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Dispositional mindfulness and working memory in the context of acute stress.

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DISPOSITIONAL MINDFULNESS AND WORKING MEMORY IN THE CONTEXT
OF ACUTE STRESS

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DEDICATION

This dissertation is dedicated to my husband

SFC Johnathan R. Vines, United States Army,

an impeccable warrior.

"The courage of a warrior is both required and developed in the practice of meditation. It

takes courage…to confront the fact that in every instant what we are is continually

dissolving, vanishing; that there is no place to take a stand at all. To experience the death

of the concept of self; to experience that death while we're living takes the courage and

fearlessness of an impeccable warrior."

Joseph Goldstein, *The Experience of Insight*, pages 64-65

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ABSTRACT

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The neuropsychological domain of working memory and the nearly 3000 year-old

Buddhist construct of mindfulness appear to be disparate concepts. However, the

measurable decline of working memory capacity (WMC) under stress, in combination

with the stress-reducing and attention-focusing effects of mindfulness suggest potential

augmentation of working memory through the engagement of mindful practice. A

theoretical process through which dispositional mindfulness exerts a moderating effect on

WMC reduction following an acute stressor is proposed.

To investigate processes within this theoretical framework, a sample of undergraduate

college students ($N = 67$) were assessed across various measures, including level of

dispositional mindfulness, affective state, WMC, and physiological indices. Participants

were then presented with an acute emotional stressor, in the form of death and injury

images of the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert,

2005). Following stress induction, participants were reassessed for WMC and affective

changes. Scores on affective measures underwent significant changes from pre- to post-

stressor in the predicted direction, while scores on a measure of WMC *increased*, in

contrast to *a priori* predictions. Dispositional mindfulness was not found to play a

mediational role in affective, cognitive, or physiological changes from pre- to post-

stressor. Implications of analyses for the present study, as well as for future research, are

discussed.

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CHAPTER 1 INTRODUCTION

Viktor Frankl, a psychiatrist and survivor of Nazi concentration camps, once wrote that "between stimulus and response there is a space. In that space is our power to choose our response" (2006). Frankl was eloquently referring to the human ability to thoughtfully respond to a stimulus, rather than physiologically react in a reflexive manner. But how exactly does one access this space? And why, in exigent moments when a situation threatens an individual's physical, mental, or emotional integrity, does this space seems to shrink or appear non-existent, triggering reflexive fight, flight, or freeze patterns of behavior rather than measured, rational responses? These questions are not only philosophically intriguing, but have implications for understanding human behavior in acutely stressful situations as well as individual differences which affect whether the behavior involves a reflexive reaction or measured response. This paper addresses these questions by exploring the relationship between two theoretically distinct yet potentially interlinked constructs: the neuropsychological construct of working memory and the construct of mindfulness, a facet of insight meditation described 2500 years ago in Buddhist texts and characterized by non-judgmental, present moment awareness (Wallace & Shapiro, 2006). A thorough review of the literature concerning these two constructs reveals numerous studies which have begun to explore their relationship; however, the research is primarily correlational. Additionally, the majority of such research has examined these constructs within the context of chronic stress. For example, the work of

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Stanley and Jha, has examined the relationship between mindfulness and working memory in a cohort of Marines during the highly stressful, pre-deployment phase of their training (Stanley, Schaldach, Kiyonaga, & Jha, 2011). Mindfulness as a clinical intervention was originally developed for use in medical patients experiencing chronic stress (Kabat-Zinn, 1990); however, recent research suggests a mindful state is equally beneficial in the context of an acute stressor, which can quickly reduce working memory capacity and alter cognitive functioning. In an effort to identify the space between stimulus and response following an acutely stressful stimulus, this paper a) reviews the extant literature concerning mindfulness and working memory; and b) proposes a novel, theoretical process through which mindful awareness may enhance working memory following an acute stressor.

Mindfulness

The concept of "mindfulness" has received much attention in clinical practice and research, empirical studies and scientific inquiry over the past two decades. Originating in Eastern philosophy and Buddhist meditation (for a detailed discussion, see Rosch, 2007), a modern definition of mindfulness denotes full and non-judgmental openness to present-moment experiences (Kabat-Zinn, 2003) which exists in humans as a dispositional aptitude which can be enhanced with training and maintained though practice (Brown & Ryan, 2003; Kabat-Zinn, 2003). While this definition of the construct is generally accepted in the literature, operational definitions of mindfulness vary and there has yet to be a consensus on one operational definition, particularly in the context of empirical studies (Grossman, 2008; Grossman, 2011).

Benefits of mindfulness. As interest in mindfulness has increased, so has evidence of its salutary effects. Suggested benefits of mindfulness for those experiencing mental disorders, chronic health conditions, and non-clinical samples include affect tolerance (Fulton, 2005), increased objectivity (Brown, Ryan, & Creswell, 2007; Leary & Tate, 2007; Shapiro, Carlson, Astin, & Freedman, 2006), improved concentration (Young, 1997), and higher levels of emotional intelligence (Walsh & Shapiro, 2006). Additionally, mindfulness has been proposed to increase effectiveness of emotion regulation (Corcoran, Farb, Anderson, & Segal, 2010; Farb et al., 2010). Emotion regulation refers to the process by which aspects of an emotional experience are modified or modulated in some form (Gross; 1998); with modifications taking place through physiological, behavioral, and cognitive means (Bridges, Denham, & Ganiban, 2004). This process is an integral facet of mental health and its dysregulation can cause severe impairment in adaptive functioning, as seen by the multitude of mental disorders which include emotion dysregulation as a primary symptom (American Psychiatric Association, 2000). The literature base concerning emotion regulation is large, and continually growing (Koole, 2009; for a complete review of the construct, see Gross, 2007). Specific to mindfulness, emotion regulation refers to the "capacity to remain mindfully aware at all times, irrespective of the apparent valence or magnitude of any emotion that is experienced" (Chambers, Gullone, & Allen, 2009, p. 569). This ability is purportedly cultivated through the systematic training of awareness and non-reactivity to emotional experiences during mindful practice (Chambers, Gullone, & Allen, 2009). The potential for mindfulness to facilitate improved emotion regulation has implications for its use in

clinical populations since, as previously mentioned, emotion dysregulation is a symptom of many mental disorders.

   As a treatment for mental disorders, mindfulness based interventions (MBIs) have been found to be particularly effective for individuals suffering from anxiety and depression. For example, a meta-analysis of 39 studies in which participants received a MBI for a variety of psychiatric and medical conditions focused specifically on symptoms of anxiety and depression (Hofmann, Sawyer, Witt, & Oh, 2010). Results indicated robust effect sizes associated with MBIs provided to subjects with anxiety and mood disorders which were maintained over follow-up. In regards to MBIs for chronic physical conditions, the effect of mindfulness on individuals with chronic pain has been the subject of multiple empirical studies. A recent review of ten empirical studies of MBIs for chronic pain found these interventions produced nonspecific effects for the reduction of pain symptoms and pain-related depressive symptoms (Chiesa & Serretti, 2011). However, due to the small sample size and lack of randomization in the majority of these studies, the review was unable to demonstrate MBIs to be more efficacious than other interventions such as support and educational groups. Additionally, the effects of MBIs focused on stress reduction have also been studied in psychologically healthy populations. Chiesa and Serretti (2009) found in a recent meta-analysis of 10 controlled and randomized controlled studies of MBIs provided to healthy subjects, there was a significant, positive nonspecific effect compared to wait list controls. These results were maintained even when the randomized controlled studies were analyzed separately. Again, small sample sizes were a significant limitation for many of the studies, and the

majority of samples were composed of female, Caucasian undergraduate students, further limiting the generalizability of results (Chiesa & Serretti, 2009). While meta-analyses of MBIs do consistently identify limitations regarding sampling and study design, overall results suggest significant benefits of MBIs for both clinical and non-clinical populations.

Aside from its benefits for various populations, the efficacy of mindfulness for stress reduction has been demonstrated in multiple studies (Birnie, Garland, & Carlson, 2010; Chang, et al., 2004; Chiesa & Serretti, 2009; Shapiro, et al., 2005). Furthermore, MBIs which have emerged over recent years are implicated in the reduction of stress for both physical and mental disorders (Carmody & Baer, 2008; Witkiewitz & Bowen, 2010). One of the most investigated mindfulness interventions is Mindfulness–Based Stress Reduction (MBSR), a clinical program originally developed by Jon Kabat-Zinn to reduce stress in medically ill patients through systematic training in mindfulness meditation (Kabat-Zinn, 1982). The MBSR program consists of 8 to 10 group sessions, which contain training in mindfulness techniques and education about the psychophysiology of stress and emotions (Santorelli, 1999). Participants are asked to engage in formal and informal meditation practices outside of the group sessions (for a more detailed discussion, see Kabat-Zinn, 1990). Grossman and colleagues (2004) conducted a comprehensive review of 64 studies in which MBSR and other MBIs were used to treat stress due to chronic health conditions. Among the twenty studies which met criteria for the final meta-analysis, medical diagnoses of participants ranged from fibromyalgia, various forms of cancer, and coronary artery disease to various forms of psychopathology. Additionally, several studies contained non-clinical samples. Results of

the meta-analysis showed consistently strong effect sizes, despite the wide variety of samples. Grossman and colleagues suggested such results indicate mindfulness may enhance more general processes related to coping under stress both in daily and atypical situations. Of the studies included in the analysis, a significant limitation was the absence of post-treatment follow-up. As a result, this meta-analysis was only able to comment on the immediate effects of MBIs. A recent review of randomized control trials of MBSR found that compared to control groups, MBSR treatment was more likely to reduce self-reported levels of anxiety, depression, anger, rumination, general psychological distress, and increase positive affect, self-compassion, and overall quality of life (Keng, Smoski, & Robins, 2011).

     Proposed models of mindfulness. As the number of studies investigating the effects of mindfulness has grown, so has interest in the proposed mechanisms through which these effects are engendered. Multiple models exist in the extant literature, with each model suggesting various mechanisms of change. For example, some proposed mechanisms focus on changes in cognitive activity, such as increased awareness of metacognitions (Teasdale et al. 2002), the ability to re-perceive (Shapiro et al. 2006), and decreased rumination (Deyo et al. 2009; Corcoran, Farb, Anderson, & Segal, 2010). Others suggest mediators involving attentional processes including an increased ability to focus attention or alternatively engage in open monitoring (Lutz et al. 2008). Holzel and colleagues (2011) have proposed a multifaceted process through which various mechanisms of mindfulness interact to produce benefits. These mechanisms include attention regulation, body awareness, emotion regulation through reappraisal and

exposure, and a change in self-perspective. Moreover, Holzel asserts that certain mechanisms may play a greater role in the overall process than others on a moment by moment basis within the mindful experience (Holzel et al., 2011). An additional model of mindfulness has been proposed by Bishop and colleagues (2004), with two over-arching components. In Bishop's model, the first component involves attention regulation, which allows the individual to maintain their focus on the immediate, present moment experience. Bishop additionally proposes that the first component of attention regulation contains two types of mental skills; sustained attention skills and switching skills. Skills in sustained attention allow an individual to maintain focus on a specific present moment experience and avoid distractions from transient thoughts, feelings, and sensations. Alternately, switching skills refer to the ability to return to the desired point of attention once distraction occurs (Bishop et al., 2004); for example, a practitioner of mindfulness would demonstrate switching when he or she redirects attention from a distracting thought back to the here-and-now experience of the breath. Attention regulation is then followed by the second component of the model, which is an open, curious orientation toward one's experiences. This attitudinal component is hypothesized to lead to reductions in experiential avoidance, increases in trait openness, and improved affect tolerance (Bishop et al., 2004).

Critiques of mindfulness. Just as proposed mechanisms for change related to mindfulness practice have begun to emerge, so have critiques of mindfulness and its related field of research. Grossman (2008; 2011) has published several critiques of mindfulness and the current assessment tools which purport to measure mindfulness. One

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of Grossman's recent critiques is the lack of gold-standard measures with which to assess an individual's level of mindfulness, despite the existence of multiple self-report inventories (Grossman, 2011). Examples of such self-report measures frequently used in empirical studies include the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003), the Kentucky Inventory of Mindfulness Skills (KIMS; Baer, Smith, & Allen, 2004), the Cognitive and Affective Mindfulness Scale (CAMS; Feldman, Hayes, Kumar, & Greeson, 2004; Hayes & Feldman, 2004), and the Philadelphia Mindfulness Scale (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008). While good internal consistencies have been found for each of these measures (Brown & Ryan, 2003; Baer, Smith, & Allen, 2004; Feldman et al., 2004; Baer et al., 2006; Cadaciotto et al., 2008), most of these inventories have been validated solely in samples of undergraduate college students; Grossman (2011) has identified this as a weakness in their psychometric construction. However, Brown and colleagues have countered this criticism by suggesting that measures such as the MAAS have been developed to measure mindfulness as it occurs in individuals without meditation experience, justifying their use of college samples for initial validation (Brown, Ryan, Loverich, Biegel, & West, 2011).

Additionally, Grossman notes the lack of a gold-standard measure with which to assess an individual's level of mindfulness, in contrast to a multitude of self-report inventories (Grossman, 2011). Grossman asserts that without a gold-standard measure, it is not possible to assess the construct validity the existing mindfulness questionnaires. Developers of mindfulness questionnaires have countered that at this early stage in mindfulness research, it may be of greater benefit to continue establishing construct

validity of existing mindfulness measures, rather than waiting for a gold-standard measure to appear (Brown, Ryan, Loverich, Biegel, & West, 2011). Additionally, good convergent validity has been found between the previously mentioned scales (Baer et al., 2006), and criterion validity of scales such as the MAAS have been supported through consistent associations with behavioral, physiological, and neurological outcomes (Brown et al., 2011).

Another critique by Grossman is that current mindfulness measures may assess qualities quite different from the original Buddhist characterization of mindfulness, and do not take into account elements of mindfulness such as intention, tolerance, compassion and kindness, and ethical behavior (Grossman, 2008; Grossman, 2011). An analysis of current mindfulness literature suggests that Grossman is correct in his assertion that empirical research of mindfulness utilizes a Western adaptation of the original Buddhist construct. However, it is also worth noting that Buddhist literature and scholars have never reached a complete consensus on the exact definition of the construct themselves (Grossman, 2008).

Other critiques of research related to mindfulness research include non-randomized samples, a heavy self-selection bias, and the difficulty of creating a double-blind condition inherent to meditation studies (Chiesa & Serretti, 2010). Chiesa and Serriti (2010) suggest the latter limitation might be overcome, to some extent, through the use of a single-blind design, and note that this strategy has already been applied in some recent studies. Additional critiques have noted a lack of attention paid to participant qualities which might affect the apparent efficacy of the interventions. Bishop (2002) has

suggested preexisting personality traits may influence recruitment and compliance particularly in MBIs, and individual differences in attention may influence the ability to utilize mindfulness practice in a manner which alleviates stress.

Current controversies: Trait or state? As previously mentioned, a current criticism of mindfulness is the varied operational definitions within its body of research. Within these varied definitions, certain discrepancies exist as to the particular qualities of this "deceptively simple concept" (Brown & Ryan, 2004, p. 242). One such discrepancy is whether mindfulness exists as a state induced through mindful practice, or as a trait-like dispositional quality, consistent across situations. An analysis of literature concerning this discrepancy suggests the distinction between mindfulness as a state or trait is subtle. For example, Kabat-Zinn (2003) has suggested that the ability to be mindful exists in all individuals to varying degrees, and that formal mindfulness practice can increase this ability. As such, sitting meditation may create a state of mindfulness by regulating attention in a particular way (Bishop et al., 2004). This state dissolves when attention ceases to be regulated in this particular fashion (Bishop et al., 2004), with the amount of mindfulness experienced during the practice dependent on the capacity for mindfulness present in the practitioner. Thus, even though mindfulness is framed as an experiential state, both Kabat-Zinn (2003) and Bishop (2004) additionally suggest the existence of a necessary capacity to engage in non-judgmental, present moment focus before the state can be experienced. Alternatively, Brown and Ryan (2003) have suggested that, while a mindful state can be produced as a product of meditation,

mindfulness is an innate attentional quality present in all individuals and independent from formal mindfulness practice.

The trait concept of mindfulness described by Brown and Ryan (2003) suggests a spectrum along which individual differences lie, with consistent mindful attention at the high end of the spectrum and habitual, automatic thinking, at the low end (Langer, 1989). Moreover, while Brown and Ryan concede that mindfulness is "inherently a state of consciousness" (2003, p. 824), they and others assert that trait-like tendencies exist in regards to the frequency with which this state of consciousness is experienced (see Brown et al., 2007; Brown & Cordon, 2009; Brown & Ryan, 2003). For example, an individual with a high capacity for the experience of mindfulness may not bring a non-judgmental attitude and focused awareness to every moment, but may be likely to do so with greater frequency than an individual with a low capacity for mindfulness.

This conceptualization of innate or dispositional mindfulness is similar to the conceptualization of positive and negative affect by Watson, Tellegen and colleagues (see Watson & Tellegen, 1985; Watson, Wiese, Vaidya, & Tellegen, 1999), who suggested that while positive and negative affect states can be induced in all individuals, individual differences occur in the capacity for each form of affect, with some individuals primed to experience greater amounts of positive or negative affect than others. Similarly, recent research on dispositional mindfulness has demonstrated that individuals with no formal meditation practice display varied individual differences in their responses to self-report measures of mindful awareness (e.g., Brown & Ryan, 2003; Carlson & Brown, 2003; Levesque & Brown, 2003).

Based on an analysis of the previously discussed literature, trait-like or dispositional mindfulness in this manuscript will be operationally defined as an individual's capacity for and frequency of a non-judgmental, present-moment attentional focus during daily life. Additionally, while there are several terms used in mindfulness literature to describe a trait-like capacity for mindful experience, such as trait mindfulness, everyday mindfulness, innate mindfulness and dispositional mindfulness, this paper will utilize the latter terminology to describe individual differences in mindful experience. Although dispositional mindfulness and trait mindfulness are both widely used by current researchers of the construct, the term "trait" is also used to describe stable aspects of personality; while mindfulness has been linked to certain core personality traits (Brown & Ryan, 2003; Bishop et al., 2005; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006), this paper is primarily concerned with a general tendency toward mindful awareness rather than personality attributes. Therefore, the innate aspect of mindfulness which exists outside of formal practice while henceforth be referred to as dispositional mindfulness (DM).

As previously mentioned, criticisms of mindfulness include the absence of a gold-standard measure and the subsequent inability to determine the construct validity of mindfulness questionnaires (Grossman, 2001). This criticism extends to measures used to determine levels of DM. Grossman (2001) has suggested that self-report trait mindfulness questionnaires may measure qualities quite different than those present during a state of formal meditation. This paper recognizes these limitations, and agrees with Grossman (2001) that new self-report measures should consider specific behaviors, or even

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physiological experiences, thought to be related to DM. While limitations exist in the measurement of DM, they are not grounds for its dismissal as a construct, but rather future areas of expansion for the field. Additionally, Grossman is likely correct that DM is not synonymous with the experience of formal mindfulness practice. In fact, there is a recent study which supports this view; Thompson and Waltz (2007) found no relationship between DM and mindfulness induced through a brief sitting meditation in a large sample of individuals with no previous meditation experience. However, an analysis of the previously mentioned DM literature does provide a theoretical foundation for the experience of mindful awareness outside of formal practice.

     Operational definition of mindfulness relevant to cognitive processes. As reviewed earlier, mindfulness research is still in an early stage and operational definitions of the construct differ with each study. However, for the purposes of this manuscript, mindfulness is defined as the experience of sustained, nonjudgmental attention towards both internal and external events, based on the two component model of Bishop and colleagues (2004). Furthermore, this particular manuscript will consider mindfulness as a dispositional attribute, with the level of this disposition present determining the frequency with which this particular state of consciousness is experienced (Brown et al., 2007; Brown & Cordon, 2009; Brown & Ryan, 2003). While other models of mindfulness exist, the simplicity of the two component model proposed by Bishop and colleagues allows for integration with cognitive processes such as working memory. Moreover, defining mindfulness as a dispositional attribute similarly allows for integration and comparison with working memory, a cognitive process in which individual differences occur

(Illkowska & Engle, 2010). Additionally, an analysis of literature concerning models of mindfulness suggest that multi-component processes such as the model suggested by Holzel and colleagues (2011) may be contained within over-arching components of attention and a nonjudgmental attitude. Lastly, the Bishop model appears to most closely reflect the original Kabat-Zinn definition of mindfulness, "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (Kabat-Zinn, 1994, p. 4), which is closely related to the original Buddhist construct (Grossman, 2011). The two components of this model, *attention* and *non-judgment*, will now be examined in terms of their relationship to cognitive processes which may sustain or enhance mental resiliency following an acute stressor.

    Attention. Outside of mindfulness research, there is a voluminous amount of literature pertaining to the cognitive process of attention. Specific to mindfulness, attention is described as the conscious awareness of internal and external stimuli as they occur in the present moment, and involves a self-regulatory process through which one's attention is constantly redirected towards present moment experiences (Bishop et al., 2004). An illustration of this can be found in formal mindfulness practice, during which practitioners focus their attention on a particular stimulus, such as the breath. At any time a practitioner finds attention has become unfocused, she or he would return the focus to the breath. For example, instructions for mindfulness meditation often include the following: "Focus your entire attention on your incoming and outgoing breath. Try to sustain your attention there without distraction. If you get distracted, calmly return your attention to the breath and start again" (Smith & Novak, 2003; p.77).

Once a stimulus becomes strong enough to cross the attentional threshold needed for an individual to detect its presence, a rapid process quickly follows; the stimulus is evaluated as 'good', 'bad', or 'neutral' as a result of prior conditioning (Brown, Ryan, & Creswell, 2007). Such rapid categorization may be influenced and aided by cognitive schemas, previously established beliefs, and automatic labels or judgments. For example, a physiological experience of anxiety, such as a rapid heartbeat might arise during mindfulness meditation. Once the sensation is detected, a novice practitioner may quickly evaluate it as "bad", having previously been conditioned to experience this sensation as distressing. However, the impartiality emphasized by attitudinal components of mindfulness aid in the redirection of attention back to the present moment focus and reduces habitual, automatic cognitive reactions (Kabat-Zinn, 1990). In this manner, a mindful individual upon experiencing external or internal events would operate from a position of "pure" attention, or simply "noticing", rather than engaging in reflexive elaboration of the experience through judgments and labels. Thus, the selective attention of an individual engaging in mindfulness is fully focused without intrusions of comparisons, categorizations, evaluations, or ruminative thoughts (Marks, Sobanski, & Hine, 2010). This focused attention has been hypothesized as the process through which long-term mindful practitioners experience cortical changes, evidenced by functional brain imaging, and associated with greater attentional capacity than novice practitioners or individuals with no mindfulness experience (Kilpatrick, et al., 2011; Pagnoni & Cekic, 2007; Brefczynski-Lewis, et al., 2007). While attention is a crucial component of

mindfulness, the manner in which attention is brought to the present moment is also important and deserves equal consideration.

Non-judgment. The idea that the quality of attention is just as important as the act of focusing one's attention is considered a primary foundation of mindfulness (Kabat-Zinn, 1990). For example, an individual might focus attention on present moment experiences but in a critical, judgmental manner (Shapiro, Carlson, Astin, & Freedman, 2006), or attention may be focused with qualities of openness and warm curiosity (Kabat-Zinn, 2003); such differences are hypothesized to influence an individual's affective and cognitive experience of moment-by-moment sensory input (Bishop, et al., 2006). The act of "being present" with external and internal experiences without "condemning, criticizing, shaming, or rejecting" (Gilbert, 2009, p. 203) represents the mindful quality of non-judgment. Similarly, non-judging may also be conceptualized as acceptance of present-moment experiences (Bishop, et al., 2006), which provides a context for internal events to be viewed as transient, observable experiences rather than concrete events requiring an immediate reaction. Specifically, open acceptance provides a mechanism through which thoughts, physical sensations, and affective responses are observed as events, rather than experienced with the elaboration of categorical judgments (Walach et al., 2006) or labels such "this experience is 'good' or 'bad' (Giluk, 2009). Such elaboration on inner experiences reduces contact with the present moment, as it directs the individual's focus inward towards cognitive events and away from the experience of the here and now (Giluk, 2009). This specific attitudinal orientation is described by Shapiro and colleagues (2006) as a facet of a single process of mindfulness combined

with attention and intention into a simultaneous cycle of awareness such that a mindful state cannot occur without openness and curiosity.

The importance of a non-judgmental attitude towards present moment experiences is particularly apparent in instances where it is excluded from the act of attention towards inner emotional experiences. For example, individuals suffering from anxiety disorders often present with various somatic, cognitive, and emotional symptoms triggered by a threatening stimuli. Posttraumatic stress disorder (PTSD) is one such condition, occurring in the form of re-experiencing, hyper-arousal, and avoidant symptoms (APA, 2000), all of which are highly distressing. Research suggests traumatized individuals who make cognitive evaluations or judgments about these symptoms, concluding something is wrong rather than accepting them as part of the natural pattern of healing post-trauma, are more likely to develop PTSD than those who did not make such evaluations (Ehlers & Clark, 2011). In contrast, Shapiro and colleagues (2006) suggest that attention coupled with an attitude of openness and acceptance allows anxiety to be viewed as an impermanent inner state, one that may be unpleasant but will pass with time, thus allowing for greater tolerance of anxiety and fewer avoidant coping strategies, such as substance use or thought suppression (Shapiro, Carlson, Astin, & Freedman, 2006). A non-judgmental attitudinal orientation allows inner experiences to be treated as sources of information for enhanced decision making and self-regulation (Shapiro, Carlson, Astin, & Freedman, 2006) rather than objects of fear, providing a mechanism by which a thoughtful response to a stimulus is engendered, rather than a reflexive reaction.

Both a non-judgmental attitude and focused attention play important roles in the creation and maintenance of a mindful experience. Analysis of these two components reveals the complementary nature of mindfulness to certain cognitive processes. For example, focused attention on specific stimuli precedes the encoding and storage of these stimuli into short-term memory (Chun & Turk-Browne, 2007) while working in concert with the mind's mental sketch-board, a functional domain known as working memory. Working memory is particularly prone to reduction in its ability to hold and protect information against distractions when an individual is cognitively compromised, due to either environmental stress or symptoms of mental distress (de Kloet, Joëls, & Holsboer, 2005; Joorman & Gotlib, 2008). This aspect of working memory coupled with the pure attention resultant from a mindful state has encouraged the development of theoretical hypotheses suggesting augmentation of working memory capacity through the engagement of mindful practice (Chambers, Lo, & Allen, 2008; Jha, Stanley, & Baime, 2010; Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010). In order to better understand the clinical implications of this theory, a thorough investigation of the importance of working memory to cognitive and affective functioning is warranted.

Working Memory Capacity (WMC)

Working memory capacity (WMC) has been operationally defined as the capacity to maintain and manipulate goal-relevant information over brief periods of time by shielding it from goal-irrelevant stimuli (Conway et al., 2005; Engle, 2002; Baddeley, 2003); WMC is "critical for surviving and thriving in complex, ever-changing, and challenging situations" (Jha & Kiyonaga, 2010, p. 1036). WMC acts as a time and

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capacity limited construct in which information is stored and then processed; it was initially considered to be solely involved in the storage of temporary, short-term memory (Baddeley & Hitchm 1974). However, more recent studies suggest WMC may in fact involve both long-term and short-term memory (Baddeley, 2003; Unsworth & Engle, 2007). Additionally, WMC operates as one of the cognitive functions by which central executive functioning is enabled (Miyake et al., 2000), thereby making higher order cognition possible. However, working memory is but one component of executive functioning, which has been defined as "the dimension of human behavior that deals with 'how' behavior is expressed" (Lezak, 1983, as cited in Jurado & Roselli, 2007, p. 213). According to Miyake and colleagues (2000), two other basic executive functions exist, which are inhibition (the ability to "deliberately inhibit dominant, automatic…responses when necessary"; Miyake et al., 2000, p. 57) and mental set shifting (the ability to shift attention between multiple tasks). Cognitive behaviors mediated by executive functions are those high-level abilities typically attributed to the prefrontal regions of the brain (Stuss et al., 2002), such as verbal reasoning, problem solving, inhibition, and initiation and monitoring of actions (Chan, Shum, Toulpoulou, & Chen, 2008). Overarching components of executive functions include goal formation, goal-related planning, behaviors associated with goal-directed plans, and effectual performance of those plans (Lezak, 1983). Due to its importance in the understanding of human cognition and behavior, a vast amount of literature covers the topic of executive functioning, much of which is outside the scope of this manuscript (for a recent review, see Jurado & Rosselli, 2007).

As an executive function, WMC is theorized to be a predictor of fluid intelligence, a significant factor in the performance of an assortment of cognitive activities (Engle, Tuholski, Laughlin, & Conway, 1999).   WMC is also responsible for cognitive flexibility, which is achieved by protecting behavioral goals from competing stimuli while concurrently monitoring for goal relevant information (Miller & Cohen, 2001). The neurological mechanisms underlying WMC and cognitive flexibility are, as previously mentioned, found within the prefrontal cortex (PFC; Mansouri, Tanaka, & Buckely, 2009). However, studies of the PFC have indicated this brain structure to be quite susceptible to the effects of both acute and chronic stress (Arnsten, 2007). Moreover, WMC's ability to protect relevant information from irrelevant or distracting sensory input appears to suffer as a result of stress (Wegner & Erber, 1992).

It has been theorized that WMC involves a combination of both trait and state aspects (Ilkowska & Engle, 2010), so while stressful environments may be deleterious to WMC in all individuals (Evans & Schamberg, 2009; Vasterling et al., 2006), some may possess higher baseline WMC in such situations. Indeed, recent research on individual differences in WMC has demonstrated low WMC to be associated with increases in emotionally intrusive thoughts, risk of substance abuse, and risk of posttraumatic stress disorder (PTSD) and other anxiety disorders, (Brewin & Smart, 2005; Schmeichel, Volokhov, & Demeree, 2008), as well as greater overall psychiatric dysfunction (Unsworth, Heitz, & Engle, 2005). Additionally, individuals with low WMC have been found to be more likely to report mind wandering during a task requiring focused attention (Kane et al., 2007), much as novice practitioners of mindfulness frequently

report mind wandering during breath focused meditations (Jha et al., 2010). In contrast, individuals high in WMC have been found to be more successful at emotion regulation (Schmiechel & Demeree, 2010); interestingly, individuals with higher levels of trait mindfulness have similarly displayed more adaptive emotional functioning and higher levels of emotional intelligence than individuals low in trait mindfulness (Baer et al., 2004; Brown & Ryan, 2003), skills which involve regulatory components such as recognition of emotional cues effective and management of affective responses (Mayer, Salovey, & Caruso, 2008). Indeed, a recent study found higher levels of trait mindfulness were associated with higher trait levels of emotional intelligence as well as higher levels of positive affect and lower levels of negative affect (Schutte & Malouff, 2011).

Self-regulatory processes in general have also been linked to working memory. In one study, setting a self-regulatory goal of not consuming candy successfully guided consumption in individuals with high WMC, but not those low in WMC (Hofmann, et al., 2008). The authors of this study suggested that individuals high in WMC might be more able to engage in goal-directed behaviors guided by self-regulatory goals. However, much of the previously reviewed research of self-regulatory behavior, affective and emotional functioning, and attention in the context of both mindfulness and WMC is largely correlational in nature. Future research concerning these two cognitive processes should investigate further into such positive associations with affect and self-regulatory behavior, and focus on potential causal relationships between WMC and mindfulness.

Mindfulness and WMC: Compatible constructs. As previously mentioned, commonalities between mindfulness and WMC appear in the context of their

relationships to attention, cognitive control, and emotion regulation. Multiple recent

studies have indicated improvements in WMC following mindfulness training

(Chambers, Lo, & Allen, 2008; Jha et al., 2010; Kozhevnikov, Louchakova, Josipovic &

Motes, 2009; Zeidan, Johnson, Diamond, David & Goolkasian, 2010), and this research

has also suggested that increases in WMC may mediate the observed improvements in

affective regulation following mindfulness training. The increases seen in WMC during

studies of mindfulness training may themselves be mediated by increases in attentional

areas, as was observed through mathematical modeling in a study of mindfulness training

and working memory (van Vugt & Jha, 2011). Following a month-long mindfulness

training retreat, participants were presented with a delayed-recognition working memory

task using highly confusable face stimuli. Results demonstrated that MT participants

demonstrated faster response times and improvements in information quality and

decisional processes when compared to an age and education matched control group.

Further investigation of the relationship between mindfulness and WMC was explored in

several studies conducted by Stanley and Jha, which assessed WMC status pre- and post-

mindfulness training, using the Ospan task[1] in a cohort of military service members (Jha

et al., 2010; Stanley & Jha, 2009). In the 2010 study, Jha, Stanley and colleagues

investigated the impact of mindfulness training (MT) on WMC and affective experience

in a cohort of Marines during the pre-deployment period. It was hypothesized that the

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[1] The Ospan requires participants to solve a series of math problems while trying to remember a sequence of unrelated letters, ranging from three to seven letters in length. The Ospan score, which is the most commonly used index of WMC (see Conway et al., 2005), is the sum of all recalled letters from letter sets that were recalled completely in the correct order. Full details of task structure and timing can be found in Unsworth, Heitz, Schrock, et al. (2005).

MT would mitigate the effects of long term stress typically experienced during the pre-deployment period by increasing WMC in the service members and decreasing negative affect. The cohort was divided into two groups, both of which were exclusively male service members. The control group contained 17 participants and the group who received mindfulness training contained 31 individuals who participated in an 8 week MT course, as well as logging MT practice hours outside of the structured course time. Of the 31 Marines who underwent MT, two were excluded from the final analysis due to failure to follow participation guidelines. A third group of civilians not undergoing the prolonged stressor of pre-deployment was also provided the MT. In regards to results, WMC remained stable throughout the study in the civilian group, and it was found to decrease in the military control group. In the MT group, those with greater amounts of MT practice time demonstrated increased WMC, while participants with low practice times experienced similar decreases in WMC to the control group. These results are suggestive of a dose-response effect. Moreover, those with greater practice times were also found to report lower levels of negative affect, measured by the PANAS, as well as higher levels of positive affect. The relationship between practice time and negative, but not positive, affect was found to be mediated by WMC. Interestingly, previous research found the presence of negative affect to mediate working memory performance (Linnenbrink, Ryan, & Pintrich, 1999). These results indicate that sufficient amounts of MT practice may provide a protective effect against impairments in WMC associated with high-stress environments. However, the implications of this study are limited to an environment of chronic stress, and cannot be generalized to the impact of an acute

stressor on WMC. Other studies, although not specifically examining the link between mindfulness and WMC, have alluded to WMC's relationship with cognitive activities purported to be contained within the construct of mindfulness. For example, Barrett and colleagues (2004) suggested that individuals high in WMC are more skilled in controlled, goal-directed cognitive processing in the face of distractions. This trend appears to reflect the focused attention component of mindfulness frequently used in factor analyses of mindfulness scales (Davis, Lau, & Cairns, 2009; Feldman et al., 2007; Brown & Ryan, 2003). Additionally, a series of studies by Schmeichel and colleagues (2008) found that individuals high in WMC were better able than those with low WMC to adopt an unemotional attitude while viewing emotionally charged stimuli. These results are reminiscent of the nonjudgmental awareness component of mindfulness as well as Lau and colleagues' mindful construct of decentering (the ability to not personally identify with internal, emotional content; Lau et al., 2006).

Neuroimaging support. In addition to the previously mentioned empirical studies, which have begun to delineate commonalities between WMC and mindfulness, recent research utilizing neuroimaging techniques further elucidate potential common structural underpinnings relevant to WMC and mindfulness, such as the dorsolateral prefrontal cortex (DLPFC). A multitude of neurophysiological studies of monkeys (Chafee & Goldman-Rakic, 1998; Funahashi, Bruce, & Goldman-Rakic, 1989; Fuster & Alexander, 1971; Miller, et al., 1996; Quintana & Fuster, 1999) and more recent fMRI studies of humans (Courtney et al., 1998; Curtis & D'Esposito, 2003; Zarahn et al. 1999; Sakai et al., 2002; Leung et al., 2002; Jha & McCarthy, 2000) have identified the DLPFC

as a brain structure critical to WMC. Additionally, several human fMRI studies have also demonstrated that reduction in activity of the DLPFC leads to WMC performance reduction (Funahashi et al., 1993; Pessoa et al., 2002; Sakai et al., 2002). Although there are relatively few neuroimaging studies specifically examining the neural correlates of mindfulness, those that exist identify brain structures associated with DM and a state of mindfulness, particularly the DLPFC. For example, Creswell and colleagues (2007) reported an association between DM, as measured by the MAAS (Brown & Ryan, 2003), and enhanced DLPFC and decreased amygdala response during an affect-labeling task presented concurrently with fMRI scanning; specifically, the task involved matching facial expressions to appropriate affect words. Moreover, DM was associated with increased overall PFC activation affect labeling, compared with a gender labeling control task. The authors also found activity in the PFC during affect labeling to be negatively associated in participants high in DM but not in low DM participants. In a similar study of 18 healthy individuals, Modinos, Ormel, and Aleman (2009) found that DM, as measured by the KIMS (Baer, Smith, & Allen, 2004) was positively associated with increased DLPFC activation during instructed reappraisal of negatively valenced photographs, viewed while participants underwent fMRI scanning. Both Modinos and Creswell's investigations utilized only one measure of DM. These studies may have contributed more to the understanding of brain structures related to mindfulness by including several measures in their assessment of DM.

While not assessing DM, a neuroimaging study of mindfulness practitioners found the amount of time spent engaging in formal mindfulness practices to be associated

with significant changes in brain structures (Lazar, Kerr, Wasserman, Gay, et al., 2005). Specifically, those participants with extensive meditation experience showed increased cortical thickness in Brodmann's Area (BA) 9, an area of the brain which contributes to the DLPFC, in comparison to novice practitioners and non-practitioners. Interestingly, this increase in cortical thickness appeared to be resilient to the effects of aging, as experienced middle-aged practitioners displayed similar cortical thickness typically seen in individuals in their twenties and thirties. These results indicate time spent in a mindful state may activate BA 9, a region previously identified as an important cortical site for the voluntary regulation of negative emotion (Levesque et al., 2003) and the regulation of stressful input (Liberzon et al., 2007). Furthermore, analysis of these results suggests a structural correlate to mindfulness' positive associations with emotion regulation (Baer et al., 2004; Brown & Ryan, 2003). Indeed, due to its anatomical connections to lateral columns of the periaquaductal grey, a structure which encircles the mesenphalic aquaduct (Linnman et al., 2012) and association with active emotional coping styles (Keay & Bandler, 2001), BA 9 has been suggested to serve as an integrative site which regulates affective states and active coping behavior during times of stress. While the results of the Lazar (2005) study reinforce the connection between mindfulness and the DLPFC, the authors did not assess for DM and were primarily concerned with formal mindfulness practice. This may limit the generalizability of the results in regards to neural correlates of DM. However, they do replicate findings similar to previously mentioned neuroimaging studies implicating the DLPFC's relationship with DM, in addition to its previously supported role in the functioning of WMC.

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Acute Stress

While the link between stress and memory has been a topic of frequent research (for a review, see Lupien, Maheu, Fiocco, & Schramek, 2007), fewer studies have considered the effect on acute stress on specific cognitive domains, such as WMC. Indeed, specific focus on a particular domain of cognitive function is crucial, as stress may actually impart unique effects on different domains (Luethi, Meier, & Sandi, 2009). Acute stress, specifically, refers to situations which involve novel problems, time pressure, and high levels of ambiguity, or scenarios in which survival is at risk (Salas, Driskell, & Hughes, 1996). Typically, the experience of acute stress results in a cascade of physiological responses primarily originating in the activation of two biological systems, the sympathetic adrenal medulla (SAM) axis and the hypothalamic pituitary (HPA) adrenal axis (Richardson & VanderKaay Tomasulo, 2011). In the event of acute stress, the SAM axis responds with the release of neurotransmitters including epinephrine and norepinephrine, which subsequently influence heart rate and blood pressure, while the HPA axis releases cortisol (Richardson & VanderKaay Tomasulo, 2011). The time frame of the acute stress response is important in understanding the neurobiology of acute stress. Previous research suggests that following a moderately acute stressor, it may take several minutes for heart rate to return to baseline, as well as approximately one to two hours for cortisol levels to return to the baseline (Kirschbaum, Pirke, & Hellhammer, 1995).

Effects of acute stress on WMC. At a moderate level, an acute stressor may result in improved performance; however, multiple studies have consistently

demonstrated high levels of stress can have negative effects on both physical and mental health (McEwen, 1998; Schneiderman, Ironson, & Siegel, 2005; Selye, 1955). As previously mentioned, stress has been shown to have particularly deleterious effects on WMC. For example, a recent study by Duncko, Johnson, Merikangas, and Grillon (2009) examined working memory performance during an item recognition task after randomly assigned subjects had been exposed to a cold pressor stress test, an acute adrenergic stressor which involves insertion of the subject's dominant hand into ice water for 60 seconds. Subjects in the control group inserted their dominant hand in room temperature water. Following a twenty minute delay, working memory performance was tested with an item recognition task. Physiological changes were assessed by measuring heart rate and salivary cortisol before, during, and after the stress procedure was administered. Through these measures, Duncko and colleagues found that stress exposure was associated with significantly shorter reaction times during recognition trials which required greater amounts of information to be processed simultaneously. Moreover, individuals exposed to the stressor were more likely to display higher false alarm rates than those in the control group. These results suggested a paradoxical effect of exposure to the cold pressor test, with indication of both enhanced and impaired performance on working memory tasks. In their discussion of these results, the authors suggested that this cognitive pattern might in fact be representative of a form of information processing utilized in threatening situations, which is more efficient in its discrimination of stimuli as to be beneficial in a scenario where rapid cognitive action might engender greater chance of survival.

A second study of WMC under stress employed an acute, social stressor, the Trier Social Stress Test[2] (TSST; Kirschbaum et al., 1993), on subjects randomly assigned to a stress group (Luethi, Meier, & Sandi, 2009). Control group participants and the stress group, following stress induction, were then asked to perform on a task of working memory, and salivary cortisol levels were sampled throughout the experiment to measure physiological stress effects. Results of this study indicated a prominent working memory deficit in those subjects exposed to the stressor. As with Dunko and colleagues, Luethi, Meier and Sandi suggested that their observations regarding the effect of stress on working memory indicated an adaptive, streamlined mode of processing initiated in potentially threatening situations, potentially mediated by the release of cortisol. However, they also noted that should this type of processing be employed continually, it might lead to the development or maintenance of disorders such as depression or PTSD. This claim is supported by neurophysiological research which suggests chronic stress may remodel neural pathways due to sustained activation of the HPA axis (Magarinos, McEwen, Flugge, & Fuchs, 1996; Vyas, Mitra, Shankaranarayana Rao, & Chattarhi, 2002). Unfortunately, Luethi and colleagues' sample consisted solely of men, limiting generalization of results to both genders. The effects of acute stressors on specific brain regions implicated in WMC have also been investigated. A study by Qin and colleagues

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[2] The TSST is a motivated performance task which combines elements of uncontrollability and high levels of social-evaluative threat (Kirschbaum et al., 1993). The task consists of a brief preparation period (3 minutes) followed by a test period. During the test period, the subject must deliver a free speech (5 minutes) and perform mental arithmetic (5 minutes) in front of an audience (for a detailed description of TSST procedures and a review of relevant research, see Kudielka, Hellhammer, & Kirschbaum, 2007).

(2009) found that acute stress significantly reduced activity in the DLPFC, which is

functionally related to working memory. Psychological stress was induced in healthy

volunteers through presentation of movie clips containing violent content during

simultaneous fMRI scans. During presentation, participants were asked to imagine

themselves in the scene as an eyewitness in order to achieve maximum emotional

involvement. While still undergoing fMRI scanning, participants completed the N-Back

test[3] (Kirchner, 1958) of WMC. As previously mentioned, study results demonstrated

reduced activity in the DLPFC following stressor presentation and during the working

memory task. FMRI scans also indicated a reallocation of cerebral blood flow away from

functional regions associated with higher order processes, or executive functioning, in

combination with less deactivation in functional areas associated with the default mode

network (DMN). The DMN is a system of cortical structures responsible for the brain's

resting state, which is activated in the absence of stimulus-dependent thought and is

associated with mind wandering (Gusnard & Raichle, 2001; Mason et al., 2007).

Moreover, activation of the DMN appears to reduce processing of sensory awareness,

thus protecting attention absorbed by internal stimuli (Barron, Riby, Greer, &

Smallwood, 2011). In regards to these findings, results of the Qin study (2009) suggest

that tasks involving WMC in the context of acute psychological stress may represent dual

processing of both external and internal stimuli. Moreover, the stress-induced

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[3] The N-Back task is a frequently used measure in studies of WMC. Participants are presented with a stream of stimuli and are asked to decide for each stimulus whether it matches the one presented N items before (Jaeggi, Buschkuehl, Perrig, & Meier, 2010). Studies have shown that processing load can be varied systematically by manipulating the value of N, which is reflected in changes in accuracy and reaction time (see, e.g., Jonides et al., 1997 for more detail).

deactivation of the DLPFC, through the release of large amounts of dopamine and norepinephrine into the PFC (Zigmond, Finlay, & Sved, 1995) in conjunction with reciprocal allocation of activity to the DMN, appears to be linked to task-irrelevant thought intrusions. As previously mentioned, the inability to screen task-irrelevant cognitions has been linked to lowered levels of WMC.

Previous research suggests that this biological response to acute stress is representative of a survival mode of cognition, in which slower higher-order cognitive processes are deactivated in order to allocate more resources to faster, reflexive types of cognition (Arnsten & Goldman-Rakic, 1998; Diamond et al., 2007), such as those related to "fight-or-flight" mechanisms (Cannon, 1929). Similar studies of working memory performance under acute stress have also indicated a change in cognitive processing biased towards speed. As previously mentioned, Dunkco and colleagues (2009) found higher false positive rates on a recognition task in individuals who had been previously subjected to a cold pressor stress test, while Luethi and colleagues (2009) similarly demonstrated a more streamlined mode of cognitive processing resulting in working memory deficit following an induced social stressor.

In addition to the cognitive costs of physiological reactions to acute stress, the deactivation of prefrontal brain structures in the presence of acute stress induced in laboratory settings, such as in the Qin study, is remarkably similar to the decreased activity of frontal regions symptomatic of individuals with various psychological dysfunctions associated with working memory deficits (Qin et al., 2009). Previous studies have demonstrated results suggesting that the hypofrontality observed in psychological

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disorders such as ADHD, schizophrenia, bipolar disorder, and posttraumatic stress disorder, may be associated with the heightened levels of stress reported by individuals with these conditions (Arnsten, 2007; Arnsten & Li, 2005).

In summary, acute stress has been demonstrated in laboratory studies to have deleterious effects on WMC. However, the studies concerning acute stress and WMC present a wide array of methods with which acute stress is induced. While the variability in the type of stressor utilized presents a limitation in regard to the ability to synthesize the collective results, analysis of the results themselves indicate several areas of congruence. For example, both performance measures of WMC and functional measurement of brain structures implicated in WMC indicate reduced functioning following the presentation of an acute stressor. Additionally, collective results suggest that the presence of an acute stressor may create a survival mode of cognition, in which higher-order processes are disabled in favor of more reflexive forms of cognition. However, the presence of mindful awareness may reduce the loss of frontal functioning, as suggested in the following review of literature concerning mindfulness and acute stress.

Acute stress and mindfulness. Research concerning mindfulness and stress is most often focused on stress-reduction outcomes, with mindfulness introduced as an independent variable acting on individuals faced with chronic stress, such as chronic medical conditions, care-giving roles, or stressful occupations (Shapiro, Astin, Bishop, & Cordova, 2005; Minor, et al., 2006; Birnie, Garland, & Carlson, 2010). However, mindfulness is much less frequently studied as a mediator of acute stress induced in

research participants. Though not directly assessing mindfulness, Gohm, Baumann, and Sniezek (2001) conducted a complementary study of affective reactions and cognitive performance in a sample of firemen during a live fire training exercise. The study examined variables such as attention and clarity, which was defined as "the extent to which individuals are able to distinguish and identify which specific emotion they are experiencing in the moment" (Gohmm, Baumann, & Sniezek, 2001, pp. 390). While not defined as mindfulness, this description certainly echoes mindfulness tenets such as present moment awareness and receptivity of inner experiences. Previous research demonstrated the activation of the SAM axis following an acute stressor can induce a prolonged negative affect state, and a subsequent loss of cognitive flexibility (Sinha, Lovallo, & Parsons, 1992; Plessow, Fischer, Kirschbaum, & Goschke, 2011). Gohm and colleagues hypothesized subjects with higher levels of clarity would spend less time attending to an emotional response to a stressful event once that emotion has been identified, and therefore better allocate cognitive resources to the task at hand. Essentially, these individuals would spend less time engaged in ruminative reactions to emotions evoked by the acute stressor and perform better than those who struggled with emotional reactions. This hypothesis was supported as firefighters who reported easily identifying emotions during the live fire exercise also reported fewer instances of cognitive difficulties. Their counterparts with low clarity of emotional experience reported greater incidence of cognitive failures, such as their mind going blank.

In a mindfulness study featuring acute stress induction, Barnes and colleagues (2007) assessed the effect of DM, as measured by the MAAS (Brown & Ryan, 2003) on

emotional, cognitive, and behavioral stress responses to conflict in romantic dyads. In order to induce relationship stress, the experimenters utilized a technique developed by Gottman (Gottman, Coan, Carrere, & Swanson, 1998; Levenson & Gottman, 1983) to create relational conflict in couples. Specifically, couples were asked to discuss areas of conflict in their relationship first in person and then over an intercom, with their interactions both observed and recorded, and later coded for discrete examples of stress responses. Results suggested that individuals in the study with high scores on a measure of DM experienced a less severe emotional reaction during the induced relational stressor, as well as significantly lower levels of anxiety and anger following the period of conflict than those with lower levels of DM.

One other study featuring the induction of acute stress in concert with measures of mindfulness was undertaken by Weinstein, Brown, and Ryan (2009), who investigated the effects of DM on stress perception. Participants were first assessed for baseline levels of stress, anxiety, and DM; DM was assessed using the MAAS (Brown & Ryan, 2003). Following assessment, participants completed a stress induction task during which they were required to perform mental arithmetic under observation with performances timed and recorded. This stress induction task was adapted from a previously verified method of stress induction developed by Cheng (2003). After a thirty minute delay, participants' ability to complete mazes (an activity incorporating both creative thinking and concentration) was assessed. Study results indicated that individuals with higher scores on a measure of dispositional mindfulness perceived less stress throughout the experiment, as well as less utilization of avoidant coping methods than those with lower

dispositional mindfulness scores. These individuals with high DM were also observed to perform with higher capabilities on the maze tasks which followed the post-stress induction delay.

A recent study of the influence of acute stress on spatial task performance indicates similar interference by emotional experiences as found by Weinstein and colleagues (2009). Richardson and Vanderkaay Tomasulo (2011) found that participants who were presented with an acute stressor performed with slower response times in two novel spatial tasks than those participants in the control group. Participants in the stressed group also reported a prolonged negative affect state following the stressor, including higher levels of anger, frustration, and irritability. The authors of the study suggested that heightened negative affect may have interfered with processing speed during the spatial tasks, indicating a reallocation of cognitive resources away from the tasks as a result of distressing, internal experiences.

To summarize, the activation of the SAM axis in response to an acute stressor has been implicated in the generation of a protracted experience of negative affect; it would appear that the associated emotional response to acute stress creates additional cognitive demand on an already taxed system, leading to changes in the processing of information. However, the perspective through which this emotional response is viewed may influence the degree to which it represents an additional cognitive demand, lessening the need for reallocation of cognitive resources towards inner events such as rumination.

Proposed Theoretical Framework

A review of the literature concerning mindfulness and WMC in the context of acute stress suggests multiple areas of overlapping processes related to emotional reactivity and higher order cognitive functioning. However, due to only relatively recent interest in neuropsychological attributes of mindful processes, there is an obvious dearth of research investigating causal relationships between WMC and mindfulness in the context of acute stress. The following theoretical model, illustrated in Figure 1, is proposed as a potential process through which the complementary mechanisms of mindfulness and WMC may interact after the presentation of an acute stressor.

This conceptual model borrows its basic structure from the transactional model of stress originally developed by Lazarus and Folkman (1984), while also integrating the construct of mindfulness. Moreover, this model is novel in its approach of considering a mindful appraisal process within the context of acute stress and its effects on working memory. The transactional model of stress (Lazarus & Folkman, 1984) was chosen as a format for the current model as the transactional model and mindfulness have previously been integrated successfully. Notably, Kabat-Zinn (1990) incorporated the transactional stress model with mindfulness during the development of the MBSR program.

The transactional model is based in Lazarus' original cognitive stress theory, which assumes cognitive appraisal processes to be important mediators of the stress process (Lazarus, 1966; Lazarus & Folkman, 1984). Appraisal refers to the cognitive process by which stressful events are evaluated in reference to one's well-being (Lazarus, 2000; Lazarus, 2001). The way in which an event is appraised by an individual has been

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shown to mediate the stressfulness of said event, and appears to aid in the regulation of the quality and intensity of emotional response to the situation (Steptoe & Vogele, 1986). In the transactional stress model, Lazarus proposed the existence of two forms of appraisal. During the primary appraisal, an individual evaluates whether the situation presents a threat to one's well-being, while the secondary appraisal involves the individual's evaluation of coping options and their effectiveness relative to the threat. According to the transactional model, a stress response occurs when the primary appraisal indicates a threat and the secondary appraisal indicates the individual's coping options are inadequate in the face of this threat. The transactional model has largely been empirically supported in a variety of areas (Quine & Pahl, 1991; Maier et al., 2003; Tomaka et al., 1993), although there is limited support for the model with regards to cortisol levels as a marker of stress response (Gaab et al., 2005; Denson et al., 2009).

As previously mentioned, Kabat-Zinn's (1990) development of the MBSR program represents an earlier successful integration of mindfulness and the transactional model. Specifically, Kabat-Zinn proposed mindfulness to be of importance during the appraisal stage of the transactional stress model, during which the individual determines whether or not a specific circumstance is indeed a stressor. At this stage, the present-moment awareness fostered during a mindful state allows for an objective, accurate appraisal of the event, which allows for effective responding rather than habitual, physiological reactivity (Ulmer, Stetson, & Salmon, 2010). This model has subsequently received empirical support (Shapiro et al., 2006). However, Kabat-Zinn's proposed model and its consequent application through the MBSR program were primarily

concerned with the appraisal of stress resultant from prolonged conditions, such as chronic pain or chronic medical illness. As previously established, chronic stress is qualitatively different from acute stress, both experientially and in terms of physiological response. Additionally, the gap in research literature concerning how mindfulness and working memory interact during acute stress to preserve cognitive functioning has also been previously established. The proposed model is an attempt to fill this gap, and its components are discussed in detail in the following sections.
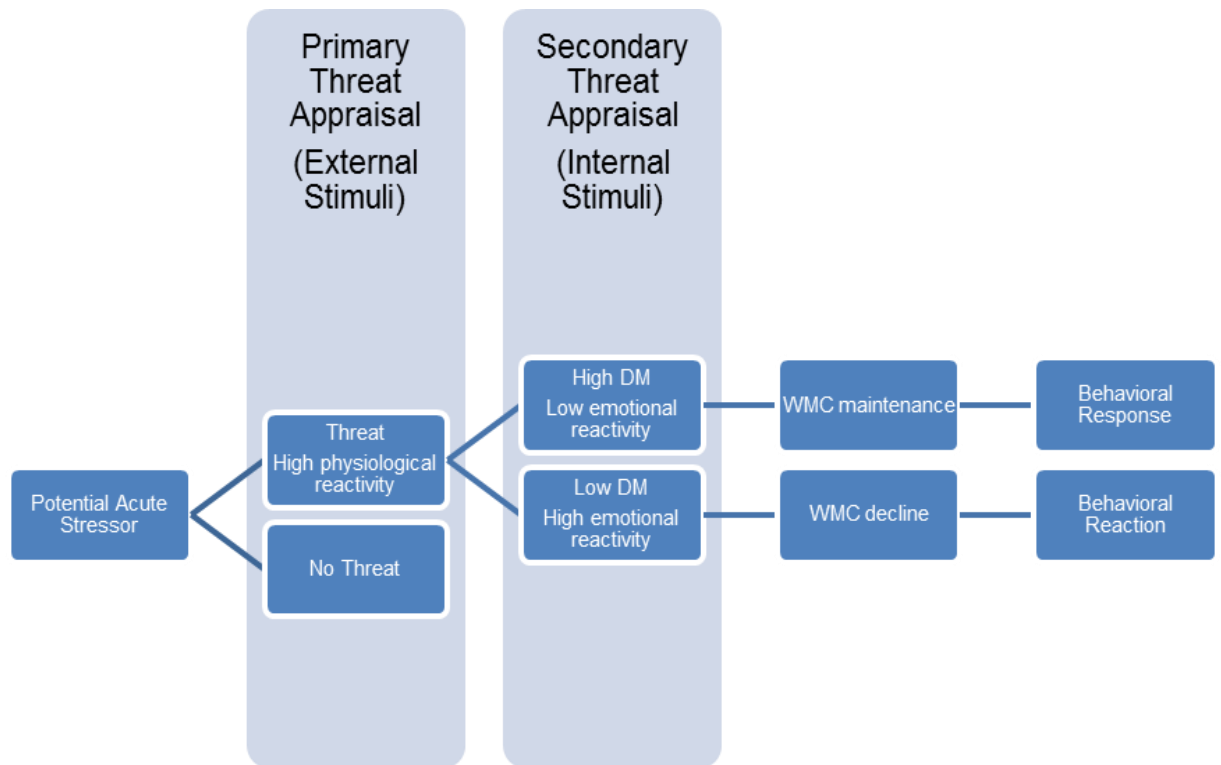
Figure 1. Theoretical illustration of relationship between DM and WMC following an acute stressor.

Primary threat appraisal. Prior to the first appraisal stage, an event occurs in the external environment which is detected by the individual; this event is termed the

potential acute stressor, as its actual threat value has yet to be determined. This determination follows during primary stage of appraisal, as in the primary appraisal of Lazarus and Folkman's model, during which the individual evaluates whether or not the event represents a threat to survival or well-being (Lazarus & Folkman, 1984). Aspects which might lead to an event being interpreted as acutely stressful include novel problems, time pressure, and immediate threats to emotional or physical integrity (Salas, Driskell, & Hughes, 1996). If, at this point, the event is not judged to be an acute stressor, the individual then exits the acute stress appraisal process. However, should elements of the event be appraised as indicative of an acute stressor, a rapid cascade of physiological responses begins. The SAM and HPA axes respond with the release of neurotransmitters and stress hormones (Richardson & VanderKaay Tomasulo, 2011), which ready the body for survival. Common effects of this physiological response include increased heart rate and blood pressure, and accelerated breathing. These physiological reactions resulting from identification and appraisal of an acute stressor become additional information to be appraised as part of this process.

Secondary threat appraisal. The current model differs from the transactional stress model (Lazarus & Folkman, 1984) in its approach to the secondary appraisal stage. The secondary stage of Lazarus and Folkman's model entails an appraisal of coping resources; however, it is suggested that in the context of an acute, potentially life-threatening stressor, there may not be enough time to methodically analyze resources available to the individual or to engage in coping methods such as seeking social support or escape-avoidance through sleep or immersion (Folkman & Lazarus, 1984). Instead,

individuals may be more likely to appraise their own internal experience of the stressor to determine their ability to manage the stressor effectively. While information evaluated in the primary threat appraisal stage is largely environmental in nature, the secondary threat appraisal phase exists as an immediate evaluation of internal sensory information, such as the previously mentioned sequelae of the SAM and HPA activation. It is during this appraisal of internal sensory experiences that an individual's level of DM is proposed to create a moderating effect. Individuals with a high level of DM are predicted to attend to internal physiological input without evaluation or judgment (Ehlers & Clark, 2011). Additionally, they are likely to experience low reactivity to intrusive thoughts and any negative affect created by HPA axis activation (Plessow, Fischer, Kirschbaum, & Goschke, 2011; Sinha, Lovallo, & Parsons, 1992). Moreover, results of the secondary threat appraisal would be akin to an objective awareness of these inner experiences, without application of "good" or "bad" labels, and maintained present moment focus (Giluk, 2009). As a result, secondary stress due to interpretations of physiological reactions as additional sources of threat does not occur (Shapiro et al., 2006), and attention may be consistently redirected towards present moment experiences rather than absorbed by inner experiences (Bishop et al, 2004).

In contrast, an individual with low levels of DM would be expected to appraise internal stimuli quite differently. Such individuals are predicted to react to the physiological sequelae of acute physiological activation without the support of a neutral, objective perspective. Instead, low DM individuals would produce cognitive evaluations of internal stimuli, elaborating on physiological reactions to the acute stressor with labels

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("this experience is bad"; Giluk, 2009), or interpreting such reactions, intrusive cognitions, or distressing affect as additional sources of fear or stress (Shapiro et al., 2006). These experiences are appraised as negative, troubling, or indicative of an inability to manage the stressor effectively (Ehlers & Clark, 2011). Low levels of mindfulness at this stage also lead to greater attentional resources directed away from the present moment, and towards intrusive thoughts or other distressing internal experiences, or the presence of HPA-induced negative affect (Plessow, Fischer, Kirschbaum, & Goschke, 2011; Sinha, Lovallo, & Parsons, 1992). Following the secondary threat appraisal stage, individuals low in DM have twice evaluated their situation as threatening: external stimuli resulted in the positive appraisal of an acute stressor, while the secondary appraisal found internal stimuli to be additional sources of acute stress. Neurologically, the result of these two appraisals is reduced activity in the DLPFC (Creswell, et al., 2007; Modinos, Ormel, & Aleman, 2009), and attention is absorbed by non-present moment, internal stimuli such as ruminations, cognitive evaluations, and judgments. Ultimately, the secondary appraisal stage for low DM individuals has resulted in the evaluation of inner experiences as additional, acute stressors in and of themselves, increasing to the point at which cognitive load compromises the mind's ability to shield itself from irrelevant stimuli (Baddeley, 2003; Engle, 2002; Evans & Schamberg, 2009).

Effect on WMC and subsequent behavioral action. Results of the secondary appraisal stage, moderated by the level of DM present in the individual, directly influence the subsequent impact on WMC. While WMC may decline to some degree in the context of any stressor (Evans & Schamberg, 2009; Vasterling, et al., 2006), it is proposed that

high DM individuals are able to avoid significant WMC degradation following an acute stressor due to an objective stance towards inner experiences during the secondary appraisal. Because of their ability to maintain a present moment focus, individuals with high DM support maintenance of relevant information by shielding it from potentially attention-absorbing inner stimuli, such as cognitive or physiological events (Marks, Sobanski, & Hine, 2010). This ability mirrors the function of WMC (Baddeley et al., 2003; Conway et al., 2005; Engle et al., 2002), producing the experience of maintained or non-significantly decreased WMC following presentation of an acute stressor. It is predicted that for this type of individual, the behavioral action taken will be that of a measured response to the stressor as a result of mindfulness-enhanced self-regulation supporting decision making (Shapiro et al., 2006). In the case of a low DM individual following presentation of the same stressor, significant decrease in WMC is unavoidable. As previously mentioned, both primary and secondary appraisals have resulted in the identification of both external and internal sources of stress, attentional resources have been directed away from the present moment and towards internal experiences (Richardson & VanderKaay Tomasulo, 2011), and activity in the DLPFC, the brain structure critical to WMC functioning (Curtis & D'Esposito, 2003; Jha & McCarthy, 2000; Leung et al., 2002), has been reduced (Creswell et al., 2007; Modinos, Ormel, & Aleman, 2009). It is predicted that for a low DM individual, the behavioral action which follows the acute stressor and both appraisal stages will be that of a reflexive reaction. As previously mentioned, numerous empirical studies suggest impaired WMC to be associated with shorter reaction times, higher false positive rates, as well as cognitive

processes biased towards speed rather than accuracy (Arnsten & Goldman-Rakic, 1998; Diamond et al., 2007; Dunkco et al., 2009).

Focus of Current Study

Study rationale. The importance of this theoretical illustration of the potential moderating effect of DM upon WMC following an acute stressor lies in its implications for future clinical interventions for individuals likely to encounter acute stressors as an occupational hazard. Mindfulness exists to some degree as an innate aptitude in all individuals, and can be enhanced with training and maintained though practice (Brown & Ryan, 2003; Kabat-Zinn, 2003). Therefore, mindfulness training interventions might be developed for individuals such as emergency service personnel, law enforcement, and military service members to enhance already present levels of DM and the likelihood of WMC maintenance following an encounter with an acute stressor. While the previously described survival mode of cognition engendered through an acute stress-induced decrease in WMC (Arnsten & Goldman-Rakic, 1998; Diamond et al., 2007; Duncko et al., 2009; Luethi et al., 2009) certainly has merit in situations requiring rapid reflexive action, it may also come at the cost of higher-order decision making required for acutely stressful circumstances with high levels of ambiguity. Such situations are frequently encountered by military personnel. Service members on the modern day battlefield contend with acutely stressful events under ambiguous circumstances (Searcey, 2005), which often require responses rather than reactions. For example, troops manning check points only have a few moments to decide if a speeding car is a civilian vehicle or a suicide bomber (Ramirez, 2005), with their decisions determining whether the vehicle is

fired upon or allowed to approach the check point. Additionally, modern warfighters must exhibit a high level of situational awareness, effectively filtering distracting information and selectively attending to crucial input (Morelli & Burton, 2009). Examples of this might include scanning a crowded marketplace to discern the presence of combatants, or analyzing input from multiple visual monitors and grounding subsequent tactical recommendations on such data (Endsley & Bolstad, 1994; Morelli & Burton, 2009), all while subjected to acute stressors such as gunfire or explosions. In such situations, the heightened false-positive response rate associated with the reduction of WMC observed in Duncko and colleague's (2009) laboratory translates to unintended civilian casualties. However, amplified levels of mindfulness during the secondary threat appraisal stage of such moments might reduce the risk of reflexive reactions, effectively supporting WMC, maintaining higher-order thought processes, and lifting the fog of war.

Current study.

This study was undertaken to test the moderating effect of DM on WMC, stress-induced negative affect, and physiological arousal. A laboratory, emotionally charged stressor was utilized to induce acute stress and associated negative affect. While there are many other types of stress induction tasks in the extant literature, this type of stressor was chosen in an effort to duplicate the emotional and cognitive effects of acute stress. While the need to work within a laboratory setting and without causing actual psychological harm to participants means that laboratory stressors are not fully representative of a real world acute stressor, this emotionally charged paradigm was most analogous to situations that might create an acute stress reaction, such as exposure to interpersonal violence or

military combat. Moreover, using this analogue of interpersonal violence or combat exposure allows results of the current study to have greater generalization to trauma-exposed populations.

This study endeavored to take the next step in understanding the relationship between WMC and DM in the context of an acute stressor. As an initial study of this relationship within the specific context of acute stress, a non-clinical population of college undergraduate students served as participants in a laboratory-based stress induction study. Based on the reviewed literature and the previously discussed proposed model of DM and WMC interaction, it was hypothesized participants' level of DM will be negatively associated with WMC loss following the stressor. Further, it is also hypothesized that level of DM will be negatively associated with amount of negative affect (NA) reported following the stress induction. Additionally, a contrasting pattern of physiological response to the acute stressor was expected. Specifically, it was hypothesized that individuals with low DM would display greater physiological reactivity during stressor presentation than those with high DM.

Hypotheses.

Hypothesis 1. It was hypothesized that working memory capacity (WMC) scores would decrease from pre- to post-stressor, and would be moderated by dispositional mindfulness (DM). An interaction was also predicted, such that the low DM group would display a significant decrease in WMC while the high DM group would not display a significant decrease in WMC following the presentation of the stressor.

Hypothesis 2. It was hypothesized that negative affect (NA) scores would decrease from pre- to post-stressor, and would be moderated by dispositional mindfulness (DM). Specifically, it was predicted that the high DM group would not display a significant increase in NA and that the low DM group would display a significant increase in NA following presentation of the stressor.

Hypothesis 3. It was hypothesized that greater physiological reactivity during stressor presentation, measured by heart rate (HR), would be observed in the low DM group than in the high DM group. Specifically, it was hypothesized that the low DM group will display higher overall HR during the stressor presentation than the high DM group.

CHAPTER 2 METHODS

Participants

Recruitment. Study participants included undergraduates recruited through the psychology department subject pool. The study description is included in Appendix A. Undergraduate students enrolled in psychology courses are eligible to sign up for various, university sponsored research studies, and receive course credit for their participation. Inclusion criteria consisted of age (18 and over), written and spoken English language comprehension sufficient for understanding directions and completing self-report questionnaires, and normal or corrected to normal vision. As the intent of the study was to examine the effects of dispositional mindfulness in a formal meditation-naïve population, exclusion criteria included ongoing formal meditation practice or prior enrollment in an MBSR program. In addition, participants were recruited and data was collected throughout the academic year, including the spring, summer, and fall semesters. This wide temporal window of data collection allowed sampling of students to take place at times of both high and low academic stress, which may have resulted from environmental factors (i.e. the start of a new school year or final examinations).

Data Collection. Participants reported individually to the Biobehavioral Research Laboratory, where data collection was conducted by the study coordinator and/or research assistants. The study coordinator conducted approximately one fourth of the total data collection, and research assistants collected the remaining data; this ensured a

minimum amount of any experimenter bias which may have affected data collection and subsequent results. Moreover, both a male and female research assistant collected data, ensuring less risk of participant bias related to the gender of the administrator. To ensure a consistent experience across all participants, a standardized protocol was used (see Appendix B).

Measures

To examine the proposed model of mindfulness and working memory within the context of an acute stressor, this study employed measures of mindfulness, working memory capacity, and affect. A measure of perceived, global stress was also utilized, and questionnaires related to traumatic stress, and phobic reactivity to blood and injury were employed as screening measures. Demographic variables used in the analyses included age, gender and education level (year in college). Samples of all assessment measures are found in Appendix C.

Mindfulness.

Mindful Attention Awareness Scale (MAAS). The MAAS (Brown & Ryan, 2003) is a 15-item single-dimension scale of trait mindfulness. The MAAS is widely used as a measure of mindfulness, and has a longstanding record of reliability, validity and psychometric consistency across various cultures (Christopher et al., 2009; Cordon & Finney, 2008; Hansen, Lundh, Homman, & Wangby-Lundh, 2009; MacKillop & Anderson, 2007; Thompson & Waltz, 2007; Van Dam, Earleywine, & Borders, 2010; Zvolensky et al., 2006). It was developed to measure the frequency of open attention to and awareness of experiential events occurring throughout day-to-day consciousness.

Response options range from 1 (almost never) to 6 (almost always) on a Likert-type scale, and items are reverse scored with higher mean scores reflecting a greater degree of trait mindfulness. Sample MAAS items include "I rush through activities without being really attentive to them" and "I find it difficult to stay focused on what's happening in the present." The MAAS shows good internal consistency across a wide range of samples, with alphas ranging from .80–.87 (Brown & Ryan, 2003). Moreover, test–retest reliability data over a one month period suggest MAAS scores are stable, with no significant differences observed between first and second administration (Brown & Ryan, 2003), and criterion validity has been supported through consistent associations with behavioral, physiological, and neurological outcomes (Brown et al., 2011).

   Philadelphia Mindfulness Questionnaire (PHLMS). The PHLMS (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008) is a self-report mindfulness measure assessing two factors: Present-Moment Awareness (PMA) and Nonjudgmental Acceptance (NJA). Items are rated on a 5-point Likert scale (1=never; 5=very often) according to the frequency that an experience occurred within the past week. Exploratory and confirmatory factor analyses support the two-factor structure of awareness and acceptance and good internal consistency was demonstrated in both clinical (Cronbach's α=0.75) and nonclinical (awareness: Cronbach's α=0.75, acceptance: .82) samples (Cardaciotto et al., 2008). While good convergent and divergent validity has been found for the PHLMS thus far (Cardaciotto et al., 2008), less validity research has been conducted than on such measures as the MAAS due to its more recent development. With less validity research in comparison to the MAAS, the PHLMS was chosen as a

secondary measure of mindfulness for the current study. This measure was included in order to determine the correlation with the MAAS, and to reveal whether the two-factor structure provided interesting information about the levels of awareness and acceptance in the current sample.

Working memory capacity.

Operation Span Task (OSPAN). Working memory capacity was assessed using a computer-based version of the Operation Span Task (OSPAN). The OSPAN (Turner & Engle, 1989) was developed from the theoretical perspective of functional working memory, which emphasizes the capacity of WM to store limited amounts of information while one is concurrently involved in a separate mental activity (Engle, 2002; Baddeley & Hitch, 1974); for example, solving a math problem while simultaneously attempting to remember a list of words. The version of the OSPAN utilized in the current study required participants to solve math problems while simultaneously attempting to remember a set of words for later recall. During administration of the OSPAN participants view one math – word combination at a time, -- referred to as a string -- on a computer monitor. There are 15 trials, each trial consisting of two to five strings. The order of string size varies randomly, so that participants cannot predict the number of items from one trial to the next. On each trial, participants are asked to read the math problem out loud, solve the math problem mentally, respond "Yes" or "No" as to whether the equation is correct, and then read aloud the word. Immediately after the participant reads the word, the next string is presented. Following the completion of each set, the

participant recalls the words presented and records them on the answer sheet. For example, a three-item set might include the following items displayed:

IS (9/2) − 1 = 1? shirt

IS (4*1) + 2 = 6? desk

IS (10*2) − 4 = 15? dog

???

Each line is presented separately; the participant's act of stating the word at the end of the equation is the prompt for the next math-word combination to be presented. The question marks are a visual cue for the participants to begin to write the words on the answer sheet. Ospan scores may be calculated a number of ways (Unsworth et al., 2005). However a total scoring method was utilized, in which the Ospan score is the sum of the total number of words recalled on the task. The rationale for this scoring method is that it would provide a greater range of scores with which to group the sample into high and low WMC subgroups, in comparison to the alternative, absolute method of scoring in which participants only receive credit for remembering all words in a strong in the correct order. Additionally, in order to ensure that participants are not trading off between solving the operations and remembering the words, an 85% accuracy criterion on the math operations was required for all participants.

During each sequence, the task of verifying math equations serves as interference as participants attempt to maintain the co-presented words in short-term memory. A higher frequency of words recalled correctly indicates greater WMC. The OSPAN has demonstrated good internal consistency in previous research utilizing adult samples

(Cronbach's alpha=0.78; test–retest reliability *r*=0.83; Unsworth et al. 2005).

Additionally, both the automated and non-automated OSPAN tasks have been previously

used in recent research concerning mindfulness and WMC (Black, Semple, Pokhrel, &

Grenard, 2011; Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010; Stanley, Schaldach,

Kiyonaga, & Jha, 2011). Furthermore, the OSPAN includes two forms (Form A and

Form B), which allows for repeated administration and counterbalancing.

Affect.

Positive and Negative Affect Schedules (PANAS). The PANAS (Watson et al.,

1988) is one of the most widely used measures of affect. It specifically measures Positive

and Negative Affect, which are considered broad mood factors under which various

mood states are subsumed (Watson, Clark, & Carey, 1988). Positive Affect (PA) refers to

"the extent to which a person feels enthusiastic, active, and alert" (Watson, Clark, &

Tellegen, 1988, p.1063). High PA would include energy and engagement, while low PA

would be characterized by melancholy and fatigue. In contrast, high Negative Affect

(NA) would involve aversive mood states such as "anger, contempt, disgust, guilt, fear,

and nervousness" (Watson, Clark, & Tellegen, p.1063), whereas low NA would involve

being a state of calmness and tranquility. The measure consists of two 10-item self-report

mood scales which were designed to measure these two separate dimensions The NA and

PA scales have been shown to be highly internally consistent, uncorrelated, and stable

over time. Moreover, high reliability has been demonstrated in validation studies, with

Cronbach's alphas of .89 and .85 found for positive and negative affect, respectively

(Crawford & Henry, 2004). Participants are asked to rate, on a scale from 1 (*very slightly*

or *not at all*) to 5 (*extremely*) to what extent they felt a certain way during a specified period of time. In this experiment, participants were asked to rate their affect in the present moment, in order to detect changes in negative affect (NA) predicted to result from the stress manipulation. The PANAS has been used in multiple studies of acute stress (Aschbacher, Epel, Wolkowitz, Prather, Puterman, & Dhabhar, 2012; Ramsey, 2014; Stoney, Niaura, Bausserman, & Matacin, 1999; van Marle, Hermans, Qin, & Fernández, 2009), as well as studies of mindfulness and acute or chronic stress (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010; Nyklíček, Mommersteeg, Van Beugen, Ramakers, & Van Boxtel, 2013).

Perceived Stress

Perceived Stress Scale (PSS). The 10-item version of the PSS was used in the current study as a measure of globally perceived stress (Cohen, Kamarck, & Mermelstein, 1983; Cohen & Williamson, 1988).The development of the measure was informed by principles of Lazarus and Folkman's (1984) transactional theory of stress . Specifically, items on the PSS assess individuals' sense of unpredictability and lack of control in their day-to-day lives.   Responses are scored on a five-point Likert scale, ranging from 'never' (0) to 'very often' (4). A total perceived stress score is generated by summing the total of all items. According to Cohen and colleagues, higher scores on the PSS are indicative of higher levels of perceived stress. A recent study of the PSS has found good internal reliability ranging from .78 to .91 (Cohen & Janicki-Deverts, 2012). The PSS has been frequently used as a measure of global stress in several other studies concerning both mindfulness and working memory (Shapiro, Astin, Bishop, & Cordova,

2005; Carmody, Baer, Lykins, & Olendzki, 2009; Lengacher et al., 2009; Klein & Boals, 2001; Mann, Canny, Reser, & Rajan, 2013), including a study of the effect of mindfulness training on WMC by Stanley and colleagues (2011). Additionally, the PSS has been found to have good reliability and validity with use among college students (Roberti et al., 2006).

Blood/Injury Sensitivity.

Blood-Injection Symptom Scale. The BISS is 17-item scale frequently used as screening measure of phobic response to blood, injections, and injury (Olatunji, personal communication, August 26, 2012; e.g. Hermann, Schäfer, Walter, Stark, Vaitl, & Schienle, 2007; Olatunji, Connolly, & David, 2008; Page, 2003; Hepburn & Page, 2000). The scale was developed to assess symptoms of fear and fainting associated with blood-injection-injury (BII) phobia as previous measures of this disorder did not fully address the complete spectrum of possible BII symptoms (Page, Bennett, Carter, Smith, & Woodmore, 1997). Items on the BISS consist of descriptions of various somatic experiences and sensations. Respondents are asked to indicate whether or not they occurred during the worst experience with blood or injections they can recall. The BISS is comprised of three subscales, including 'Faintness' (e.g. dizziness, nausea, fainting; nine items), 'Anxiety' (e.g. heart pounding, sweating, clammy hands; four items), and 'Tension' (e.g. trembling, tense/ achy muscles; four items), with possible scores ranging from 0 to 17 (Page et al., 1997). Page and colleagues (1997) demonstrated in a large sample of individuals with BII phobia that blood related concerns typically produce greater scores on the faintness scale. This was of use to the present study, as syncope in

response to images of blood within the emotional stressor was a concern for the primary investigator. Participants who endorsed having experienced syncope in response to seeing blood or endorsed multiple items within the Faintness subscale were excluded from the stressor portion of the study.

Trauma Sensitivity.

PTSD Checklist-Civilian Version. The PCL–C is a well-validated and frequently used measure designed to assess PTSD symptoms in civilian populations (e.g. Adkins, Weathers, McDevitt-Murphy, & Daniels, 2008; Busner, Kaplan, Greco, & Sheehan, 2011; Read, Colder, Merrill, Ouimette, White, & Swartout, 2012).The scale consists of 17 items that correspond to DSM–IV symptoms of PTSD (Weathers et al., 1991, 1993). Using a 5-point Likert-style scale, respondents indicate how much they have been bothered by each symptom in the past month. Possible scores range from 17 to 85, and higher scores on the PCL-C indicate a greater likelihood of PTSD. During initial validations studies, PCL–C scores demonstrated a coefficient alpha of .97, a test–retest reliability of .96, and convergent validity with other PTSD scales, such as the Mississippi Scale and the Minnesota Multiphasic Personality Inventory (MMPI–2) Keane PTSD (PK) Scale (Weathers et al., 1993). Additionally, Weathers and colleagues found good diagnostic sensitivity and specificity in the original validation samples of Vietnam and Gulf War veterans, with further validation studies performed with good results in civilian samples of motor-vehicle accident and sexual assault victims (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996). In regard to factor structure, investigations of the PCL-C in civilian primary care populations support a four-factor model of re-

experiencing, avoidance, hyperarousal, and numbing symptoms (Asmundson, Frombach, McQuaid, Pedrelli, Lenox, & Stein, 2000). However, a recent factor analysis of the PCL-C in a non-clinical college sample found support for both a one-factor and two-factor model of PTSD symptoms (Conybeare, Behar, Solomon, Newman, & Borkovec, 2012). In this study, a conservative cut-point score was chosen with the intention of maximizing detection of possible PTSD cases in the sample. The National Center for PTSD (NCPTSD) suggests a higher cut-point score when estimated prevalence of PTSD is low to maximize detection. Based on the NCPTSD's recommendations for settings with an estimated prevalence of 15% or below (e.g. general population samples), a threshold score of 35 was chosen (NCPTSD, 2014).

Stress induction.

International Affective Picture System. Previous studies of working memory and acute stress have utilized primarily physiological stressors (e.g. cold pressor test) to produce a stress response in participants, and this form of stress induction has been demonstrated to be a successful method of eliciting a stress response with consequences for WMC (e.g. Duncko, Johnson, Merikangas, & Grillon, 2009). However, given that the aim of the present study was to investigate the potential for mindfulness to mitigate the cognitive cost of an acute stress reaction and associated negative affect, an emotional stress induction technique was chosen in an effort to ensure a strong, affective reaction. The International Affective Picture System (IAPS; Lang et al., 2005) has been used as an emotional stressor in both studies involving mindfulness (Ortner, Kilner, & Zelazo, 2007; Sauer, Walach, Schmidt, Hinterberger, Horan, & Kohls, 2011; Silverstein, Brown, Roth,

& Britton, 2011; Taylor et al., 2011) as well as prior studies of emotion and WMC

(Mather, Mitchell, Raye, Novak, Greene, & Johnson, 2006; MacNamara, Ferri, &

Hajcak, 2011; Pearson & Sawyer, 2011; Perlstein, Elbert, & Stenger, 2002). The IAPS

consists of photographs of real people and objects selected to evoke negative, positive, or

neutral affect, and it is one of the most frequently used forms of emotion elicitation in

laboratory settings (Fechir et al., 2008; Lynch, Schneider, Zachary Rosenthal, &

Cheavens, 200). This large set of images has demonstrated good stability of affective

responses, and these responses to the slides have been exhibited across various

populations and cultures (Hamm et al., 2003). Responses to the slides are empirically

rated on two dimensions: valence (ranging from pleasant to unpleasant) and arousal

(ranging from calm to excited). Each dimension is ranked on a 9 point scale, with 1

representing low valence or arousal and 9 representing high valence or arousal (Lang, et

al., 2005). Highly unpleasant images typically have a low valence rating and a high

arousal rating, and prior fMRI research has demonstrated that viewing such pictures

produces the same response observed in the amygdala and prefrontal cortex during fear-

provoking situations (Kensinger & Schacter, 2006), as well as similar sympathetic

nervous system activation (Carter, Durocher, & Kern, 2008). Examples of such images

in the IAPS include included mutilated bodies, physical assault scenes, and accident

scenes. To create the effect of an emotional stressor, pictures which are both negatively

valenced and highly arousing were presented in a blocked fashion; a blocked presentation

refers to a method during which all pictures presented to participants have similar arousal

and valance ratings. Previous research has found that blocked presentation of IAPS

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pictures with similar affective valence consistently produces both emotional and

behavioral reactions which are sustained even after exposure to the pictures has ceased

(Azevedo et al., 2005; Mendonca-de-Souza et al., 2007; Pereira et al., 2006; Smith et al.,

2005). Additionally, research by Bradley and colleagues (2001, 2003) has shown that

viewing pictures of mutilated human bodies evokes strong psychophysiological reactions,

negative affect, and arousal in research participants, a finding that has been further

corroborated by Azevedo et al. (2005). Bradley (2001) theorized that, from a survival

perspective, visual images of same-species death and mutilation are the most threatening

visual stimuli, and therefore produces a fight-or-flight response through activation of the

sympathetic nervous system. In keeping with this theory and prior research by Bradley

and others, 24 pictures containing images of mutilated bodies were selected from the

IAPS bank. This number is consistent with previous research which utilized blocked

presentation of negatively valenced IAPS pictures to induce negative affect and a

physiological stress response (Azevedo et al., 2005; Pereira et al., 2006). Normative

mean ratings of the images based on a sample of North American men (Lang et al., 1997)

in terms of valence (nine-point scale from unpleasant to pleasant) and arousal (nine-point

scale from calm to excited) were 1.8, and 6.5, respectively. A full description of each

slide and individual valence and arousal means can be found in Appendix D.

In order to detect emotional arousal in response to the stressor, physiological

indices of arousal were utilized. Prior research using the IAPS has demonstrated

significant changes in resting heart rate during viewing of pictures (Lang et al., 1997).

Heart rate response has been noted to be useful in demonstrating sympathetic activation,

as well as differentiating between an orienting response and a defensive response to an aversive stimulus, as it will decelerate during orienting and accelerate during a defensive response (Öhman & Mineka, 2001). An initial deceleration in heart rate has been described by Lang and colleagues (1997) as participants orient to distressing IAPS pictures, followed by heart rate acceleration as the defensive cascade of sympathetic arousal is activated. Increases in both skin conductance and heart rate are frequently and reliably used as physiological indicators of a defensive response to those pictures in the system which are highly arousing and negatively valenced (Lang et al., 1997).

Procedure

Prior to beginning data collection, the informed consent document was reviewed and signed by participants, who were given the opportunity to ask questions about the study prior to assenting. Following this, participants were given a self-report questionnaire packet containing a demographic information questionnaire, the PHLMS, the MAAS, and the PANAS for completion. Following completion of these questionnaires, baseline heart rate was determined through use of an automatic blood pressure and heart rate monitoring cuff; resting heart rate data were collected for the duration of inflation and deflation of the cuff, an average of approximately 15-20 seconds. Heart rate was measured following completion of questionnaires to ensure that participants had time to acclimate to the laboratory, ambient temperature, and presence of the investigator, as well as recovered from previous physical activity (e.g. walking to the laboratory building, taking the stairs instead of the elevator, etc.). Although all steps were taken to ensure a calm and comfortable environment for the participants to decrease

potential stress-related heart rate elevations prior to the stressor, it is possible that reactivity effects to the blood pressure cuff occurred in some participants. Participants were then seated in front of a 19 inch LCD, color widescreen computer monitor at a distance of approximately 48 inches. When seated facing the computer, the participants were also facing a blank wall, and the room in which the experiment took place contained minimal furniture and visual stimuli. Every effort was taking to maintain a quiet, non-distracting environment for the participants to minimize any effect on WMC not related to the presentation of the stressor. Participants were then prepared for physiological recording of HR. Physiological recordings were made using the ProComp5 Infiniti biofeedback system, manufactured by thought technology, Ltd. The software used to store and analyze the physiological data was the Biograph Infiniti 7900, version 5.0.3. The inside of both forearms was first lightly abraded with a pre-moistened alcohol swab to ensure good contact of the electrodes. Three pre-jelled sensors were then applied to both inner wrists; negative and positive leads were located on the left wrist, and a ground lead was attached to the right wrist. Physiological data was collected over three separate time blocks: pre-stressor, during administration of the stressor, and post-stressor. The first time block contained the administration of the pre-stressor Ospan and lasted, on average, 713.5 seconds. The second time block contained the administration of the screening measures and the IAPS; this block lasted on average 372.9 seconds. The third time block contained the administration of the post-stressor Ospan and the post-stressor PANAS, and lasted, on average, 549.7 seconds. There were no structured breaks between time blocks.

Participants were then provided the OSPAN response sheet and a writing utensil, and instructed to pay attention to and follow the OSPAN instructions presented on the computer screen. The pre-stressor OSPAN included a brief practice period, in which participants were instructed on the procedure for completing the task. Administrations of the two forms of the OSPAN were counterbalanced to account for any potential carryover effects. Participants assigned odd subject numbers for de-identification purposes received form A pre-stressor, and participants assigned even subject numbers received form B pre-stressor.

Following completion of the pre-stressor OSPAN, participants remained seated at the computer monitor and the BISS and PCL-C were administered as screening measures. Screening measures were given following administration of the pre-stressor OSPAN to reduce the potential effect of stress created by items on the BISS and PCL-C on participants' baseline WMC scores. Although participants knew from the study description that they would be exposed to a "brief stressor," care was taken to neither describe the exact nature of the stressor, nor present participants with pre-stressor stimuli that might inadvertently increase stress levels and diminish WMC prior to administration of the baseline Ospan. The BISS and PCL-C were deemed to be potentially stress-inducing, due to the high face validity of both measures. Participants who endorsed items on the BISS related to symptoms of fainting or dizziness in response to the sight of blood, or those whose total score exceeded a threshold of 35 on the PCL-C were excluded from the remainder of the study. The study coordinator and/or research assistants discussed the results of the screening process with participants who were excluded and provided them

with psychoeducation related to any potential clinical diagnoses. All participants were provided with information about mental health resources available at the University of Louisville Counseling Center and the University of Louisville Psychological Services Center, should they wish to receive follow-up counseling or a more in-depth psychological evaluation. Several participants elected to discontinue further participation at this time, following detailed explanation of the stress induction methodology.

Following administration of the screening measures, the IAPS was administered. The first slide presented was a blank, white slide presented for 6 seconds. The purpose of this slide was so that the experimenter or research assistant could have the slide show prepared to play on the computer monitor without inadvertently exposing a participant to an image before the official start of the stressor. Twenty-four color photos containing images of human death and mutilation were then presented at a presentation rate of six seconds per picture, for a total of 150 seconds including the blank slide, 144 seconds of which were IAPS content. The presentation rate of 6 seconds per picture is the rate suggested by IAPS developers (Bradley, Codispoti, Cuthbert, & Lang, 2001); Bradley and colleagues (2001) have found this rate to produce heightened phasic indices of emotion during blocked presentation of unpleasant pictures. While similar affective and increased skin conductance responses have also been observed with briefer presentation of unpleasant pictures (i.e. 300–500 ms; Codispoti et al., 2001), the typical presentation rate was chosen to ensure adequate stimulus exposure and production of a defensive, fight-or-flight response.

During the IAPS presentation, the experimenter and/or research assistants were seated approximately three feet to the right of the participant, so that they could observe reactions to the IAPS and prompt participants, if necessary, to look directly at the computer monitor during the presentation. Immediately following the last IAPS slide, participants were administered the post-stressor OSPAN. The post-stressor OSPAN included a brief reminder of basic instructions for completing the task, but did not include a practice period. The rationale behind excluding a practice period was to avoid any dissipation of acute emotional distress evoked through the stressor.

At the completion of the post-stressor OSPAN, participants were asked to complete the final self-report questionnaire, the post-stressor PANAS. Participants were asked to complete the PANAS based on their feelings in the present moment, just as they had during its previous administration at the start of data collection. They were then debriefed using the standardized script (see Appendix A) and thanked for their participation.

CHAPTER 3 RESULTS

Descriptive Statistics

Demographics. An initial sample of 131 participants was recruited into the study. Forty-six participants were excluded from the stressor portion of the study due to scores higher than the predetermined PCL-C cut-off score, or evidence of a BII phobia. Thirteen participants chose to discontinue participation prior to exposure to the stressor. Additionally, five participants' data were excluded from final analyses due to errors with data recording of physiological reactivity scores. Demographic data and mean scores on initial self-report measures for those participants who were discontinued are reported in a separate section.

The final sample consisted of sixty-seven participants. An *a priori* power analysis using G*Power 3.1.3 (Erdfelder, Faul, & Buchner, 1996) software suggested a sample size of 24 would be necessary to detect a medium effect size (f^2=.4) with an alpha of .05 and a power of .05 using the proposed statistical analyses. Over sampling was conducted to ensure adequate subsamples of low and high DM groups. As a result, the final sample size is nearly three times larger than the minimum suggested by results of the power analysis.

In the final sample, 61 percent of participants were female ($N = 41$) and 39% were male ($N = 26$). Mean age was 20.12 ($SD = 2.20$) and mean number of college semesters completed was 3.57 ($SD = 3.11$); 31 percent of the sample were in their first semester of

college ($N = 21$). In regards to ethnicity, 81 percent of the sample identified as White ($N = 54$), 9 percent as Black (n = 6), 5 percent as multiracial ($N = 3$), 3 percent as Hispanic ($N = 2$), 1 percent as Indian ($N = 1$), and 1 percent as Asian ($N = 1$). Participants were asked about previous exposure to mindfulness and meditation to ensure measures of mindfulness reflected dispositional qualities rather than skills built from formal practice. None had previously completed an MBSR program, and only 3% ($N = 2$) endorsed any previous experience with meditation. Upon being questioned about prior meditation practice, their experience proved to be very limited and unrelated to mindfulness. Consequently both participants' data were included in the final analyses.

Measures. The following section contains a summary of results of descriptive statistics for both pre- and post-stressor measures used in the current study. A comparison of pre- and post-stressor mean scores and standard deviations are presented below in Table 1.

Mindful Attention Awareness Scale (MAAS). The mean total score for the MAAS was 3.92 ($SD=0.86$). Cronbach's α score, $α = 0.898$ is indicative of high internal reliability. These scores were similar to those reported in validation studies of the MAAS in large samples of undergraduate students ($M=3.83$, $SD=0.70$; Brown & Ryan, 2003; $M=4.00$, $SD=0.85$, $α = 0.89$; MacKillop & Anderson, 2007) as well as normative information for college students ($N= 2277$, $M=3.83$, $SD=.70$; Brown & Ryan, 2003). Scores on the MAAS were normally distributed, skewness $= 0.08$ (SE$= 0.29$), kurtosis $= -0.60$ (SE$=0.58$), with no evidence of outliers.

As analyses related to the main study hypotheses required participants to be divided into groups of either high or low DM based on their MAAS scores, a median split was performed on MAAS total scores of the final sample to create these groups, utilizing the MAAS total score median of 3.80. Those categorized as high scorers (N=33) on the MAAS became the high DM group, and those categorized as low scorers (N=34) became the low DM group. There was a significant difference between the mean scores of these two groups, $t(65) = -11.79$, $p < .001$. On average, participants categorized through the median split as the high DM group received a score of 4.63 (SD=0.51), while the mean score for the low DM group was 3.22 (SD=0.47).

The MAAS and the PHLMS were found to be significantly but not strongly correlated, $r(65) = 0.46$, $p < .01$. As a strong correlation was not found, the PHLMS was not utilized in further analyses of the primary study hypotheses. Further exploration of the PHLMS data is contained in Appendix E.

Positive and Negative Affect Scale (PANAS). The PANAS may be administered using several different instructions related to a participant's affective experience over various timespans (e.g. present moment, over the past two weeks, etc.; Watson, Clark, & Tellegen, 1988). For the purposes of this study, the present moment-oriented instructions for the PANAS were utilized, which asked participants to rate how they felt "right now." The pre-stressor Positive Affect (PA) mean was 30.22 (SD=6.4), and mean Negative Affect (NA) was 13.01 (SD=6.4). These scores are consistent with normative data found for present moment-oriented instructions during the initial development and validation of the PANAS in a large sample of undergraduate students (PA, M=29.7, SD=7.9; NA,

M=14.8, *SD*=5.4; Watson, Clark & Tellegen, 1988). Post-stressor PA (*M*=14.97,

SD=4.95) was found to be significantly lower than pre-stressor PA (*M*=25.09, *SD*=7.19),

t(65) = 7.40, *p* <.01.

  Operation Span Task (Ospan). As previously mentioned, a total scoring method

was utilized, with which the Ospan score results from the sum of the total number of

words recalled on the task. All participants in the final sample passed the 85% accuracy

criterion on the math operations, which suggests that they were attending to the math

problems. Prior to exposure to the stressor, participant's mean number of correct words

recalled was 30.21 (*SD*=4.42). In a previous study of working memory capacity in

undergraduate college students, similar mean scores were found (*M*=31.33, SE=0.69;

Sibley & Beilock, 2007) while a slightly lower mean score was found in a large

community sample (*M*=23.53, *SD*=7.92; Unsworth, Heitz, Schrock, & Engle, 2005).

Following exposure to the stressor, mean number of correct words recalled was 31.67

(*SD*=4.40). A significant difference was found for male and female participants on post-

stressor Ospan scores, with males recalling, on average, three more words than female

participants, *t*(65) = 2.22, *p* = .03 (males, *M*=33.16, *SD*=4.86; females, *M*=30.75,

SD=3.88).

  Perceived Stress Scale (PSS). The mean PSS total score was 15.67 (*SD*=6.44).

This is lower than normative data from a large, national sample of individuals under the

age of 25 (*M*=16.78, *SD*=6.86; Cohen & Janicki-Deverts, 2012), suggesting the current

sample perceived themselves as experiencing slightly less stress than what has been

previously reported by individuals in their age group. Normative studies of the PSS have

consistently found that women typically report more perceived stress then men (Cohen &

Janicki-Deverts, 2012). PSS scores were compared between genders in the current study

to determine if there were any observable differences in total scores between genders.

No significant difference was found in PSS total mean scores between male ($M=16.11$,

$SD = 6.33$) and female participants ($M=15.39$, $SD= 6.57$), $t(65) = 0.45$, $p = 0.66$. A

regression was used to determine if participants' baseline level of perceived stress as

measured by the PSS would predict pre-stressor Ospan scores. The PSS scores did not

significantly predict pre-test Ospan scores, $b = .001$, $t(65) = .01$, $p = 0.99$, suggesting that

participants' level of perceived stress at the start of the study did not influence their pre-

stressor Ospan scores.

Blood-Injection Sensitivity Scale (BISS). The purpose of the BISS was to

identify individuals who might experience such symptoms during the stressful exposure

task. Total scores on this measure were not utilized, nor were they incorporated into

analyses of the main study hypotheses. However, analysis of BISS total scores in the final

sample does yield some relevant data. In the final sample, the mean score for the BISS

was 3.70 ($SD = 3.39$), and Cronbach's α is indicative of excellent internal reliability, α =

0.83. A previous validation study of the BISS in a large, non-clinical undergraduate

sample found that female participants endorsed more anxiety symptoms than male

participants, necessitating separate norms (Page et al., 1997). A similar pattern was found

in the present sample (female $M=4.00$, $SD=3.68$, male $M=3.23$, $SD=2.87$).

PTSD Checklist-Civilian (PCL-C). The mean score for the PCL-C in the final

sample was 25.72 ($SD = 5.87$), and Cronbach's α is indicative good internal reliability, α

= 0.765. A validation study of the PCL-C in a large, non-clinical undergraduate sample found similar results to the current study (M = 29.12, SD = 12.31; Conybeare, Behar, Solomon, Newman, & Borkovec, 2012).

Table 1

Comparison of Pre- and Post-stressor Mean Scores, Final Sample

	Mean	S.D.
Pre-stressor Ospan	**30.21**	**4.42**
Post-stressor Ospan	**31.67**	**4.40**
Pre-stressor PANAS NA	**13.01**	**6.4**
Post-stressor PANAS NA	**14.97**	**4.95**
Pre-stressor PANAS PA	**30.22**	**6.4**
Post-stressor PANAS PA	**25.09**	**7.19**

Note. Values in bold font represent significant differences

Discontinued Sample Analyses.

  Demographics. Of the initial sample of 131 participants recruited to the study, 64 were discontinued from the full study protocol. Almost all participants excluded from the final sample were discontinued prior to stressor exposure due to their scores on screening measures. The demographics of the discontinued sample differed in multiple areas when compared to the demographics of the participants who completed the full study protocol. Of the participants who were screened out of the final sample, 72 percent were female (N = 46) compared to 61 percent female participants in the final sample. Additionally, the

discontinued sample had an average age of 21.55 years (*SD*=6.37). Additionally, 64.1%

of the discontinued sample identified as White (*N*=41), 14.1% identified as Black (*N*=9),

12.5% identified as bi- or multi-racial (*N*=8), and the remaining participants identified as

Hispanic (*N*=2), other (*N*=2), Asian (*N*=1) and Native American (*N*=1). The discontinued

sample and final sample differed significantly by ethnic representation, c^2(*N*=131) = 4.49,

p = .034; there were more participants who identified as an ethnicity other than White

who were discontinued from the study than who were included in the final sample.

Measures. Due to the large number of participants removed from the final

sample, pre-stressor measures completed by the discontinued sample were analyzed

separately. A summary of these analyses is presented below in Table 2.

MAAS. In the discontinued sample, the mean total score for the MAAS was 3.78

(*SD*=0.64). These scores were similar, although slightly lower, to those found in a

validation study of the MAAS in a large sample of undergraduate students (*M*=4.00,

SD=0.85, α=0.89; MacKillop & Anderson, 2007). There was no significant difference in

MAAS total score between the final and discontinued sample, *t*(129) = 1.05, *p* =.30.

Moreover, there was no difference in MAAS scores due to gender, *t*(65) = 0.30, *p* =0.77,

just as in the final sample. Additionally, MAAS scores in the discontinued sample did not

predict pre-stressor Ospan total scores, *b* = -.01, *t*(60) = .63, *p* = 0.53.

PANAS. In the discontinued sample, the average score received for NA was 15.05

(*SD*=5.92), while the mean score for PA was 28.95 (*SD*=7.10). While there were no

significant differences reported between the final and discontinued samples regarding

positive affect, a significant difference did occur on the PANAS Negative Affect scale,

t(129)=-2.49, *p* =.014. NA scores for the discontinued participants were significantly

higher than scores received by participants who remained in the final sample (*M*=13.01,

SD=3.06). As in the final sample, PANAS scores in the discontinued sample remain

consistent with initial normative data from the initial validation study of the measure in a

large sample of undergraduate students (PA, *M*=29.7, *SD*=7.9; NA, *M*=14.8, *SD*=5.4;

Watson, Clark & Tellegen, 1988).

 Ospan. A significant difference occurred between the discontinued participants

and the final sample in regard to total number of words recalled on the pre-stressor

Ospan, *t*(126) = 3.50, *p* =.001. On average, individuals who were retained into the final

sample recalled three words more (M=30.20, *SD*=4.42) than those individuals who were

discontinued from the study (*M*=27.40, *SD*=4.74). The discontinued sample's mean

score falls between average scores found in a previous working memory study of

undergraduate students (*M*=31.33, SE=0.69; Sibley & Beilock, 2007) and the mean score

in a study utilizing a large community sample (*M*=23.53, *SD*=7.92; Unsworth et al.,

2005).

 Due to the significant difference between the discontinued sample and final

sample in representation of ethnic minorities, data was analyzed for any trends across

study measures related to this demographic characteristic. The only significant difference

which emerged between ethnic minorities and participants identifying as White occurred

on the Ospan total score, *t*(126) =-4.05, *p* <.001. On average, participants identifying as

ethnic minorities recalled three less words on the Ospan (*M* = 26.22, *SD* = 4.60) than

those who identified as White (*M* = 29.85, *SD* = 4.48).

PSS. Average scores on the PSS were significantly higher for the discontinued

sample (M=19.73, SD=6.23) than the final sample (M=15.67, SD=6.44), $t(129)$ = -3.67,

p <.001. PSS scores did not significantly predict pre-test Ospan scores, b = -.128, $t(60)$ =

-.988, p = 0.33. In the discontinued sample, PSS total scores were significantly and

positively correlated with both the PCL-C total scores $r(59)$ = 0.39, p =.002 ,as well as

with the NA subscale of the PANAS, $r(59)$ = .48, p < .001. Moreover, PSS scores were

found to be inversely correlated with MAAS total scores in the discontinued sample,

$r(62)$ = -0.40, p < .01.

BISS. As previously mentioned, total scores on the BISS were not utilized as part

of the study; items targeting specific symptoms of BII phobia (e.g. dizziness or fainting)

were utilized as the part of the pre-stressor screening procedure. However, analysis of

BISS total scores in the discontinued sample did yield some interesting data. The mean

score for the BISS in the discontinued sample was 28.61 (SD=4.22), compared to the

final sample's mean of 3.70 (SD=3.39).

PCL-C. The mean score for the PCL-C in the discontinued sample was 38.77

(SD=8.95), significantly higher than the mean score found in the final sample, $t(126)$ = -

9.84, p <.01. Moreover, the discontinued sample reported, on average, more symptoms of

PTSD than did undergraduate students in a recent validation study of the PCL-C

(M=29.12, SD=12.31; Conybeare, Behar, Solomon, Newman, & Borkovec, 2012).

Further investigation of PCL-C data in the discontinued sample demonstrated

associations between the PCL-C and several other measures. PCL-C scores were

positively correlated with the PSS, $r(59)$ =0.39, p < .01, as well as positively correlated

with the NA subscale of the PANAS, $r(59) = 0.43$, $p = .001$. Additionally, PCL-C scores

in the discontinued sample were found to be inversely correlated with mean Ospan total

scores, $r(59) = -0.25$, $p = .05$.

Table 2

Comparison of Final and Discontinued Sample Mean Scores

		Mean	S.D.
MAAS	Final Sample	3.92	0.86
	Discontinued Sample	3.78	0.64
PANAS NA	Final Sample	**13.01**	**6.4**
	Discontinued Sample	**15.05**	**5.92**
PANAS PA	Final Sample	30.22	6.4
	Discontinued Sample	28.95	7.10
Ospan	Final Sample	**30.21**	**4.42**
	Discontinued Sample	**27.40**	**4.74**
PSS	Final Sample	**15.67**	**6.44**
	Discontinued Sample	**19.73**	**6.23**
BISS	Final Sample	**3.70**	**3.39**
	Discontinued Sample	**28.61**	**4.22**

PCL-C	Final Sample	**25.72**	**5.87**
	Discontinued Sample	**38.77**	**8.95**

Note. Values in bold font represent significant differences

Main Analyses

Hypothesis 1. *It was hypothesized that contrasting trends in working memory capacity (WMC) pre- and post-stressor scores would occur, and would be moderated by dispositional mindfulness (DM). It was also predicted that the low DM group will display a significant decrease in WMC while the high DM group would not display a significant decrease in WMC following the presentation of the stressor.*

A 2 (Test condition) x 2 (DM) mixed factorial ANOVA was conducted to examine group differences in pre- and post-stressor Ospan performance. Test condition (i.e. pre- vs post-stressor) and DM category (i.e. high vs low) served as grouping variables, with Ospan total recall scores served as the dependent variable. The main effect of test condition was significant, $F(1, 64), = 11.49, p < .01$. Contrary to what was predicted, mean Ospan post-stressor scores ($M=31.67$; $SD=4.40$) were higher than mean Ospan scores pre-stressor ($M=30.21$, $SD=4.42$). The main effect of DM category, $F(1,64), = 0.01, p = .91$, was not found to be significant. In addition, the interaction between Ospan score x DM category was not found to be statistically significant, $F< 1$.

Hypothesis 2. *It was hypothesized that contrasting trends in negative affect (NA) pre- and post-stressor scores would occur, moderated by dispositional mindfulness (DM). It was also predicted that the high DM group would not display a significant increase in NA and that the low DM group would display a significant increase in NA following presentation of the stressor.*

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To test whether group differences in pre- and post-stressor levels of NA,

measured by the NA subscale of the PANAS, would be moderated by DM, a 2 (Test

condition) x 2 (DM) mixed factorial ANOVA was conducted. The main effect of NA was

significant, F (1, 64), $= 13.60.$, $p < .01$. Post-stressor PANAS negative affect scores

($M=14.97$, $SD=4.95$) were higher than PANAS negative affect scores pre-stressor

($M=13.02$, $SD=3.06$). The main effect of DM group, F (1,64), $= 2.97$, $p = 0.09$, was not

found to be statistically significant. Moreover, the interaction between NA X DM

category, $F<1$, was not found to be statistically significant.

Hypothesis 3. *It was hypothesized that greater physiological reactivity during*

stressor presentation, measured by heart rate (HR), would be observed in the low DM

group than in the high DM group. Specifically, it was hypothesized that the low DM

group will display higher overall HR during   the stressor presentation than the high DM

group.

Although physiological data was collected from all 67 participants in the final

sample, data from 18 participants was excluded either due to missing or corrupted data.

Thus, the following statistical analyses were based on the data from 49 participants. Of

these 49 participants, 59.2 percent were female ($N=29$) and the mean age was 20.33 years

old ($SD=2.32$).

Heart rate data were collected during the IAPS presentation. Baseline HR had

been previously collected following each participant's completion of self-report measures

at the start of the protocol, and was used as the pre-stressor measure of HR. To determine

if HR was affected through exposure to the IAPS presentation in the sample as a whole,

HR was averaged across the time period during which the participants viewed the IAPS images (150 seconds; M=78.75 beats per minute, SD=14.37) and then compared to participants' mean baseline heart rate (M=77.24 beats per minute, SD=14.77).

A 2 (Test condition) x 2 (DM) mixed factorial ANOVA was conducted to examine group differences in pre- and stressor HR. Test condition (i.e. pre- vs stressor) and DM category (i.e. high vs low) served as grouping variables, with HR as the dependent variable. The main effect of test condition was not significant, $F(1, 47)$, = 1.62, p =.21. Moreover, the main effect of DM category, F<1, was not significant. In addition, the interaction between HR x DM category was not statistically significant, F<1.

As no significant results were identified through use of the mean HR over the course of the IAPS, the mean HR at the end of the IAPS presentation was calculated (M=85 beats per minute, SD=25.37) in an effort to determine whether use of this data point would produce different results. A paired sample t-test demonstrated a significant difference between baseline HR (M=77.69, SD=14.59) and final HR data collected at the end of the stressor, $t(47)$ = -2.413, p =.02, indicating that between the collection of the baseline HR and the end of the IAPS presentation, HR increased significantly, an average of eight beats per minute. A comparison of high and low DM HR data revealed no significant difference $t(46)$=.63, p =.53.

CHAPTER 4 DISCUSSION

Primary Findings

It was originally predicted that working memory capacity (WMC) post-stressor

scores would be lower than pre-stressor scores, moderated by dispositional mindfulness

(DM). Additionally, it was predicted that participants in the low DM group would display

a significant decrease in WMC, while high DM group members would not show a

significant decrease in WMC following stressor. Results of the statistical analyses failed

to support this hypothesis; moreover, the trend which emerged regarding WMC was a

slight increase in Ospan scores following the stressor presentation. No differences were

found between DM groups.

It is interesting that that compared to participants' mean baseline HR, HR at the

end of the stressor presentation was elevated. Within the study protocol, the post-stressor

Ospan directly followed the stressor presentation, which means that participants entered

into this test of WMC with slightly elevated HR (on average, 5 BPM more than baseline

resting HR). The fact that Ospan scores were higher post-stressor than they were prior to

the IAPS presentation, coupled with this elevation, suggests that the level of

physiological arousal experienced on average was potentially enough to enhance

cognitive abilities, and yet not high enough to engender the predicted decrease in

cognitive functioning which has been observed in other studies utilizing this stressor.

Moreover, the current study was able to demonstrate a change, although slight, in HR

following presentation of the IAPS. This finding is consistent with extant literature concerning the IAPS and its ability to produce measurable physiological arousal. The small amount of change which occurred is itself interesting, and potential theories and implications concerning the impact of the IAPS on this sample will be discussed further in a later section.

In regard to the hypothesis that changes in NA, measured by the NA subscale of the PANAS, would be seen from baseline to post-stressor, participants as a group experienced an increase in NA following exposure to the IAPS. This finding is consistent with previous IAPS literature documenting negatively valenced images' ability to create a negative affective state in individuals. Moreover, PA scores following exposure to the IAPS were significantly lower than they had been at baseline, demonstrating a parallel process of increasing NA and decreasing PA in the current study. Although no differences were seen between DM groups in regard to the changes in negative or positive affect produced through the IAPS presentation, this study further supports the utility of the IAPS in creating changes in affect. Moreover, the blocked style of presentation used for the IAPS images in the current study is not as prominent in the extant literature as other presentation formats (i.e. combining negative and positively valenced images, or combining valenced images with neutral images). This study provides further documentation of significant change in both positive and negative affective states resulting from a blocked presentation style.

This was a study which made use of a widely researched and well validated measure of DM, the MAAS. However, it is important to note that the concept of DM has

not yet been fully formalized. As mentioned in the initial literature review, multiple definitions of mindfulness currently exist. Brown and Ryan (2003), developers of the MAAS, define dispositional mindfulness as a spectrum of conscious experience along which individual differences lie, with consistent mindful attention at the high end of the spectrum and habitual, automatic thinking, at the low end. The MAAS, therefore, provides information related to the trait-like frequency with which an individual has access to a mindful state of attention and present-moment awareness. Analysis of the MAAS yielded several findings of importance related to both the measure and the concept of DM. First, the average level of DM found in the current study through the MAAS was a replication of previous findings in validation studies of the measure as well as its normative data (Brown & Ryan, 2003; MacKillop & Anderson, 2007). Secondly, DM as defined by Brown and Ryan (2003) was found to be normally distributed across the sample, with scores on the MAAS ranging at the low end of DM at 2.07 to the high end at 5.80. Scores on the MAAS range from one to six, suggesting that this sample may have a slightly restricted range. However, the results do display variance in reported DM in a sample of mindfulness-naïve, undergraduate students. As a result, this study further demonstrated the ability of the MAAS to measure mindfulness on a dispositional level in undergraduate college students.

Additionally, it is important to note the structure of the MAAS allowed the current study to compare individuals along the previously mentioned spectrum of mindfulness. The MAAS is written so that during scoring of the measure item scores are reversed (e.g. *It seems I am "running on automatic," without much awareness of what I'm*

doing) in order to determine an individual's level of mindful attention and awareness. Strong endorsement of the items as they are written would indicate an individual with tendencies toward "mindlessness", or someone with very little capacity for present moment attention and awareness. Specifically, Brown and Ryan (2003) define mindlessness as "the relative absence of mindfulness" or an individual who does not "acknowledge or attend to a thought, emotion, motive, or object of perception" (p.823). The fact that the MAAS is able to assess both mindfulness and mindlessness was a strength within the present study's design. The initial theoretical framework which influenced the study's development and hypotheses proposed a differing process of events for individuals high in mindfulness versus those high in mindlessness. Use of the MAAS allowed for measurement of both mindfulness and mindlessness. Within the study design, individuals who were identified through the median split of the MAAS as part of the low DM group did tend to endorse more qualities of "mindlessness", in comparison to the high DM group who tended to endorse more qualities of mindfulness. Thus, both poles of the spectrum of mindful ability were represented in the subsequent analyses, and in keeping with the theoretical framework of the study.

The current study examined only dispositional mindfulness, as opposed to mindfulness associated with formal training. Indeed, care was taken to ensure measurement of dispositional mindfulness rather than the effects of formal training by utilizing a mindfulness-naïve sample and using formal mindfulness training or intentional mindfulness practice as exclusion criteria. Future studies should compare groups of individuals identified as having high levels of dispositional mindfulness versus those

reporting high levels of mindfulness following formal mindfulness training. As the concept of dispositional mindfulness is still evolving in regard to conceptualization and measurement, such studies may shed light on differences in cognitive abilities and functioning between those with formal mindfulness training and those identified as simply having naturally occurring mindful traits and qualities.

One concern during creation of the current study's design was related to participants' baseline level of perceived stress upon entering the study. Because stress levels affect WMC performance, it was thought that undergraduate students participating in the current study under a large amount of perceived stress might display less variation in their Ospan scores from pre- to post-stressor. Additionally, it was considered that environmental stressors (e.g. midterm or final exams) might create within-group cohorts of individuals with lower pre-stressor Ospan scores when compared to students who participated during less stressful academic periods. Due to this concern, the PSS had been added to the study protocol as a measure of perceived stress. Fortunately, concerns regarding the impact of perceived stress on pre-stressor Ospan scores were unfounded, as analysis of the PSS and baseline Ospan suggested participants' level of perceived stress did not predict their pre-stressor Ospan scores. Furthermore, these findings demonstrate the efficacy of the current study in measuring WMC before and after a discrete emotional stressor, without intrusion of globally perceived stress potentially complicating study results.

Ancillary Findings

Additionally, although not directly related to the main study hypotheses, several interesting observations were made through careful analysis of the demographic characteristics of the current study's sample. First, the screening procedure resulted in a sample of participants containing more female participants and more participants identifying as ethnic minorities than the sample retained through the entire study protocol. Not only is this finding interesting, but it does have implications for the generalizability of the study results, as well as implications for future studies which may utilize similar protocols. As previously mentioned, women more frequently endorse symptoms of anxiety and are more frequently diagnosed with anxiety disorders than men (Egloff & Schmukle, 2004; McLean, Asnaani, Litz, & Hofmann, 2011; Nolen-Hoeksema, 2012). Moreover, a recent study of PTSD risk and prevalence across ethnic groups using a large, national sample found increased prevalence rate and higher number of reported symptoms for African Americans when compared to non-Hispanic whites and as well as other ethnic minority groups (Roberts, Gilman, Breslau, Breslau, & Koenen, 2011); the majority of those identifying as an ethnic minority within the current study specifically identified as African American. The findings of the current study pertaining to these demographic differences resulting from the screening process may be useful to future studies utilizing a similar procedure. Using different cut-points for screening measures based on gender or ethnic status might allow for inclusion of certain participant groups within the final sample, allowing for greater generalization of results.

A second finding of interest was that participants in the discontinued sample reported significantly higher levels of both perceived stress and negative affect than did their peers who continued through the study protocol. The results indicate the efficacy of the PCL-C and the BISS in identifying individuals experiencing higher levels of stress, and who are more likely to be experiencing a negative affective state than their counterparts in the final study. Future research on measures of specific anxiety disorders, such as PTSD or BII phobia, may wish to focus on identifying cut-points related to general levels of anxious distress versus those cut-points with good clinical utility in identifying individuals likely to meet full diagnostic criteria.

Limitations

Stressor. There are several reasons why Ospan scores may have increased from pre-stressor to post-stressor. As previously mentioned, it is possible that the stress level induced via the IAPS was not high enough to engender the predicted decrease in cognitive functioning which has been observed in other studies utilizing this stressor. Over the past several decades, the level of violence and physical injury portrayed in popular media has significantly increased, to include television programming, cinema, and video games. It is possible that this study's sample of undergraduate students may have been desensitized to images of death and injury to an extent that viewing static IAPS images did not cause a full-scale activation of the sympathetic nervous system. Supporting this theory is the physiological data collected during the study in the form of HR; only a very slight increase was seen between baseline HR and final HR collected at the end of the IAPS presentation (an average increase of 5 beats per minute).

Additionally, neurocognitive literature suggests that moderate levels of acute stress result in improved cognitive functioning (Hidalgo et al., 2011; Lewis, Nikolova, Chang, & Weekes, 2008; Mohan, Sharma, & Bijlani, 2011; Weerda, Muehlhan, Wolf, & Thiel, 2010), which would provide an explanation for the slight increase observed in post-stressor Ospan scores.

To control for potential cultural habituation toward images of death and injury, additional screening questions could have been utilized to identify those participants who frequently view media with high levels of violence and imagery of human death and injury. If the cultural habituation hypothesis is correct, the static nature of the IAPS images may also have been less stress-inducing than a video clip. Other laboratory stress induction studies have utilized brief clips from violent movies to induce stress and negative affect with good success (del Palacio-González & Clark, 2013; Cousijn et al., 2010; Henckens, Hermans, Pu, Joëls, & Fernández, 2009; Ossewaarde et al., 2010 ; van Marle, Hermans, Qin, & Fernández, 2009). Use of such stressful, negative affect inducing clips for commercially available films may have been a more appropriate stressor for the sample utilized in the current study.

If the IAPS did not engender a stress response strong enough to activate the sympathetic nervous system, it is possible that the level of NA produced was similarly not high enough to be differentiated between the two DM groups. In other words, the current study's stressor may have only produced moderate levels of NA across both DM groups, whereas a more salient stressor might have produced levels of NA high enough to display variation between low and high DM groups. In support of this reasoning, pre-

stressor MAAS scores significantly and negatively predicted NA scores. This finding is in line with current mindfulness research that individuals reporting higher levels of mindfulness simultaneously report lower levels of negative affect (Chambers, Lo, & Allen, 2008; Jha et al., 2010; Schutte & Malouff, 2011; Keng, Smoski, & Robins, 2011). Following the stressor, MAAS scores are no longer predictive of NA. Instead, MAAS scores significantly predicted post-stressor PA scores, which are again in line with current mindfulness research findings that individuals with higher levels of mindfulness report higher levels of positive affect. Thus, while NA scores were elevated post-stressor, appears that this increase may have been to a comparable degree for both high and low DM individuals.

Future studies utilizing the IAPS as an emotional stressor may also wish to utilize a sample with a broader age range to reduce potential of a cohort effect, or compare reported level of stress across varying age groups. The college sample utilized in the current study is a limitation itself, both in the previously discussed manner of a potential age related cohort effect, as well as in the difficulty in generalizing to broader populations. Use of a community sample in conjunction with the less restrictive screening approach may have resulted in a different outcome in regard to the impact of the stressor.

Screening procedure. Another possible explanation for this study's failure to support the initial hypotheses related to WMC and DM may lie in the screening procedures utilized as part of the protocol. Due to the graphic nature of the IAPS images chosen to serve as an emotional stressor, an extremely conservative screening approach was used. It was of importance to the primary investigator that the screening protocols

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ensure any participants who might have a strong, negative reaction to the images were not exposed to the stressor. Clinical concerns included participants who might meet criteria for Blood-injection-injury phobia (BII) or posttraumatic stress disorder (PTSD). BII phobia is relatively common, with a lifetime prevalence of 3.5% (Bienvenu & Eaton, 1998). Moreover, a symptom unique to BII phobia is a strong vasovagal response (e.g., fainting; Barlow, 2002; Mednick & Claar, 2012); as the majority of the IAPS images contained blood, the possibility of a vasovagal reaction in participants with undetected BII phobia was a concern.

In regards to PTSD as a clinical concern, a recent study of a large, nonclinical college sample found 67% had been exposed to a traumatic stressor at some point in their life, with 4.3% meeting full criteria for a diagnosis of PTSD (Elhai, Miller, Ford, Biehn, Palmieri, & Frueh, 2012). A similar study found 66% of a large, undergraduate sample reported exposure to a traumatic stressor, and 9% met full diagnostic criteria for PTSD (Read, Ouimette, White, Colder, & Farrow, 2011). In addition, the university recruitment site is located in an urban environment with a diverse student body, many of whom are from lower socioeconomic backgrounds and are first generation college students. Lower socioeconomic status has been found to be a significant risk factor for increased risk of PTSD development in young people (DiGangi, Gomez, Mendoza, Jason, Keys & Koenen, 2013; Enlow, Blood, & Egeland, 2013; Milan, Zona, Acker, & Turcios-Cotto, 2013).

Thus, while it was felt that a stringently conservative approach to pre-stressor screening was both warranted and appropriate, an unintended consequence may have

been the exclusion of individuals who would have found the IAPS images stressful enough to induce the reduction in WMC performance. Those participants who were exposed to the stressor, and whose data were included in the analyses may represent a resilient subsample, with underlying protective traits or factors minimizing the impact of the stressor. Supporting this hypothesis are the higher PSS scores were seen in the discontinued sample when compared to the final sample. Previous research has found measures of resiliency to be inversely associated with the PSS (Connor & Davidson, 2003; Vaishnavi, Connor, & Davidson, 2007; Sood, Prasad, Schroeder, & Varkey, 2011).

In retrospect, solutions to the screening issue could have included raising the PCL-C cut-point to a less conservative score, use of a PTSD measure with higher specificity, or use of a structured diagnostic interview to exclude only individuals meeting diagnostic criteria for PTSD or BII phobia. Stress induction studies utilizing an emotional stressor must take a dialectical approach between protecting participants from unnecessary psychological harm and inducing enough psychological distress to study the emotional and physical sequelae of this process. Erring too far in either direction of this research dialectic may result in negative consequences for the entirety of the study, whether it involve triggering a potentially significant, negative psychological reaction in a participant or losing access to potentially significant data; it is likely that the current study's protocol resulted in the latter case.

Conclusion

The purpose of the current study was to investigate the potential role of dispositional mindfulness in mediating emotional reactivity and working memory

degradation in the context of an acutely stressful event. The study's design and initial

hypotheses were grounded in a conceptual model of mindfulness and WMC in the

context of acute stress presented previously in this manuscript. Based on this conceptual

framework, DM was proposed to act as a buffer against WMC loss, due to a tendency by

mindful individuals to exhibit less emotional reactivity and experience less cognitive

intrusions when they are under stress. In the current study, presentation of an acute,

emotional stressor did engender heightened NA, as well as some physiological changes.

These findings support the basic structure of the conceptual model, and are consistent

with other research findings resulting from a similar stressor. In contradiction of the

conceptual model's proposal that WMC would either decline or be maintained due to

variations in levels of dispositional mindfulness, scores on a WMC measure actually

showed a slight increase following the presentation of an acute stressor.

Due to the support of the conceptual model through extant literature regarding

WMC loss following acutely stressful events, it is likely that the current study did not

utilize an adequate stress induction task. Failing to engender the necessary stress response

likely caused the deviations from the conceptual model seen in the findings of the current

study. Moreover, the conceptual model places emphasis on a two-step appraisal process

which is theorized to occur directly following the acute stressor and immediately prior to

proposed mediation of cognitive abilities by mindful traits. During the appraisal process,

the individual first appraises whether or not the external event merits categorization as an

acute stressor, defined as an immediate threat to emotional or physical integrity (Salas,

Driskell, & Hughes, 1996). Secondly, and only if the event is determined to be a threat,

the individual appraises his or her own internal experience of the stressor to determine whether it can be managed effectively. During application of a laboratory stressor, it is difficult to approximate any form of threat toward emotional or physical integrity. Additionally, participants entered into the laboratory setting with the knowledge that they were free to end their participation and withdraw from the study at any time. This ability to escape a potential threat is often unavailable to individuals experiencing a "real world" stressor, necessitating the secondary appraisal of their own experience to determine their capability for management of the stressor. These aspects of the conceptual model and the realities of laboratory-based stress induction also likely contributed with the difficulty in creating the necessary stress response.

Major implications for the current study include a more adequate stress induction task as well as a less stringent screening process. It is proposed that with these two significant alterations to the current study's protocol, results may have been more closely aligned to the original conceptual framework around which the study was designed. Regardless of these shortcomings, the current study did generate a host of intriguing data related to the constructs of mindfulness and working memory in the context of acute stress. Research involving acute stress and potential mediators of the affective, cognitive and behavioral aftereffects of acutely stressful events is not only intriguing, but also necessary. Outside of the laboratory setting, acutely stressful events can range from public speaking to a motor vehicle accident to a physical assault. Moreover, the ending of the United States' involvement in Middle Eastern military conflicts has created a large population of American veterans, many of whom have experienced a multitude of acutely

stressful, combat-related events. Despite the fact that the current study's initial

hypotheses were demonstrated to be unfounded, it is hoped that the findings of this study

are able to contribute to furthering the understanding of the human experience in the

context of an acutely stressful event.

REFERENCES

Adkins, J. W., Weathers, F. W., McDevitt-Murphy, M., & Daniels, J. B. (2008).

Psychometric properties of seven self-report measures of posttraumatic stress

disorder in college students with mixed civilian trauma exposure. *Journal of*

anxiety disorders, *22*(8), 1393-1402.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental*

disorders (4th ed., text rev.). Washington, DC: Author.

Arnsten, A.F.T. (2007). Catecholamine and second messenger influences on prefrontal

cortical networks of "representational knowledge": A rational bridge between

genetics and the symptoms of mental illness. *Cerebral Cortex*, *17,* 6–15.

Arnsten, A.F.T. & Goldman-Rakic, P.S. (1998). Noise stress impairs prefrontal cortical

cognitive function in monkeys: Evidence for a hyperdopaminergic mechanism.

Archives of General Psychiatry, *55,* 362–369.

Arnsten, A.F.T. & Li, B.M. (2005). Neurobiology of executive functions: Catecholamine

influences on prefrontal cortical functions. *Biological Psychiatry*, *57,* 1377–1384.

Asmundson G, Frombach I, McQuaid J, Pedrelli P, Lenox R, Stein M. Dimensionality of

posttraumatic stress symptoms: a confirmatory factor analysis of DSM-IV

symptom clusters and other symptom models. Behaviour Research and Therapy.

38(2), 203–214.

Azevedo, T. M., Volchan, E., Imbiriba, L. A., Rodrigues, E. C., Oliveira, J. M., Oliveira,

L. F., & ... Vargas, C. D. (2005). A freezing-like posture to pictures of mutilation.

Psychophysiology, *42*(3), 255-260.

Baer, R. A. (2003). Mindfulness training as a clinical intervention: A conceptual and

empirical review. *Clinical Psychology: Science And Practice*, *10*(2), 125-143.

Baer, R.A., Smith, G.T. &. Allen, K.B (2004). Assessment of mindfulness by self-report:

The Kentucky inventory of mindfulness skills. *Assessment*, *11,* 191–206.

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using Self

-Report Assessment Methods to Explore Facets of Mindfulness. Assessment,

13(1), 27-45.

Baddeley, A. (2003). Working Memory: Looking Back and Looking Forward. *Nature*

Reviews Neuroscience, *4*(10), 829-839.

Baddeley, A .D., & Hitch, G. (1974). Working memory. In G.H. Bower (Ed.), *The*

psychology of learning and motivation: Advances in research and theory (Vol. 8,

pp. 47–89). New York: Academic Press.

Barnes, S., Brown, K., Krusemark, E., Campbell, W., & Rogge, R. D. (2007). The role of

mindfulness in romantic relationship satisfaction and responses to relationship

stress. *Journal of Marital and Family Therapy*, 33(4), 482-500.

Barrett, L., Tugade, M. M., & Engle, R. W. (2004). Individual Differences in Working

Memory Capacity and Dual-Process Theories of the Mind. *Psychological*

Bulletin, *130*(4), 553- 573.

Barron, E., Riby, L. M., Greer, J., & Smallwood, J. (2011). Absorbed in thought: The

    effect of mind wandering on the processing of relevant and irrelevant events.

    Psychological Science, *22*(5), 596-601.

Bernstein, A., Tanay, G., & Vujanovic, A. A. (2011). Concurrent relations between

    mindful attention and awareness and psychopathology among trauma-exposed

    adults: Preliminary evidence of transdiagnostic resilience. *Journal of Cognitive*

    Psychotherapy, 25(2), 99-113.

Birnie, K., Garland, S. N., & Carlson, L. E. (2010). Psychological benefits for cancer

    patients and their partners participating in mindfulness-based stress reduction

    (MBSR). *Psycho-Oncology*, 19(9), 1004-1009.

Bishop, S. R. (2002). What do we really know about Mindfulness-Based Stress

    Reduction? Psychosomatic Medicine, 64(1), 71-83.

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., & Devins,

    G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology:*

    Science and Practice, *11*(3), 230-241.

Bradley, M. M., Sabatinelli, D., Lang, P. J., Fitzsimmons, J. R., King, W., & Desai, P.

    (2003). Activation of the visual cortex in motivated attention. *Behavioral*

    Neuroscience, 117, 369–380.

Bradley, M. M., Codispoti, M., Cuthbert, B. N., & Lang, P. J. (2001). Emotion and

    motivation I: Defensive and appetitive reactions in picture processing. *Emotion, 1*,

    276–298.

Brefczynski-Lewis, J. A., Lutz, A. A., Schaefer, H. S., Levinson, D. B., & Davidson, R. J. (2007). Neural correlates of attentional expertise in long-term meditation practitioners. *PNAS Proceedings of the National Academy of Sciences of the United States of America*, 104(27), 11483-11488.

Brewin, C. R., & Smart, L. (2005). Working memory capacity and suppression of intrusive thoughts. *Journal Of Behavior Therapy And Experimental Psychiatry*, *36*(1), 61-68.

Bridges, L. J., Denham, S. A., & Ganiban, J. M. (2004). Definitional issues in emotion regulation research. Child Development, 75(2), 340-345.

Brown, K.W.*, & Ryan, R.M. (*2003*). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84,* 822–848.

Brown, K.W., Ryan, R.M. & Creswell, J.D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry*, *18*, 211–237.

Brown, K., Ryan, R. M., Loverich, T. M., Biegel, G. M., & West, A. (2011). Out of the armchair and into the streets: Measuring mindfulness advances knowledge and improves interventions: Reply to Grossman (2011). Psychological Assessment, 23(4), 1041-1046.

Busner, J., Kaplan, S. L., Nicholas Greco, I. V., & Sheehan, D. V. (2011). The use of research measures in adult clinical practice. *Innovations in clinical neuroscience*, *8*(4), 19.

Cannon WB. 1929. Bodily changes in pain, hunger, fear and rage. Boston: Branford.

Cardaciotto, L., Herbert, J. D., Forman, E. M., Moitra, E., & Farrow, V. (2008).
The assessment of present-moment awareness and acceptance: The Philadelphia
Mindfulness Scale. Assessment, 15(2), 204-223.

Carmody, J., & Baer, R. A. (2008). Relationships between mindfulness practice and
levels of mindfulness, medical and psychological symptoms and well-being in a
mindfulness-based stress reduction program. *Journal of Behavioral Medicine*,
31(1), 23-33.

Chafee, M. V., & Goldman-Rakic, P. S. (1998). Matching patterns of activity in primate
prefrontal area 8a and parietal area 7ip neurons during a spatial working memory
task. *Journal Of Neurophysiology*, *79*(6), 2919-2940.

Chambers, R., Gullone, E., & Allen, N. B. (2009). Mindful emotion regulation: An
integrative review. Clinical Psychology Review, 29(6), 560-572.

Chambers, R., Lo, B., & Allen, N. B. (2008). The impact of intensive mindfulness
training on attentional control, cognitive style, and affect. *Cognitive Therapy and
Research*, 32(3), 303-322.

Chan, R. K., Shum, D., Toulopoulou, T., & Chen, E. H. (2008). Assessment of executive
functions: Review of instruments and identification of critical issues. Archives Of
Clinical Neuropsychology, 23(2), 201-216.

Chang, V. Y. et al. (2004). The effects of a mindfulness-based stress reduction program
on stress, mindfulness self-efficacy, and positive states of mind. *Stress and*

Health: Journal of the International Society for the Investigation of Stress, 20(3), 141-147.

Chiesa, A., & Serretti, A. (2009). Mindfulness-based stress reduction for stress management in healthy people: A review and meta-analysis. *The Journal of Alternative and Complementary Medicine*, 15(5), 593-600.

Chiesa, A., & Serretti, A. (2011). Mindfulness-based interventions for chronic pain: A systematic review of the evidence. *The Journal Of Alternative And Complementary Medicine*, *17*(1), 83-93.

Chun, M. M., & Turk-Browne, N. B. (2007). Interactions between attention and memory. *Current Opinion in Neurobiology*, 17(2), 177-184.

Connor, K. M., & Davidson, J. R. (2003). Development of a new resilience scale: The Connor-Davidson resilience scale (CD-RISC). Depression and anxiety, 18(2), 76-82.

Codispoti, M., Bradley, M. M., & Lang, P. J. (2001). Affective reactions to briefly presented pictures. *Psychophysiology, 38*, 474–478

Cohen, S., & Janicki-Deverts, D. (2012). Who's stressed? Distributions of psychological stress in the United States in probability samples from 1983, 2006 and 2009. Journal of Applied Social Psychology, 42, 1320-1334.

Conybeare, D., Behar, E., Solomon, A., Newman, M. G., & Borkovec, T. D. (2012). The PTSD Checklist—Civilian Version: reliability, validity, and factor structure in a nonclinical sample. *Journal of clinical psychology*, *68*(6), 699-713.

Conway, A. A., Kane, M. J., Bunting, M. F., Hambrick, D., Wilhelm, O., & Engle, R. W. (2005). Working memory span tasks: A methodological review and user's guide. *Psychonomic Bulletin & Review*, *12*(5), 769-786.

Corcoran, K. M., Farb, N., Anderson, A., & Segal, Z. V. (2010). Mindfulness and emotion regulation: Outcomes and possible mediating mechanisms. In A. M. Kring & D. M. Sloan, Emotion regulation and psychopathology: A transdiagnositc approach to etiology and treatment (pp. 339–355). New York: Guilford Press.

Courtney, S. M., Petit, L., Maisog, J. a., Ungerleider, L. G., & Haxby, J. V. (1998). An area specialized for spatial working memory in human frontal cortex. *Science*, *279*(5355), 1347-1351.

Cousijn, H., Rijpkema, M., Qin, S., van Marle, H. J., Franke, B., Hermans, E. J., ... & Fernández, G. (2010). Acute stress modulates genotype effects on amygdala processing in humans. *Proceedings of the National Academy of Sciences*, *107*(21), 9867-9872.

Creswell, J., Way, B. M., Eisenberger, N. I., & Lieberman, M. D. (2007). Neural correlates of dispositional mindfulness during affect labeling. *Psychosomatic Medicine*, *69*(6), 560-565.

Curtis, C. E., & D'Esposito, M. (2003). Persistent activity in the prefrontal cortex during working memory. *Trends In Cognitive Sciences*, *7*(9), 415-423.

del Palacio-González, A., & Clark, D. A. (2013). Cognitive specificity in fear and sad affect: an investigation of emotional reactivity and recovery from experimental mood induction. *Cognitive Therapy and Research*, 1-10.

Davis, K. M., Lau, M. A., & Cairns, D. R. (2009). Development and preliminary

validation of a trait version of the Toronto Mindfulness Scale. *Journal Of Cognitive Psychotherapy*, *23*(3), 185-197.

Diamond, D.M. Campbell, A.M. Park, C.R. Halonen, J. & Zoladz, P.R. (2007).The

temporal dynamics model of emotional memory processing: A synthesis on the neurobiological basis of stress induced amnesia, flashbulb and traumatic memories, and the Yerkes–Dodson law. *Neural Plasticity, 2007*, 1–33.

Duncko, R., Johnson, L., Merikangas, K., & Grillon, C. (2009). Working memory

performance after acute exposure to the cold pressor stress in healthy volunteers. *Neurobiology of Learning and Memory*, 91(4), 377-381.

Egloff, B., & Schmukle, S. C. (2004). Gender differences in implicit and explicit anxiety

measures. *Personality and Individual Differences*, *36*(8), 1807-1815.

Ehlers, A., & Clark, D. M. (2000). A cognitive model of posttraumatic stress disorder.

Behaviour Research and Therapy, 38(4), 319-345.

Endsley, M. R., & Bolstad, C. A. (1994). Individual differences in pilot situation

awareness. *International Journal of Aviation Psychology*, 4(3), 241-264.

Engle, R. W. (2002). Working memory capacity as executive attention. *Current*

Directions In   Psychological Science, *11*(1), 19-23.

Engle, R. W., Tuholski, S. W., Laughlin, J. E., & Conway, A. A. (1999). Working

memory, short-term memory, and general fluid intelligence: A latent-variable approach. *Journal Of Experimental Psychology: General*, *128*(3), 309-331.

Evans, G. W., & Schamberg, M. A. (2009). Childhood poverty, chronic stress, and adult working memory. *PNAS Proceedings Of The National Academy Of Sciences Of The United States Of America*, *106*(16), 6545-6549.

Fechir, M., Schlereth, T., Purat, T., Kritzmann, S., Geber, C., Eberle, T., ... & Birklein, F. (2008). Patterns of sympathetic responses induced by different stress tasks. *The open neurology journal*, *2*, 25.

Feldman, G., Hayes, A., Kumar, S., Greeson, J., & Laurenceau, J. (2007). Mindfulness and emotion regulation: The development and initial validation of the Cognitive and Affective Mindfulness Scale-Revised (CMS-R). *Journal Of Psychopathology And Behavioral Assessment*, *29*(3), 177-190.

Frankl, V., & Lasch, I. (Trans). (2006). *Man's search for meaning*. Boston, MA US: Beacon Press.

Frewen, P. A., Dozois, D. A., Neufeld, R. J., Lane, R. D., Densmore, M., Stevens, T. K., & Lanius, R. A. (2010). Individual differences in trait mindfulness predict dorsomedial prefrontal and amygdala response during emotional imagery: An fMRI study. *Personality And Individual Differences*, *49*(5), 479-484.

Funahashi, S., Bruce, C. J., & Goldman-Rakic, P. S. (1989). Mnemonic coding of visual space in the monkey's dorsolateral prefrontal cortex. *Journal Of Neurophysiology*, *61*(2), 331-349.

Funahashi, S., Bruce, C. J., & Goldman-Rakic, P. S. (1993). Dorsolateral prefrontal lesions and oculomotor delayed-response performance: Evidence for mnemonic 'scotomas.' *The Journal Of Neuroscience*, *13*(4), 1479-1497.

Fuster, J. M., & Alexander, G. E. (1971). Neuron activity related to short-term memory. *Science*, *173*(3997), 652-654.

Gilbert, P. (2009). An Introduction to Compassion Focused Therapy. *Advances in Psychiatric Treatment, 15,* 199-208.

Giluk, T. L. (2009). Mindfulness, Big Five personality, and affect: A meta-analysis. *Personality and Individual Differences*, 47(8), 805-811.

Gohm, C. L., Baumann, M. R., & Sniezek, J. A. (2001). Personality in extreme situations: Thinking (or not) under acute stress. *Journal of Research in Personality*, 35(3), 388-399.

Gottman, J. M., Coan, J., Carrere, S., & Swanson, C. (1998). Predicting marital happiness and stability from newlywed interactions. *Journal Of Marriage & The Family*, *60*(1), 5-22.

Gross, J. J. (1998). Antecedent- and response-focused emotion regulation: Divergent consequences for experience, expression, and physiology. Journal of Personality and Social Psychology, 74, 224-237.

Gross, J. J. (Ed.). (2007). Handbook of emotion regulation. New York: Guilford Press.

Grossman, P. (2008). On measuring mindfulness in psychosomatic and psychological research. Journal Of Psychosomatic Research, 64(4), 405-408.

Grossman, P. (2011). Defining mindfulness by how poorly I think I pay attention during everyday awareness and other intractable problems for psychology's (re)invention of mindfulness: Comment on Brown et al. (2011). Psychological Assessment, 23(4), 1034-1040.

Grossman, P., Niemann, L., Schmidt, S., & Walach, H. (2004). Mindfulness-based stress

    reduction and health benefits: A meta-analysis. *Journal Of Psychosomatic Research*,

    57(1), 35-43.

Gusnard, D.A. & Raichle M.E. (2001). Searching for a baseline: Functional imaging and the

    resting human brain. *National Review of Neuroscience*, *2,* 685–694.

Henckens, M. J., Hermans, E. J., Pu, Z., Joëls, M., & Fernández, G. (2009). Stressed memories:

    how acute stress affects memory formation in humans. *The Journal of Neuroscience*,

    29(32), 10111-10119.

Hermann, A., Schäfer, A., Walter, B., Stark, R., Vaitl, D., & Schienle, A. (2007). Diminished

    medial prefrontal cortex activity in blood-injection-injury phobia. *Biological*

    psychology, *75*(2), 124-130.

Hepburn, T., & Page, A. C. (2000). Effects of images about fear and disgust upon responses to

    blood-injury phobic stimuli. *Behavior Therapy*, *30*(1), 63-77.

Hofmann, W., Gschwendner, T., Friese, M., Wiers, R. W., & Schmitt, M. (2008). Working

    memory capacity and self-regulatory behavior: Toward an individual differences

    perspective on behavior determination by automatic versus controlled processes. *Journal*

    of Personality and Social Psychology, 95(4), 962-977.

Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness- based

    therapy on anxiety and depression: A meta-analytic review. *Journal Of Consulting And*

    Clinical Psychology, *78*(2), 169-183.

Ilkowska, M., & Engle, R. W. (2010). Working memory capacity and self-regulation. In
R. H. Hoyle, R. H. Hoyle (Eds.) , *Handbook of personality and self-regulation*
(pp. 265-290). Wiley-Blackwell.

Jaeggi, S. M., Buschkuehl, M., Perrig, W. J., & Meier, B. (2010). The concurrent validity
of the   N-back task as a working memory measure. Memory, 18(4), 394-412.

Jha, A. P., & Kiyonaga, A. (2010). Working-memory-triggered dynamic adjustments in
cognitive control. *Journal Of Experimental Psychology: Learning, Memory, And
Cognition*, *36*(4), 1036-1042.

Jha, A. P., & McCarthy, G. (2000). The influence of memory load upon delay-interval
activity in a working-memory task: An event-related functional MRI study.
Journal Of CognitiveNeuroscience, *12*, 90-105.

Jha, A. P., Stanley, E. A., & Baime, M. J. (2010). What does mindfulness training
strengthen? Working memory capacity as a functional marker of training success.
In R. A. Baer, R. A. Baer (Eds.), *Assessing mindfulness and acceptance processes
in clients: Illuminating the theory and practice of change* (pp. 207-221). Oakland,
CA US: Context Press/New Harbinger Publications.

Jha, A. P., Stanley, E. A., Kiyonaga, A., Wong, L., & Gelfand, L. (2010). Examining the
protective effects of mindfulness training on working memory capacity and
affective experience. *Emotion*, *10*(1), 54-64.

Joormann, J., & Gotlib, I. H. (2008). Updating the contents of working memory in
depression: Interference from irrelevant negative material. *Journal of Abnormal
Psychology*, 117(1), 182-192.

Jurado, M., & Rosselli, M. (2007). The elusive nature of executive functions: A review of our

current understanding. Neuropsychology Review, 17(3), 213-233.

Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients

based on the practice of mindfulness meditation: Theoretical considerations and

preliminary results. General Hospital Psychiatry, 4, 33-47.

Kabat-Zinn, J.(1990). *Full catastrophe living: Using the wisdom of your body and mind to face*

stress, pain and illness. Delacorte, New York.

Kabat-Zinn, J. *(* 2003*).* Mindfulness-based interventions in context: Past, present, and future.

Clinical Psychology: Science and Practice, 10, 144–156.

Kane, M. J., Brown, L. H., McVay, J. C., Silvia, P. J., Myin-Germeys, I., & Kwapil, T. R.

(2007). For whom the mind wanders, and when: An experience-sampling study of

working memory and executive control in daily life. *Psychological Science*, *18*(7), 614-

621.

Kashdan, T. B., Afram, A., Brown, K. W., Birnbeck, M., & Drvoshanov, M. (2011). Curiosity

enhances the role of mindfulness in reducing defensive responses to existential threat.

Personality and Individual Differences, 50(8), 1227-1232.

Keay, K. A., & Bandler, R. (2001). Parallel circuits mediating distinct emotional coping

reactions to different types of stress. *Neuroscience And Biobehavioral Reviews*, *25*(7-8),

669-678.

Keng, S., Smoski, M. J., & Robins, C. J. (2011). Effects of mindfulness on psychological health:

A review of empirical studies. *Clinical Psychology Review*, *31*(6), 1041-1056.

Kilpatrick, L. A., Suyenobu, B. Y., Smith, S. R., Bueller, J. A., Goodman, T., Creswell,

J., & Naliboff, B. D. (2011). Impact of mindfulness-based stress reduction

training on intrinsic brain connectivity. *NeuroImage*,

doi:10.1016/j.neuroimage.2011.02.034

Klein, K., & Boals, A. (2001). Expressive writing can increase working memory

capacity. Journal of Experimental Psychology: General, 130(3), 520.

de Kloet, E.R, Joëls, M., & Holsboer, F.(2005). Stress and the brain: From adaptation to

disease, *National Review of Neuroscience, 6*, 463–475.

Kirchner, W. K. (1958), Age differences in short-term retention of rapidly changing

information. Journal of Experimental Psychology, 55(4), 352-358

Kirschbaum, C., Pirke, K., & Hellhammer, D. H. (1993). The 'Trier Social Stress Test': A

tool for investigating psychobiological stress responses in a laboratory setting.

N*europsychobiology*, *28*(1-2), 76-81.

Kirschbaum, C., Pirke, K., & Hellhammer, D. H. (1995). Preliminary evidence for

reduced cortisol responsivity to psychological stress in women using oral

contraceptive medication. *Psychoneuroendocrinology*, *20*(5), 509-514.

Koole, S. L. (2009). The psychology of emotion regulation: An integrative review.

Cognition & Emotion, 23(1), 4-41.

Kozhevnikov, M., Louchakova, O., Josipovic, Z., & Motes, M. A. (2009). The

enhancement of visuospatial processing efficiency through Buddhist Deity

meditation. *Psychological Science*, *20*(5), 645-653.

Kudielka, B. M., Hellhammer, D. H., & Kirschbaum, C. (2007). Ten Years of Research with the Trier Social Stress Test--Revisited. In E. Harmon-Jones, P. Winkielman (Eds.), Social neuroscience: Integrating biological and psychological explanations of social behavior (pp. 56-83). New York, NY US: Guilford Press.

Larson, C. L., Ruffalo, D., Nietert, J. Y., & Davidson, R. J. (2005). Stability of emotion-modulated startle during short and long picture presentation. *Psychophysiology, 42*, 604–610.

Lau, M. A., Bishop, S. R., Segal, Z. V., Buis, T., Anderson, N. D., Carlson, L., & ... Devins, G. (2006). The Toronto Mindfulness Scale: Development and Validation. *Journal Of Clinical Psychology*, *62*(12), 1445-1467.

Lazar, S. W., Kerr, C. E., Wasserman, R. H., Gray, J. R., Greve, D. N., Treadway, M. T., & ... Fischl, B. (2005). Meditation experience is associated with increased cortical thickness. *Neuroreport: For Rapid Communication Of Neuroscience Research*, *16*(17), 1893-1897.

Leung, H., Gore, J. C., & Goldman-Rakic, P. S. (2002). Sustained mnemonic response in the human middle frontal gyrus during on-line storage of spatial memoranda. *Journal Of Cognitive Neuroscience*, *14*(4), 659-671.

Levenson, R. W., & Gottman, J. M. (1983). Marital interaction: Physiological linkage and affective exchange. *Journal Of Personality And Social Psychology*, *45*(3), 587-597.

Lévesque, J., Fanny, E., Joanette, Y., Paquette, V., Mensour, B., Beaudoin, G., & ... Beauregard, M. (2003). Neural circuitry underlying voluntary suppression of sadness. *Biological Psychiatry*, *53*(6), 502-510.

Lezak, M. D. (1983). Neuropsychological assessment (2nd ed.). New York: Oxford
University Press.

Liberzon, I., Taylor, S. F., Phan, K., Britton, J. C., Fig, L. M., Bueller, J. A., & ...
Zubieta, J. (2007). Altered central μ-opioid receptor binding after psychological
trauma. *Biological Psychiatry*, *61*(9), 1030-1038.

Linnenbrink, E. A., Ryan, A. M., & Pintrich, P. R. (1999). The role of goals and affect in
working memory functioning. *Learning And Individual Differences*, *11*(2), 213-
230.

Linnman, C., Zeidan, M. A., Pitman, R. K., & Milad, M. R. (2012). Resting cerebral
metabolism correlates with skin conductance and functional brain activation
during fear conditioning. *Biological Psychology*, *89*(2), 450-459.

Luethi, M., Meier, B., & Sandi, C. (2009). Stress effects on working memory, explicit
memory, and implicit memory for neutral and emotional stimuli in healthy men.
Frontiers in Behavioral Neuroscience, Retrieved from EBSCO*host*.

Lupien, S. J., Maheu, F. F., Tu, M. M., Fiocco, A. A., & Schramek, T. E. (2007). The
effects of stress and stress hormones on human cognition: Implications for the
field of brain and cognition. Brain And Cognition, 65(3), 209-237.

Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and
monitoring in meditation. *Trends in Cognitive Sciences*, 12(4), 163-169.

Lynch, T. R., Schneider, K. G., Zachary Rosenthal, M., & Cheavens, J. S. (2007). A
mediational model of trait negative affectivity, dispositional thought suppression,

and intrusive thoughts following laboratory stressors. *Behaviour research and therapy*, *45*(4), 749-761.

Mann, C., Canny, B. J., Reser, D. H., & Rajan, R. (2013). Poorer verbal working memory for a second language selectively impacts academic achievement in university medical students. PeerJ, 1, e22.

Magariños, A., McEwen, B. S., Flügge, G., & Fuchs, E. (1996). Chronic psychosocial stress causes apical dendritic atrophy of hippocampal CA3 pyramidal neurons in subordinate tree shrews. *The Journal Of Neuroscience*, *16*(10), 3534-3540.

Mansouri, F. A., Tanaka, K., & Buckley, M. J. (2009). Conflict-induced behavioural adjustment: A clue to the executive functions of the prefrontal cortex. *Nature Reviews Neuroscience*, *10*(2), 141-152.

Marks, A. G., Sobanski, D. J., & Hine, D. W. (2010). Do dispositional rumination and/or mindfulness moderate the relationship between life hassles and psychological dysfunction in adolescents? *Australian And New Zealand Journal Of Psychiatry*, *44*(9), 831-838.

Mason, M.F., Norton, M.I., Van Horn, J.D., Wegner, D.M., Grafton S.T., & Macrae, C.N. (2007).Wandering minds: The default network and stimulus-independent thought. *Science*, *315***,** 393–395.

Mayer, J.D., Salovey, P., & Caruso, D.R. (2008). Emotional intelligence: New ability or eclectic traits? *American Psychologist, 63*, 503–517.

McEwen, B.S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine, 338*, 171–179.

McLean, C. P., Asnaani, A., Litz, B. T., & Hofmann, S. G. (2011). Gender differences in
anxiety disorders: prevalence, course of illness, comorbidity and burden of illness.
Journal of psychiatric research, *45*(8), 1027-1035.

Mendonça-de-Souza, A. F., Souza, G. L., Vieira, A. A., Fischer, N. L., Souza, W. F.,
Rumjanek, V. M., & ... Volchan, E. E. (2007). Negative affect as a predisposing
factor for cortisol release after an acute stress--The impact of unpleasant priming.
Stress: The International Journal On The Biology Of Stress, *10*(4), 362-367.

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function.
Annual Review Of Neuroscience, *24*167-202.

Miller, E. K., Erickson, C. A., & Desimone, R. (1996). Neural mechanisms of visual
working memory in prefrontal cortex of the macaque. *The Journal Of
Neuroscience*, *16*(16), 5154-5167.

Minor, H. G., Carlson, L. E., Mackenzie, M. J., Zernicke, K., & Jones, L. (2006).
Evaluation of a Mindfulness-Based Stress Reduction (MBSR) Program for
Caregivers of Children with   Chronic Conditions. Social Work In Health Care,
43(1), 91-109.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., & Howerter, A. (2000). The
unity and diversity of executive functions and their contributions to complex
'frontal lobe'   tasks: A latent variable analysis. *Cognitive Psychology*, *41*(1), 49-
100.

Modinos, G., Ormel, J., & Aleman, A. (2010). Individual differences in dispositional

    mindfulness and brain activity involved in reappraisal of emotion. *Social Cognitive And*

    Affective Neuroscience, *5*(4), 369-377.

Morelli, F., & Burton, P. A. (2009). The impact of induced stress upon selective attention in

    multiple object tracking. *Military Psychology*, 21(1), 81-97.

Morrison, A. B., & Chein, J. M. (2011). Does working memory training work? The promise and

    challenges of enhancing cognition by training working memory. *Psychonomic Bulletin &*

    Review, 18(1), 46-60.

National Center for PTSD. (January 2014). Using the PTSD Checklist for DSM-IV (PCL).

    Retrieved from http://www.ptsd.va.gov/professional/assessment/overview/index.asp

Nolen-Hoeksema, S. (2012). Emotion regulation and psychopathology: The role of gender.

    Annual review of clinical psychology, *8*, 161-187.

Ossewaarde, L., Hermans, E. J., van Wingen, G. A., Kooijman, S. C., Johansson, I. M.,

    Bäckström, T., & Fernández, G. (2010). Neural mechanisms underlying changes in

    stress-sensitivity across the menstrual cycle. *Psychoneuroendocrinology*, *35*(1), 47-55.

Page, A. C. (2003). The role of disgust in faintness elicited by blood and injection stimuli.

    Journal of Anxiety Disorders, *17*(1), 45-58.

Page, A. C., Bennett, K. S., Carter, O., Smith, J., & Woodmore, K. (1997). The Blood-

    Injection Symptom Scale (BISS): Assessing a structure of phobic symptoms

    elicited by blood and injections. Behaviour Research And Therapy, 35(5), 457-

    464.

Pagnoni, G., & Cekic, M. (2007). Age effects on gray matter volume and attentional

performance in Zen meditation. *Neurobiology of Aging*, 28(10), 1623-1627.

doi:10.1016/j.neurobiolaging.2007.06.008

Pereira, M.G., Volchan, E., Souza, G.L.L., Oliveira, L., Campagnoli, R.R., Pinheiro,

W.M., & Pessoa, L. (2006). Sustained and transient modulation of performance

induced by emotional picture viewing. *Emotion 6*(4), 622– 634.

Pessoa, L., Kastner, S., & Ungerleider, L. G. (2002). Attentional control of the processing

of neutral and emotional stimuli. *Cognitive Brain Research*, *15*(1), 31-45.

Plessow, F., Fischer, R., Kirschbaum, C., & Goschke, T. (2011). Inflexibly focused under

stress: Acute psychosocial stress increases shielding of action goals at the

expense of reduced cognitive flexibility with increasing time lag to the stressor.

Journal Of Cognitive Neuroscience, *23*(11), 3218-3227.

Posner, M. I. (1980). Orienting of attention. *The Quarterly Journal Of Experimental

Psychology*, *32*(1), 3-25.

Qin, S., Hermans, E. J., van Marle, H. F., Luo, J., & Fernández, G. (2009). Acute

psychological stress reduces working memory-related activity in the dorsolateral

prefrontal cortex. *Biological Psychiatry*, *66*(1), 25-32.

Quintana, J., & Fuster, J. M. (1999). From perception to action: Temporal integrative

functions of prefrontal and parietal neurons. *Cerebral Cortex*, *9*(3), 213-221.

Read, J. P., Colder, C. R., Merrill, J. E., Ouimette, P., White, J., & Swartout, A. (2012).

Trauma and posttraumatic stress symptoms predict alcohol and other drug

consequence trajectories in the first year of college. *Journal of consulting and   clinical psychology*, *80*(3), 426.

Richardson, A. E., & VanderKaay Tomasulo, M. M. (2011). Influence of acute stress on spatial tasks in humans. *Physiology & Behavior*, *103*(5), 459-466.

Roberts, A. L., Gilman, S. E., Breslau, J., Breslau, N., & Koenen, K. C. (2011). Race/ethnic differences in exposure to traumatic events, development of post-traumatic stress disorder, and treatment-seeking for post-traumatic stress disorder in the United States. Psychological medicine, 41(01), 71-83.

Rosch, E. (2007). More than mindfulness: When you have a tiger by the tail, let it eat you. *Psychological Inquiry*, *18*(4), 258-264.

Salas, E., Driskell, J. E., & Hughes, S. (1996). The Study of Stress and Human Performance. In Driskell & Salas (Eds.) Stress and Human Performance, Mahwah, NJ: Lawrence Erlbaum Associates, 1-46.

Sakai, K., Rowe, J. B., & Passingham, R. E. (2002). Active maintenance in prefrontal area 46 creates distractor-resistant memory. *Nature Neuroscience*, *5*(5), 479-484.

Santorelli S.F. (1999) *Mindfulness-Based Stress Reduction: Qualifications and recommended guideline for providers.* Center for Mindfulness in Medicine, Health Care, and Society. Worcester, MA: University of Massachusetts Medical Center.

Schmeichel, B. J., & Demaree, H. A. (2010). Working memory capacity and spontaneous emotion regulation: High capacity predicts self-enhancement in response to negative feedback. Emotion, 10, 739–744.

Schmeichel, B. J., Volokhov, R. N., & Demaree, H. A. (2008). Working memory

capacity and the self-regulation of emotional expression and experience. *Journal Of Personality And Social Psychology*, *95*(6), 1526-1540.

Schneiderman, N, Ironson, G, & Siegel, S.D. (2005). Stress and health: Psychological,

behavioral, and biological determinants. *Annual Review of Clinical Psychology, 1*:607– 628.

Schutte, N. S., & Malouff, J. M. (2011). Emotional intelligence mediates the relationship

between mindfulness and subjective well-being. *Personality and Individual Differences*, *50*(7), 1116-1119.

Selye, H. (1955). Stress and disease. *Science, 122*, 625–631.

Shapiro, S. L., Astin, J. A., Bishop, S. R., & Cordova, M. (2005). Mindfulness-Based

Stress Reduction for Health Care Professionals: Results From a Randomized Trial. *International Journal of Stress Management*, 12(2), 164-176.

Shapiro, S. L., Brown, K., Thoresen, C., & Plante, T. G. (2011). The moderation of

mindfulness-based stress reduction effects by trait mindfulness: Results from a randomized controlled trial. *Journal of Clinical Psychology*, 67(3), 267-277

Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of

Mindfulness. *Journal of Clinical Psychology*, 62(3), 373-386.

Sinha, R., Lovallo, W.R., & Parsons, O.A. (1992).Cardiovascular differentiation of

emotions. *Psychosomatic Medicine*, *54*, 422–435.

Smith, H., & Novak, P. (2003). Buddhism: A concise introduction. New York, NY:

Harper Collins.

Smith, J.C., Bradley, M.M., & Lang, P.J. (2005). State anxiety and affective physiology: Effects of sustained exposure to affective pictures. *Biological Psychology, 69*(3), 247–260.

Sood, A., Prasad, K., Schroeder, D., & Varkey, P. (2011). Stress management and resilience training among Department of Medicine faculty: a pilot randomized clinical trial. Journal of general internal medicine, 26(8), 858-861.

Stanley, E. A., Schaldach, J. M., Kiyonaga, A., & Jha, A. P. (2011). Mindfulness-based mind fitness training: A case study of a high-stress predeployment military cohort. *Cognitive and Behavioral Practice*, *18*(4), 566-576.

Stuss, D. T., Alexander, M. P., Floden, D., Binns, M. A., Levine, B., & McIntosh, A. R., et al. (2002). Fractionation and localization of distinct frontal lobe processes: Evidence from focal lesions in humans. In D. T. Stuss, & R. T. Knight (Eds.) Principles of frontal lobe function (pp. 392–407). New York, NY: Oxford University Press.

Thompson, B. L., & Waltz, J. (2007). Everyday mindfulness and mindfulness meditation: Overlapping constructs or not?. *Personality and Individual Differences*, 43(7), 1875-1885.

Unsworth, N., & Engle, R. W. (2007). On the division of short-term and working memory: An examination of simple and complex span and their relation to higher order abilities. *Psychological Bulletin*, *133*(6), 1038-1066.

Unsworth, N., Heitz, R. P., & Engle, R. W. (2005). Working Memory Capacity in Hot   and Cold Cognition. In R. W. Engle, G. Sedek, U. von Hecker, D. N. McIntosh, R. W.

Engle, G. Sedek, & D. N. McIntosh (Eds.), *Cognitive limitations in aging and psychopathology* (pp. 19-43). New York, NY US: Cambridge University Press.

Unsworth, N., Heitz, R. P., Schrock, J. C., & Engle, R. W. (2005). An automated version of the operation span task. Behavior Research Methods, 37, 498–505.

Vasterling, J. J., Proctor, S. P., Amoroso, P., Kane, R., Heeren, T., & White, R. F. (2006). Neuropsychological Outcomes of Army Personnel Following Deployment to the Iraq War. *JAMA: Journal Of The American Medical Association*, *296*(5), 519-529.

Vaishnavi, S., Connor, K., & Davidson, J. R. (2007). An abbreviated version of the Connor-Davidson Resilience Scale (CD-RISC), the CD-RISC2: Psychometric properties and applications in psychopharmacological trials. Psychiatry research, 152(2), 293-297.

van Marle, H. J., Hermans, E. J., Qin, S., & Fernández, G. (2009). From specificity to sensitivity: how acute stress affects amygdala processing of biologically salient stimuli. *Biological psychiatry*, *66*(7), 649-655.

van Vugt, M. K., & Jha, A. P. (2011). Investigating the impact of mindfulness meditation training on working memory: A mathematical modeling approach. *Cognitive, Affective & Behavioral Neuroscience*, *11*(3), 344-353.

Vyas, A., Mitra, R., Rao, B., & Chattarji, S. (2002). Chronic stress induces contrasting patterns of dendritic remodeling in hippocampal and amygdaloid neurons. *The Journal Of Neuroscience*, *22*(15), 6810-6818.

Walach, H., Buchheld, N., Buttenmüller, V., Kleinknecht, N. & Schmidt, S. (2006). Measuring mindfulness – the Freiburg mindfulness inventory (FMI). *Personality and Individual Differences*, *40*, 1543–1555.

Wallace, B., & Shapiro, S. L. (2006). Mental balance and well-being: Building bridges between Buddhism and Western psychology. *American Psychologist*, *61*(7), 690-701.

Wegner, D. M., & Erber, R. (1992). The hyperaccessibility of suppressed thoughts. *Journal Of Personality And Social Psychology*, *63*(6), 903-912.

Weinstein, N., Brown, K. W., & Ryan, R. M. (2009). A multi-method examination of the effects of mindfulness on stress attribution, coping, and emotional well-being. *Journal of Research in Personality*, 43(3), 374-385.

Witkiewitz, K., & Bowen, S. (2010). Depression, craving, and substance use following a randomized trial of mindfulness-based relapse prevention. *Journal of Consulting and Clinical Psychology*, 78(3), 362-374.

Zarahn, E., Aguirre, G. K., & D'Esposito, M. (1999). Temporal isolation of the neural correlates of spatial mnemonic processing with fMRI. *Cognitive Brain Research*, *7*(3), 255-268.

Zeidan, F., Johnson, S. K., Diamond, B. J., David, Z., & Goolkasian, P. (2010). Mindfulness meditation improves cognition: Evidence of brief mental training. *Consciousness And Cognition: An International Journal*, *19*(2), 597-605.

Zigmond, M. J., Finlay, J. M., & Sved, A. F. (1995). Neurochemical studies of central noradrenergic responses to acute and chronic stress: Implications for normal and abnormal behavior. In M. J. Friedman, D. S. Charney, A. Y. Deutch, M. J.

Description of Study on SONA Website

You are invited to participate in a research study being conducted by Paul Salmon, PhD, principal investigator, and Lauren Vines, M.S., project director. The study is sponsored by the University of Louisville, Department of Psychological and Brain Sciences and will take place at the Biobehavioral Research Laboratory, located in Rm. 320, Lutz Hall.

The purpose of this study is to learn about the relationships between mindfulness (the ability to be non-judgmental and present-moment focused), a specific type of short-term memory, and stress. Participating in the study will require only one visit and take approximately 1 hour. Participants will be asked to complete several questionnaires and as well as tasks on a computer.

Eligibility requirements: University of Louisville undergraduate students who do not have a formal meditation practice, and who have never participated in a Mindfulness-Based Stress Reduction Program.

Research Protocol and Script

Note: When running participants, the experimenters should act in a *neutral* emotional state (not overly friendly or overly cold) to minimize any effect of their demeanor on the affect of participants prior to the emotional stressor.

When participant arrives

Are you here for an experiment? What is your name?

Do you have a cell phone with you? If yes, **please turn it off or on silent– not on vibrate.**

You can have a seat right here. Participant is seated at computer table.

Consent Form & Introduction

First I have a form that tells you a little bit about the study. [Hand to them] **Let me know if you have any questions.** Participant signs two copies of consent form (one copy is given to them). Any questions asked by the participant are answered as thoroughly as possible.

The purpose of this study is to examine how types of people perform certain tasks after experiencing stress. We really appreciate it if you give your full attention and effort to the tasks you are asked to perform during the experiment. First we will be collecting some information about you, using these questionnaires. Please take as long as you need to complete them. Give participant questionnaire packet. Answer any questions as thoroughly as possible.

Now we will be taking your blood pressure and heart rate using this blood pressure cuff, just like at the doctor's office. We will be taking your heart rate again later in the experiment and will compare it to your resting heart rate now. Using blood pressure cuff, take blood pressure and resting heart rate. If participant asks what their blood pressure or resting heart rate is, tell them. Remove blood pressure cuff. **Now I will attach these sensors to your forearm and finger tips so we can measure your heart rate and skin conductance throughout the remainder of the experiment. Before I do so, could you please take this alcohol wipe and vigorously rub the inside of your forearms with it. This will help us get a better reading from the sensors.** Hand pre-moistened alcohol wipe to participant. If necessary prompt them to scrub vigorously. Attach skin conductance and EKG electrodes. Check physio program to make sure you are receiving data from the electrodes. Move to alternate locations if necessary.

Next you will be performing several computer tasks, and there will be instructions on the screen walking you through these. First you will be given an opportunity to practice the task. Again, please make sure to give it your full attention and effort. If you have any questions, or if the computer tells you to get the experimenter, I will be right here. Begin physio recording. Begin Ospan program. Answer questions as needed.

Pre-stressor Ospan

When the participant finishes the practice period, say, **Go ahead and read through these instructions, and just let me know if you have any questions.** Press ENTER to begin. **Okay, you can begin when you're ready.** When Ospan is complete, end physio

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recording and save. Begin second block of physio recording and place screeners in front of participant.

Screener

I have a few more questionnaires that I would like for you to complete. Administer PCL-C and BISS. Answer questions as necessary.

If they do not pass the screeners: **Based on how you answered these questions, I believe that you will have a very intense reaction to viewing the pictures shown during the study. Thank you for your interest in participating; at this time we will have to discontinue the study. If any of the symptoms you reported have been causing you difficulties, I'd like to give you some information about resources here at UofL that might be helpful to you.** You may now break with the formal script and use a warm interpersonal manner. Describe the UofL PSC as well as counseling center. You may provide brief psychoeducation on BII phobia and/or PTSD as warranted. **.**

If they pass screeners: **Thank you. We can continue with the experiment.**

IAPS Slides

Next I will be showing you the pictures we talked about earlier. Please try to look at them for the full amount of time they are on the screen, even if you feel like closing your eyes or looking away. Pull up the IAPS slide show and play slide show.

If participant asks what they should do while looking at the pictures, say **"Just try to look at the pictures for the full amount of time they are shown."**

When IAPS slide show ends, end second block of physio recording and save data. Begin new block of physio data recording. Begin the post-stressor OSPAN.

Post-stressor OSPAN (alternate form)

The IAPS slides are being used as an emotional stressor, and have reliably produced negative affect in previous studies. It is important to continue using a *neutral* tone with the participant at this time, regardless of any observable change in affect. The one exception would be if a participant requests to discontinue during presentation of the slide show.

Next you will perform several computer tasks similar to those you completed before; the instructions are the same however there will not be a practice period. Please begin.

Post-stressor PANAS

Administer PANAS immediately following completion of the post-stressor OSPAN.

Please complete this final questionnaire based on how you feel at the current moment, right now.

Debriefing

When the participant completes the post-stressor PANAS, hand them the debriefing

sheet: **Here's a sheet telling you what this study is about. We were looking at how**

the ability to be in the present moment and accepting of certain feelings impact how

people perform on certain tasks after they have been exposed to something that is

emotionally stressful. Some people have a strong ability to be present-moment

focused and accepting of difficult emotions as part of their personality, something

we call mindfulness, and some people less so. However, we can teach people to be

more mindful through exercises such as meditation. If being mindful can help

people perform certain tasks better after an emotional stressor, it may be important

to give this type of training to people who may face emotional stressors frequently as

part of their job, such as soldiers, law enforcement, and emergency personnel. Do

you have any questions? Thank you so much for participating in this study.

Answer any questions the participant may have. Now that the study is complete it is no

longer necessary for you to maintain a neutral tone. Thank them for their participation.

Mindfulness Attention Awareness Scale (MAAS)
Day-to-Day Experiences
Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	2	3	4	5	6
Almost Always	Very frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

1) I could be experiencing some emotion and not be conscious of it until sometime later.	1	2	3	4	5	6
2) I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5	6
3) I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5	6
4) I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5	6
5) I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5	6
6) I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5	6
7) It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5	6
8) I rush through activities without being really attentive to them	1	2	3	4	5	6
9) I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1	2	3	4	5	6
10) I do jobs or tasks automatically, without being aware of what I'm	1	2	3	4	5	6

doing.						
11) I find myself listening to someone with one ear, doing something else at the same time.	1	2	3	4	5	6
12) I drive places on "automatic pilot" and then wonder why I went there.	1	2	3	4	5	6
13) I find myself preoccupied with the future or the past.	1	2	3	4	5	6
14) I find myself doing things without paying attention.	1	2	3	4	5	6
15) I snack without being aware that I'm eating.	1	2	3	4	5	6

PHLMS

Instructions: Please rate each of the following statements using the scale provided. Circle the number that best describes **your own opinion** of what is **generally true for you**.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

1. I am aware of what thoughts are passing through my mind.
   1   2   3   4   5

2. I try to distract myself when I feel unpleasant emotions.
   1   2   3   4   5

3. When talking with other people, I am aware of their facial and body expressions.
   1   2   3   4   5

4. There are aspects of myself I don't want to think about.
   1   2   3   4   5

5. When I shower, I am aware of how the water is running over my body.
   1   2   3   4   5

6. I try to stay busy to keep thoughts or feelings from coming to mind.
   1   2   3   4   5

7. When I am startled, I notice what is going on inside my body.
   1   2   3   4   5

8. I wish I could control my emotions more easily.
   1   2   3   4   5

9. When I walk outside, I am aware of smells or how the air feels against my face.
   1   2   3   4   5

10. I tell myself that I shouldn't have certain thoughts.
   1   2   3   4   5

11. When someone asks how I am feeling, I can identify my emotions easily.
   1   2   3   4   5

12. There are things I try not to think about.
   1   2   3   4   5

13. I am aware of thoughts I'm having when my mood changes.
   1   2   3   4   5

14. I tell myself that I shouldn't feel sad.
   1   2   3   4   5

15. I notice changes inside my body, like my heart beating faster or my muscles getting tense.
   1   2   3   4   5

16. If there is something I don't want to think about, I'll try many things to get it out of my mind.

1	2	3	4	5

17. Whenever my emotions change, I am conscious of them immediately.

1	2	3	4	5

18. I try to put my problems out of my mind.

1	2	3	4	5

19. When talking with other people, I am aware of the emotions I am experiencing.

1	2	3	4	5

20. When I have a bad memory, I try to distract myself to make it go away.

1	2	3	4	5

PANAS Questionnaire

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. **Indicate to what extent you feel this way right now, that is, at the present moment.**

1	2	3	4	5
Very Slightly or Not at All	A Little	Moderately	Quite a Bit	Extremely

_____ 1. Interested

_____ 2. Distressed

_____ 3. Excited

_____ 4. Upset

_____ 5. Strong

_____ 6. Guilty

_____ 7. Scared

_____ 8. Hostile

_____ 9. Enthusiastic

_____ 10. Proud

_____ 11. Irritable

_____ 12. Alert

_____ 13. Ashamed

_____ 14. Inspired

_____ 15. Nervous

_____ 16. Determined

_____ 17. Attentive

_____ 18. Jittery

_____ 19. Active

_____ 20. Afraid

References

Watson, D., Clark, L. A., & Tellegan, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. Journal of Personality and Social Psychology, 54(6), 1063–1070.

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

Age _____ Gender (*Circle*): **M F** Other

0 = Never   1 = Almost Never   2 = Sometimes   3 = Fairly Often   4 = Very Often

1. In the last month, how often have you been upset
because of something that happened unexpectedly?..................................... **0 1 2 3 4**

2. In the last month, how often have you felt that you were unable
to control the important things in your life?.. **0 1 2 3 4**

3. In the last month, how often have you felt nervous and "stressed"? **0 1 2 3 4**

4. In the last month, how often have you felt confident about your ability
to handle your personal problems?.. **0 1 2 3 4**

5. In the last month, how often have you felt that things
were going your way?.. **0 1 2 3 4**

6. In the last month, how often have you found that you could not cope
with all the things that you had to do? **0 1 2 3 4**

7. In the last month, how often have you been able
to control irritations in your life?.. **0 1 2 3 4**

8. In the last month, how often have you felt that you were on top of things?..... **0 1 2 3 4**

9. In the last month, how often have you been angered
because of things that were outside of your control? **0 1 2 3 4**

10. In the last month, how often have you felt difficulties
were piling up so high that you could not overcome them?............................ **0 1 2 3 4**

The Blood-Injection Symptom Scale

These questions ask about sensations that you may experience in situations involving blood or injections. For each sensation, circle 'yes' if you noticed the sensation during one of your worst experiences involving blood or injections and circle 'no' if you did not notice the sensation during one of your worst experiences involving blood or injections.

1. Did you have tightness, pain or discomfort in your chest?	No/Yes
2. Were you anxious?	No/Yes
3. Did you have blurred vision?	No/Yes
4. Did you have cold or clammy hands?	No/Yes
5. Were you dizzy or lightheaded?	No/Yes
6. Did you feel faint?	No/Yes
7. Were you fatigued?	No/Yes
8. Did you faint?	No/Yes
9. Did you feel unreal?	No/Yes
10. Did your heart pound?	No/Yes
11. Were you particularly irritable?	No/Yes
12. Did you feel nauseous?	No/Yes
13. Did the room spin?	No/Yes
14. Did you sweat?	No/Yes
15. Did your muscles feel tense, sore, or ache?	No/Yes
16. Did you tremble?	No/Yes
17. Did you have trouble walking?	No/Yes

PCL-C

Below is a list of problems and complaints that people sometimes have in response to stressful life
experiences. Please read each one carefully, put an "X" in the box to indicate how much you have been bothered by that problem *in the last month*.

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

8.	Trouble *remembering important parts* of a stressful experience from the past?					
9.	Loss of *interest in things that you used to enjoy?*					
10.	Feeling *distant* or *cut* off from other people?					
11.	Feeling *emotionally numb* or being unable to have loving feelings for those close to you?					
12.	Feeling as if your *future* will somehow be *cut short*?					
13.	Trouble *falling* or *staying asleep*?					
14.	Feeling *irritable* or having *angry outbursts*?					
15.	Having *difficulty concentrating*?					
16.	Being *"super alert"* or watchful on guard?					
17.	Feeling *jumpy* or easily startled?					

Appendix D

IAPS Slide Information: Slide Numbers, Descriptions and Normative Sample Valence
and Arousal Means

Slide No.	Picture Description	Valence Mean (SD)	Arousal Mean (SD)
3000	Mutilation	1.59(1.35)	7.34(2.27)
3010	Mutilation	1.79(1.28)	7.26(1.86)
3030	Mutilation	1.91(1.56)	6.76(2.10)
3051	Mutilation	2.30(1.86)	5.62(2.45)
3053	Burn Victim	1.31(0.97)	6.91(2.57)
3060	Mutilation	1.79(1.56)	7.12(2.09)
3061	Mutilation	2.32(1.61)	5.28(2.60)
3062	Mutilation	1.87(1.31)	5.78(2.57)
3063	Mutilation	1.49(0.96)	6.35(2.60)
3064	Mutilation	1.45(0.97)	6.41(2.62)
3068	Mutilation	1.80(1.56)	6.77(2.49)
3069	Mutilation	1.70(1.41)	7.03(2.41)
3080	Mutilation	1.48(0.95)	7.22(1.97)
3100	Burn Victim	1.60(1.07)	6.49(2.23)
3102	Burn Victim	1.40(1.14)	6.58(2.69)
3110	Burn Victim	1.79(1.30)	6.70(2.16)
3120	Dead Body	1.56(1.09)	6.84(2.36)
3130	Mutilation	1.58(1.24)	6.97(2.07)
3140	Dead Body	1.83(1.17)	6.36(1.97)
3150	Mutilation	2.26(1.57)	6.55(2.20)
3168	Mutilation	1.56(1.06)	6.00(2.46)
3225	Mutilation	1.82(1.22)	5.95(2.46)
9252	Dead Body	1.98(1.59)	6.64(2.33)
9253	Mutilation	2.00(1.19)	5.53(2.40)

The information presented above is taken from the IAPS instruction manual by Lang,
Bradley, and Cuthbert (2005). Normative ratings on the IAPS were collected over a
period of 13 years in large samples of undergraduate students.

Further Exploration of PHLMS Data

The PHLMS (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008) is a self-report mindfulness measure assessing two factors: Present-Moment Awareness (PMA) and Nonjudgmental Acceptance (NA). Items are rated on a 5-point Likert scale (0=never; 4=very often) according to the frequency that the item was experienced within the past week. Exploratory and confirmatory factor analyses support the two-factor structure of awareness and acceptance and good internal consistency was demonstrated in both clinical (Cronbach's α=0.75) and nonclinical (awareness: Cronbach's α=0.75, acceptance: .82) samples (Cardaciotto et al., 2008). While good convergent and divergent validity has been found for the PHLMS thus far (Cardaciotto et al., 2008), less validity research has been conducted than on such measures as the MAAS due to its more recent development.

With less validity research in comparison to the MAAS, the PHLMS was chosen as a secondary measure of mindfulness for the current study. The rationale for its inclusion was that if the PHLMS was found to be highly correlated with the MAAS, its two-factor structure might provide interesting information about the levels of awareness and acceptance in the current sample. In the final sample, the MAAS and the PHLMS were found to be significantly but not strongly correlated, r (65) = 0.46, p <.01. As a strong correlation was not found, the PHLMS was not utilized in further analyses of the primary study hypotheses. The following analyses represent a further exploration of the PHLMS data collected from the final sample.

The mean PHLMS total score for the final sample was 36.52 (SD=5.10). As previously mentioned, a benefit of the PHLMS is that it assesses two factors related to mindfulness: Present-Moment Awareness (PMA) and Nonjudgmental Acceptance (NJA). Participants in the final sample scored an average of 36.52 points on the PMA subscale (SD=5.10) and an average of 30.87 points on the NJA scale (SD=7.14). These scores are virtually identical to normative data reported by Cardaciotto and colleagues (2008) in the initial PHLMS validation study, which utilized a college student sample (PMA, M=36.65, SD=4.93; NJA, M=30.19, SD=5.84). No significant differences related to participant gender were found for the PHLMS total score, or either of the two subscales. No relationship was found between the two subscale, $r(65) = 0.02$, p=.87. Therefore, the total score was not utilized in further analyses, and the subscale scores were used separately to reexamine the primary study hypotheses.

The primary study hypotheses were reanalyzed, utilizing PMA and NJA separately as the measure of DM. The rationale for these analyses was that one of the discrete mindfulness factors might mediate changes in cognitive, affective, and physiological changes, whereas the single factor MAAS did not. As analyses related to the main study hypotheses required participants to be divided into groups of either high or low DM based on their scores on mindfulness measures, median splits were performed on PHLMS subscale scores to create these groups

For the PMA subscale, a median split was performed to divide participants into groups of either high or low DM based on their PMA subscale scores. The PMA median of 36 was utilized to perform the median split. Those categorized as high scorers (N=31)

became the high DM group, and those categorized as low scorers (*N*=36) became the low DM group. There was a significant difference between the mean scores of these two groups, $t(65) = -9.80$, $p <.001$. On average, participants categorized through the median split as the high DM group received a PMA subscale score of 40.71 (*SD*=3.20), while the mean PMA subscale score for the low DM group was 32.92 (*SD*=3.29). To test Hypothesis 1, a 2 (Test condition) x 2 (DM/PMA) mixed factorial ANOVA was conducted to examine group differences in pre- and post-stressor Ospan performance. Test condition (i.e. pre- vs post-stressor) and DM/PMA category (i.e. high vs low) served as grouping variables, with Ospan total recall scores served as the dependent variable. To test Hypothesis 2, a 2 (Test condition) x 2 (DM/PMA) mixed factorial ANOVA was conducted. Test condition (i.e. pre- or post-stressor) and DM category (i.e. high or low) served as the grouping variables. NA scores served as the dependent variable. No significant findings related to mediation resulted from the analyses of either of these two hypotheses. The previously reported significant differences between pre- and post-stressor Ospan scores and NA were maintained. Table 3 and Table 4 contain the relevant data and are presented below.

Due to missing physiological data, a second median split was performed in order to test for the third study hypothesis related to changes in HR. The remaining 49 participants with physiological data yielded a median of 36 on the PMA subscale. High and low DM group mean scores were quite similar to the findings of the previous median split for the final sample (High, *M*=40.67, *SD*=3.31; Low, *M*=33.48, *SD*=2.91), and the two groups differed significantly in their scores, $t(65) = -8.08$, $p<.01$. A 2 (Test

condition) x 2 (DM/PMA) mixed factorial ANOVA was conducted to examine group differences in pre- and stressor HR. Test condition (i.e. pre- vs stressor) and DM/PMA category (i.e. high vs low) served as grouping variables, with HR as the dependent variable. No significant findings were produced. Data relevant to these analyses of mindfulness and HR are presented in Table 5.

For the NJA subscale, the same median split procedure was performed, this time utilizing the NJA subscale median of 32. Those categorized as high scorers ($N=31$; $M=31.17$, $SD=0.95$) became the high DM group, and those categorized as low scorers ($N=36$; $M=30.52$, $SD=8.69$) became the low DM group. There was no significant difference between the mean scores of these two groups, $t(65) = 0.37$, $p =.71$. As no significant difference occurred between these two groups, they were not used in further analysis of the primary study hypotheses.

Table 3

Test Condition x DM (PMA) Factorial Analysis of Variance for Ospan Scores

	Df	F	Mean Square	P
(A) Test Condition	1	10.68	65.94	<.01
(B) DM	1	1.31	43.07	.26
A x B (interaction)	1	2.79	16.94	.10
Error (within groups)	64			

Table 4

Test Condition x DM (PMA) Factorial Analysis of Variance for PANAS NA

	Df	F	Mean Square	P
(A) Test Condition	1	12.98	133.83	<.01
(B) DM	1	0.12	2.43	.75
A x B (interaction)	1	1.10	11.35	.29
Error (within groups)	64			

Table 5

Test Condition x DM (PMA) Factorial Analysis of Variance for HR

	Df	F	Mean Square	P
(A) Test Condition	1	12.98	133.83	<.01
(B) DM	1	0.12	2.43	.75
A x B (interaction)	1	1.10	11.35	.29
Error (within groups)	64			

CURRICULUM VITA

NAME: Lauren M. Vines
ADDRESS: 3209 S. Fork Circle
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DOB: New Orleans, Louisiana – January 3, 1985

EDUCATION AND TRAINING:

2010 - 2014
Doctor of Philosophy, Clinical Psychology,
Department of Psychological and Brain Sciences
University of Louisville, Louisville, KY

- Dissertation: The Interaction Between Mindfulness and Working
  Memory Capacity in the Context of Acute Stress
- Faculty Mentor: Paul Salmon, PhD

2008 - 2010
Master of Science, Clinical Psychology
Eastern Kentucky University, Richmond, KY

- Thesis: Predictive Ability of the MMPI-2 Restructured Form Over-
  Reporting Validity Scales Compared to Effort Tests In a Sample of
  Head-Injured Personal Injury Litigants
- Faculty Mentor: Dustin Wygant, PhD

2003 - 2007
Bachelor of Arts, Psychology,
Summa Cum Laude
William Woods University, Fulton, MO
- Cumulative GPA: 3.9/4.0

CLINICAL EXPERIENCE:

3/2014 – 7/2014
Central Texas Veterans Healthcare System

137

Rehabilitation Reintegration Program, Temple, TX
Pre-doctoral Intern
Supervisor: Catherine Cotton, PsyD
- Work in a residential treatment setting with an interdisciplinary team
- Conduct evidenced based individual and group therapy with veterans from backgrounds, including Acceptance and Commitment Therapy, Dialectical Behavior Therapy, and Cognitive Processing Therapy
- Conduct psychological assessments of veterans for diagnostic clarification and treatment planning purposes
- Serve as case manager for RRTP residents, including duties such as treatment and discharge planning, identifying local housing resources, and collaborating with other VA services
  40 hours per week

11/2013 – 3/2014
Central Texas Veterans Healthcare System
Temple Mental Health Clinic, Temple, TX
Pre-doctoral Intern
Supervisors: Jana Drew, PhD, Candice Ackerman, PhD
- Conduct evidenced based individual and group therapy with veterans from diverse backgrounds, including Acceptance and Commitment Therapy, Dialectical Behavior Therapy, and Cognitive Processing Therapy
- Conduct diagnostic interviews for veterans seeking treatment from the MHC for a variety of mental health concerns
- Consult with an interdisciplinary treatment team to develop effective treatment plans for veterans treated through the MHC
  40 hours per week

7/2013 – 11/2013
Central Texas Veterans Healthcare System
Temple PTSD Clinical Team, Temple, TX
Pre-doctoral Intern
Supervisors: Stacy Gwynn, PhD, James Rodgers, PhD
- Conduct evidenced based individual therapy with veterans from diverse backgrounds, including Prolonged Exposure Therapy and Cognitive Processing Therapy
- Conduct evidenced based group therapy with veterans from diverse backgrounds, including Cognitive Processing Therapy
- Conduct diagnostic interviews for veterans seeking treatment from the PCT for combat-related PTSD
  40 hours per week

10/2010 – 5/2013
Psychological Services Center
University of Louisville, Louisville, KY
Clinician
Supervisors: Paul Salmon, PhD, David Winsch, PhD, Bernadette Walter, PhD, Janet Woodruff-Borden, PhD

- Conduct individual therapy with clients from the surrounding community with diverse ethnic, economic, and educational backgrounds
- Treat a broad range of psychopathology with cognitive-behavioral, acceptance-based, and mindfulness techniques
- Administered intellectual, psychological, and personality assessments
- Completed integrated reports detailing conclusions drawn from scores received during assessments
  20 hours per week

07/2012 – 5/2013
Psychological Services Center
University of Louisville, Louisville, KY
Clinic Assistant
Supervisor: Bernadette Walter, PhD

- Work 5 hour shifts at the clinic front desk, which include administrative duties such as accepting payment, entering intake assessment data and interacting with clients in the waiting room
- Conduct phone intakes of prospective clients, schedule intake appointments and provide referral sources
- Conduct intake assessments for potential therapy clients from the surrounding community with diverse ethnic, economic, and educational backgrounds
- Completed integrated reports drawn from semi-structured clinical interview and self-report questionnaires administered during intake assessment of prospective clients
- Organized the 2012-2013 PSC Colloquium Series comprised of monthly lectures by mental health professionals from the surrounding area
- Taught a 6 week clinical interviewing course to first year Clinical Psychology graduate students
- Organized full day workshop on PTSD for mental health providers in the Louisville community through the Center for Deployment Psychology
- 20 hours per week

05/2012 – 5/2013
Fort Knox Department of Behavioral Health
Fort Knox, KY
Supervisor: Charles G. Thomas, PsyD

- Conducted individual therapy with male and female active duty US Army soldiers and family members of diverse ethnicities and backgrounds
- Observed and participated in hospital-return, fit-for-duty, and intake evaluations
- Co-led therapy groups for US Army soldiers experiencing deployment-related psychopathology and substance abuse-related difficulties
- Worked with an interdisciplinary treatment team, including civilian and US Army psychologists, psychiatrists, social workers, and nurse practitioners
  16 hours per week

05/2011 – 08/2011
Robley Rex Veterans Affairs Medical Center
Louisville, KY
Supervisor: Marilyn Wagner, PhD

- Administered, scored, and interpreted neuropsychological assessment batteries for veterans of various generations, ethnicities, conflicts, and service backgrounds
- Completed integrated reports detailing conclusions drawn from cognitive and personality assessment measure
- Conducted feedback sessions with veterans and their family members, outlining findings of the assessment and providing recommendations based on these findings
  16 hours per week

08/2011 – 12/2011
Robley Rex Veterans Affairs Medical Center
Louisville, KY
Supervisor: Steve Bliss, PhD

- Conducted group therapy with residents and intensive outpatient program members at the Louisville VAMC Substance Abuse Treatment Clinic & Substance Abuse Residential Rehabilitation Treatment Program
- Led a weekly one hour process group with veterans of various generations, ethnicities, conflicts, and service backgrounds
- Co-led a weekly two hour process group containing both residents and IOP members

- Attended interdisciplinary treatment team meetings and assisted with treatment planning for SAATRP residents
  8 hours per week

12/2008 – 05/2010
Eastern Kentucky University Psychology Clinic
Richmond, KY
Clinician
Supervisors: Don Beal, PhD, Robert Brubaker, PhD, Theresa Botts, PhD, and Dustin Wygant, PhD
- Completed over 60 hours of individual therapy with children and adults using behavioral and cognitive-behavioral techniques
- Conducted intake interviews and administered intellectual, psychological, and personality assessments
  6 hours per week

01/2010 – 05/2010
Robley Rex Veterans Affairs Medical Center
Louisville, KY
Masters Internship Student
Supervisors: Marilyn Wagner, PhD & Katie LeSauvage, PsyD
- Conducted individual and group therapy for veterans of various generations, ethnicities, conflicts, and service backgrounds and performed intake assessments
- Trained in Acceptance and Commitment Therapy and co-led two ACT groups for veterans struggling with depression
- Administered, scored, and interpreted neuropsychological assessment batteries
- Conducted clinical interviews with veterans of various generations, ethnicities, conflicts, and service backgrounds
- Performed assessments for differential diagnosis of veterans of various generations, ethnicities, conflicts, and service backgrounds
- Completed integrated reports detailing conclusions drawn from scores received during their neuropsychological assessments
  40 hours per week

08/2009 – 12/2009
CAFÉ Research Lab
University of Louisville, Louisville, KY
Practicum Student
Supervisor: L. Kevin Chapman, PhD
- Administered the Anxiety Disorders Interview Schedule for DSM IV to adults and children, as well as multiple self-report measures of anxiety and mood disorders

- Scored and interpreted the Symptom Checklist-90, the Multidimensional Anxiety Scale for Children, the Beck Youth Inventories, and the Resiliency Scales for Children and Adolescents
- Conducted statistical analysis of data collected from clinical interviews and assessment results
  20 hours per week

01/2009 – 05/2009
Robley Rex Veterans Affairs Medical Center
Louisville, KY
Practicum Student
Supervisor: Jeanne Bennett, PsyD.
- Administered, scored, and interpreted neuropsychological assessment batteries within the Polytrauma Clinic
- Conducted clinical interviews with veterans of various generations, ethnicities, conflicts, and service backgrounds
- Completed integrated reports for several patients detailing conclusions drawn from scores received during their neuropsychological assessments
  16 hours per week

RESEARCH PUBLICATIONS:

Chapman, L. K., Petrie, J., & Vines, L. M. (2012). The factor structure of the SCL-90-R in a community-based sample of African American women. Psychiatry Research, 199, 2, 140-144.

Chapman, L. K., Vines, L., & Petrie, J. (2011). Fear factors: Cross validation of specific phobia domains in a community-based sample of African American adults. Journal of Anxiety Disorders, 25(4), 539-544.

Chapman, L. K., Vines, L., Petrie, J., & Durret, E. (2012). The co-occurrence of anxiety disorders in African American parents and their children. Journal of Anxiety Disorders, 26(1), 65-70.

Petrie, J. M., Chapman, L. K., & Vines, L. M. (2013). Utility of the PANAS-X in Predicting Social Phobia in African American Females. Journal of Black Psychology, 39(2), 131-155.

Vines, L.M. & Salmon, P.S. (2014). Embrace the suck: Increasing receptivity to mindfulness in military and veteran populations. Manuscript submitted for publication.

Vines, L.M. & Salmon, P.S. (2014). Mindfulness and working memory capacity in the context of acute stress. Manuscript in preparation.

Vines, L.M., Wygant, D.B., & Gervais, R.O. (2012). Empirically Guided Case Conceptualization of Posttraumatic Stress Disorder with the Minnesota Multiphasic Personality Inventory-2 Restructured Form (MMPI-2-RF) in a Forensic Disability Evaluation. Journal of Psychological Practice, 17, 180-205.

RESEARCH PRESENTATIONS:

Chapman, L. K., Petrie, J. M., Diggs, Q. T., Vines, L. M., & Goodwin, S. (2010, March). The CAFE Project: An Examination of Anxiety Disorders in African American Parents and Their Children. Poster presented at the 30th Annual Anxiety Disorders Association of America (ADAA) Conference, Baltimore, MD.

Davis, D., Vines, L., Petrie, J. M., & Chapman, L. K. (2011) Worry Content in an Anxious and Non-Anxious Sample of African American Adults. Poster presented at the 31st Annual Anxiety Disorders Association of America (ADAA) Conference, New Orleans, LA.

Durrett, E., Petrie, J. M., Vines, L., & Chapman, L. K. (2011). The Effects of Child Psychopathology on Parenting Stress in a Community Based Sample of African Americans. Poster presented at the 31st Annual Anxiety Disorders Association of America (ADAA) Conference, New Orleans, LA.

Gurren, M., Petrie, J. M., Vines, L., Durrett, E., & Chapman, L. K. (2011). The Relationship between Emotional Regulation and Social Anxiety in African American Children and Adolescents: An Examination of Internalizing and Externalizing Symptoms. Poster presented at the 31st Annual Anxiety Disorders Association of America (ADAA) Conference, New Orleans, LA.

Jones, K. C., Vines, L. M., Ahmad, Z. S., Bentley, J. A., & Thoburn, J. (2009, May). Current reintegration programs for U.S. military veterans: Are they adequately holistic? Poster presented at the School of Psychology, Family, and Community Conference, Seattle, WA.

Kakar, S., Petrie, J. M., Mitchell-Hurd, L., Vines, L. M., & Chapman, L. K. (2010, March). The Scary Truth: The Familial Linkage of Phobias in African American Youth. Poster presented at the Kentucky Psychological Association Conference, Louisville, KY.

Petrie, J.M., Vines, L.M., & Chapman, L.K. (2010). Fear Factors: Cross Validation of Specific Phobia Domains in a Community Based Sample of African American

Adults. Poster presented at the Association for Behavioral and Cognitive Therapy Annual Convention, San Francisco, CA.

Petrie, J., Vines, L., & Chapman, L. K. (2011). The Clinical Utility of the Positive and Negative Affect Scales- Extended Version in Predicting SP in African American Adults. Poster presented at the Association for Behavioral and Cognitive Therapies Convention, Toronto, ON, Canada.

Petrie, J., Vines, L., & Chapman, L. K. (2011). The co-occurrence of anxiety disorders in African American parents and their children. Poster presented at the Association for Behavioral and Cognitive Therapies Convention, Toronto, ON, Canada.

Petrie, J. M., Vines, L., & Chapman, L. K. (2011). The Clinical Utility of Self-report Measure in Predicting Social Phobia in African American Adults: A Receiver Operating Characteristic Analysis. Poster presented at the 31st Annual Anxiety Disorders Association of America (ADAA) Conference, New Orleans, LA.

Salmon, P., Bauer-Wu, S., Vines, L.M., & Stewart, K. (2012, March). Cultural Considerations to Foster Receptivity to Mindfulness Training. Presentation Dialogue presented at the 10th Annual International Scientific Conference for Investigating and Integrating Mindfulness in Medicine, Health Care, and Society, Norwood, MA.

Simmons, A., Vines, L., Petrie, J. M., & Chapman, L. K. (2011). The Familial Transmission of Anxiety in African Americans: Does Resiliency Moderate that Relationship? Poster presented at the 31st Annual Anxiety Disorders Association of America (ADAA) Conference, New Orleans, LA.

Vines, L.M. & Chapman, L.K. (2010, March). Does the SCL-90 Predict Clinical Severity Ratings in African American Adults? Poster presented at the Kentucky Psychological Association Spring Academic Conference, Louisville, KY.

Vines, L. M., Jones, K. C., Ahmad, Z. S., Bentley, J. A., & Thoburn, J. (2009, April). Reintegration of military veterans: Family systems approach to holistic care. Poster presented at the Western Psychological Association Annual Convention, Portland, OR.

Vines, L.M., Petrie, J.M, & Chapman, L.K., (2010). The SCL-90 Revised as a Predictor of Anxiety Disorder Severity in a Community Sample of African American Adults. Poster presented at the Association for Behavioral and Cognitive Therapy Annual Convention, San Francisco, CA.

Vines, L., Petrie, J. M., & Chapman, L. K. (2011). Confirmatory Factor Analysis of the Multidimensional Anxiety Scale for Children in a Community Sample of African

American Youth. Poster presented at the 31st Annual Anxiety Disorders Association of America (ADAA) Conference, New Orleans, LA.

Vines, L.M., Wygant, D.B., & Gervais, R.O. (2010, March). Empirically Guided Case Conceptualization of PTSD with the MMPI-2-RF. In D.B. Wygant (Chair), Forum: Empirically-Guided Case Conceptualization with the MMPI-2-RF. Paper presented at the 45th Annual Symposium of Recent Developments of the MMPI-2, MMPI-2-RF, & MMPI-A, St. Petersburg, FL.

HONORS & AWARDS:

2013	University of Louisville, Stanley A. Murrell Scientist-Practitioner Award
2009	Eastern Kentucky University, Phi Kappa Phi Honor Society and Golden Key International Honor Society Member
2007	William Woods University, Psychology Department Distinguished Scholar Award Recipient

PROFESSIONAL AFFILIATIONS:

2008-2013 Kentucky Psychological Association (student affiliate)
2008-2014 American Psychological Association (student affiliate)