aversive emotions and thoughts (Baer, 2003; Twohig, Masuda, Varra, & Hayes, 2005), they have neglected to take into account findings from basic science. However, numerous findings from the basic science of extinction learning discussed above point to possible ways in which mindfulness may positively impact exposure and extinction processes. The following sections explore these possibilities.

Mindfulness and Extinction Learning

An inherent component of mindfulness practice is the cultivation of attention and awareness. While the focus of this awareness and attention may differ by the particular mindfulness exercise, the ultimate goal is broadened awareness of one's present moment experience (Kabat-Zinn, 1990). In the treatment of pathological anxiety, this broadened awareness may facilitate extinction learning through increased awareness and attention to multiple conditioned excitors. As discussed previously, the presence of multiple excitors helps to facilitate extinction by "overpredicting" the occurrence of the US, thereby increasing the discrepancy between what is predicted and what occurs (Rescorla, 2006). While multiple excitors might be present during any given exposure procedure, the individual may fail to be aware of them. Mindfulness interventions may naturally help to increase awareness of these cues.

Several experimental studies point to the benefits of mindfulness practice on one's awareness or attentional capacity. Jha, Krompinger, and Baime (2007) examined various attentional subsystems, including alerting, orienting, and conflict monitoring, in both seasoned and novice meditators. Attentional systems were measured using the Attentional Network Test (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002). Performance on the ANT was measured before and after an 8-week course in mindfulness-based stress reduction (MBSR) for the seventeen meditation naïve participants, before and after a one month intensive retreat in the experienced meditation group, and before and after an 8-week time period in the seventeen control participants. Results indicated that participants in the MBSR course demonstrated improved orienting compared to controls. That is, MBSR participants demonstrated an improved ability to

direct their attention (Jha et al., 2007). Moreover, following the intensive retreat, experienced meditators demonstrated an improvement in alerting, and this increased ability was also correlated with total meditation experience. The authors concluded that this reflected a more receptive awareness, corresponding to improved exogenous stimulus detection.

A similar improvement in stimuli detection was observed in untrained participants following randomization to an 8-week MBSR course. Anderson, Lau, Segal, and Bishop (2007) randomly assigned 86 participants to either an 8-week MBSR course or an 8-week waitlist control. Participants reported having no prior experience with meditation, yoga, or other mindfulness related activities. However, unlike the participants in the Jha et al. (2007) study, participants in the mindfulness condition did not demonstrate improved voluntary attentional control. However, greater changes in mindfulness were associated with a greater ability at object detection.

Therefore, both the Jha et al. (2007) and Anderson et al. (2007) point to the possible relationship between mindfulness training and improved attentional capacities. More importantly, both studies suggest that an improvement in exogenous stimulus detection may be one benefit of mindfulness training. Inasmuch as mindfulness training may enhance stimulus detection, it may facilitate extinction learning through increased awareness of multiple conditioned excitors. However, as summarized above, evidence also suggests that the presence of multiple cues can actually detract from extinction learning if the cues are equally salient (Rescorla, 2006). Mindfulness training may only be helpful in this regard if one can maintain the salience of the target stimulus.

Several studies point to the possibility that mindfulness practice can enhance an individual's ability to maintain attention on a particular cue or task (sustained attention), despite the presence of distracter stimuli. Lutz, Slagter, Rawlings, Francis, Greishcar, and Davidson (2009) used a dichototic listening task to examine attentional capacities in a group of mindfulness meditators following a 3-month retreat. The authors collected neurophysiological measures, via electroencephalograph, in addition to behavioral measures such as reaction time. Results indicated an improved ability to sustain attention in practitioners following the meditation retreat, along with increases in stimulus processing of distracter stimuli. The authors argue that meditation may result "not only in a high frequency of moments of attention on the attended object (or increased attentional stability), but also to improve one's ability to remain vigilant and monitor distracters without losing focus" (Lutz et al., 2007, p. 13426). These results match those of other studies which observed a correlation between improved ability to sustain attention and mindfulness meditation experience (Valentine & Sweet, 1999), or an increased ability to sustain attention in novice meditators following a short retreat (Chambers, Lo, & Allen, 2008).

Taken together, the results of the above studies suggest that mindfulness practice may be associated with an increased ability to detect multiple stimuli, while simultaneously maintaining focus on a target stimulus. However, even in the absence of awareness of multiple cues, the enhanced attentional capacity which results from mindfulness practice may be beneficial for extinction learning. A key facet of the Rescorla-Wagner model is the salience of the conditioned stimulus (α). By increasing the

salience of the conditioned stimuli, one can enhance extinction learning. Once again, it may be helpful to examine this with actual numbers. The initial equation for extinction presented previously was: $\Delta V_x = .2(0-1) = -.2$. By increasing the salience of α to .4 we obtain the following decrease in associative strength $\Delta V_x = .4(0-1) = -.4$. In essence, the less aware an individual is of a given CS, the less able she/he is to form a contingent relationship between a particular CS and the non-occurrence of the US (or occurrence of the US in conditioning trials). This corresponds to the importance on awareness highlighted in many models of classical conditioning (e.g., Lovibond & Shanks, 2002; Pearce & Hall, 1980).

In summary, experimental examinations of attention and mindfulness suggest numerous ways in which mindfulness may positively impact extinction learning including increased awareness of the CS, along with increased awareness of multiple conditioned excitors while maintaining the primary salience of a particular target stimulus. Although the studies described thus far are promising in these regards, there are important limitations and considerations worth noting.

First and foremost is the wide variation in level of mindfulness experience reported by the participants in various studies. Several studies (Jha et al., 2007; Lutz et al., 2009) examined attentional capacity in seasoned meditators. Even in studies in which novice meditators were examined, the training period often included a mindfulness retreat or course that was several weeks in duration. It remains unclear what level of mindfulness practice is necessary to achieve the attentional effects noted here. Indeed, the question of "dosage" remains an important empirical question that has yet to be

adequately addressed in the literature (Roemer & Orsillo, 2003). Moreover, it is not yet clear whether mindfulness practice elicits stable attentional changes, or whether engaging in the process of mindfulness is necessary to see these effects. For example, both the Lutz et al. (2009) and the Valentine and Sweet (1999) study asked participants to engage in mindfulness practices just prior to the attention task, whereas other authors (e.g., Jha et al., 2007) did not ask this of participants. It also is unclear which mindfulness practices may be most efficient for eliciting attentional improvements. Many of the studies described here employed a multifaceted meditation course (i.e., MBSR), or participants with years of experience in a variety of mindfulness and meditation practices. The variety of practices employed in mindfulness training include exercises that require the participant to maintain a focus on particular sensation, such as the breath or sounds, in addition to more advanced techniques that ask clients to mindfully observe their thoughts or emotions (Roemer & Orsillo, 2009). Particular mindfulness exercises may be better at eliciting particular attentional capacities. Finally, several of these studies were limited by methodological concerns such as limited randomization, and poor descriptions of the participant characteristics. However, despite these questions and limitations, the evidence is promising for the effect of mindfulness training on attentional capacity. Taken with the findings from the basic science of extinction learning discussed previously, it is possible that mindfulness training may enhance extinction learning through attentional mechanisms.

Mindfulness as a Retrieval Cue

Perhaps the most straightforward benefit of conducting mindfulness interventions in conjunction with exposure-based procedures is the ability of mindfulness inductions to

act as a retrieval cue to mitigate the return of fear. As discussed previously, a wealth of evidence points to the context dependent nature of extinction learning (Bouton, 2004). When an individual or organism confronts a previously conditioned stimulus in a context that differs from that of extinction training, she/he is likely to display a renewal of conditioned responding unless contextual cues or conscious self-generated retrieval can retrieve the "extinguished" association between the CS and US. In experimental investigations of extinction in human samples, simply asking participants to recall the context in which extinction took place was sufficient to mitigate a return of fear (Mystkowski et al., 2006). By conducting mindfulness inductions along with exposure procedures, one has effectively associated the process of mindfulness with the extinction context. Should the client practice mindfulness when she/he encounters the feared stimulus (e.g., public speaking, traumatic memory) in another context, then the process of mindfulness should act as a retrieval cue to mitigate renewal of fear. There may be numerous reasons that one might wish to conduct mindfulness exercises as part of anxiety treatment, and researchers have outlined various arguments to support this proposition. Mindfulness may facilitate decentering (Baer, 2003; Roemer & Orsillo, 2009) or may act as an emotion regulatory strategy (Erisman & Roemer, 2010). It may also help facilitate exposure and reduce efforts at experiential avoidance (Roemer & Orsillo, 2009). The present paper also argues that simply pairing mindfulness with exposure processes may provide the additional benefit of acting as a retrieval cue. Unfortunately, there have been no direct examinations of this possibility. However, given that retrieval cues as simple as lighting (Vansteenwegen et al., 2005) and instructions to recall the context which exposures occurred were effective in reducing the renewal of

fear, it is reasonable to expect that engaging in the process of mindfulness would act in a similar manner.

Thus far the present paper has argued that mindfulness may *enhance* extinction learning via mechanisms elucidated in the basic science of conditioning and extinction. However, it is also important to consider ways in which mindfulness may negatively impact extinction learning. The following section will briefly explore this possibility.

Mindfulness as a Conditioned Inhibitor

In addition to mechanisms such as increased awareness, decentering and acceptance, some have suggested that mindfulness training may induce relaxation (Baer, 2003). While increased relaxation may indeed be an occasional effect of mindfulness practice, it is not the goal of mindfulness interventions. Mindfulness practice encourages contact with emotional states, even aversive ones, absent attempts at trying to control or change them (e.g., relax them away). Nevertheless, the decrease in distress that may come from abandoning rigid attempts at control may be reinforcing for some individuals, and clients may inadvertently come to use mindfulness strategies as a means to avoid or reduce distress (Roemer & Orsillo, 2009). In this case the process of mindfulness may come to be viewed as a safety behavior and can interfere with successful extinction learning. In behavioral terms, safety behaviors function as conditioned inhibitors (stimuli with an inhibitory association that signal the non-occurrence of the US). When presented in conjunction with excitatory conditioned stimuli, the inhibitory "charge" of the conditioned inhibitory cancels out the positive associative strength of the conditioned excitor, which leads to no change in associative strength (Craske et al., 2008). In essence, they "protect" the CS from extinction (Lovibond et al., 2000). Common safety behaviors

include anxiolytic drugs, the presence of a trusted friend, or even distraction (Barlow, 2002).Therefore, care must be taken when employing mindfulness practices in conjunction with exposure exercises in order to ensure that clients are not using them as a means of avoidance.

In addition to its use as a means of avoidance, there are other avenues through which mindfulness practices could possibly become conditioned inhibitors. The Rescorla-Wagner model suggests that by presenting a cue with no associative strength during extinction, it will gradually develop an inhibitory association. For example, if mindfulness practices (or any other cue) had no previous association with the US, the reduction in associative strength that occurs as a result of extinction trials would steadily transform this neutral cue into a conditioned inhibitor (Bouton, 2006). When subsequently presented with the target cue during extinction, its inhibitory properties would protect the stimulus from extinction. Yet, extinction cues that mitigate the return of fear are also present during extinction, but evidence suggests that they function as negative occasion setters and not conditioned inhibitors (Brooks & Bouton, 1994). Unlike inhibitory or excitatory stimuli, occasion setters do not form a direct relationship with the US. Rather, they modulate the relationship between the CS and US by "setting the occasion" for which relationship is operative (Bouton, 2006). There may be several reasons why extinction cues function as occasion setters and not conditioned inhibitors. First, evidence suggests that occasion setting is most often formed when the occasion setter is presented before the CS in a sequential fashion, or when the extinction cue is less salient then the CS. Inhibitors are more likely to form when presented simultaneously in combination with the CS during extinction, or when the cue is as equally salient as the

CS (Bouton, 2006). In addition, studies testing the ability of extinction cues to act as retrieval cues often present the extinction cue on only *some* extinction trials (e.g., 75% of trials, Brooks & Bouton, 1994). By presenting the cue on only a portion of the extinction trials, the subject may be less likely to attribute the non-occurrence of the US solely to the extinction cue (i.e., like an inhibitor). If one were to apply this rationale to mindfulness practices, it may best to conduct mindfulness interventions just prior to an exposure procedure, and during only some of the exposure sessions.

Summary

Recent behavioral treatments that incorporate mindfulness have shown promise in the treatment of several anxiety disorders (Batten & Hayes, 2005; Dalrymple & Herbert, 2007; Roemer et al., 2008). Several mechanisms have been posited to underlie the efficacy of these approaches including decentering, experiential acceptance, and compassion. In addition to these mechanisms, mindfulness may be beneficial for anxiety disorder treatment by enhancing exposure and extinction processes. Recent findings in the basic science of extinction learning suggest that extinction can be enhanced through the presence of multiple conditioned excitors, and that retrieval cues can help mitigate renewal or return of fear. The increased attentional capacity that results from mindfulness may help facilitate awareness of multiple conditioned excitors. In addition, pairing mindfulness with extinction procedures may allow it to function as a retrieval cue. The current study sought to examine these possibilities, while simultaneously exploring the feasibility of laboratory-based examinations of mindfulness and extinction learning.

Hypotheses

1. **Hypothesis 1**: *Individuals receiving mindfulness inductions prior to exposure procedures would display enhanced extinction when compared to individuals receiving exposure alone*.
2. **Hypothesis 2:** *Individuals receiving mindfulness inductions prior to exposure procedures would display enhanced extinction throughout a series of massed exposures, when compared to individuals receiving exposure alone*
3. **Hypothesis 3***: Individuals who receive a retrieval cue (i.e., another mindfulness induction) would display reduced return of fear when compared to individuals who do not receive a retrieval cue when tested in a different context, at a different time.*

CHAPTER 3

RESEARCH DESIGN AND METHODS

Sample

Four-hundred and ninety-two participants completed a screening packet administered online to a pool of students, faculty and staff at the University of Massachusetts, Boston. Participants were entered into a raffle for a $50 gift certificate in exchange for this initial screening. One-hundred and four met inclusion criteria for subsequent study procedures including a score above 30 on the Leibowitz Social Anxiety Scale-Self Report (LSAS-SR; Fresco et al., 2001), scoring 16 or above on the Personal Report of Confidence as a Speaker Scale (PRCS; Paul, 1966), being between the ages of 18-64, and being fluent in English. Exclusion criteria include previous exposure treatment for social anxiety (e.g., in the context of cognitive behavior therapy or other experimental studies. Participants who met the above criteria, and indicated an interest in participating in future studies were emailed by the PI who informed them about the study. Twenty-seven responded to the email and of those twenty-two agreed to participate in Study 1. Participants who agreed to participate in the study did not differ on levels of social anxiety as measured by the Leibowitz Social Anxiety Scale ($M = 60.74$, $SD = 19.37$) from those who did not ($M = 57.00$, $SD = 21.40$). All of the mindfulness participants ($N = 14$) were asked to return for Study 2 between 1 and 3 weeks after Study

1. Only 11 were able to return within that time frame. Participants ranged in age from 18-56 (M = 23.86, SD = 8.54), were primarily female (86.4%) and endorsed the following sexual orientation categories: Bisexual (13.6%), Gay/Lesbian (4.5%), Heterosexual (77.3%), and Other (e.g., Queer, Questioning, 4.5%). Participants were allowed to select multiple racial and ethnic identifications resulting in the following distribution: Asian (13.6%), Black (18.2%), Latino/a (13.6%), and White (59.1%). Participants received $30 for participating in Study 1, while those who completed Study 2 received an additional $20.

Measures

US-Expectancy ratings. A common procedure in many conditioning and extinction studies is to measure a participant's expectation that the US (unconditioned stimulus) will occur (cf. Van Gucht, Vansteenwegen, Beckers, & Van den Bergh, 2008). Reduction in expectancy ratings during extinction can provide evidence for a decrease in the associative strength between a CS and US. That is, the participant recognizes that the CS is no longer the best predictor of US's occurrence (or at least not the best predictor in the current context). Although these ratings are commonplace in conditioning and extinction studies, they have not been commonly employed in exposure studies with anxiety disorders. However, as Mineka and Zinbarg (2006) have convincingly argued, many of the tenets of learning theory can be applied to our understanding of anxiety disorders, including the CS-US relationships. In the case of social anxiety, the feared occurrence (or US) can generally be thought of as the fear of negative evaluation or social exclusion (Mineka & Zinbarg, 2006). Measuring changes in associative

relationships may be an important aspect of treatment. Therefore, the present study obtained expectancy ratings by asking participants to quickly rate, on a 100 mm VAS scale, "How likely do you think it is that (insert personally relevant fear) will occur as a result of giving a speech" Personally relevant fears where obtained by asking participants to rank their top three fears during the online screening. Fears that resemble social exclusion or rejection were provided. In addition, participants were reminded of their choice throughout the study. As this is not a validated measure, it only formed one portion of our process and outcome measurement battery. However, a measure of expectancy such as this seems to be closely related to many of the mechanisms of extinction noted in the basic science literature, and thought to underlie successful treatment of pathological anxiety.

Brief State Anxiety Measure (BSAM; Berg, Shapiro, Chambless, & Ahrens, 1998). The BSAM is a shortened version of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). It contains 6 of the 20 items from this scale (relaxed, steady, strained, comfortable, worried, tense). The BSAM has demonstrated good internal consistency ($\alpha = 0.83$) and a strong correlation with the STAI ($r = 0.93$). The BSAM was used throughout Study 1 and 2 to assess the participants' current level of anxiety.

Subjective Units of Distress Scale (SUDS; Hope et al., 2000; Wolpe & Lazarus, 1967) is a frequently used measure of a participants' current level of distress. Participants are asked to rate their current level of distress or anxiety on a 0 (completely calm, relaxed) to 100 (extreme anxiety or distress. The worst ever encountered.) SUDS were obtained before, during, and after each speech task.

Willingness. Participants were asked to rate how willing they are to engage in another speech task at various times throughout the study. Participants rated their willingness on a 100 mm VAS scale.

Leibowitz Social Anxiety Scale - Self-Report (LSAS-SR; Fresco et al., 2001) measures fear and avoidance of 24 situations related to social anxiety. Participants rate their fear on a 4-point Likert scale ranging from 0 (never) to 3 (severe) and their avoidance on a similar scale ranging from 0 (never) to 3 (usually, 67-100%). Rytwinksi et al. (2009) report that a cutoff of 30 accurately identifies individuals with social anxiety disorder. The LSAR-SR has demonstrated good internal consistency and test-retest reliability (Baker, Heinrichs, Kim, & Hofmann 2002). This measure was used to help select potential participants from a large pool of subjects.

Personal Report of Confidence as a Speaker – revised (PRCS-R; Paul, 1966). The PRCS-R is a 30 item true-false measure which assesses speech anxiety. It has demonstrated satisfactory internal consistency (Klorman, Weerts, Hastings, Melamed, & Lang, 1974) and validity (Lombardo, 1988). The PRCS-R was used to screen for participants with high speech anxiety from a larger pool of subjects, and also as an outcome measure.

The *Brief Fear of Negative Evaluation Scale* (BFNE; Leary, 1983) is a 12-item measure of an individual's fear of negative evaluation (e.g., "I am afraid that others will not approve of me"). Participants indicate how characteristic each item is of them on a 5-point-Likert-type scale, with 1 being "not at all characteristic of me" and 5 corresponding to "extremely characteristic of me." The BFNE has demonstrated good internal consistency (α = .89) in clinical samples and adequate test-retest reliability in

undergraduate samples (Leary, 1983; Weeks et al., 2005). The BFNE was given both pre and post experiment in Study 1 and 2.

Toronto Mindfulness Scale (TMS: Lau et al., 2006). This is a 13-item questionnaire that measures state-level mindfulness on a 5-point Likert scale. It contains two subscales (curiosity and decentering). The TMS was shown to have high internal consistency (α = .95) and was used as a manipulation check.

Procedures

Study 1.

After arriving for the study, participants provided informed consent, and completed the PRCS and the Brief Fear of Negative Evaluation Scale (BFNE; Leary 1983). Following this, participants were shown the experimental room, told that they could communicate with the experimenter through an intercom, and were told that they would be observed via a camera.

Participants were assigned to either an exposure condition or a mindfulness plus exposure condition. Blocked assignment was used in order to balance conditions on trait mindfulness, age, racial identification, and gender identity. Blocked randomization resulted in 14 participants in the mindfulness plus exposure condition and 8 in the exposure only condition. Detailed descriptions of each condition, along with a flowchart of the study procedures, are presented below.

Baseline assessment. Regardless of condition, participants first completed a baseline measurement of anxiety (Rating 1) consisting of the Brief State Anxiety

Measure (BSAM; Berg, Shapiro, Chambless, & Ahrens, 1998) and Subjective Units of Distress Scale (SUDS; 0-100; Wolpe & Lazarus, 1967).

Pre-manipulation speech. These procedures were adapted from those used by Baggett, Saab, and Carver (1996), Moscovitch and Hoffman (2004), and Tsao and Craske (2000). Moscovitch and Hoffman (2004) note that fear of public speaking is an extremely common fear among individuals with social phobia, and, given the high degree of external reliability, represents an ideal task in which to examine social anxiety in a laboratory setting.

After obtaining baseline state anxiety measurements, participants were told that in a few minutes they will be asked to provide a 5 minute speech about one of several topics. They were then given 3 minutes to prepare, although they were instructed that they could not write anything down. In addition, they were told that they would be videotaped and that their performance would later be judged by an expert panel of raters on the basis of poise, articulation, and appearance. Following their preparation time, participants completed measures of state anxiety (BSAM, SUDS), measures of willingness to engage in a speech task, as well as a measure of US-expectancy (detailed more fully below; Pre-Manipulation Speech Pre-Rating).

Participants were allowed to choose among two topics for each speech such as "Should English be the national language?", or "Is it wrong for the government to execute people?" Speech topics were different in each subsequent speech task but were once again of a political or emotionally charged nature (e.g., thoughts regarding same-sex marriage). Topics were fixed at each time point. Participants were asked to speak for the full five minutes but were allowed to stop if they chose to. Confederates were asked to

maintain a neutral facial expression throughout the task and to take notes to highlight the evaluative nature of the exposure. Immediately following the speech, participants completed measures of anxiety (BSAM, SUDS), measures of willingness to engage in further speech tasks, and measures of US-expectancy. In addition, SUDS were obtained throughout the speech task (i.e., every minute). These measures were taken after each preparation time and following each speech in subsequent exposures. However, the PRCS and BFNE were not given again until after the final speech in order to minimize participant burden and streamline assessment procedures (Post-Speech 3 Rating; see flowchart below).

Manipulation. Participants completed a total of 3 additional speeches, in a massed exposure fashion, by closely following the procedures above. Completing several additional exposures allowed us to measure change over time, rather than simply comparing participants before and after an intervention. In addition, although massed exposure procedures result in the greatest initial decrease in fear (Cain, Blouin, & Barad, 2003), they are also more likely to engender return of fear when subjects are tested at a later date (Tsao & Craske, 2000). This represents an ideal condition in which to examine our hypothesis that a mindfulness induction might act as a retrieval cue to mitigate return of fear. Although there exists no single definition of what constitutes massed exposure, these procedures are similar to those used by Tsao and Craske (2000).

Participants were randomly assigned to either an exposure condition or a mindfulness plus exposure condition. Although participants in both conditions were provided with the rationale behind exposure procedures, they were not given specific

information regarding their respective manipulations (e.g., mindfulness) in order to minimize expectancy.

Following the pre-manipulation speech, individuals in the mindfulness plus exposure condition listened to an audiotaped description of mindfulness in addition to engaging in an experiential mindfulness exercise. This took approximately 15 minutes. Similar procedures have been shown to elicit mindfulness in the laboratory (Erisman & Roemer, 2010). Participants then completed the Toronto Mindfulness Scale (TMS; Lau et al., 2006) as a manipulation check. Given the length of this initial manipulation, participants prepared for their speech following the manipulation. For the next two exposures, individuals completed another mindfulness exercise directly prior to each speech task (immediately following their preparation time). These mindfulness exercises consisted of mindfulness of sounds and physical sensations (please see appendix materials for a description). It was hypothesized that this introduction to mindfulness would induce the broadened awareness necessary for enhanced extinction (through awareness of multiple conditioned excitors) in addition to acting as a retrieval cue (see hypotheses section as well).

Following the pre-manipulation speech, individuals in the exposure only condition listened to an audiotaped radio program about a neutral topic (e.g., "smart" elevators) and completed a word search task. As in the mindfulness condition, these tasks combine instructional and experiential components. This took approximately 15 minutes. As in the mindfulness condition, participants also completed the TMS following this control manipulation. For the next two exposures, individuals in this condition completed word searches for approximately 3 minutes prior to conducting the speech task

(immediately following their preparation time). Although participants might have been somewhat distracted during this manipulation, they were not instructed to distract themselves during the exposures themselves, so this was not a distraction condition, but instead a control for the time spent in the mindfulness exercises. As in the mindfulness condition, individuals in the exposure only condition were given their preparation time following the initial manipulation, and prior to the manipulations in the following exposures.

Following the final exposure, individuals in both conditions completed the BFNE and PRCS in addition to the BSAM, SUDS, measure of willingness and US-expectancy, and TMS. As stated previously, it was hypothesized that individuals receiving mindfulness inductions prior to exposure procedures would display enhanced extinction and emotional processing when compared to individuals receiving exposure alone. Study 1 took approximately two hours to complete.

Study 1 Procedures

Baseline Assessment → Baseline Rating → 3 min prep → Pre-Manipulation Speech Pre-Rating → Pre-Manipulation Speech → Pre-Manipulation Speech Post-Rating → Rationale → Manipulation (15 min) → TMS → 3 min prep → Pre-Speech 1 Rating → Speech 1 → Post-Speech 1 Rating → 3 min prep → Pre-Speech 2 Rating → 3 min manipulation → Speech 2 → Post-Speech 2 Rating → 3 min prep → Pre-Speech 3 Rating → 3 min manipulation → Speech 3 → Post-Speech 3 Rating

Rating 1 (BSAM, SUDS), Pre and Post Speech Ratings (BSAM, SUDS, willingness, US-expectancy), Post-Speech 3 Rating (BSAM, SUDS, BFNE, PRCS, willingness, US-expectancy, TMS)

Study 2.

In order to examine whether or not mindfulness inductions during exposure procedures could act as a retrieval cue to mitigate return of fear, the 14 participants who received mindfulness inductions prior to their exposures were invited back between one and three weeks after the massed exposure session. Only eleven participants were able to participate within the allotted time frame. Participants were randomly assigned to either one of two conditions: another mindfulness induction prior to a speech task (retrieval cue condition, N = 5) or to a non-retrieval cue condition (N = 6).

Procedures.

Apart from the particular manipulation, procedures for participants in both conditions followed those from Study 1, with only a single speech exposure to assess return of fear. Please see the flow chart below. Speech topics were different from those used in Study 1 but were once again of a political or emotionally charged nature.

Manipulation.

Following their preparation time, but prior to the speech task, participants participated in one of two manipulations depending on their assigned condition. Participants in the retrieval cue condition once again received a mindfulness induction based on sounds and physical sensations. Given that this is the same induction these individuals received during extinction in Study 1, and that mindfulness itself may

represent a unique internal context, this manipulation was expected to serve as a retrieval cue to mitigate return of fear in this sub-sample of participants. Individuals in the non-retrieval cue condition participated in a word search task for 3 minutes prior to engaging in the speech task. As stated above, it was hypothesized that individuals in the retrieval cue condition would display reduced return of fear when compared to individuals in the non-retrieval cue condition.

Study 2 Procedures

Baseline Assessment → BL rating → 3 min prep → Pre-Retrieval Cue Rating → 3 min manipulation (retrieval cue or non-retrieval cue) → Post-Retrieval Cue Rating → Speech → Post-Speech Rating

Rating 1 (BSAM, SUDS), Pre and Post Retrieval Cue Rating (BSAM, SUDS, willingness, US-expectancy), Post-Speech Rating (BSAM, SUDS, BFNE, PRCS, willingness, US-expectancy)

Context shift.

As discussed previously, evidence suggests that extinction learning is highly context dependent and individuals often display a return of fear when tested in a different context, at a different time. The following steps were taken to help ensure a different testing context to test the effects of mindfulness on return of fear. First, the participants were consented in a different room than that of Study 1, and Study 2 procedures took place in a different room than that of Study 1. Lighting in the experimental room was also

different (e.g., dimmed) from what the participants experienced during their initial exposure/extinction sessions in Study 1. Vansteenwegen and colleagues (2005) successfully demonstrated a context effect and return of fear in human participants by manipulating lighting.

Second, the time that has passed since the original massed exposure session represents a context shift in and of itself. Bouton and colleagues (2006) have persuasively argued that organisms associate a temporal context with extinction. For example, an organism may learn that the US does not occur during the particular trial spacing during extinction. With the passage of time the organism is removed from this unique temporal context and renewal can occur. A similar spacing of exposure and testing sessions (1 week) was successfully used by Mystkowski et al., (2006) to examine return of fear.

In addition, the PI wore a lab coat during Study 2. Although these may seem to represent minor changes, others have used similar procedures to enhance context shifts (e.g., Mystkowski et al., 2006). Finally, having participants choose different topics for their speeches may also provide a context shift. While the task of giving a speech is a unique CS in social anxiety disorder, the particular type of speech (i.e., subject matter) used during extinction may represent a unique context.

Data Analytic Plan

Study 1.

Hypothesis 1: *Individuals receiving mindfulness inductions prior to exposure procedures would display enhanced extinction and emotional processing, as measured by the BFNE and PRCS (Post-Speech 3 Rating), when compared to individuals receiving exposure*

alone. This hypothesis was tested using two univariate ANCOVAs, with the final BFNE and PRCS scores as dependent measures and baseline measurements of the same scale as the covariate.

Hypothesis 2: *Individuals receiving mindfulness inductions prior to exposure procedures would display enhanced extinction and emotional processing throughout the series of massed exposures, when compared to individuals receiving exposure alone.* Enhanced extinction and emotional processing was measured by a greater decrease in scores on the BSAM and US-expectancy ratings, increased willingness to engage in further speech tasks, and a greater decrease in average SUDS ratings over the series of exposures (separate average for each of the three speeches). A series of latent growth curves were calculated using Mplus 3.13 software (Muthén & Muthén, 2006) to examine the trajectory of change among these variables. Given the small sample size, ANCOVAs were also conducted as a check on the latent growth curve results with the covariate set at the Pre-Manipulation Speech Post-Rating (just following the baseline speech) and the dependent variable set at the Post-Speech 3 Rating (final rating) . Latent growth curve modeling measures growth using two parameters: the intercept, or initial level, and the slope, or average rate of change between time points. For potential changes in state anxiety, US-expectancy ratings, willingness, and distress the intercept, or starting value, was set at the Post-Manipulation Speech Rating (just following the baseline speech) to control for initial distress to this task. For average SUDS during each speech, the intercept was set at the average SUDS ratings during the baseline speech.

Study 2.

Hypothesis 3*: Individuals who receive a retrieval cue (i.e., another mindfulness induction) would display reduced return of fear when compared to individuals who do not receive a retrieval cue when tested in a different context, at a different time.* Return of fear was measured by BSAM, SUDS, and US-expectancy ratings that occur just following their speech preparation. Residual gain scores were then calculated for each group's mean score at the Post-Retrieval Cue Rating (after the introduction of the retrieval cue) taking into account their scores at the Pre-Retrieval Cue Rating (just following their speech preparation) in order to examine the effect of the retrieval cue condition, while preserving power by not using a covariate model.

CHAPTER 4

RESULTS

Preliminary Analyses

Data were screened for normality. Means for all variables, at each time point, are presented in Table 1-6. In addition, variables were examined in each group condition. All variables were normally distributed and no outliers were present. Given the small sample size, and the potential for Type II error, effect sizes will be reported for all analyses with "small", "medium", and "large" corresponding with .20, .50, and .80 for Cohen's *d* and .01, .06, and .14 for partialη^2 respectively. However, the direction of effects will only be interpreted for results with a significant trend and a medium or greater effect size.

Table 1

Means and Standard Deviations of Distress Ratings

	Mindfulness	Control
Baseline Rating	25.39 (19.84)	26.86 (25.49)
PMSPR	48.15 (15.09)	51.25 (31.25)
PMSP	60.71 (20.93)	58.12 (35.85)
Pre-Speech 1	37.14 (15.90)	38.86 (23.82)
Post-Speech 1	32.86 (15.90)	50.00 (31.28)
Pre-Speech 2	42.86 (18.58)	46.86 (27.12)
Post-Speech 2	32.42 (26.87)	50.00 (29.40)
Pre-Speech 3	33.79 (24.38)	46.86 (21.87)
Post-Speech 3	29.50 (27.63)	41.63 (26.85)

Note. PMSPR = Pre-Manipulation Speech Pre-Rating, PMSP = Pre-Manipulation Speech Post-Rating

Table 2

Means and Standard Deviations of Willingness Ratings

	Mindfulness	Control
PMSPR	48.08 (28.54)	40.00 (30.36)
PMSP	35.71 (25.93)	30.00 (27.77)
Pre-Speech 1	49.29 (22.00)	40.00 (32.66)
Post-Speech 1	55.00 (19.11)	37.50 (29.15)
Pre-Speech 2	50.64 (23.82)	46.25 (24.46)
Post-Speech 2	55.00 (26.62)	37.50 (32.40)
Pre-Speech 3	48.93 (28.70)	38.75 (33.14)
Post-Speech 3	55.00 (24.42)	42.25 (36.10)

Note. PMSPR = Pre-Manipulation Speech Pre-Rating, PMSP = Pre-Manipulation Speech Post-Rating

Table 3

Means and Standard Deviations of US-Expectancy Ratings

	Mindfulness	Control
PMSPR	63.77 (21.72)	57.75 (35.70)
PMSP	71.43 (25.07)	62.50 (33.27)
Pre-Speech 1	55.00 (22.79)	64.29 (22.99)
Post-Speech 1	46.43 (22.74)	65.00 (19.27)
Pre-Speech 2	44.29 (21.74)	55.62 (22.60)
Post-Speech 2	40.71 (26.15)	61.88 (21.37)
Pre-Speech 3	42.14 (26.65)	59.38 (29.33)
Post-Speech 3	37.14 (30.49)	55.63 (28.71)

Note. PMSPR = Pre-Manipulation Speech Pre-Rating, PMSP = Pre-Manipulation Speech Post-Rating

Table 4

Means and Standard Deviations of State Anxiety Ratings

	Mindfulness	Control
PMSPR	18.07 (3.07)	18.00 (4.84)
PMSP	13.14 (3.51)	12.87 (4.94)
Pre-Speech 1	11.93 (4.20)	12.00 (5.15)
Post-Speech 1	16.36 (2.44)	13.13 (4.61)
Pre-Speech 2	16.79 (3.21)	15.00 (4.50)
Post-Speech 2	16.29 (3.27)	14.13 (4.82)
Pre-Speech 3	16.00 (3.85)	14.13 (5.41)
Post-Speech 3	16.43 (4.55)	13.63 (4.84)

Note. PMSPR = Pre-Manipulation Speech Pre-Rating, PMSP = Pre-Manipulation Speech Post-Rating

Table 5

Means and Standard Deviations of SUDS Ratings During the Speech Task

	Mindfulness	Control
PMS	62.32 (15.77)	60.73 (26.27)
Speech 1	39.94 (15.07)	50.96 (23.17)
Speech 2	35.89 (20.62)	45.58 (24.96)
Speech 3	34.21 (22.80)	48.00 (24.01)

Table 6

Means and Standard Deviations of Social Anxiety and Mindfulness

	Mindfulness		Control	
	Pre	Post	Pre	Post
PRCS	19.54 (7.04)	17.79 (7.19)	18.57 (6.45)	19.12 (6.79)
BFNE	41.93 (8.72)	40.57 (7.43)	44.00 (9.97)	44.12 (9.37
LSAS	58.73 (19.09)		64.19 (20.68)	
FFMQ	114.07 (13.57)		107.25 (19.61)	

Equivalence Ratings

In order to examine potential differences in between group levels of social anxiety, mindfulness, distress, and US-expectancy ratings prior to the manipulation and the experiment several independent t-tests were conducted. There were no significant between group differences in social anxiety as measured by the LSAS (M = 58.77, SD = 19.10, M = 64.19, SD = 20.68 for mindfulness and control respectively), $t(20) = .62$, $p = .54$, $d = .27$, PRCS (M = 19.54, SD = 7.04, M = 18.57, SD = 6.45 for mindfulness and control respectively), $t(18) = -.30$, $p = .77$, $d = .14$, or BFNE (M = 41.93, SD = 8.72, M = 44.00, SD = 9.97 for mindfulness and control respectively), $t(20) = .51$, $p = .62$, $d = .22$. There were no significant between group differences in trait mindfulness as measured by

the FFMQ (M = 114.07, SD = 13.57, M = 107.26, SD = 19.61 for mindfulness and control respectively), $t(19) = -.94$, $p = .36$, $d = .40$. There were also no significant between group differences in age (M = 25.07, SD = 10.05, M = 21.75, SD = 4.80 for mindfulness and control respectively), $t(20) = -.87$, $p = .39$, $d = .42$, sex χ^2 (1) = .01, p = .91, or race χ^2 (1) = 1.32, p = .25.

Ratings following the initial baseline speech preparation (Pre-Manipulation Speech Pre-Rating) were also examined for equivalence. At this time point, there were no significant between group differences in SUDS (M = 48.15, SD = 15.09, M = 51.25, SD = 31.25 for mindfulness and control respectively), $t(9.04) = .26$, $p = .80$, $d = .13$, willingness (M = 48.08, SD = 28.54.10, M = 40.00, SD = 30.36 for mindfulness and control respectively), $t(19) = -.62$, $p = .55$, $d = .27$, state anxiety (M = 13.14, SD = 3.51, M = 12.88, SD = 4.94 for mindfulness and control respectively), $t(20) = -.15$, $p = .88$, $d = .06$, or US-expectancy ratings (M = 63.77, SD = 21.71, M = 57.75, SD = 35.70 for mindfulness and control respectively), $t(19) = -.48$, $p = .63$, $d = .20$. Ratings following the baseline speech (Pre-Manipulation Speech Post-Rating), were also examined for equivalence. At this time point, there were also no significant between group differences in SUDS (M = 60.71, SD = 20.93, M = 58.13, SD = 35.85 for mindfulness and control respectively), $t(9.79) = -.19$, $p = .88$, $d = .09$, willingness (M = 35.71, SD = 25.93.10, M = 30.00, SD = 27.77 for mindfulness and control respectively), $t(20) = -.49$, $p = .63$, $d = .56$, state anxiety (M = 11.93, SD = 4.20, M = 12.00, SD = 5.15 for mindfulness and control respectively), $t(20) = .03$, $p = .97$, $d = .56$, or US-expectancy ratings (M = 71.43, SD = 21.71, M = 57.75, SD = 35.70 for mindfulness and control

respectively), $t(19) = -.48$, $p = .63$, $d = .56$. Based on these analyses, we determined that the groups were equivalent prior to the beginning of the experiment.

In order to examine whether our mindfulness induction was successful in inducing a state of mindfulness independent sample t-tests were conducted comparing scores on the Toronto Mindfulness Scale (TMS) given immediately following the inductions in both conditions. A significant trend emerged for individuals in the mindfulness condition to report more curiosity (M = 14.36, SD = 6.03) then individuals in the exposure only condition (M = 9.88, SD = 4.19) $t(20) = -1.85$, $p = .08$, with a large effect $d = .86$. Although there were no significant between group differences on the decentering subscale of the TMS, participants in the mindfulness condition reported higher scores (M = 15.64, SD = 5.11) than individuals in the control condition (M = 13.12, SD = 3.76) with a medium effect size $t(20) = -1.21$, $p = .24$, $d = .56$. Interestingly, these differences seemed to decrease by the end of the experiment although participants in the mindfulness condition tended to report higher curiosity (M = 13.78, SD = 4.14) and decentering (M = 14.21, SD = 16.92) than individuals in the control condition (M = 11.86, SD = 4.60; M = 13.63, SD = 4.14 for curiosity and decentering, respectively).

Hypothesis 1

Hypothesis 1 predicted that individuals in the mindfulness plus exposure condition would display enhanced extinction when compared to individuals in the exposure only condition as measured by changes on the BFNE and PRCS. In order to test this hypothesis, a series of univariate ANCOVAs were run controlling for baseline levels of the BFNE and PRCS (administered prior to experimental procedures). Results were

non-significant for the effect of condition on the BFNE F (1, 22) = .9, p = .352, partialη^2 = .05 and PRCS F (1, 22) = 1.09, p = .352, partialη^2 = .06, although the latter was a medium effect size.

Hypothesis 2

Hypothesis 2 predicted individuals receiving mindfulness inductions prior to exposure procedures would display enhanced extinction and emotional processing throughout the series of massed exposures, when compared to individuals receiving exposure alone. Enhanced extinction and emotional processing was measured by a greater decrease in scores on the BSAM and US-expectancy ratings, increased willingness to engage in further speech tasks, and a greater decrease in average SUDS ratings over the series of exposures (separate average for each of the three speeches). In order to test this hypothesis, a series of latent growth curves were calculated first for the group as a whole, and then adding in condition as a predictor variable (see Fig 1 for an example). For potential changes in state anxiety, US-expectancy ratings, willingness, and distress, the intercept, or starting value, was set at the Pre-Manipulation Speech Post-Rating (just following the baseline speech) to control for initial distress to this task. For average SUDS during each speech, the intercept was set at the average SUDS ratings during the baseline speech. We choose to include both pre and post speech ratings given that extinction processes should display a linear trend and carry over from one rating period to the next.

US-expectancy ratings.

In order to examine change in US-expectancy ratings we first calculated a linear growth curve model for the group as a whole. The model yielded an adequate fit to the data χ^2 (23) = 35.00, p = .052; CFI = .92, RMSEA = .15. The intercept, or average expectancy present after the baseline speech (Pre-Manipulation Speech Post-Rating) was 60.33 and the slope was -2.82 (z = -3.42, p = .001). In other words, participants' expectancy ratings decreased on average from 60.33 at the start of the experiment to 43.41 by the end of the experiment. There was a significant trend for the variance in the slope (z = 1.72, p = .09) suggesting that other variables (such as group condition) may be impacting change over time.

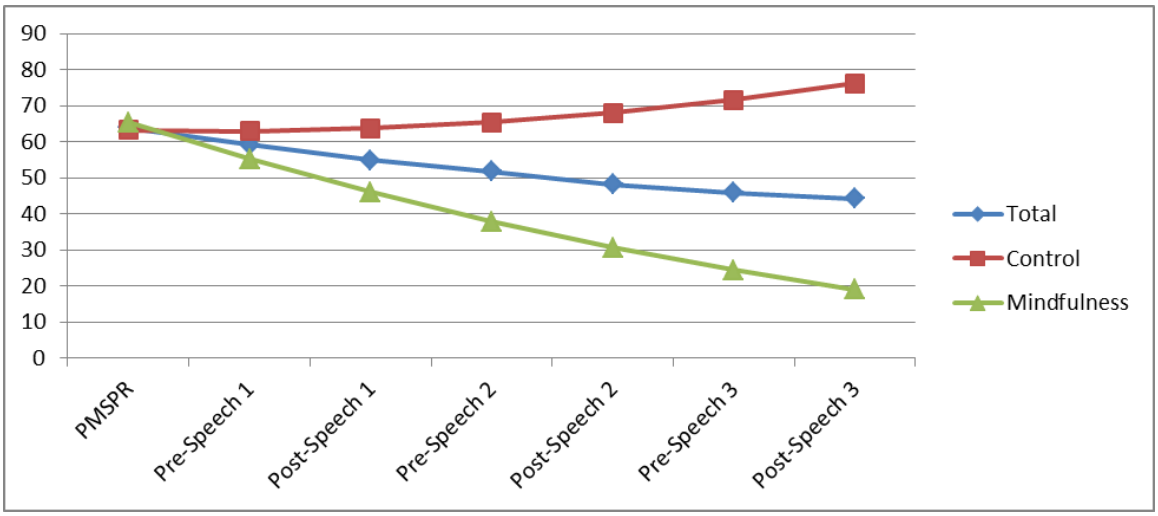
A visual inspection of the group means suggested that US-expectancy ratings flattened over time. This, combined with the relatively poor fit of the linear model, suggested that a quadratic slope may fit the data better. Chi-square difference tests yielded a significantly better for the quadratic model χ^2 (4) = 12.65, p < .05. The newer model yielded an overall average fit to the data χ^2 (19) = 22.35, p = .27; CFI = .98, RMSEA = .09. The intercept, or average expectancy present after the baseline speech (the Pre-Manipulation Speech Post-Rating) was 63.95 while the slope was -5.22 (z = -1.84, p = .07) and the quadratic term was .32 (z = .78, p = .44). In other words, participants' expectancy ratings decreased on average from 63.95 at the start of the experiment to 45.15 by the end of the experiment. Although the slope only demonstrated a significant trend in the quadratic model, and the quadratic term itself was not significant, the newer model yielded a substantially better fit to the data. In addition, Z-scores for the variance in the slope and quadratic term were significant (z = 2.14, p < .05; z = 2.24, p < .05

respectively) suggesting that other variables (such as group condition) may be impacting change over time.

We then examined potential group differences in expectancy ratings. Given the small sample size, we chose to incorporate treatment condition as a predictor variable in a latent growth curve model rather than conduct a multi group analyses. The model yielded an adequate fit to the data χ^2 (25) = 33.95, p = .11; CFI = .94, RMSEA = .13. The effect of condition on the slope was negative, and significant (z = -2.55, p < .05), suggesting that participants in the mindfulness condition had a steeper decrease in expectancy ratings than control participants. Although the quadratic term itself was not significant (z = 1.58, p = .11) there was a significant correlation between the condition and quadratic terms (z = 2.00, p < .05) which substantiates the claim that one condition (mindfulness) was significantly more quadratic than the other. See Fig 1 for a graphical representation of the growth curves for all participants, as well as separate slopes for participants in the mindfulness and exposure only conditions. This group difference may explain why previous quadratic models fit the data better despite a non-significant quadratic term. In addition, to examine these findings using an alternative method, we conducted an ANCOVA controlling for expectancy ratings following the baseline speech (the Pre-Manipulation Speech Post-Rating). Results revealed a significant effect for condition on US-expectancy ratings, F (1, 22) = 5.58, p < .05, partialη^2 = .23, with a large effect size.

Fig. 1

US-Expectancy Ratings



Note: PMSPR = Pre-Manipulation Speech Post-Rating

Willingness.

In order to examine change in willingness ratings we first calculated a linear growth curve model for the group as a whole. The model yielded an overall poor fit to the data χ^2 (23) = 42.31, p < .01; CFI = .88, RMSEA = .20. Chi-square difference tests yielded a significantly better for a quadratic model χ^2 (4) = 12.55, p < .05. The newer model yielded an adequate fit to the data χ^2 (19) = 30.26, p = .05; CFI = .93, RMSEA = .17. The intercept, or average willingness present after the baseline speech (Pre-Manipulation Speech Post-Rating) was 38.54 while the slope was 5.21 (z = 3.29, p < .01) and the quadratic term was -.68 (z = -2.88, p < .01). In other words, participants' willingness ratings increased, on average, from 38.54 at the start of the experiment to 45.32 by the end of the experiment. In addition, Z-scores for the variance in the slope and quadratic term were significant (z = -2.14, p < .05; z = -2.93, p < .05 respectively)

suggesting that other variables (such as group condition) may be impacting change over time.

We then examined potential group differences in willingness ratings. As with expectancy ratings, we chose to incorporate treatment condition as a predictor variable in a latent growth curve model. The model yielded an adequate fit to the data χ^2 (25) = 40.09, $p < .05$; CFI = .91, RMSEA = .17. The effect of condition on the slope was not significant ($z = .68$, $p = .50$), suggesting that participants in both conditions did not differ in their increase in willingness throughout the series of exposures. However, we also examined potential group differences using an ANCOVA controlling for willingness ratings following the baseline speech (rating 3). Results provided support for the growth curve analyses suggesting that the effect of condition on willingness ratings was not significant F (1, 22) = .74, $p = .40$, partial$\eta^2 = .04$ with a small effect size.

Distress.

In order to examine change in distress (measured by SUDS ratings obtained before and after each speech), we first calculated a linear growth curve model for the group as a whole. The model yielded an overall poor fit to the data χ^2 (23) = 60.28, $p < .01$; CFI = .69, RMSEA = .28. We then added a quadratic term to the model but this yielded a similarly poor fit to the data χ^2 (19) = 58.39, $p < .01$; CFI = .68, RMSEA = .31. Given that the data did not yield a good fit for either the linear or quadratic model, and was therefore uninterpretable, we did not proceed with group analyses. However, we also examined potential group differences using an ANCOVA controlling for distress ratings following the baseline speech (the Pre-Manipulation Speech Post-Rating). The effect of

condition on distress ratings was not significant F (1, 22) = 1.61, p = .22, partialη^2 = .08 with a medium effect size. However, the direction of the results suggest that participants in the control condition reported slightly higher distress ratings at the end of Study 1 than participants in the mindfulness condition.

BSAM.

In order to examine change in BSAM ratings, obtained before and after each speech, we first calculated a linear growth curve model for the group as a whole. The model yielded an overall poor fit to the data χ^2 (23) = 68.70, p < .01; CFI = .59, RMSEA = .31. We then added a quadratic term to the model but this yielded a similarly poor fit to the data χ^2 (19) = 58.87, p < .01; CFI = .65, RMSEA = .32. Given that the data did not yield a good fit for either the linear or quadratic model, and was therefore uninterpretable, we did not proceed with group analyses. However, we also examined potential group differences using an ANCOVA controlling for BSAM ratings following the baseline speech (Pre-Manipulation Speech Post-Rating). The effect of condition on BSAM ratings was not significant F (1, 22) = .25, p = .62, partialη^2 = .01 with a small effect size.

SUDS during the Speech Task

In order to examine change in SUDS ratings during each speech task we first calculated a linear growth curve model for the group as a whole. The model yielded an overall poor fit to the data χ^2 (5) = 12.18, p = .03; CFI = .80, RMSEA = .26. and the quadratic model did not converge.

However, we examined potential group differences using an ANCOVA. The effect of condition on SUDS ratings was not significant F (1, 22) = 3.45, p = .08,

partialη^2 = .15, although there was a large effect size. The direction of the results suggest that participants in the control condition reported higher SUDS ratings at the end of Study 1 than participants in the mindfulness condition.

Study 2

In order to examine potential differences in between group levels of social anxiety, mindfulness, distress, and US-expectancy ratings prior to the manipulation and the experiment during Study 2 several independent t-tests were conducted comparing participants in the retrieval cue or non-retrieval cue conditions. There were no significant between group differences in social anxiety as measured by the BFNE (M = 41.80, SD = 4.71, M = 38.33, SD = 7.81 for retrieval cue and non-retrieval cue respectively), $t(8.33) = -.91$, $p = .39$, $d = .54$. However, there was a significant trend for individuals in the retrieval cue condition to report less confidence in themselves as a speaker as measured by the PRCS (M = 21.40 SD = 5.41) than individuals in the non-retrieval cue condition (M = 13.00, SD = 8.79), $t(9) = -1.86$, $p = .10$, $d = 1.15$. There were no significant between group differences in distress (M = 16.00, SD = 20.74, M = 21.00, SD = 18.35 for retrieval cue and non-retrieval cue respectively), $t(9) = .48$, $p = .69$, $d = .26$, or state anxiety (M = 20.60, SD = 3.21, M = 18.50, SD = 3.62 for retrieval cue and non-retrieval cue respectively), $t(9) = -1.01$, $p = .34$, $d = .61$.

We also examined groups for potential differences following the speech preparation (Pre-Retrieval Cue Rating) but prior to the introduction of the retrieval cue. There were no significant between group differences in distress (M = 25.00, SD = 26.93, M = 32.50, SD = 18.37 for retrieval cue and non-retrieval cue respectively), $t(9) = .55$, *p*

= .60, *d* = .32, willingness (M = 50.00, SD = 29.15, M = 48.33, SD = 37.64 for retrieval cue and non-retrieval cue respectively), *t*(9) = -.08, *p* = .94, *d* = .05, state anxiety (M = 16.20, SD = 4.44, M = 15.83, SD = 4.71 for retrieval cue and non-retrieval cue respectively), *t*(9) = -.13, *p* = .90, *d* = .08, or US-expectancy ratings (M = 28.00, SD = 22.80, M = 40.00, SD = 25.30 for retrieval cue and non-retrieval cue respectively), *t*(9) = .81, *p* = .43, *d* = .50. Means for all variables, at each time point, are presented in Table 7-9.

Table 7

Study 2: Means and Standard Deviations of Distress Ratings

	Retrieval	Non-Retrieval
Baseline	16.00 (20.74)	21.67 (18.35)
Pre-Retrieval Cue	25.00 (26.93)	32.50 (18.37)
Post-Retrieval Cue	27.50 (28.73)	35.00 (20.00)
Post-Speech	24.00 (19.49)	25.00 (16.43)

Table 8

Study 2: Means and Standard Deviations of State Anxiety Ratings

	Retrieval	Non-Retrieval
Baseline	20.60 (3.20)	18.50 (3.62)
Pre-Retrieval Cue	16.20 (4.44)	15.83 (4.71)
Post-Retrieval Cue	18.00 (3.74)	15.60 (3.36)
Post-Speech	14.20 (4.94)	18.00 (3.35)

Table 9

Study 2: Means and Standard Deviations of US-Expectancy Ratings

	Retrieval	Non-Retrieval
Pre-Retrieval Cue	28.00 (22.8)	40.00 (25.29)
Post-Retrieval Cue	27.50 (26.30)	50.00 (18.71)
Post-Speech	36.00 (25.10)	45.00 (27.39)

Hypothesis 3.

Hypothesis 3 predicted that individuals in the retrieval cue condition would display a reduced return of fear when compared to individuals in the no retrieval cue condition. We first conducted paired sample t-tests comparing Study 1 post-treatment scores (Post-Speech 3 Rating) to Study 2 scores following the speech preparation (Pre-Retrieval Cue Rating) on the BSAM, SUDS, willingness, and US expectancy in order to examine return of fear for all participants. A significant trend emerged for participants to report higher SUDS on day 2 (M = 29.1, SD = 21.77) then on the end of day 1 (M = 17.55, SD = 20.79) $t(10) = -1.86$, $p = .09$, with a medium effect size, $d = .56$. A significant trend also emerged for participants to report higher state anxiety on day 2 (M = 16, SD = 4.36) then on the end of day 1 (M = 11, SD = 9.38) $t(10) = -2.11$, $p = .06$, with a medium effect size, $d = .56$. Results for return of fear as measured by US-expectancy was non-significant (M = 34.55, SD = 23.82, M = 21.82, SD = 28.57) $t(10) = -1.33$, $p = .21$, with a small to medium effect size, $d = .40$.

We then calculated residual gain scores between the Pre-Retrieval Cue Rating (obtained just following the speech preparation) and the Post-Retrieval Cue Rating (obtained just following the retrieval cue or word search). Independent t-tests were used to examine the effect of condition (retrieval cue versus no retrieval cue) on these gain scores for SUDS, state anxiety, and US-expectancy. There was a significant trend for individuals in the retrieval cue condition to report lower US-expectancy ratings following the retrieval cue (M = 27.50, SD = 26.30) then individuals in the no retrieval cue condition (M = 50.00, SD = 18.71) $t(4.86) = 2.32$, $p = .07$, with a large effect size, $d =$

1.48. Results were non-significant for SUDS $t(7) = -.40$, $p = .70$, $d = .28$, willingness $t(3.03) = .98$, $p = .40$, $d = .70$, and state anxiety $t(7) = -.98$, $p = .36$, $d = .68$.

CHAPTER 5

DISCUSSION

The present study sought to examine the potential of brief mindfulness inductions on exposure and extinction processes in social anxiety. Based on the findings in the basic science of conditioning and extinction, as well as experimental investigations of mindfulness, we hypothesized that mindfulness may facilitate extinction learning through increased awareness of multiple conditioned excitors. In addition, we hypothesized that mindfulness may act as a retrieval cue to mitigate return of fear. Given the small sample size, it is difficult to draw definitive conclusions. However, the results provide promising preliminary evidence for the possibility of mindfulness enhancing exposure and extinction processes, although much more research is needed.

In order for our manipulation to be successful, we had to ensure that the mindfulness instructions and experiential exercise were sufficient to induce a state of mindfulness. Results demonstrated a significant trend for individuals in the mindfulness plus exposure condition to report more curiosity than individuals in the exposure only condition following a brief mindfulness induction. Heightened curiosity may reflect an openness to present moment experience and therefore greater ability to detect multiple conditioned excitors as hypothesized. There were no significant between group differences in decentering, or the ability to observe thoughts, sensations and emotions as

transitory experiences rather than indications of truth (Teasdale et al., 2002). Our manipulation might not be strong enough to induce decentering. Alternatively, decentering might require greater practice to cultivate. Nevertheless, there is some evidence that the mindfulness plus exposure condition reported greater state mindfulness than the exposure only condition, although this only approached statistical significance.

Hypothesis 1 predicted that individuals receiving brief mindfulness reductions would display enhanced extinction when compared to individuals in the exposure only condition as measured by changes on the BFNE and PRCS. Given our small sample size, we may not have had the power to detect between group differences. Alternatively, the BFNE and PRCS may reflect trait like constructs that require more time to alter. Previous studies examining changes on the BFNE and PCRS examined changes following longer cognitive-behavioral treatments (Weeks, et al., 2005).

Hypothesis 2 predicted individuals receiving mindfulness inductions prior to exposure procedures would display enhanced extinction and emotional processing throughout the series of massed exposures, when compared to individuals receiving exposure alone. Hypothesis 2 was partially supported. There were no significant effects of condition on changes in SUDS ratings obtained before and after each speech, state anxiety, willingness or SUDS during the speeches. However, there was a significant effect of group on US-expectancy ratings. Participants in the mindfulness plus exposure condition displayed a significantly steeper decrease in expectancy ratings than participants in the exposure only condition. Expectancy ratings are perhaps the closest measure of extinction learning as theorized in error correction models such as the

Rescorla-Wagner (1972) model. Expectancy violation also figures prominently in several current theories of anxiety disorder treatment (Craske et al., 2008, Lovibond, 2006).

If expectancy violation is a core component of extinction learning then why did we fail to see a significant decrease in participants in the exposure only condition? As discussed previously, successful extinction learning relies on an individual's awareness that a cue is no longer the best predictor of an aversive event. This requires awareness of the cue, or CS, and awareness of the non-occurrence of the US. There are several processes in social anxiety disorder that may inhibit this learning. A wealth of evidence points to the deleterious effects of post-event processing in social anxiety disorder. Post-event processing refers to the tendency to imaginally rehearse the negative aspects of a social interaction following social contact (Rapee & Heimberg, 1997). Inasmuch as a person is focusing on the perceived negative aspects of a social situation, including potential cues of rejection, they may fail to consolidate the non-occurrence of the US. Several researchers have also demonstrated that individuals with anxiety disorders display attentional biases towards negative information. This includes enhanced attention to threatening information at relatively rapid stimulus presentation times, difficulty disengaging from these cues at moderate presentation lengths (e.g., 500 ms), and avoiding these cues at longer stimulus lengths (Onnis, Dadds, & Bryant, 2011). Inasmuch as participants may avoid a cue for rejection, possibly due to worry of self-focused attention, they are once again unable to learn that the cue is no longer the best predictor of social rejection.

Mindfulness may have disrupted post-event processing or attentional biases thereby facilitating extinction learning. In fact, Cassin and Rector (2011) have recently

argued that mindfulness is an effective intervention for post event processing. At first glance, this may seem different than the argument we have laid out above. However, it is consistent with the notion that extinction learning is dependent on the awareness of the CS, and non-occurrence of the US that is found in modern learning theory, and that mindfulness may facilitate this process in individuals with social anxiety. Moreover, it is possible that the change in US-expectancy ratings in the mindfulness condition was a result of increased awareness of multiple conditioned excitors, or facilitation of contingency learning as described above. The present study was not designed to assess the precise mechanisms through which mindfulness may impact extinction learning, but merely as a modest first step in this direction. However, given that individuals in the mindfulness condition did not report a significant change in state anxiety or distress across the speeches, it is unlikely that relaxation was responsible for these differences.

It is unclear why we did not obtain an effect of group condition on other indices of extinction learning (e.g., willingness, distress, state anxiety), although we did find a general trend for distress during the speeches to decrease, and a slight increase in willingness to engage in further speech tasks. Inasmuch as mindfulness encourages contact with aversive emotional states, it is possible that we would not see a significant decrease in distress or state anxiety in the mindfulness group. However, it is surprising that we would not see a significant effect on willingness. It is possible that our mindfulness induction was not strong enough, or that increases in distress tolerance and willingness require more time to cultivate.

Study 2 attempted to examine the potential of mindfulness to act as a retrieval cue to mitigate the return of fear. Retrieval cues are only effective in situations if there is a

successful change of context that prevents self-generated retrieval of extinction learning as evidenced by a return of fear. Therefore, it was important to try and alter the testing context. Several procedures, including conducting experimental procedures in different rooms, altering the lighting, and inviting participants back between one and three weeks later were used to bring about a renewal effect. Results suggested that there was a significant trend for individuals to report higher distress and higher state anxiety when presented with the possibility of performing another speech task. However, there appeared to be no return of fear as measured by US-expectancy ratings. There were no significant differences between the retrieval and non-retrieval groups following the introduction of a retrieval cue (another mindfulness induction). However, there was a significant trend for individual in the retrieval cue condition to report lower US-expectancy ratings than individuals in the non-retrieval cue condition with a large effect size. Moreover, the direction of the results suggest that participants in the retrieval cue condition reported slightly higher willingness and state anxiety ratings, and slightly lower SUDS ratings following the introduction of the retrieval cue than participants in the no retrieval cue condition. There are several important considerations when interpreting these results. First, although there was a significant trend in regard to US-expectancy ratings, we did not see a return of fear as measured by US-expectancy ratings. In addition, a visual inspection of the means suggests that US-expectancy ratings did not decrease in the retrieval cue condition, but rather remained stable while ratings in the non-retrieval cue condition increased somewhat. The extremely small sample size, combined with the inconsistent pattern of results, may indicate that the results are spurious.

In addition, we did not compare individuals who received mindfulness inductions to those that did not on indices of return of fear. Extinction learning entails both initial acquisition of extinction learning, consolidation and retention of this learning, and retrieval. It is unclear what, if any, effect mindfulness may have had on these processes.

In summary, the present study offers promising preliminary evidence that mindfulness inductions might enhance extinction learning as measured by US-expectancy ratings. However, the extremely small sample size makes interpretation of potential changes in state anxiety, distress, and willingness difficult, and the ability of mindfulness to act as a retrieval cue requires further research.

Limitations and Future Directions

There are several limitations worth noting. First and foremost, the small sample size makes it difficult to draw any definitive conclusions. Future research, with much larger sample sizes, will be needed to replicate these findings, and further explore the potential of mindfulness to impact distress, willingness, and state anxiety.

The present study was unable to determine the precise mechanisms through which mindfulness might facilitate extinction learning. Future research may wish to include another experimental group, explicitly directed to attend to multiple conditioned excitors during exposure, as a comparison condition. It is also unclear if the potential mechanisms measured here (expectancy ratings, willingness, distress) are related to overall improvement. In fact, this problem plagues the field of exposure researchers in general. Successful exposure is often measured by reduced symptoms. However, reduced distress during exposures has been found to be a poor predictor of treatment outcome (Craske et al., 2008 but see Norton, Hayes-Skelton, & Klenck, 2011), and confuses the response

with the mechanisms. Craske et al. (2008) argue that the best measure of extinction learning is re-test, but this too confuses extinction learning with both retention and retrieval. It will be important to develop accurate measures of extinction learning, both through self-report, behavioral and physiological indices, and examine their relationship with treatment outcome.

It is necessary to develop additional experimental methods for inducing context effects. Although return of fear has been demonstrated in both clinical (Rachman, 1989) and experimental settings (Mystowski et al., 2006), we did not find a strong renewal effect in this study. It is possible that merely returning the same building, or encountering the principal investigator, acted as a retrieval cue thereby mitigating any renewal effects.

Future research should also examine the optimal way to combine mindfulness with exposure processes. We argued that it is best to use mindfulness prior to exposure procedures, and on only some exposure trials, in order for mindfulness to become a negative occasion setter and not a conditioned inhibitor. However, empirical investigations into this hypothesis are necessary.

Although mindfulness has shown promise in the treatment of several disorders laboratory-based examinations of mindfulness are still in the early stages (Arch & Craske, 2006; Erisman & Roemer, 2010). It is unclear how much mindfulness practice is necessary to engender desired effects such as distress tolerance and attentional focus and what practices are ideal for cultivating particular facets of mindfulness. It remains unclear whether we can engender these effects in brief laboratory based procedures in meditation naïve participants.

Given the preliminary nature of the present study it is difficult to draw any clinical implications. However, mindfulness inductions did appear to be successful in decreasing the expectancy of social rejection and humiliation when combined with exposure. However, future research is still needed to determine whether mindfulness inductions strongly impact extinction learning, what degree of practice is needed to engender these effects, and the optimal manner in which to pair mindfulness with exposure procedures prior to drawing any clinical suggestions.

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