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The impact of yoga on military personnel with post traumatic stress disorder

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The Impact of Yoga on Military Personnel with Post Traumatic Stress
Disorder

A dissertation presented

by

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to

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The Impact of Yoga on Military Personnel with Post Traumatic
Stress Disorder

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Abstract

The goal of this study was to evaluate the impact of yoga on post traumatic stress disorder (PTSD) symptoms, resilience, and mindfulness in military personnel. Participants were 12 military members who met the diagnostic criteria for PTSD. The study assessed pre-post within-subject scores on PTSD, resilience and mindfulness measures. It also compared, through benchmarking, results obtained from the PTSD measure utilized in this study (Clinician Administered PTSD Scale: CAPS; Blake et al., 1998) with those of other military intervention studies of PTSD using the CAPS as an outcome measure. Results of within-subject analyses supported the study's primary hypothesis that yoga would reduce PTSD symptoms but did not support the hypothesis that yoga would increase mindfulness and resilience in this population. Benchmarking results indicated that although the current intervention was significantly more effective than the control condition, it was also significantly less effective than the aggregated treatment benchmark derived from other studies.

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Chapter One: Introduction

This chapter explores the background of and issues related to post traumatic stress disorder (PTSD) in the military. It also describes the purpose and significance of the study, the theoretical perspective of yoga as a potentially efficacious intervention for PTSD in the military, and the corresponding hypotheses. This project arose because of the need for more empirical research on yoga as a treatment for this frequently chronic anxiety disorder. The aim of the study was to provide empirical support for the use of this holistic mind-body intervention as a treatment for service men and women. It extends prior research by assessing whether the physical, mental, and psychological practices used in yoga are an effective means of decreasing PTSD symptoms and increasing mindfulness and resilience.

Background

PTSD: A multi-faceted response to traumatic events. Post-traumatic stress disorder (PTSD) has been part of diagnostic nomenclature since its inception into the *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition (*DSM-III*; American Psychiatric Association; APA, 1980). It is a debilitating illness for many people who have experienced a traumatic event. In adults, the hallmark characteristic of PTSD is exposure to a catastrophic, extreme, traumatic event during which the person experiences intense fear, helplessness, or horror (*Diagnostic and Statistical Manual*, Fourth Edition, text revised: *DSM-IV-TR*; American Psychiatric Association; APA, 2000). Current diagnostic criteria are comprised of 17 symptoms in three areas, including: re-experiencing the traumatic event, increased arousal, and avoidance of stimuli associated with the trauma. PTSD can be diagnosed one month after exposure to

a traumatic event, and often manifests within three months after a trauma (*DSM-IV-TR*; APA, 2000). The *DSM-IV-TR* predicts a lifetime prevalence of 1-14% in the general population; with at risk populations, including military personnel in combat situations, the range increases to 3 - 58%.

PTSD has cognitive, psychological, biological, and physiological impacts. Aston-Jones et al. (1991) hypothesized that noradrenergic hyperreactivity in patients with PTSD may be associated with the conditioned or sensitized responses to specific traumatic stimuli. PTSD sequelae may also be related to the failure to erase (Wagner & Rescorla, 1972; Estes, 1955) or replace information via new learning (Konoriski, 1948). This hyperarousal, including flashbacks, irritability and angry outbursts, insomnia, exaggerated startle response, and hypervigilance may initiate increased avoidance of events that the person associates with the trauma (Charney et al., 1993). Rumination on the traumatic event can also affect mood states, including increased anger, anxiety, and guilt (Stapleton, 2006). The severity of anger and guilt are correlated with the severity of PTSD symptoms (Henning & Frueh, 1997; Riggs et al., 1992). These issues often become longstanding, pervasive challenges for people with PTSD, affecting all aspects of their lives.

PTSD in the military. While PTSD can occur in any individual who has experienced trauma, military service men and women are particularly at risk. Interpersonal violence, which many troops experience, is more highly correlated with PTSD than other, non-interpersonal types of trauma such as natural disasters and motor vehicle accidents (*DSM-IV-TR*; APA, 2000). Furthermore, most randomized controlled trials with combat veterans indicate that interventions are often less efficacious than with

people who have PTSD related to other types of trauma (Foa, Keane, Friedman, & Cohen, 2009). Even service personnel who do not become involved in active military combat are exposed to a variety of psychosocial and physical stressors, among them: deployment to countries where they are unfamiliar with the culture, climate, and language; isolation from family and loved ones; and exposure to neurotoxicants, improvised explosive devices (IEDs), and other military-specific situations to which the general population would not normally be exposed. In the ongoing wars in Afghanistan and Iraq, Hoge, Auchterlonie, and Milliken (2006) showed that 31% of returning soldiers had at least one outpatient mental health visit within a year after deployment, and the mental health issues experienced were combat-related. Hoge also showed that these mental health concerns lead to attrition from the military and increased mental health care. Hoge et al. (2004) also found that 12 - 20% of Marines met the criteria for PTSD three - four months after their return from Iraq.

These studies provide important information about returning servicemen and women. It remains, however, a challenge to clearly delineate the overall impact of the military experience on the health of servicemen and women. The figures above only include soldiers who have left combat conditions, and do not reflect the many still in combat. Moreover, PTSD symptoms may manifest months and years after the original trauma, and are often triggered by exposure to similar traumatic situations, such as current wars. Therefore it is possible that even some of the soldiers who have not endorsed a PTSD diagnosis are still at risk for this disorder after their return home and reintegration into their home lives.

PTSD often co-occurs with other mental health and medical concerns. This comorbidity further complicates effective treatment options. Kulka et al. (1990) reported that 98.8% of Vietnam War veterans with PTSD had a history of some other DSM-III-R disorder, compared with 40.6% of those without PTSD. Hoge et al. (2006) and Creamer et al. (2001) found those in the military with PTSD had a comorbidity rate of 84 - 88% with other mental health disorders. Foa, Keane, Friedman, and Cohen (2009) report that people with a lifetime PTSD diagnosis also have an 80% comorbidity of lifetime diagnoses of other anxiety disorders, depression, or chemical abuse or dependency. Trauma survivors also report more medical symptoms and have more medical illnesses than the general population (Foa, Keane, Friedman, & Cohen), which further compounds the clinical picture and increases the vulnerability of this population.

Furthermore, combat trauma, which many in the military experience, may impair more than other traumas. In a study by Prigerson et al. (2001), men reporting combat as their worst trauma were more likely to have lifetime PTSD, delayed PTSD symptom onset, and unresolved PTSD symptoms. These men were also more likely to be unemployed, fired, divorced, and physically abusive to their spouses than men reporting other traumas as their worst experience.

Current treatments for PTSD in the military. PTSD, particularly in the military, is a focus of much research investigation. Most conclusions about treatments have been gleaned from efficacy trials (Foa, Keane, Friedman, & Cohen, 2009). Current treatment has focused on the reduction in symptoms in people with this disorder, rather than a global improvement in quality of life in individuals with this concern (Schottenbauer, Glass, Arnkoff, Tendick, & Gray, 2008). This is clinically relevant for

people with PTSD, as, for some, their primary concern may be more related to functioning, for example, more effectively in relationships, rather than symptom reduction. Unfortunately, treatments that fully alleviate or remit the extensive suffering of people with PTSD, and treatments that increase positive health outcomes in this population, have not yet been identified.

Psychotherapeutic treatments for PTSD in the military. A recent Cochrane meta-analysis of psychological treatments for PTSD (Bisson & Andrew, 2005) reviewed 33 protocols and found that individual and group trauma-focused cognitive behavioral therapy (TFCBT), individual eye movement desensitization (EMDR), and individual stress management training (SM) all reduced symptoms significantly more than a waitlist control, and were superior to other therapies for this health concern. These data build on earlier studies (i.e., Keane, Fairbank, Caddell, & Zimmering, 1989), which demonstrated the efficacy of exposure to trauma-related stimuli, and the use of desensitization to reduce hyperarousal responses, as the foci of investigation. Other treatments studied for PTSD, in particular with the military, are prolonged, imaginal, and virtual reality exposure treatments (Foa, Keane, Friedman, & Cohen, 2009).

While exposure treatments are often considered a treatment of choice for military personnel because of the proven reduction in some PTSD symptoms, unfortunately these reductions have not translated to an overall increase in global health and well-being in these servicemen and women. In a recent study by Hofmann and Smits (2008), CBT for anxiety disorders in general found similar results; although cognitive behavioral therapy (CBT) has been efficacious in the reduction of symptoms, there is still considerable room for improvement in the overall health of PTSD sufferers. Also important is that although

these treatments have been helpful in reducing symptoms in some individuals with PTSD, many individuals find these treatments problematic (Pitman, Altman, Greenwald, Longpre, Macklin, Poiré, & Steketee, 1991). Pitman et al. indicated that some individuals who receive exposure treatment, such as flooding, are re-traumatized rather than healed when exposed to trauma-related stimuli. In these cases, dysregulated psychobiological sequelae are strengthened rather than lessened. Also noteworthy is that one meta-analysis (Cochrane, 2007) illustrated that active treatment protocols had higher attrition, and that heterogeneity in the comparisons of the treatments was confounding.

Pharmacological treatments for PTSD in the military. Pharmacological treatments for PTSD include a wide range of medications, among them selective serotonin reuptake inhibitors and serotonin-norepinephrine reuptake inhibitors, monoamine oxidase inhibitors, tricyclic antidepressants, anti-adrenergics and beta blockers, mood stabilizers and anticonvulsants, and atypical antipsychotics (Foa, Keane, Friedman, & Cohen, 2009). These are all geared towards the reduction of specific psychophysiological symptoms. While there has been evidence supporting some of these interventions, pharmacological treatments have yet to prevent PTSD, or accelerate the process of recovery in PTSD (Marshall, 2002).

There is still much work to do in terms of finding efficacious comprehensive treatments for this population.

Yoga as an efficacious treatment for psychophysiological health concerns. Yoga is an integrative mind/body system of practices geared towards self-understanding and psychological and physical well-being (Khalsa, 2004; Garfinkel & Schumacher, 2000). Yoga, unlike some of the well-studied meditative practices in the United States,

such as mindfulness and the relaxation response, contains within its system not only mental practices but also physical poses (*asanas*) geared towards bringing awareness of, and a reduction in, musculoskeletal and mental tension, increasing cognitive attentiveness, physical flexibility and strength, and eliciting the relaxation response.

While yoga is fairly a new addition to evidence-based protocols in the U.S., Khalsa (2004) found over 150 studies, in which most demonstrated efficacious treatment with yoga in studies conducted in the U.S. and other countries, and in particular in India. Although many of these studies have not been empirically rigorous, much evidence implicates the utility of yoga for healthy populations (Udupa, 1975; Pal, 2004) and for many health concerns, among them respiratory and autonomic dysfunction (Morse, 1980, 1984), stress (Lehrer, 1980), negative mood states (Harvey, 1983; Harte, 1995; Szabo, 1998; Malathi, 2000) and cardiovascular disorders such as hypertension (Telles, Nagarathna, & Nagendra, 1996; Stancak, Kuna, Srinivasan, Vishnudevananda, & Dostálek, 1991; Bhargava, Gogate, & Mascarenhas, 1988; Grossman, Grossman, Schein, Zimlichman, & Gavish, 2001). Yogic breathing exercises (*pranayama*) modify respiratory frequency and tidal volume, which can elicit specific psychological and physiological changes (Morse, Cohen, Furst, & Martin, 1984; Udupa, Singh, & Settiwar, 1975; Pal, Velkumary, & Madanmohan, 2004). Meditation, a critical component of yoga, has been seen to decrease sympathetic arousal and increase a wakeful tranquility (Shapiro, 1982; West, 1979; Funderburk, 1977; Delmonte, 1989; Woolfolk, 1975; Jevning, Wallace, & Beidebach, 1992). Meditation has also shown demonstrated reductions in anxious and depressive symptoms in adults and adolescents with ADHD (Zylowska, Ackerman, Yang, Futrell, Horton, Hale, et al., 2008). Research has demonstrated that yoga increases

positive mood states (Wood, 1993; Harvey, 1983), concentration, (Hopkins & Hopkins, 1979), and a subjective sense of well-being (Malathi et al., 2000). Research has also demonstrated that yoga is effective in managing psychosomatic disorders (Delmonte, 1989; Goyeche, 1979).

Yoga as a treatment for military personnel with PTSD. Relaxation training and yoga interventions have become treatments of interest for the military. Anxiety and somatic symptoms have decreased following mind-body interventions, including yoga (Nakao et al., 2001). Morse et al., 1984 showed yoga to be effective in increasing respiratory control of autonomic nervous system activity, the dysregulation of which is largely implicated in PTSD. Hypervigilance, exaggerated startle response, and sleep disturbances are common and extremely distressing symptoms for sufferers of PTSD. Yoga, which trains the practitioner to decrease sympathetic nervous system activity and at the same time strengthen the parasympathetic nervous system to enable deeper relaxation, has intriguing possibilities for people with hyperarousal symptoms such as somatic and psychological anxiety. Yoga elicits the “relaxation response” through attentive awareness of the breath and body movements (West, 1979; Funderburk, 1977; Delmonte, 1989; Benson, Beary, & Carol, 1974). The relaxation response counterbalances the “fight or flight” response, which is hyperactive in people with PTSD.

There have been studies conducted specifically related to post-traumatic symptoms. Yogic breathing and yogic breathing with exposure treatment reduced anxiety and depressive symptoms in survivors of the South-East Asia tsunami (Descilo, Vedamurtachar, Gerbarg, Nagaraja, Gangadhar, Damodaran, Adelson, et al., 2009) and

Van Der Kolk (2006) conducted a study of yoga as a treatment for women with PTSD in which yoga significantly improved PTSD reexperiencing and avoidance symptoms.

As to yoga interventions with the military, there are as yet no published protocols empirically supporting yoga practices for PTSD. However, Carter and Byrne (2002) conducted an unpublished randomized controlled study of yoga, which was recently reviewed in the Harvard Mental Health Letter (2009). The protocol studied yoga and breathing for symptom reduction in Australian Vietnam veterans and used the Clinician Administered PTSD Scale (CAPS; Blake et al., 1995) to assess symptoms. The study demonstrated that after six weeks, the yoga and breathing groups had had a reduction in CAPS scores from an average of 57 (moderate - severe symptoms) to an average of 42 (mild - moderate symptoms). These improvements persisted in a six-month follow-up.

Also, preliminary results from a study of a yogic deep relaxation practice (Engel et al., 2006) with active duty personnel indicated a trend toward decreasing PTSD symptomatology, as measured by a posttraumatic symptom scale, the PCL.

Yoga to increase mindfulness in military personnel. Yoga has been shown to increase mindfulness (Shelov, Suchday, & Friedberg, 2009), reduce both the physical and psychological effects of stress, and increase flexibility and strength in some populations. Mindfulness, or present-moment awareness, is an integral dimension in yoga practice, which has been shown to negatively correlate with physical and psychiatric symptoms and positively correlate with well-being. Carmody and Baer (2008) indicated that various psychological and physical complaints have been reduced through a mindfulness practice, as have previous studies (Linehan, 1993; Dimidjian & Linehan, 2003; Kabat-Zinn, 1990; Baer, 2003). The integration of mindfulness and the relaxation response has

long been studied as an effective tool to reduce both medical and psychiatric symptoms (Kutz et al., 1985; Hellman et al., 1990).

Yoga to increase resilience in military personnel. Resilience is an individual's ability to adjust or cope with change or misfortune (Rutter, 1987). It is also sometimes viewed as hardiness (Hoge, Austin, & Pollack, 2007), and is clearly a protective factor for the population from which this study draws. Frueh et al. (2007) specifically noted the necessity for the U.S. Department of Veterans Affairs to update policies to include current empirically supported concepts of resilience. This is an important and active area of research and intervention with this population, for good reason. Resilience may not only help in increasing a person's ability to cope and manage chronic high stress situations and prevent PTSD but may be an important treatment intervention to reduce symptoms, and heal those dealing with the myriad sequelae of military service, combat, and exposure to war conditions.

As yoga has been seen to increase positive mood as well as balance a dysregulated stress response system, these changes may be protective or resilience factors, which enable troops to persist in the face of arduous circumstances. Yoga has been seen to improve resilience in other populations by reducing oxidative stress (Martarelli, Cocchioni, Scuri, & Pompei, 2009), increasing longevity (Brown & Gerbarg, 2009), increasing aerobic endurance (Ray, Mukhopadhaya, Purkayastha, Asnani, Tomer, & Prashad, 2001), and reducing and preventing inflammation (Olivo, 2009). Yoga also increases resilience by reducing anxiety (Subramanya & Telles, 2009), perceived stress and depressive symptoms (Simard & Henry, 2009), and by increasing meaning and promoting dynamic coping (Chan, Chan, & Ng, 2009). Given the potential for yoga to be

helpful for both reducing hyper-responsivity of the sympathetic nervous system and also for increasing mindfulness and resilience, the aim of this research is to identify whether these changes will also be seen specifically in a military population with PTSD, where these issues are of grave concern.

Purpose of This Study

This study is being proposed in order to examine yoga for the treatment of PTSD. In general, there is a paucity of research assessing interventions specifically and holistically geared to reduce psychopathology and increase positive mental and physical states, such as mindfulness and resilience. This dissertation will assess specific outcomes of yoga as a therapeutic tool for PTSD, and whether yoga is a feasible intervention for military personnel with PTSD. The proposed research will assess whether yoga will reduce PTSD symptoms and increase mindfulness and resilience in service personnel.

Significance of the Study

This study is critical for many reasons. Of paramount importance is that many military servicemen and women suffer because of this debilitating, chronic disorder, and that many treatments available are only partially effective in treating PTSD. The results of this study will further elucidate a potentially efficacious treatment for people with PTSD and provide an additional method of treatment, which also focuses on increasing positive physical and psychological states.

If positive results are found for the subjects who participate in the intervention, this information can be disseminated to the field to support yoga-based practices as an effective means for increasing mindfulness and resilience and reducing PTSD symptoms with this population, and yoga as a means to optimally support the health and well-being

of military personnel, who are often called upon to persist in extremely difficult circumstances. The research contains both a group and a home practice component. These two modes of practice may well provide the participants with self-care tools that sustain them even in times of strife.

Hypotheses

Hypothesis 1. Yoga decreases PTSD symptoms. It is hypothesized that psychophysiological symptoms, as assessed by the Clinician Administered PTSD Scale (CAPS; Blake et al., 1998), will decrease as a result of the intervention. As this study is a single-armed protocol, in order to assess the viability of yoga for an effective treatment with PTSD in the military, the data for the participants in the study will be compared to other interventions used to treat the military men and women with PTSD. This will enable the author to assess whether changes seen in this protocol are significant, not only as related to pre-treatment within subject scores but also as compared to other studies with the military personnel with PTSD. Subjective reports of the research subjects' experience of the intervention will also be included, which will help to illustrate the feasibility and advisability of implementing yoga interventions with this population in the future.

Hypothesis 2. Yoga increases mindfulness and resilience. For the study, it is proposed that the intervention will increase mindfulness, as demonstrated by the Five Facet Mindfulness Questionnaire (FFMQ; Baer, 2006), and resilience, as demonstrated by the Resilience Scale (RS; Wagnild & Young, 1990, 2009).

Chapter Two: Literature Review

This chapter explores PTSD as a diagnostic concept and reviews relevant treatment protocols, as well as issues regarding PTSD in the military. It also conceptualizes yoga and provides an evidence-based rationale for yoga as an effective intervention with servicemen and women with PTSD.

Post Traumatic Stress Disorder (PTSD)

PTSD is a chronic and severely debilitating psychiatric disorder that is in many cases refractory to current available treatments. PTSD was first included as a diagnosis in the *DSM-III* (APA, 1980). PTSD as a diagnosis is unique in that it is a disorder conceptualized to be caused by outside influences (i.e., a traumatic event in the person's external environment) rather than internal conflict. However, the impact of these external events on an individual can be idiosyncratic. For example, what one individual may experience as traumatic may not be traumatic for someone else in the same situation. In the *DSM-III*, a traumatic event was conceptualized as a catastrophic stressor that was outside the range of usual human experience.

In the *DSM-IV-TR* (APA, 2000), the trauma experienced for a diagnosis of PTSD is specifically defined. The *DSM-IV-TR* requires that a person experience, witness, or be confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity to self or others, and that the person responds to this experience with intense fear, horror, or helplessness (*DSM-IV-TR*; APA, 2000). If these two criteria were not endorsed, an individual would likely be diagnosed with adjustment disorder or another anxiety disorder.

Diagnostic criteria for PTSD, along with exposure to a specifically defined traumatic event and experience of helplessness or horror to the event (criterion A), also includes specific endorsement of three symptom clusters (Criteria B, C, and D; First, Spitzer, Gibbon & Williams, 1997; APA, 2000).

Symptom cluster B includes five symptoms related to *re-experiencing* the traumatic event. In order to fit the diagnostic criteria for PTSD, an individual must endorse one or more symptom in this cluster. Cluster B symptoms include intrusive, upsetting memories of the event, flashbacks (acting or feeling like the event is re-occurring), nightmares (specifically trauma-related or related to other frightening things), feelings of intense distress when exposed to trauma-related cues, and intense physical reactivity when reminded of the event (e.g. pounding heart, rapid breathing, nausea, muscle tension, and sweating.)

Cluster C symptoms include experiences of *avoidance* and emotional numbing. In order to be diagnosed with PTSD, three of the seven symptoms in this cluster must be endorsed. Cluster C symptoms include avoiding activities, places, thoughts, or feelings that reminds the person of the trauma, inability to remember important aspects of the trauma, reduced interest or participation in significant activities, feelings of detachment or estrangement from others, restricted range of affect (examples include feeling emotionally numb, or feeling unable to have loving feelings towards others), and a sense of a foreshortened future (examples include lacking expectation of living a normal life or performing long term activities that others perform).

Cluster D symptoms relate to experiences of increased *arousal*. For a PTSD diagnosis, two of five D cluster symptoms must be endorsed. Cluster D symptoms

include sleep disturbance (difficulty falling or staying asleep), irritability and/or outbursts of anger, difficulty concentrating, hypervigilance, and an exaggerated startle response.

Endorsing these symptom clusters, and having symptoms for a month or longer (criterion E), with clinically significant distress/impairment (criterion F) comprises a PTSD diagnosis (*DSM-IV-TR*; APA, 2000). Since the inception of PTSD into the diagnostic nomenclature, the conceptualization of the construct has remained fairly stable. Pitman, Orr, Shalev, Metzger, and Mellman (1999) indicate that research in trauma-exposed populations has provided objective data supporting the validity the post-traumatic stress disorder (PTSD) as a diagnostic concept.

Aside from the above symptoms, people with PTSD often experience thoughts and feelings of guilt, shame, self-blame, hopelessness, and suicidality. Foa and Jaycox (1999) suggest that two types of negative thinking may predict PTSD: one cognitive style frames the world as an unsafe place, and the other involves the PTSD sufferer's self-perception as responsible (more specifically, blameworthy) for having symptoms (i.e., the fact that the sufferer has symptoms at all displays weakness, and that others would be able to manage without symptoms). Individuals suffering from PTSD often also have difficulty trusting others. Extreme traumatization inhibits the individual's ability to relate to others in several ways. The post-traumatic experiences bring forth for people with PTSD feelings of helplessness, insecurity, and anxiety, and a loss of basic trust (Rosenbaum & Varvin, 2007). People with PTSD frequently experience an inability to regulate negative emotions like extreme fear, distress, anguish, anger, rage, and shame (Foa, 1995), and are unable to activate internal positive and empathic object relations, in

part because the capacity for symbolization and cohesive integration of traumatic experience is reduced (Rosenbaum & Varvin, 2007).

PTSD is highly comorbid with other psychiatric diagnoses (Davidson & Foa, 1991; Southwick et al., 1993). Part of this comorbidity lay in overlap between the diagnostic criteria in PTSD and other disorders. Overlap of criteria C (avoidance) and D (arousal) PTSD symptoms with symptoms of depression confounds clear diagnosis, while several criteria C PTSD symptoms are also included in criteria for generalized anxiety disorder. Criterion D symptoms overlap with social phobia, simple phobia, and panic disorder (Kessler, 1995; DSM-IV-TR; APA, 2000).

While comorbidity with other disorders and variance in the manifestation of PTSD symptoms somewhat inhibits clarity regarding treatment efficacy, Kessler (1995) described that average duration of PTSD symptoms was shorter in the subsample of people who had obtained treatment (36 months) than those who did not receive treatment (64 months). This suggests that treatment is effective in reducing the duration of PTSD. However, the National Comorbidity Study (Kessler, 1995) also indicated that over a third of people with PTSD never fully recover even after many years and even if they had treatment. For those who have not been in treatment, there is a 50% chance of eventual remission after two years. These data demonstrate that some people with PTSD will recover without treatment and that a substantial number of PTSD sufferers never recover even if given treatment.

PTSD in the Military

PTSD is particularly debilitating for service men and women. Kessler (1995) indicated that in the general United States population, PTSD lifetime prevalence was

7.8%. For women who have experienced physical assault, prevalence is 29%; for men with combat experience, prevalence is 39% (Bisson et al., 2007). Byrne et al. (2004) demonstrated, in a twin registry study with Vietnam War veterans, that combat exposure was related to the persistence of PTSD. In this study, 25 years after the end of combat exposure, PTSD symptoms continued to be elevated in people exposed to the highest levels of combat, and that between 30 - 50% of PTSD cases become chronic. Byrne et al. document that chronicity was proportional to combat exposure, and indicated that monozygotic twins who had the highest combat levels in 1997 were nine times more likely to have increased PTSD symptoms compared with their twin who did not engage in combat. Regarding dizygotic twins, those twins exposed to the highest levels of combat were eight times more likely to have PTSD symptoms. Statistical testing found strong evidence for the effect of combat ($p < .001$) and time period ($p < .001$) and interaction of combat by time ($p < .05$). There was no evidence of combat by zygosity interaction ($p = .29$) or combat by time by zygosity ($p = .98$). These data suggest that combat and physical assault, as expressed in other studies (Davidson & Foa, 1991; Clancy, Graybeal, Tompson, Badgett, Feldman, Calhoun, et al., 2006; Friedman, Schnurr, & McDonagh-Coyle, 1994) are likely risk factors for chronicity.

Combat exposure also predicted self-reported PTSD symptoms in service personnel returning from wars in Iraq and Afghanistan (Smith, Ryan, Wingard, Slymen, Sallis & Kritz-Silverstein, 2008). In a prospective cohort analysis, authors collected enrollment data from July 2001 to June 2003, obtained before the wars in Iraq and Afghanistan, as well as follow-up data (June 2004 - February 2006) on health outcomes from 50,184 participants. More than 40% of this cohort was deployed during 2001 - 2006

to support the wars in Afghanistan and Iraq, and 24% of this 40% were deployed for the first time. Of these service men and women, 7.6 - 8.7% who reported combat exposure (as opposed to 1.4 - 2.1% of those deployed who did not report combat exposure) reported symptoms of PTSD, indicating a three-fold increase in new onset PTSD symptoms in those who experienced combat exposure.

Another significant difference between military veterans and other trauma survivors is that there are instances in which guilt and shame—common reactions among survivors of various types of trauma—are considered justified and rational from the veteran's perspective (Foa & Meadows, 1997). This makes the cognitive and emotional sequelae distinct in PTSD with veterans. Challenging the guilt that a person experiences when a person is clearly not at fault, like a victim of childhood sexual assault is very different from helping the veteran who may have been involved in, for example, the killing of civilians (Foa & Meadows, 1997).

Meta-analyses of Psychotherapy for PTSD

Several meta-analyses provide information on treatment outcome and PTSD. Van Etten and Taylor (1998) conducted a meta-analysis of 61 treatment outcome trials for chronic PTSD (i.e., persisting for three months or longer) from 39 research studies. All but two trials were completed in an individual treatment format. Conditions included drug therapies (tricyclic antidepressants, carbamazepine, monoamineoxidase inhibitors, selective serotonin reuptake inhibitors, and benzodiazepines), psychological therapies (behavior therapy, Eye-Movement Desensitization and Reprocessing (EMDR), relaxation training, hypnotherapy, and dynamic therapy), and control conditions (pill placebo, wait-list controls, supportive psychotherapies, and non-saccade EMDR control).

Thirteen of the trials were behavioral therapies, of which 11 were exposure-based treatments, and three of which included a stress inoculation component. The sole relaxation trial involved a biofeedback-guided relaxation intervention. Eleven of the trials used CAPS as an outcome measure, and three types of trauma were classified: combat related, rape or assault-related, and a mixed category including mixed or other types of trauma. Fifty-nine of the 61 trials reported trauma type, of which 51% involved combat-related trauma only, 19% rape or assault-related trauma only, and 30% a mix of trauma or other trauma (Van Etten & Taylor, 1998).

Van Etten and Taylor (1998) found the overall effect size for psychotherapy treatments ($M = 1.17$, 90% CI [0.99, 1.35]) to be significantly greater than both the drug effect size ($M = 0.69$, 90% CI [0.55, 0.83]) and the control effect size ($M = 0.43$, 90% CI [0.33, 0.53]). In this study, within psychotherapies, behavior modification ($M = 1.27$, 90% CI [.80-1.74]) and EMDR ($M = 1.24$, 90% CI [.99, 1.49]) were found to be equally effective across the specific symptom domains of PTSD. However, behavior therapy was significantly more effective than all treatments on observer-rated total PTSD symptoms. Within drug treatment, selective serotonin reuptake inhibitors (SSRIs) were found to be more effective than other drug treatments. The drop-out rates for pharmacological treatments ($M = 31.9$, 90% CI [25.4, 38.4]) were more than twice than that of psychotherapies ($M = 14.0$, 90% CI [10.8, 17.2]). This meta-analysis indicated that treatment effects for behavior therapy and EMDR were maintained at 15-week follow-up.

Bisson and Andrew (2005) conducted a Cochrane systematic review of all randomized controlled trials (RCTs) of psychological treatment of PTSD. Types of interventions studied were trauma-focused cognitive behavioral therapy/exposure therapy

(TFCBT), EMDR, stress management (SM), other therapies (supportive therapy, non-directive counseling, psychodynamic therapy and hypnotherapy), and group cognitive behavioral therapy (group CBT). Types of outcomes included severity of clinician-rated traumatic stress symptoms, self-reported traumatic stress symptoms, depressive symptoms, anxiety symptoms, adverse effects, and dropouts. Thirty-three studies of “variable quality” according to guidelines delineated in the meta-analysis (Bisson & Andrew, 2005, p. 7) were included in the review. Participants in the studies were men and women who had experienced a variety of traumas and who had been diagnosed with PTSD from 3 months to 30 years. Six of the studies were conducted with veterans.

To calculate treatment effects, Bisson and Andrew (2005) analyzed continuous outcomes as standardized mean differences (*SMDs*) to allow for ease of comparison across studies, and authors used relative risk as the main categorical outcome measure. Based on clinician-assessed PTSD symptoms measured “using a standardized measure such as the Clinician Administered PTSD Symptom Scale” (p. 3) immediately after treatment, TFCBT, SM, and EMDR did significantly better than waitlist/usual care, and there was no significant difference between TFCBT, SM, and EMDR. There was no significant difference between TFCBT and SM (*SMD* = -0.27, 95% CI [-0.71, 0.16], 6 studies, *n* = 239). There was no significant difference between EMDR and TFCBT (*SMD* = 0.02, 95% CI [-0.28, 0.31], 6 studies, *n* = 187). There was no significant difference between EMDR and SM (*SMD* = -0.35, 95% CI [-0.90, 0.19], 2 studies, *n* = 53). Group TFCBT was significantly better than waitlist/usual care (*SMD* = -0.72, 95% CI [-1.14, -0.31]). TFCBT did significantly better than other therapies (*SMD* = -0.81, 95% CI [-1.19, -0.42], 3 studies, *n* = 120). Stress management did significantly better than waitlist/usual

care ($SMD = -1.14$, 95% CI [-1.62, -0.67], 3 studies, $n = 86$) and than other therapies ($SMD = -1.22$, 95% CI [-2.09, -0.35], 1 study, $n = 25$). EMDR did significantly better than waitlist/usual care ($SMD = -1.51$, 95% CI [-1.87, -1.15], 5 studies, $n = 162$). EMDR did significantly better than other therapies ($SMD = -0.84$, 95% CI [-1.21, -0.47], 2 studies, $n = 124$). There was no significant difference between other therapies and waitlist/usual care control ($SMD = -0.43$, 95% CI [-0.90, 0.04], 2 studies, $n = 72$). Some evidence indicated that individual TFCBT is superior to stress management in the treatment of PTSD at two- to five- month follow-up.

Bisson (2007) conducted an in-depth review of psychological treatment for chronic PTSD and found that TFCBT and EMDR were superior to other treatments. Distinct from the study mentioned earlier (Bisson & Andrew, 2005), stress management training was found to be less efficacious than EMDR and TFCBT in this meta-analysis, although it was superior to the other therapies in the study. Unfortunately, the protocols in this review were not delineated so it is difficult to ascertain the reason for the discrepancies between the two publications, but it could be that the authors were including data related to the two- to five-month follow-up indicating superiority of TFCBT. Noteworthy was that dropout rates for the TFCBT and other active treatments were not significantly dissimilar, but the active treatment dropout rates were higher than for TAU and waitlist control groups.

Bisson, Ehlers, Matthews, Pilling, Richards, and Turner (2007) conducted a meta-analysis, and the results of this study reiterated those of the Bisson (2007) in-depth review. Specifically, TFBCT, EMDR, and stress management training were superior to control and TAU conditions, and TFBCT and EMDR were superior to stress management

training. In this meta-analysis, Bisson et al. reviewed Vietnam veteran studies and found that on one of these studies there was less evidence favoring EMDR or TFCBT over waitlist conditions for reducing symptoms (based on clinician-rated measures) as compared to other EMDR and TFCBT studies. Bisson et al. reiterated Van Etten and Taylor's (1998) contention that pharmacological treatments were less efficacious than individual trauma-focused treatments and should therefore be considered adjunctive rather than primary forms of treatment.

Bradley, Greene, Russ, Dutra, and Westen (2005) conducted a comprehensive multidimensional meta-analysis, calculating effect size, improvement rate, and recovery rate from data from 26 studies assessing 44 PTSD treatments conducted between 1980 and 2003. Inclusion of studies in this meta-analysis was based on rigorous criteria related to treatment condition, type of trauma, number of subjects, and type of PTSD outcome measures used. This study reviewed the recovery rate and clinically significant improvement outcomes in intent-to-treat and completer conditions, and included only RCTs that had at least ten people in each group. To balance internal and external validity, this study aggregated data on both inclusion/exclusion criteria and patient exclusion rates.

Five of the 26 studies indicated combat as the trauma (two exposure studies, two EMDR studies, and one TFCBT study); whether this combat was military combat was unclear. Relaxation strategies were included under the rubric of control condition rather than as a primary treatment. Noteworthy was that this analysis demonstrated that combat trauma showed the least effect size change ($M = 0.81$, $SD = 0.78$) compared to mixed trauma ($M = 1.24$, $SD = 0.52$) and assault ($M = 1.82$, $SD = 0.66$). The study also reiterated that exposure therapies are effective in reducing PTSD symptoms.

This study also explicitly highlighted the challenges inherent in methodology for the study of PTSD and psychological treatment. This review found that the studies with higher exclusion criteria had larger effect sizes, and that completion rate and effect size rate were negatively correlated, potentially demonstrating that those who do not see symptom resolution quickly drop out.

Although there is some convergence among the studies in this review in terms of exclusion criteria (i.e., excluding people who do not fit the criteria for PTSD on a given measure), there is nonetheless variability among exclusion and inclusion criteria, which confounds comparison of protocols and generalizability of results. For example, 65% of the studies included in this review excluded for psychosis, 46% excluded for suicide risk, 62% excluded for drug or alcohol abuse, and 62% excluded for unclear comorbidity. This review also underlined the importance of distinguishing between clinically meaningful improvements versus no longer fitting the diagnostic criteria for PTSD. This is a critical distinction because for many individuals who have, or have had, PTSD, even when they do not fit the diagnostic criteria for PTSD, may still suffer from considerable PTSD-related symptoms.

Foa and Meadows (1997) conducted a literature review, which provided an in-depth overview of the studies included for treatment outcome for PTSD. Protocols reviewed included research which followed the authors' conceptualization of seven "gold standard" methodological considerations: (a) clearly defined target symptoms; (b) reliable and valid measures; (c) use of blind evaluators; (d) assessor training; (e) manualized, replicable, specific treatment programs; (f) unbiased assignment to treatment; and, (g) treatment adherence. This review found that cognitive-behavioral

treatments had the most controlled outcome studies, and have been the most rigorously tested.

The studies in this review demonstrated that both prolonged exposure (PE) and stress inoculation training (SIT) are effective in reducing symptoms of PTSD. Cognitive processing therapy (CPT) also showed promising results, but authors felt this treatment required further study. In this review, the authors expressed discontent with the methodology of the studies examining EMDR, and provided compelling evidence for the need for a discerning review of EMDR studies, and the importance of rigorous methodology in all studies of PTSD.

Interestingly, the Foa and Meadows' (1997) review found no increased benefit in combining various aspects of CBT treatments studied and purported that the combination programs that have been examined either were not the best combination or disallowed enough time with one component when combined.

Several studies described in this review were conducted with military personnel. Cooper and Clum (1989) studied imaginal flooding (IF) with standard treatment (ST; IF + ST) versus ST alone with 26 veterans with combat-related PTSD. In this protocol, for the IF + ST group, a flexible, 6- to 14-session program was used, with up to nine sessions including flooding. The IF + ST arm of the study demonstrated a 96% reduction in nightmares as opposed to a 15% reduction in ST alone. There was also a 33% reduction in anxiety in the IF + ST group versus an 18% increase in anxiety in the ST group. Keane, Fairbank, Caddell, and Zimering (1989) studied flooding in Vietnam veterans, randomly assigning veterans to a 14- to 16-session flooding treatment or a waitlist control. Flooding treatment demonstrated a 40% reduction in fear, a 33% reduction in

depression, and a 35% reduction in re-experiencing symptoms, although avoidance symptoms remained unchanged. The components of this treatment included relaxation training, non-trauma related imagery, and trauma-related imagery, and it is not clear whether one of these components, or the interaction of them, created the treatment effect.

Synopsis of studies reviewed. Although these meta-analyses provide compelling data regarding the treatment of PTSD, there were also a variety of methodological challenges that confound interpretation of results and demonstrate the need for restraint regarding the generalization and interpretation of results for psychological treatment for PTSD. There are several methodological and diagnostic issues across studies and meta-analyses, which must be taken into account when assessing efficacy of treatment for PTSD. While trauma-focused treatments were demonstrated to be superior in the meta-analyses for reduction of PTSD symptoms, it has also been shown that active treatments such as prolonged exposure (PE) may trigger PTSD symptoms (Pitman et al., 1991) in some individuals. In some studies, active interventions requiring disclosure and discussion of trauma-related details gave rise to re-experiencing and other adverse symptoms, which then led to high attrition (Pitman et al, 1991). For some such studies, attrition was reported to be as high as 30% (Bisson et al., 2007). While these active treatments were efficacious for some, almost one third of the people with PTSD did not receive the positive benefits of these interventions, and instead experienced a re-emergence of symptoms.

While these meta-analyses have demonstrated that psychotherapy can be effective in helping those with PTSD experience an improvement in symptoms, generalization of results is challenging given the heterogeneity of symptoms, the various traumas and

variation in PTSD sequelae, and the comorbidity of psychiatric and medical concerns with PTSD. There is also both variability among interventions within the same modality and inclusion of similar strategies across treatment modalities, which further complicates interpretation of results. For example, some exposure-based interventions focus solely on exposure to traumatic sequelae (i.e., prolonged exposure, as described in Foa & Meadows, 1997), whereas others include cognitive interventions and protocols utilizing relaxation strategies (Keane et al., 1989). As not all of the studies reported how each intervention was conducted, conclusions must be viewed with caution. Although Bradley et al. (2005) included in their meta-analysis an evaluation of inclusion and exclusion criteria and distinguished between clinically significant improvements rather than simply assessing symptom reduction, none of the meta-analyses provided information regarding adverse effects and treatment tolerability. Many did not include information on attrition. These are all critical considerations when assessing overall treatment efficacy. Also, although a number of studies in these meta-analyses clearly indicated that people experience some symptom relief, the majority of patients still unfortunately have substantial symptoms even after what is considered successful treatment. Another consideration is that the protocols in the above reviews included studies specifically selected on the basis of strict methodological criteria, so conclusions drawn are based on a specific subset of the clinical research literature. Therefore, potentially efficacious treatments that may not have fit into the methodology of these meta-analyses may not have been considered.

Stress Physiology and PTSD

In the presence of an acute threat to the wellbeing of an organism, the activation of the stress response can be lifesaving. Stress physiology is a very costly, and critical, psychophysiological response, which encompasses a variety of systems and produces profound alterations in these systems (McEwen, 2007). In an adaptive stress reaction, these systems activate long enough to ascertain safety of the organism, and through a negative feedback loop mediated by the neurohormone cortisol, the stress response is then dampened when the threat resolves (McEwen, 2007; Rodrigues, LeDoux, & Sapolsky, 2009). In PTSD, however, the stress response is either so overwhelming in an acute circumstance, or so chronically elicited, that what was once an intermittent and acute adaptive response converts into a maladaptive dysregulated response imbalancing the entire organism.

Studies have documented heightened autonomic or sympathetic nervous system arousal in combat veterans with chronic PTSD (Kosten, Mason, Giller, Ostroff, & Harkness, 1987; Yehuda, Southwick, Giller, Ma, & Mason, 1992). Although sympathetic nervous system (SNS) activation when in the combat arena can be lifesaving, in non-combat situations an overactive SNS can become debilitating and problematic. Stress increases noradrenergic function (i.e., Charney, et al., 1993), which is implicated in chronic symptoms experienced by patients with PTSD such as panic attacks, insomnia, heightened startle responses, and autonomic hyperarousal. Noradrenalin is also implicated in the sensitization and increase in response magnitude that occurs following exposure to a stimulus, which occurs in PTSD. Glucocorticoids, among them, cortisol, also acutely increase in response to stress. After a stressor has been effectively handled,

cortisol modulates catecholamine response (Rose, 1984), and also lowers at the termination of stressor. Investigations evaluating hypothalamic-pituitary-adrenal axis (HPA) system regulatory mechanisms in PTSD vary regarding cortisol production and glucocorticoid receptor function. In one study with people with PTSD (Yehuda, Lowy, Southwick, Shaffer, & Giller, 1991), the adreno-corticotrophin-releasing hormone response (ACTH) to corticotrophin-releasing factor (CRF) was blunted in the presence of normal plasma cortisol levels. Another study indicated that people with PTSD might be overly sensitive to the medication-induced suppression of cortisol (Smith et al., 1989). The reduction in sensitivity of ACTH and the sensitivity to pharmacologically induced cortisol suppression imply that cortisol levels may be lower in people who have chronic PTSD, perhaps because the inhibitory mechanisms (CRF and ACTH) may be increased in chronic PTSD. However, more research needs to be conducted to ascertain clarity regarding the impact of PTSD on HPA axis function, specifically glucocorticoid responsiveness.

Chronic elicitation of stress hormones, as seen in PTSD, impacts not only brain function but also brain structure. Liberzon, Britton, and Phan (2003) demonstrated, through neuroimaging, different experiential, psychophysiological, and neurobiological responses to traumatic symptom provocation that can take place in people with posttraumatic stress disorder (PTSD). Authors suggested two subtypes of trauma response, one characterized predominantly by hyperarousal and the other by primarily dissociative sequelae, with each subtype representing unique pathways to chronic stress-related psychopathology. Shin, Rauch, and Pitman (2006) reviewed neuroimaging studies and found heightened amygdala responsiveness in PTSD to both traumatic triggers and

more general affective stimuli, and an association between amygdala responsivity and symptom severity in PTSD. Findings were also suggestive of diminished hippocampal volumes in PTSD compared to either trauma-exposed control subjects or trauma-unexposed healthy subjects. These neuroimaging findings, paired with the findings above related to PTSD and stress hormone dysregulation, suggest that the chronic stress response in PTSD has a neurohormonal and structural impact that concomitantly results in emotional, cognitive, and behavioral alterations.

Wessa and Flor (2007) hypothesized that PTSD may be a disorder related to extinction deficit, by which trauma triggers are unconditioned stimuli, thus generalizing enhanced emotional responses to many previously neutral cues and impeding extinction. Aston-Jones et al. (1991) hypothesized that because central noradrenergic and peripheral sympathetic systems function in concert, noradrenergic hyperreactivity in patients with PTSD may be associated with the conditioned or sensitized responses to specific traumatic stimuli. Pitman et al. (1999) described the physiological basis for the manifestation of PTSD symptoms, and indicated that PTSD subjects showed increased peripheral physiological responding to audio-visually and imaginally presented stimuli that symbolize or resemble the etiologic traumatic event. PTSD patients responded to startling stimuli with larger autonomic and electromyographic responses, especially under threat conditions, suggesting sensory, cognitive, and affective processing abnormalities in PTSD. With the physiological hyperreactivity also comes behavioral and cognitive avoidance, which can be seen as hyporesponsive, such as dissociative episodes.

Treatments focusing on the extinction of problematic learned responses, both hypo- and hyperactive, are critical. This extinction is often the goal of exposure treatment

and, for those who complete treatment, a reduction in symptoms is frequently achieved, as was seen in the meta-analyses above. Nonetheless, as highlighted in Pitman et al. (1991), some treatments, while efficacious for some, may be ineffective or in fact harmful for others with the same disorder.

Yoga

The biological impact of PTSD on the body, specifically as related to how PTSD sufferers have a sensitized and non-habituated startle response, provide direction to how yoga, with its concomitant reduction in muscular tension and stress physiology, may be helpful for people with PTSD, in that it reduces chronic psychosomatic tension that people with PTSD often manage. Yoga is an integrative practice, which includes physical postures (asanas), breathing exercises (pranayama), and meditation (Benson, Bear, & Carol, 1974), all of which contribute towards eliciting the “relaxation response” (Benson et al.). Yoga is a practice stemming from Eastern philosophy. Rather than focusing on symptom reduction, as seen in the allopathic model, yoga is geared toward holistic healing and wellness, with symptom relief as a positive and beneficial side effect of the healing of the whole system. People of all ages and ability levels can practice yoga. Although there are a number of styles of yoga practiced in the U.S.—among them, Kripalu, Iyengar, Ashtanga, and Viniyoga—most commonly practiced styles include yoga poses, mindfulness and concentration meditation, as well as yogic breathing practices. As stated in Groessl, Weingart, Aschbacher, Pada, and Baxi (2008):

Some of the differences between types of yoga include rate at which students cycle through poses, a varying emphasis on alignment during poses, the extent to which deep or rhythmic breathing is emphasized, the extent to which

concentration or attention is emphasized, where cognitive attention is directed, room temperature, and the overall intensity and difficulty of the poses. Although hundreds of postures and their variations have been developed, each is designed to stretch and strengthen particular areas of the body. (p. 1124)

According to a recent national prevalence survey (Saper, Eisenberg, Davis, Culpepper, & Phillips, 2004), mind-body practices have become increasingly popular. This study suggests that 15 million Americans have practiced yoga at least once in their lifetime. Yoga is widespread in the U.S., with most health clubs offering yoga classes, and many hospital-based integrative health programs including yoga as a component of healing. Yoga may be considered a feasible and gentle alternative or adjunct to traditional aerobic and strength training programs because it requires little space, virtually no equipment, and has limited harmful side effects (Labarthe et al., 2002; Gimbel, 1998).

Yoga, with its focus on relaxation, body awareness, and mediation, provides a qualitatively different experience from other forms of body movement, which may be perceived as less strenuous and more pleasurable (Hagins et al., 2007), and therefore may decrease attrition in research protocols if yoga is included as a component. Studies of yoga have taken place in a number of settings, among them college, community, psychiatric, and medical settings.

Mechanisms of Therapeutic Action in Yoga

There are a number of viable mechanisms for the benefits of yoga, as yoga is an integrative practice including several elements, among them yoga postures, deep breathing, and cognitive exercise. Performing the yoga postures has been shown to result in increased musculoskeletal strength and flexibility. Research also demonstrates that

deep breathing promotes relaxation (Vempati, 2002) and cognitive strategies improve mood and reduce anxiety (Parshad, 2004; Groessl et al., 2008).

Yoga in the Military

Yoga and meditative practice-based research has been conducted with the military population. These studies have found yoga to be helpful in ameliorating a variety of symptoms, including back pain (Groessl et al., 2008), depression (Carter and Byrne, 2002), aircrew stress (Singh, 1999), heroin abuse (Anderson, 1977), and hypertension (Brownstein & Dembert, 1989). While many of these studies may have involved military personnel who have PTSD, most were not specifically assessing yoga and its efficacy in reducing or alleviating PTSD symptoms.

Yoga and the Modulation of the Stress Response in PTSD

Yoga may be an effective treatment for PTSD because of its impact on the sympathetic nervous system. Yoga practices, in some ways similar to many cognitive-behavioral interventions such as Dialectical Behavior Therapy (DBT), Mindfulness-Based Stress Reduction (MBSR), and exercise and body movement regimens, include components that may reduce, interrupt, or reframe re-experiencing, arousal, and avoidance symptoms in PTSD. In the current study, breathing practices focused on reducing stress and rebalancing the SNS (Benson, 1975; Kabat-Zinn, 2003), *de-centering* (a state of meta-awareness of the process of thinking; Bishop et al., 2004), and present-moment awareness are likely mechanisms for efficacy. Along with these practices, a cognitive component of the yoga program is the philosophical stance embedded in the yoga practices (Iyengar, 1979); the ethical practices, nonjudgmental awareness, and

listening to, and taking action from, the true voice of the body are components common to all yoga methodologies.

Yoga practices induce a sense of tranquility (Orman, Shapiro, Thoresen, & Plante, 2008). Diaphragmatic breathing, a critical component of yoga, has been shown to reduce plasma cortisol levels in people who practice yoga (Sudsuang, Chentanez, & Veluvan, 1991), suggesting that it is possible to modulate the neuroendocrine system through neurobehavioral pathways. Martarelli, Cocchioni, Scuri, and Pierluigi Pompei (2009), in a study on the impact of diaphragmatic breathing and oxidative stress on athletes, found that after an exhaustive training session, those who spent 60 minutes performing diaphragmatic breathing experienced increased antioxidant defense status, which correlated with a decrease in cortisol, suggesting diaphragmatic breathing could protect athletes from long-term adverse effects of free radicals and elevated cortisol levels.

Yoga has been demonstrated to have an impact on both the mind and the body: yoga increases psychomotor performance (Sahu & Bhole, 1983), emotional stability (Gore, Bhogal, & Rajapurkar, 1990), and muscle relaxation (Kulkarni & Bhogal, 1991). A review article by Kulkarni and Bera (2009) proposed a rationale for the benefits of yoga as a means to restore health. They propose that modulation of breath, which impacts central nervous system (CNS) activity, plays a critical role in maintaining balance or homeostasis (Desiraju, 1988). The effectiveness of yoga can be seen in its comprehensive manner of overcoming stress via increased body awareness and muscular stretching and relaxation, which influences the central nervous system. Yoga, through the elicitation of the relaxation response, reduces sympathetic nervous system reactivity (Benson, 1974). In their review, Kulkarni and Bera proposed an operational definition of yogic exercises

(which encompasses all yoga modalities, among them Kripalu yoga), as “the science of synchronized attention, directed breathing activity, regulated by the major function of the cerebral cortex to monitor body awareness and well directed homeostasis on all aspects of body functions” (p. 8).

Yoga postures increase flexibility and reduce tension (Netz & Lidor, 2003; Goyeche, 1979; Benson et al., 1974; Serber, 2000). Breathing exercises geared towards quieting the mind and reducing cognitive and emotional reactivity also result in psychological and physiological change, including increasing mindfulness and reducing stress (Morse et al., 1984; Udupa et al., 1975; Brown & Gerberg, 2009). Meditation consists of self-regulation practices to train attention and awareness towards bringing mental processes under greater voluntary control. This increase in awareness and voluntary control fosters general well being and increases calm, clarity, and concentration. With the practiced elicitation of the relaxation response through simple relaxed focus of attention (West, 1979; Funderburk, 1977; Shapiro, 1982), meditation is associated with low arousal and decreased activation (Delmonte, 1989; Woolfolk, 1975; Jevning, Wallace, & Beidebach 1992), which is potentially of great benefit to the population being studied.

Numerous research studies have supported the view that regular yoga practice produces physical as well as psychological benefits. Along with the concerns mentioned in the previous chapter, yoga has also been found to be an effective treatment for a number of other chronic and debilitating medical issues, among them, irritable bowel syndrome (Kuttner et al., 2006), arthritis (Kolasinski et al., 2005), musculoskeletal disorders (Raub, 2002), chronic pain (Sherman et al., 2005; Williams et al., 2005),

multiple sclerosis (Oken, 2004), migraine (John et al., 2007) and cancer-related symptoms (Bower et al., 2005; Carson et al., 2007; Distasio, 2008).

With respect to psychological benefits, yoga has been reported to improve anxiety (Khalsa & Cope, 2006; Smith et al., 2007), decrease depressive symptoms (Krishnamurthy & Telles, 2007; Vedamurthachar et al., 2006), enhance positive mood states (Culos-Reed et al., 2006; Lavey et al., 2005), improve self-regulation (Shapiro, 1982) and improve quality of life in general (Chen & Tseng, 2008; Oken et al., 2006; Sareen et al., 2007)

Other studies indicate the potential efficacy of yoga or components of yoga with the military. Brown and Gerbarg (2005) found that yoga helped depression in service personnel, as well as some intrusive and avoidance symptoms in a non-military population with PTSD. Bormann, Thorp, Wetherell, & Golshan (2009) reported that a meditative concentration practice (mantra repetition) with 29 male Vietnam Veterans reduced PTSD symptom severity ($d = -.72$), psychological distress ($d = -.73$) and increased quality of life ($d = .70$). Groessl, et al. (2008) studied yoga as a treatment with people in the military who had back pain. They found that not only was the study with this population feasible, but that there was a dose-response relationship between home and yoga session practice and increases in wellbeing and decreases in depression.

Carter and Byrne (2002) conducted a series of unpublished six-week pilot studies in Australia with veterans with PTSD (Carter, www.therapywithyoga.com). Eight male Australian Vietnam War veterans were recruited for a once-weekly, one-hour long group yoga intervention. The mean age of the population was 60.25 years and the range was 53-84. There was no control group. Noteworthy is that one subject, because of issues with

avoidance, did the designated yoga practices at home and another subject, because of hearing concerns, took private classes after 1 or 2 sessions, but the remaining 6 finished the group intervention. Three series of six-week classes were conducted, the first using an Iyengar Yoga protocol for specifically for depression, the second using an Iyengar Yoga protocol for anxiety, and the third using a variety of breathing exercises along with poses from the Viniyoga tradition of yoga.

Carter and Byrne (2002) reported that these brief interventions reduced depressive symptoms as seen on the self-administered Center for Epidemiologic Studies Depression Scale (CES-D: Radloff, 1977), and on the physician-administered Hamilton Depression Rating Scale 17-Item version (HDRS-17: Polts, Daniels, Burman, & Wells, 1990), although the some scores were unavailable for review other than in non-specific graphs. The CES-D, a 20-item scale, has a maximum score of 60, with a score higher than 22 indicating significant depression. For the first trial, the baseline CES-D scores were indicated ($M = 37$, $SD = 12.39$) and graphs in the protocol indicated a drop in scores to between 0 -10 after six weeks. The HDRS-17 is a 17-item scale with a maximum score of 52. For the initial trial study graphs indicated that HDRS-17 scores ranged from between 10 - 35 at baseline and dropped to between 0 - 5 after six weeks.

In these pilot studies, although yoga was efficacious for depressive symptoms in all variations of the protocols, in the first two interventions, the yoga did not reduce anger and insomnia; however, in the third study, with the inception of breathing exercises, depression, insomnia, and anger decreased. Carter and Byrne reported that veterans often spontaneously applied techniques learned in order to reduce insomnia and to manage anger, with reportedly “very good” results according to the participants.

Carter and Byrne (2002) described additional benefits than those gleaned from the self-report and clinician-administered depression questionnaire:

Associated benefits for all the participants have included better sleep, better anger management, less medication, better quality of life as measured by patient and spousal satisfaction. Many of the spouses tell the veterans that they must continue their yoga as it causes much improvement. (p. 10)

Carter and Byrne (2002) surmised that mechanisms of action for these improvements could be “distraction, self-efficacy, mastery, social interaction, aerobic fitness, monoamines, endorphins, and thermogenesis” (p. 10), though felt that given the low dose and brief term of yoga practice, other unknown factors may have been involved. They concluded that (a) the poses specifically geared towards depression elevated mood, at least for a short time; (b) the breathing practices and relaxation (*savasana*) alleviated insomnia; and (c) the more sedating poses (which were not specifically described) helped with anger management.

Another study by Smith, Hancock, Blake-Mortimer, and Eckert (2007) demonstrated the impact of yoga in anxiety and stress in a general population. They conducted a 10-week study of a yoga intervention versus a progressive muscle relaxation (PMR) intervention on stress, anxiety, and quality of life. This study was conducted in South Australia using 131 community-dwelling participants between the ages of 18 to 65 with mild to moderate levels of stress. Measures used were the State Trait Personality Inventory (STPI) sub-scale anxiety, the General Health Questionnaire (GHQ), and the Short Form-36 (SF-36). Data were collected at baseline, 10 and 16 weeks. After the 10-week intervention, yoga was found to be as effective as PMR in reducing STPI scores (*M*

= -.89, 95% CI [-3.24, 1.46], $p = .45$), GHQ scores ($M = .84$, 95% CI [-3.58, 1.89], $p = .54$ at the end of 10 weeks. Interestingly, for this 10-week intervention, both the yoga group and the PMR group have subjects come only an average of 5 sessions.

A recent study with a college population may suggest another mechanism as to how yoga may be beneficial for people with PTSD. Shelov et al. (2009) suggested that a brief (eight week, one hour weekly) yoga intervention in a college population had a significant impact on mindfulness. The study was a randomized controlled trial of 46 men and women ages 22-65 years of age. The outcome measure was the Freiburg Mindfulness Inventory (FMI), which is a 30-item scale comprised of four subscales, measuring separate constructs of mindfulness: *disidentifying attentional processes of mindfulness*, *accepting and open attitudes toward experience*, *process oriented understanding*, and *paying attention without distraction*. Overall mindfulness was calculated by summing the four subscales (Buchheld & Walach, 2007). After the eight-week intervention, scores on all subscales significantly increased ($p < .01$). Disidentification believed to lead to a reduction in reactivity and believed to be critical in the construct of mindfulness (Buchheld, Grossman, & Walach, 2001), may be extremely helpful for those with PTSD.

In terms of treating people with PTSD, if conditions are not conducive to a sense of emotional safety, trauma reemergence and interruption of treatment may result. Given the ubiquitous nature of triggers for many with PTSD it may be that exposure is likely to occur without specific elicitation. Although yoga is not specifically focused on enforcing this exposure paradigm, the increased mindfulness in yoga practice may well increase exposure to commonly avoided thoughts, feelings, and sensations. The critical difference between yoga and exposure protocols such as flooding is that the practitioner is invited to

accept the triggers and concomitant sequelae without judgment rather than simply habituate to it, which for some may, paradoxically, increase symptomatology. In yoga, the yoga practitioner is provided with opportunities to reduce reactivity to triggers via relaxation response-inducing practices. Also, when triggers are present, yoga empowers the individual to make conscious choices by using mindfulness to bring awareness to the experience of triggers, or, if an individual feels unable to maintain a mindful stance to the trigger, this person may choose to consciously refocus attention elsewhere using the concentration skills cultivated in yoga. In this way, the yoga practitioner is given a number of choices regarding how to manage triggers, and is empowered to find balance between hypo- and hyper-reactivity by cultivating mindfulness and by consciously focusing attention. Yoga combines a variety of relaxation strategies to reduce maladaptive responding so that the yoga practitioner benefits from both mental and physical reduction of stress.

Cukor, Spitalnick, Difede, Rizzo, and Rothbaum's (2009) review reiterated that although there is still a dearth of published data to support the efficacy of yoga with PTSD specifically, one research protocol (Brown & Gerbarg, 2005) indicated yoga is effective in decreasing depression symptoms in a veteran population, and this study reiterated the utility of yoga breathing practices to reduce intrusive and hyperarousal symptoms. Another study by Gangadhar, Janakiramaiah, Sudarshan, and Shety (1999) demonstrated a drop in cortisol with a yoga breathing protocol, and which potentially alludes to the manner in which yoga practices may reduce hyperarousal symptoms.

While there are few published studies as yet looking at the impact of yoga on PTSD, at least conceptually, yoga's integrative practices, which reduce stress physiology

and increase non-reactive, nonjudgmental awareness have great potential to holistically respond to the needs of servicemen and women with PTSD. Clearly, additional research trials are needed to verify the feasibility of yoga as an intervention for military veterans with PTSD, and also to objectively measure the generalizability of yoga practices and their relevance to the emotional and physiological disturbances seen in PTSD.

Re-experiencing symptoms and yoga. Yoga enables the practitioner to learn strategies to be aware of thoughts and symptoms without judgment and without assuming they are true, and the technology to train the body to reduce reactivity, and when this is not possible, to release judgment and negative appraisal of symptoms. This shift to acceptance and positive reappraisal may help the yoga practitioner to understand the symptoms as transient, and reinterpret them, thereby shifting the re-experiencing paradigm so that these sensations may be experienced without the traumatic storyline.

Avoidance symptoms and yoga. While intuitive reasoning speaks to the validity of avoidance as a paradigm to manage triggers, ongoing use of avoidance, in particular in the presence of overgeneralized triggers, not only maintains symptoms but also excludes possibilities for corrective experiences and habituation (Foa & Meadows, 1997). While yoga is not an exposure treatment, mindfulness and psychophysiological stress reduction skills developed in a yoga program provide the practitioner with tools to manage triggers and symptoms with acceptance rather than avoidance. This may reduce reactivity and ensuing learned avoidance behaviors.

Hyperarousal symptoms and yoga. Yoga has also been shown to reduce hyperreactivity of the sympathetic nervous system (Vempati & Telles, 2002) leading to the reduction hyperarousal symptoms. Gordon, Staples, Blyta, Bytyqi, and Wilson (2008), in

an RCT of PTSD in adolescents in postwar Kosovo, studied students in a 12-session mind-body intervention. The research included guided imagery, biofeedback, deep breathing, meditation, drawing, and body movement. Results indicated that within subjects scores demonstrated a significant decrease in all PTSD cluster symptoms (re-experiencing, avoidance/numbing, and arousal), as seen in the Harvard Trauma Questionnaire (HTQ), although arousal was not reduced significantly when compared to a waitlist control group. In a pilot study by Van der Kolk (2006), which included eight females with PTSD from ages 25 to 55 years who undertook either eight sessions of DBT or 75 minutes of hatha yoga exercises, the yoga group showed decreases in the frequency of intrusions and severity of hyperarousal symptoms although the author noted that these changes did not reach statistical significance. Nonetheless, the results point towards the possibility of significant reductions in hyperarousal given a study with more power to detect differences.

Yoga in the current protocol was geared toward becoming aware of and releasing chronic tension coupled with a non-judgmental attitude, and inducing a state of relaxation, thereby reducing hyperarousal. These changes may enable the yoga practitioner to decrease maladaptive automatic trigger-engendered reactions toward long-term reduction in hyperarousal. Baer (2004) noted an inverse relationship between mindfulness and dissociative states. The nonjudgmental awareness and ongoing development and cultivation of a nonreactive relationship with thoughts, sensations, and experiences may provide the opportunity to manage these symptoms toward resolution. With this decrease in maladaptive automaticity and increase in nonjudgmental, present-moment awareness from yoga practice, people with PTSD may be enabled to not only

experience the present moment in a different manner but also to reframe past-focused sensations in a new context. Also, attention modulation via meditative practice (Lutz, Slagter, Dunner, & Davidson, 2008) could help people with PTSD shift attention away from hyperawareness on symptoms, and reduce hyperarousal, both of which may also reduce avoidance behavior, as the psychophysiological cues for avoidance will be reduced.

Mindfulness, Meditation, and Yoga

Meditation, a critical aspect of yoga, can be viewed in a number of both esoteric and practical ways. One style of meditation is *concentration* meditation, during which time an individual retains attention to one focus (i.e., a word, phrase, prayer, image; Benson, 1974). Another form of meditation, often referred to as *mindfulness* meditation, involves having the practitioner enter a state of awareness and witnesses without judgment phenomenological moment-to-moment experience. Although the latter practice is usually referred to as mindfulness meditation, a concentration meditation also requires mindful awareness, but on one point of focus rather than the changing moment-to-moment experience. Both concentration and mindfulness meditation practices train attention, modulate emotional and behavioral regulatory processes, teach non-judgmental awareness, and reduce emotional reactivity (Lutz, Slagter, Dunne, & Davidson, 2008).

Mindfulness has been shown to correlate negatively with physical and psychiatric symptoms and positively with well-being. Baer, Smith, Lykins, Button, Krietemeyer, Sauer, et al. (2008) described mindfulness as a nonreactive, nonjudgmental awareness of present moment experience, including thoughts, behaviors, sounds, sensations, emotions and reactions. Baer et al. also described an attitude of willingness and acceptance of

moment-to-moment phenomena, whether or not it is pleasant or comfortable. Baer et al. indicated the components of mindfulness as *observing, describing, acting with awareness, accepting without judgment, and nonreactivity to inner experience.*

Observing refers to the ability to attend to internal and external environmental stimuli in the environment (i.e., thoughts, emotions, five-sensory experience). Describing is the ability to put observations into words (i.e., labeling the experience of thinking as “thinking”, noting “thoughts of worry”; sensory experiences “stomach rumbling” or “pins and needles in feet”). Acting with awareness is participating fully in an action (i.e., acting with full awareness and without automaticity while consciously refraining from doing anything else at the same time). An example of this would include eating and focusing on the five-sensory experience of eating, without reading the paper, watching TV, listening to music, searching on the computer, or talking on the telephone. Accepting without judgment includes accepting whatever is happening in the present moment without evaluation or interpretation, or attempting to change it. Nonreactivity to inner experience relates to allowing inner experience phenomena to come and go without trying to hold onto it (i.e., when it is pleasant) or push it away (i.e., when it is uncomfortable.)

Baer et al. (2008) found a relationship between meditation practice and psychological well-being, and between four facets of mindfulness on the FFMQ and meditation practice (the factor not correlated with meditation in this study was “acting with awareness”). A systematic review (Chiesa & Serretti, 2009) of the mindfulness literature assessed the impact of mindfulness on several populations, both healthy individuals and people with psychological and physiological problems. They found evidence indicating that mindfulness practitioners show superior attentional performance

as compared to both meditators using a concentrative focus and non-meditators, and that these improvements in attentional levels could be related to improvements in psychological outcomes. Kabat-Zinn (1982) indicated that chronic pain is reduced in a mindfulness-based stress reduction protocol (MBSR) as compared to treatment as usual (TAU). Morone et al. (2008) found that MBSR was more efficacious in reducing pain and psychological distress, and also demonstrated an increase in pain acceptance and physical function. Studies have shown anxiety and somatic symptoms have also decreased following a mindfulness intervention (Kabat-Zinn, Massion, Kristeller, Peterson, Fletcher, Pbert et al., 1992; Kabat-Zinn, Chapman, & Salmon, 1997).

A recent review of emerging treatments for PTSD (Cukor et al., 2009) described the efficacy for mindfulness to reduce depersonalization and demonstrated that mindfulness has been incorporated into studies with PTSD. In a study by Baer (2006), mindfulness and its potential value for people with PTSD was demonstrated as related to dissociative phenomena. Baer found that measures of dissociation had a significant negative relationship with measures of mindfulness, so the introduction of mindfulness-based practices with people with dissociative symptoms, such as is seen in some people with PTSD, may be helpful. In her five-facet model of mindfulness, Baer (2004) found that four of the five of these factors accounted for 50% of the variance in dissociation, thereby concluding the potential benefit of mindfulness-inducing practices for dissociative sequelae.

Resilience, Yoga, and PTSD

Resilience can be described as an individual's capacity to bounce back, withstand hardship, and repair oneself (Wolin, 1993), and "the positive pole of individual

differences in people's response to stress and adversity" (Rutter, 1987). Agaibi and Wilson (2005), in their literature review of trauma, PTSD, and resilience, described resilience as "effective coping and adaptation under adverse environmental circumstances." (p. 196) Felsman and Vaillant (1982) purported that for resilient adult development, periods of recovery and restoration, which facilitate competence, active coping, and a sense of mastery in the presence of challenging life experiences are involved.

An increase in resilience may well be a critical component for healing for people who have suffered trauma. While resilience has been historically framed as an inherent personality characteristic or trait, resilience can also be conceptualized as a state-related skill to be honed (Yehuda & Flory, 2007).

Agaibi and Wilson (2005) proposed the construct of resilience as both a personality trait, and a state-dependent, developmentally mediated behavior. This concept of perceiving personality qualities as an interaction between environmental demand and personality is consistent with recent literature (Caspi & Bem, 1989). Others indicated that personality characteristics may also be mediated by training (Maddi & Khoshaba, 2003; Linehan, 1993). In this study, the hypothesis is that the construct of resilience will be, at least in part, a learned behavior, which can be implemented and honed through training (Agaibi & Wilson, 2005), and further developed to increase effective coping.

Several studies (Yehuda & Flory, 2007; Hoge, Austin, & Pollack, 2007; Nemeroff et al., 2006; Agabai & Wilson, 2005) have investigated the relationship between trauma and resilience, and recommend that resilience interventions be utilized as critical components of PTSD prevention and intervention programs.

King, King, Fairbanks, Keane, and Adams (1998) conducted research on PTSD, Vietnam veterans, and resilience using a measure of hardiness for an outcome measure. Those who scored high on the quality of hardiness had fewer PTSD symptoms and were adept at creating relationships which facilitated coping in the presence of PTSD symptoms; however, hardiness did not protect against PTSD symptoms when veterans experienced heavy combat. Agaibi and Wilson (2005) described several studies supporting hardiness as a dimension associated with resilience, and further reiterated that both qualities involve active, problem-focused coping. They surmise that resilience reflects aspects of personality, coping, and a “capacity to modulate the stress response to promote resilient behavior” (p. 207), which is critical as related to optimally managing PTSD. This modulation of the stress response as a means to effective behavior also introduces a potential mechanism by which yoga may increase resilience and also help people with PTSD.

Vogt, Rizvi, Shipherd, and Resick (2008) also investigated the impact of stressful life events on hardiness. The authors described that although previous research has historically suggested that hardiness precedes and protects against stress sequelae, it may be plausible that the stressful life events and their associated stress reactions may lead to a reduction in hardiness over time. Vogt et al. conducted a 13-week study of 1,571 Marine recruits (826 women and 1021 men) in a highly stressful training program, and found that, as one would intuitively assume, those who were harder at baseline reported lower stress reactions at the time of follow-up questionnaires. Again, not surprisingly, they also found that those who reported experiencing more stress reactions at baseline also reported more stress (and less hardiness) at follow-up.

Vogt et al. (2008) also provided evidence of gender specificity as related to stress reactions and hardiness, and indicated that social support may moderate these associations. This further demonstrated hardiness as a malleable construct rather than a fixed characteristic.

The current protocol study will similarly examine whether yogic practices increase resilience. Just as the Vogt et al. study demonstrated the variability of hardiness as related to stressors, this study hopes to demonstrate that resilience can be increased with positive practices such as utilized in the yoga intervention.

Yoga has been shown to promote coping (Chan, Chan, & Ng, 2009), an important aspect of resilience, and may be critical in creating an *optimal healing environment* (OHE: Osuch & Engel, 2004) for people with PTSD, not only because of its potential to reduce symptoms but also because of its potential to increase wellbeing and a sense of agency in people with PTSD. In a review of the OHE in PTSD, Osuch and Engel claimed that an important aspect of healing, which includes an individual's reclamation of a sense of "agency" in one's own life, is often disrupted in people who have experienced trauma. Osuch and Engel define *agency* as "the capacity to choose consciously to engage in some action or activity, carry through that action by one's own effort, with or without the help of others, resulting in a particular outcome that one has foreseen in part or whole" (p.S-215).

Through relaxation exercises, the conscious use of the breath, the body, and mental awareness, yoga may well facilitate the reclamation and experience of this sense of agency, as well as a sense of cohesiveness in the person. These integrative and encompassing yogic practices create opportunities to experience resilience in a holistic

sense. As the brain, body, and whole self can be impacted by negative events such as trauma, so too can they be impacted by positive events, such as relaxation and accepting oneself and the present moment. Osuch and Engel (2004) explicitly recommend mind/body practices as a means to heal intrapsychic, neurobiological, interpersonal, and subjective trauma spectrum responses.

Summary of the Literature Review

In summary, while there are treatments available for PTSD that reduce symptoms, there are still several areas for improvement in terms of PTSD intervention. As described above, various psychotherapeutic modalities, in particular trauma-focused treatment protocols, have been demonstrated to be effective in reducing symptoms of trauma. Nonetheless, these interventions have been shown to be effective in very specific circumstances, often with a specific subset of the population of people with PTSD. At the same time, there is also heterogeneity in the research literature for PTSD in terms of types and frequency of trauma, types of symptoms, comorbidity, and outcome measures. These issues, as well as the highly specific and structured protocols conducted in research, make translation of the research to a clinical and “real world” setting complex, and make holistic assessment of the research literature difficult.

Even given some successful treatment of symptoms of PTSD, expanding the evidence base and researching innovative treatments for PTSD is critical. While symptom reduction occurs during treatment for people with PTSD, considerable and debilitating symptoms often remain. It is important, then, for non-conventional treatments to become more widely researched and developed for people with PTSD. Holistic treatments, such as yoga, may be both effective at reducing symptoms and for helping

individuals to move beyond symptom reduction toward increasing wellness and healing. These types of holistic treatments are critical if we are to enable people with PTSD live fuller, happier lives, with reduced or alleviated chronic symptoms. While specific symptoms of PTSD are an important area of research and clinical focus, it is also critical to help PTSD sufferers manage emotions, reduce stress, and build into their lives an array of skills, which reorient them toward their lives, interpersonal relationships, and long-term life goals.

Chapter Three: Method

Acknowledgements

This study was made possible by a grant funded by the U.S. Department of Defense (DOD) and led by Sat Bir Khalsa, PhD. Dr. Khalsa has generously granted permission for this author to utilize resources from the grant for the purpose of this dissertation. As the “Seedling Grant” mechanism of the DOD grant requires “research to be completed within 18 months” and with a restricted budget, and because of the uncertainty as to the level of success in subject recruitment, the grant was approved without a control group and with less restrictive inclusion criteria than would typically be acceptable for a randomized control trial. The grant that Dr. Khalsa obtained from the DOD was originally funded as a single-armed study, but the DOD augmented the funding to enable a randomized control condition. This dissertation was carved from the single-armed study. To overcome the deficit of an uncontrolled trial, the results in this study was benchmarked against other PTSD intervention studies in the literature. Also, given the less stringent exclusion and inclusion criteria for the grant, this dissertation similarly allowed for psychiatric medications and clinical treatments that may typically be restricted for a research protocol. However, whether clients were on medications or were undergoing current treatment, only those who still met diagnostic criteria of PTSD as assessed by the SCID were included.

Participants

Inclusion and exclusion criteria. Eligible participants were military personnel (active or veteran) aged 18 and older with a *DSM-IV-TR* diagnosis of post-traumatic stress disorder, as ascertained by the posttraumatic stress disorder (PTSD) module's

trauma screen from the Structured Clinical Interview for *DSM-IV-TR* (SCID; APA, 2008). For this feasibility study, potential subjects who fit inclusion criteria for the study were eligible to participate, regardless of gender, race, or ethnicity. No recruitment efforts expressly focused on recruiting a specific number of participants according to gender, race, ethnicity, or socioeconomic status. Potential subjects were excluded if they practiced more than one-hour weekly strategies directly related to yoga before undertaking the current protocol. Potential subjects who were unable to follow the parameters of the study because they did not have the cognitive capacity to do so or because physical limitations impeded their ability to do even a modified version of the protocol were also excluded from the study. Participants who were receiving additional treatment (e.g., medication, psychotherapy) were eligible if they met diagnostic criteria for PTSD at the time of screening, despite receiving treatment. Data regarding medications, treatments currently utilized, and length of treatment, including when treatment began, was ascertained.

Settings. The screenings took place at the Brigham and Women’s Sleep Disorders Research Center in Boston, Massachusetts. Upon inclusion into the study, subjects met with a clinician at the Trauma Center at Justice Resource Institute in Brookline, Massachusetts, where the pre- and post-intervention Clinician Administered PTSD Scale (CAPS; Blake et al., 1995) assessments took place. The self report measures—the Resiliency Scale (RS; Wagnild & Young, 1990), the Five Facet Mindfulness Questionnaire (FFMQ; Baer, 2006), and the Yoga Follow-up Questionnaire (Khalsa, 2009)—were given to study participants at the Black Lotus Yoga studio or Gessner Geyer’s studio in Cambridge, Massachusetts. These studios were equipped with supports

(yoga props) that were available to participants so they could modify poses and comfortably and safely participate in the yoga program. The Black Lotus studio, aside from having public yoga classes, also has a non-profit program called “the Black Lotus Yoga Project” that was founded in 2004 to teach yoga to people with PTSD. Proceeds from the public studio classes help support the Project work (Black Lotus website, 2009). Gessner Geyer’s studio is in Harvard Square and has public yoga classes.

Materials

Phone and in-person screening materials, CAPS measures, and the pre- and post-treatment questionnaires are kept at the Brigham and Women’s Hospital. Yoga mats and props appropriate to ensure the comfort and safety of the subjects during session were available at the yoga studios. Subjects were also given log sheets to log their daily practice, a CD of four 15-minute yoga practices to use for home practice, and written guidelines for home practice.

Measures

Structured Clinical Interview for DSM-IV (SCID), PTSD module. The SCID is a widely used structured clinical interview for psychiatric disorders that contains a PTSD-specific module with 19 items. The SCID, PTSD module has questions related to each of the *DSM-IV* diagnostic criteria; patients’ responses are listed as present, absent, or sub threshold (First, Spitzer, Gibbon, & Williams, 1997). The SCID does not assess the severity of PTSD symptoms; the determination of whether a symptom passes a severity threshold is left to clinical judgment or further testing with a symptom-severity scale. The symptom severity scale used is the CAPS.

Demographic Information form. The participants filled out a demographic information form, which delineated the age, race, and gender of participants.

Medical and Personal History form. A medical and personal history form was administered after participants consented to take part in the research protocol. This form ascertains information about personal history, current and previous medical psychological concerns, and military service.

The Clinician Administered PTSD Scale (CAPS) for the DSM-IV. The CAPS for the DSM-IV, revised version (Blake et al., 1998) was used to assess PTSD symptoms. It was administered at baseline and post-treatment for the current protocol. The CAPS evaluations were administered by independent master's and doctoral level clinicians who were unaware of the condition assignment of the subjects. The clinician scored the CAPS according to the "rule of 4" (Weathers, Keane, & Davidson, 2001) which requires that total symptom severity scores (*frequency plus intensity*) for each item be equal to or greater than four, with *intensity* scores being at least two.

The CAPS (Blake et al., 1995) was developed in 1990 and has been revised several times, with the most significant revision taking place in 1998 to align symptoms with PTSD criteria in the DSM-IV. It is a structured interview administered by a trained professional for assessing core and associated symptoms of PTSD. It assesses the frequency and intensity of PTSD symptoms using behaviorally anchored rating scales. The CAPS yields both continuous and dichotomous scores for current and lifetime PTSD symptoms. The CAPS contains 34 questions, 17 of which measure symptom frequency and 17 measure symptom intensity. The CAPS generally takes 40-60 minutes to administer.

CAPS subscales assess symptoms from each of the three PTSD symptom clusters as defined by the DSM-IV. The following must be endorsed in order to be given a PTSD diagnosis according to the CAPS: endorsement of one re-experiencing symptom, three avoidance and numbing symptoms, and two arousal symptoms. As exposure to a traumatic event, duration of symptoms for longer than one month, and impairment in functioning as a result of the trauma are all necessary for the diagnosis of PTSD, these parameters are also verified. Initially validated on combat veterans, the CAPS has now been used successfully in a wide variety of trauma populations, including victims of rape, crime, motor vehicle accidents, incest, the Holocaust, torture, and cancer, and has been translated into over 10 languages (Weathers, Keane, & Davidson, 2001). The updated version of the CAPS (Blake et al., 1995) includes wording changes which enabled the CAPS to be directly comparable to the DSM-IV (APA, 1994) description of PTSD and to have descriptors that achieve consistency across intensity dimensions. Weathers et al. (2001) indicated in their review that while the format and the procedures for administering and scoring the CAPS have evolved since the CAPS was developed, the changes were more refinements than major revisions, “and the goal of backward compatibility of the latest CAPS with the original version appears to have been accomplished.” (p.135). The CAPS is considered the gold standard (Hudson, Beckford, Jackson, & Philpot, 2008) assessment of PTSD, in particular with the military population, and has been routinely used for clinical care and in research. A recent study (Cicchetti, Fontana, & Showalter, 2009) found that interrater reliability for frequency and severity is excellent for the re-experiencing, arousal, and avoidance subscales ($r > .92$). Internal consistency is also good ($\alpha > .87$ for each subscale). Weathers, Keane, and Davidson, in

their review of the first 10 years of CAPS use, reported several studies assessing reliability and validity. Blake et al. (1990) provided the first study of CAPS psychometrics with a sample of 25 veterans with the earliest (1990) version of the CAPS. They found interrater reliability for frequency and severity scores across the symptom clusters (avoidance and numbing, hyperarousal, and re-experiencing) to range from .92 - .99, with high internal consistency ($\alpha = .73 - .85$). Hovens et al. (1994) studied CAPS psychometrics in a Dutch sample and found interrater reliability with a mean of .92 for frequency scores and a mean of .86 for intensity scores. For internal consistency, alphas of .63 for re-experiencing, .78 for avoidance and numbing, and .79 for hyperarousal were found respectively, and an alpha of .89 was found for all 17 core symptoms. Hyer et al. (1996) studied older veterans and found in terms of internal consistency the alphas were .88, .87, and .87 for re-experiencing, avoidance and numbing, and hyperarousal respectively, with an alpha of .95 for all 17 core items. Weathers et al. (2001) found both convergent and discriminant validity. In a sample of 123 veterans, they found total severity score correlated with the CES at .53, the Mississippi PTSD Scale, at .91, .77 with the MMPI-PTSD (PK) scale (Keane et al., 1984), .89 with the SCID and .94 with the PTSD Checklist. CAPS were correlated at .61 - .75 for depression and at .66 - .76 for anxiety.

Resilience Scale. The 25-item Resilience Scale (RS; Wagnild & Young, 1990; Wagnild, 2009) was administered at baseline and post-treatment. It measures the degree of individual resilience, as defined by five interrelated components: *perseverance* (the ability to keep going despite setbacks), *equanimity* (accepting; taking what comes in life, thereby moderating the extreme responses to adversity) *meaningfulness* (life has a

purpose), *self-reliance* (a belief in one's personal strengths and capabilities) and *existential aloneness* (the sense that each person is unique and that while some experiences can be shared, others must be faced alone; Wagnild & Young, 1990). All items are scored on a 7-point scale from 1 (disagree) to 7 (agree). Possible scores range from 25 to 175, with scores greater than 145 indicating moderately high to high resilience, 125–145 indicating moderate levels of resilience, and scores of 120 and below indicated low resilience (Wagnild, 2009).

Wagnild (2009), in a review of the RS, looked at 12 studies conducted with a variety of populations. The RS has been used with populations from adolescent to older adults, with people from 16 - 103 years old, with the predominant racial group studied being European American. Smaller representations of African American, Hispanic, American Indian, and Asian samples have been studied. In all studies reviewed, there were no age-related differences on RS scores, no gender differences were reported in 10 of the studies, and, with one exception, differences among racial groups were not reported. Average RS scores in this review were moderate to moderately high with most scores ranging from 140 - 148. Internal consistency of the RS was consistently high in 11 of 12 reviewed studies (Cronbach's alpha coefficient ranged from .85 to .94). The lowest reported coefficient was .72.

Five-Facet Mindfulness Questionnaire. The 5-Facet Mindfulness Questionnaire (FFMQ; Baer, 2006) was acquired at baseline and post-treatment. The FFMQ is a 39-item self-report questionnaire using a five-point Likert-type scale (*never or very rarely true to very often or always true*) and assessing five component skills: *observing, describing,*

acting with awareness, nonjudging of inner experience, and nonreactivity to inner experience (Baer et al., 2008).

The factor structure for this scale was created using data derived from 613 undergraduate psychology students (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). Regarding convergent validity, the factor of *acting with awareness*, assessed in both the FFMQ and the Mindful Awareness and Attention Scale (MAAS; Brown & Ryan, 2003), was $r = .89$; correlations between *non-reactivity to inner experience* as assessed in the FFMQ and the Mindfulness Questionnaire (MQ; Chadwick, Hember, Mead, Lilley, & Dagnan, 2005) was $r = .75$.

The FFMQ was then validated with a sample of meditators (119 subjects were recruited from a meditation program and around 24 were recruited via flyers), demographically matched non-meditators (197 were respondents to a mailing, 23 of these were meditators so were placed in the meditators sample), a community non-meditating sample from the United Kingdom (293 of these respondents filled out the FFMQ and were included as they did not have a meditation practice; 14 of this group were included in the meditators sample) and a student non-meditating sample (269 of whom completed the FFMQ; 8 of these respondents were moved to the meditation group). Age ranged from 18-83 across the four groups, with an educational range from 9.7 -20.3 years of formal education. Alpha coefficients of four of the five facets of mindfulness ranged from .72 - .92. The facet of *nonreactivity to inner experience* had some variability among the sample groups; in the student sample the alpha coefficient was .67 but ranged from .81 - .86 for the other three groups.

Yoga instructor's attendance and compliance records. The yoga instructor

kept attendance records for the yoga classes and tracked treatment compliance as defined by attending class, completing log sheets, and performing daily home practice.

Intervention

The intervention was constructed from the Kripalu Yoga methodology. Kripalu yoga incorporates not only poses and breathing strategies but also awareness-building strategies, meditative practices, and deep relaxation at the end of the pose segment of practice. The yoga instructor for this study has advanced training with a 500-hour certification from the Kripalu Yoga Teachers' Association. The yoga intervention was specifically geared towards helping participants to learn ways to relax, reduce hyperarousal, cultivate mindful awareness, enhance flexibility, strength, and balance, and build a sense of mastery and self-confidence. The intervention entailed biweekly 90-minute group practice sessions for 10 weeks (20 sessions in total). Participants were also asked to perform a 15-minute daily home yoga practice during the length of the intervention. In order to facilitate compliance with home practice, participants received a CD and written instructions for the daily sessions. Participants were asked to keep a daily diary throughout the treatment phase to record home treatment practice.

During the in-person yoga sessions, subjects were monitored to ensure that they safely practiced the components of the intervention and were provided modifications when necessary. The instructor collaborated with the subjects to rectify difficulties in complying with the protocol. Session structure included check-ins at the beginning of each class to clarify practice points from the previous class or to answer any questions. After the check-in a group centering and breathing practice ensued, followed by a 10-15 minute warm-up period and 50-55 minutes of practice involving poses. The last 5-10

minutes allowed time to integrate the breathing and poses (savasana), and included guided relaxation and mindfulness cues.

Among the general themes for practice were: increasing strength and flexibility, and reducing stress; balancing the sleep-wake system; developing a responsive (rather than avoidant or hyperaware) relationship to the environment and with self and others; and engaging conscious awareness in poses.

Study Procedures

IRB approval for the study and for study materials was obtained from the Partners, DOD, and Northeastern University institutional review boards. Upon approval of the various IRBs, recruitment of subjects took place via posting flyers in the Boston area, listing study ads in the Metro research study section, and posting study information on Craig's list and a veteran's research study website. Study staff conducted phone and in-person screening and consenting. Clinicians specifically trained in administering CAPS questionnaires administered CAPS assessments and the research coordinator administered self-report questionnaires.

Screening protocol. Subjects were initially screened by telephone or email to preliminarily assess entry criteria by the study staff members. Potential subjects who were screened in from the phone screen met in person with research staff. During the in-person screening process, the phone screen was reviewed, the subject was informed fully of the study parameters and provided informed consent. After consent was obtained, study staff performed a medical and personal history interview and conducted a SCID, PTSD module, to ensure inclusion criteria were met. Subjects who did not meet entry

criteria were excluded from the study and referred to a healthcare practitioner as appropriate and provided information about free or reduced rate local yoga classes.

Post screening protocol. After screening into the study, subjects underwent baseline assessments via clinician-administered and self-report questionnaires. These assessments ascertained baselines of outcome variables (CAPS, RS, and FFMQ). After these data were collected the subjects were eligible to begin the ten-week yoga intervention.

Study Design

This study is an uncontrolled intervention study. Matched-pair *t* test analyses were performed to directly test whether there were significant differences within subjects on each of the three dependent measures (CAPS, RS, and FFMQ). To overcome the deficit of an uncontrolled intervention, the pre-post effect size of the CAPS measure in this study was benchmarked against a treatment and a control condition effect size from published studies that have used the CAPS in research with military personnel.

Data Analysis

Power analysis. Calculation of the number of participants to assure sufficient power for a pre-post matched-pair *t* test was conducted using the G*Power 3.1 software (Buchner, Erdfelder, & Faul, 1997). The sample size of 26 subjects was computed with an effect size of $d = .5$, an alpha of 0.05, at a power of 0.8. The expectation was that the study would achieve these sample size requirements for adequate power, however, the study design shifted from a single-armed study to a randomized controlled trial before doing so. Therefore, data was analyzed for the 12 participants who completed pre and

post intervention self report questionnaires and the 10 participants who completed the pre and post intervention CAPS measure.

Calculation of within-subject effect size. In order to calculate the effect size (Cohen, 1988) for the measures in this study as well as for the CAPS scores in studies included in the benchmarks, the group means at baseline and immediately post-intervention, as well as the baseline standard deviation, were ascertained. The formula used to calculate effect size g is the following:

$$g = \frac{M_{post} - M_{pre}}{SD_{pre}} \quad (1)$$

The decision to calculate effect size using the pre-treatment standard deviations was made *a priori* based on extant literature (Becker, 1988; Morris, 2000; Minami, Serlin, Wampold, Kircher, & Brown, 2008). These authors indicate that the baseline standard deviation is optimal to use to reduce confounds in effect size since the pre-intervention standard deviation is not impacted by repeated testing and treatment. The results of the current yoga trial study are indicated in Chapter Four.

Benchmarking: Overview. In order to create a benchmark, a meta-analysis was performed of studies using CAPS as an outcome measure in research with military personnel who have a PTSD diagnosis. Studies which have used CAPS as a primary outcome measure were included. The effect size of the current intervention was compared to the aggregated benchmark similar to manner in which Wade, Treat, and Stuart (1998) conducted their research. Wade et al. (1998) compared 110 clients who received treatment for panic disorder in a behavioral health center with efficacy trials conducted by Barlow et al. (1989) and Telch et al. (1993). Wade et al. included people who fit the Diagnostic and Statistical Manual of Mental Disorders, third edition revised

(DSM-III- R; APA, 1987) criteria for panic disorder, with or without agoraphobia. Exclusionary criteria included psychosis, other psychological treatment, alcohol or drug dependence, or medically induced mental health conditions. These exclusionary criteria were also ones used in the Barlow et al. and Telch et al. studies, although noteworthy is that Barlow et al. excluded for agoraphobia in their study, whereas Telch et al. did not. Individuals who fit inclusionary criteria and were on medication were allowed in the study.

Clients included participated in a 15-session CBT protocol. Most participants (82.7%) in the Wade et al. study were treated in a group format; 11.8% were treated individually, and 5.5% were treated in a combination of group and individual therapy. Subjects completed daily self-monitoring logs, performed weekly bibliotherapy, and did deep breathing, exposure, and cognitive practices. Although there was some variation among measures used in the three studies, common measures were compared. Benchmarking comparisons were made on a number of issues, among them, panic-free status, frequency of panic attacks, and scores on the Beck Depression Scale (BDI). Based on these comparisons, the magnitude of improvements in the Wade et al. study completers was comparable to the Barlow et al. and Telch et al. efficacy trials.

Although Wade et al. (1998) did not use a meta-analytically aggregated benchmark, this was done in this study to enable a more reliable and statistically sound comparison of the effect size obtained from the current study.

Selection of studies used in construction of CAPS benchmarks. An aggregated treatment benchmark and a control benchmark by which to compare this study were created by reviewing studies from meta-analyses and conducting an updated literature

review using MEDLINE, PILOTS, and Psychinfo databases, searching for the terms “clinician administered PTSD scale” and “military” with no date limitations in order to be as inclusive of potentially relevant studies as possible. Studies selected included protocols that used CAPS as an outcome measure, were conducted with military members as subjects, and formally assessed the diagnosis of PTSD for inclusion.

From these searches, 196, 101, and 26 studies were amassed from the PILOTS, PsychInfo, and MEDLINE databases respectively; these were reviewed and crosschecked, and 19 contained the appropriate parameters for inclusion. However, only nine (Beidel, Frueh, Uhde, Wong, & Mentrkoski, 2011; Chard Schum, Owen, & Cottingham, 2010; Frueh, Turner, Beidel, Mirabella, & Jones, 1996; Jakupcak, Roberts, Martell, Mulick, Michael, Reed, et al., 2006; Jakupcak, Wagner, Paulson, Varra, & McFall, 2010; McLay, Wood, Webb-Murphy, Spira, Wiederhold, Pyne, & Wiederhold, 2011; Monson, Schnurr, Resick, Friedman, Young-Yu, & Stevens, 2006; Rothbaum Hodges, Ready, Graap, & Alarcon, 2001; Tan, Dao, Farmer, Sutherland, & Gevirtz, 2010) fit the above inclusion criteria and also contained the pre- and post-intervention mean CAPS scores and standard deviations or provided data (e.g., data on least square means) permitting the calculation of effect size for each study.

Computation and aggregation of benchmarks. In order to ensure consistency, the effect sizes of each study were calculated independently. Although effect sizes were indicated in many of the studies, there was variability in how these were computed (i.e., some used post-treatment standard deviation and others computed effect sizes and only provided least square means data). From the above nine studies, 12 treatments and one waitlist control condition were acquired for comparison with the current protocol. Two

benchmarks were created, one which included the 12 treatment conditions and one from a waitlist condition. After effect size g was computed, an unbiased estimator d as well as the variance of this unbiased estimator d was computed. Unbiased estimator d was calculated using the formula below (Morris, 2000; Minami, et al, 2008):

$$d = c(n-1)g, \quad (2)$$

Where d is the unbiased estimator for the treatment condition; $c(n-1)$ is the formula for correcting bias in the effect size g . The approximation of $c(n-1)$ was calculated, as indicated by Hedges (1982), with the formula:

$$c(n-1) \approx 1 - \frac{3}{4(n-1)-1} \quad (3)$$

Once the unbiased estimator d value was obtained, the variance of this value was computed using the below formula from Morris, 2000.

$$\sigma_d^2 = [c(n-1)]^2 \left(\frac{2(1-\rho)}{n} \right) \left(\frac{n-1}{n-3} \right) \left(1 + \frac{n}{2(1-\rho)} d^2 \right) - d^2 \quad (4)$$

For the aggregated benchmark, after g , unbiased estimator d , and the variance of unbiased estimator d were calculated, results were aggregated across studies in order to obtain one pre-post effect size d_{ICAPS} , using the formula in Minami, et al. (2008).

$$d_{ICAPS} = \frac{\sum \frac{d}{\sigma^2 d}}{\sum \frac{1}{\hat{\sigma}^2 d}} \quad (5)$$

This effect size d_{cCAPS} is the benchmark of the efficacy of PTSD treatment for the 12 clinical trials. For the other benchmark, d_{cCAPS} , g , d , and the variance of d were obtained. As this benchmark included only one condition, aggregation of the benchmark was unnecessary.

Statistical analysis of dependent measures. Changes in all outcome measures were assessed using a matched-pair t test. The effect size of the pre-post CAPS scores were benchmarked against studies included in the meta-analysis to ensure significance in effect size as compared to other clinical protocols. The records of compliance from the daily home practice sessions were evaluated from daily diaries.

Chapter Four: Results

The primary hypotheses of this study are that the yoga intervention described in Chapter Three would result in:

- Significantly reduced clinician-rated overall PTSD symptoms as assessed by the CAPS (Blake et al., 1995).
- Significantly increased mindfulness and resilience, as demonstrated by the Five-Facet Mindfulness Questionnaire (FFMQ; Baer, 2006), and
- The Resilience Scale (RS; Wagnild & Young, 1990).

Effect sizes were computed within subjects for the three above measures, and results of CAPS scores obtained from this study were also benchmarked against other studies to ascertain relative efficacy as compared to other clinical trials involving service members with PTSD.

Demographic Variables

In Chapter Three, it was stated that in order to have adequate power to detect significance, a sample size of 26 subjects was needed for this trial. However, difficulties in subject recruitment and retention, as well as a shift of the grant study design from an uncontrolled trial to a randomized controlled trial reduced sample size to 12 participants who completed the self-report measures (the RS and FFMQ) and ten who completed the primary outcome measure (CAPS) for this single-armed protocol. Those data are included in the analyses.

All subjects in the study completed a demographic information form, which included age, gender, and race of participants. The demographic characteristics of the study participants are noted in Table 1. Age ranged from 36-63, with a mean age of 51.

Fifty percent of the participants (6) identified themselves as white and 50% (6) as black; one participant (8%) was female, and 11 (92%) were male.

Table 1

Participant Demographics, Practice Information and CAPS Effect Size

Subject	Age	Gender	Race	# Classes	Home practice	CAPS <i>g</i>
1	60	M	White	17	4:55:00	1.11
3	36	M	Black	11	N/A	
5	44	M	Black	17	63:00:00	1.02
8	55	M	White	3	N/A	2.96
12	52	F	Black	17	69:15:00	0.14
13	49	M	White	17	45:50:00	0.56
14	51	M	Black	6	24:45:00	
16	63	M	White	16	23:15:00	1.76
17	57	M	White	9	0:00:00	0.05
20	56	M	White	18	56:30:00	-0.23
25	51	M	Black	17	9:46:00	0.65
38	38	M	Black	16	4:08:00	0.42

Data analysis: Within-subjects data from the current study

Matched-pair *t*-tests were used to directly test whether there were significant differences within subjects on the continuous variables of each of the three dependent measures (PTSD symptoms, and resilience and mindfulness changes). The unbiased effect size *d* was also calculated (Hedges & Olkin, 1985).

Outcome data for individuals who participated in the intervention for at least three sessions and who completed the pre- and post-intervention CAPS measure and/or self-report questionnaires were used. These participants received treatment between December 2009 and December 2010. Mean attendance to yoga classes by the 12 subjects was $M = 13.67$ with a range of three to 18 of 20 classes attended by each participant.

Home practice information provided by the participants was at times incomplete or incorrect, so these data must be viewed with caution. For home practice compliance calculations, when a start time for home practice was indicated with no end time written, it was assumed that the 15 minute requirement was achieved. When information was incorrectly noted, for example, when one participant wrote down that practice time regularly was 6:30 – 7:00 and at one point wrote in practice time as 7:00 – 6:30 (which would have indicated negative practice time), it was assumed that the numbers had been transposed and the logical time period (i.e., 30 minutes) was calculated.

The Clinician Administered PTSD Scale (CAPS) for the DSM-IV. The CAPS (Blake et al., 1998) was administered at baseline and post-treatment for the current protocol. Mean change was 18.2, indicating a statistically ($t = 2.822; p = .019$) and clinically significant reduction in PTSD symptoms with a 25% drop on CAPS scores. The group mean of CAPS scores at baseline was $M = 70.40$ ($SD = 21.60$), which fell in the “severe PTSD symptomatology” (Weathers et al., 2001) range. Post-intervention, mean CAPS score was $M = 52.20$ ($SD = 24.10$), which fell in the “moderate/PTSD threshold” (Weathers et al., 2001) range. Effect sizes and variance for this measure are noted under “Benchmarking.” Table 2 displays group and individual CAPS scores at baseline and post-intervention.

Table 2

Group and individual CAPS scores

Group				
<u>M pre</u>	<u>SD pre</u>	<u>M post</u>	<u>SD post</u>	<u>M CAPS change</u>
70.40	21.56	52.21	24.10	18.20

Individual

<u>Subject</u>	<u>Pre</u>	<u>Post</u>	<u>CAPS change</u>
1	113	89	24
5	81	59	22
8	87	23	64
12	37	34	3
13	62	50	12
16	58	20	38
17	84	83	1
20	66	71	-5
25	50	36	14
38	66	57	9

Individual CAPS scores. Results of individual CAPS scores (Table 2)

demonstrate the range of scores. Using the criteria from Weathers et al. (2001), four of the ten participants (40%) demonstrated a clinically significant drop of 15 points or more on the CAPS. Using the criteria from Monson et al. (2006) of a change in CAPS score of greater than 12 points, five (50%) individuals had a clinically significant reduction in PTSD symptoms. Also, although the drops in CAPS scores for six participants was not clinically significant, three of the six experienced a reduction in the severity score *range*: for participant 13, the severity score range dropped from 62 (severe PTSD symptomatology) to 50 (moderate/threshold PTSD); for participant 25, severity score range dropped from 50 (moderate/threshold PTSD) to 36 (mild PTSD/subthreshold); and for participant 38, severity score range dropped from 66 (severe PTSD symptomatology) to 57 (moderate/threshold PTSD).

The results of the CAPS scores are compared to other trials under the “Benchmarking” heading below to further elucidate efficacy of this study relative to other PTSD interventions for service personnel.

CAPS subscale scores. CAPS subscale scores derived from the total CAPS scores demonstrated reductions as well; criterion D (hyperarousal, $p = .013$) mean scores dropped significantly from an $M = 22.00$ to $M = 15.30$, and, although criterion B (re-experiencing) and criterion C (avoidance) mean scores decreased from $M = 19.50$ to $M = 13.80$ and $M = 30.80$ to $M = 21.20$, respectively, reductions did not reach statistical significance (re-experiencing, $p = .076$; avoidance, $p = .055$). Table 3 shows the results of the pre-post individual CAPS scores by subscale.

Table 3

Individual Pre Post CAPS subscale scores

Subject	Pre			Post		
	B	C	D	B	C	D
1	31	47	35	24	38	27
5	15	41	25	17	27	14
8	24	61	26	6	12	5
12	17	4	16	12	0	4
13	20	19	23	16	10	24
16	18	20	15	0	9	11
17	30	28	26	24	33	26
20	5	36	25	14	41	16
25	22	15	13	14	11	11
38	13	37	16	11	31	15

Note. B, C, and D denote re-experiencing, avoidance, and hyperarousal scores respectively. p values for pre-post B, C, and D scores are 0.076, 0.055, and 0.013, respectively.

Resilience Scale (RS). The 25-item Resilience Scale (RS; Wagnild & Young, 1990) was administered pre- and post-treatment. Effect size calculations and variance values for the RS and the Five Facet Mindfulness Questionnaire (FFMQ) are indicated below, and an illustrative example of the manner to compute unbiased effect size d and variance σ_d^2 using the CAPS measure are demonstrated under the “Benchmark” heading.

The mean RS score at baseline was $M = 131.25$ ($SD = 29.91$) and at post-intervention was $M = 139.92$ ($SD = 20.54$). The effect size for the RS (g_{yRS}) was calculated as below:

$$g_{y(RS)} = \frac{139.92 - 131.25}{29.91} = 0.290$$

The unbiased effect size for the RS of the yoga intervention (d_{yRS}) was:

$$d_{y(RS)} = \left(1 - \frac{3}{4n_y - 5}\right) \cdot g_y = \left(1 - \frac{3}{4 \cdot 12 - 5}\right) \cdot 0.290 = 0.270$$

and unbiased variance, $\sigma_{dy(RS)}^2$, for results on this measure was:

$$\sigma_{dy(RS)}^2 = [c(n-1)]^2 \left(\frac{2(1-\rho)}{n} \right) \left(\frac{n-1}{n-3} \right) \left(1 + \frac{n}{2(1-\rho)} d^2 \right) - d^2$$

$$\sigma_{dy(RS)}^2 = (.914)^2 \left[\frac{2(1-.668)}{12} \right] \left[\frac{12-1}{12-3} \right] \left[1 + \frac{12}{2(1-.668379)} \cdot .270^2 \right] - .270^2$$

$$\sigma_{dy(RS)}^2 = 0.006$$

According to these data, resilience scores ($d = 0.270$; $t = -1.220$; $p = .248$) did not significantly increase post-intervention. There was considerable variability in the scores by individual, with a range of change in scores from -25 (a drop of 25 points in the resilience score) to 55 (an increase of 55 points in the resilience score). Individual pre-post scores are indicated in Table 4.

Table 4

Resilience Scale scores

Subject	Pre	Post	Pre-Post Difference
1	136	127	-9
3	168	143	-25
5	108	151	43
8	118	141	23
12	170	166	-4
13	154	160	6
14	139	117	-22

16	114	131	17
17	153	162	9
20	138	159	21
25	113	103	-10
38	64	119	55

Note. *M* Pre: 131.25 (*SD* = 29.91); *M* Post: 139.92 (*SD* = 20.54); *d* = 0.270

Five Facet Mindfulness Questionnaire. The Five Facet Mindfulness Questionnaire (FFMQ; Baer, 2006) was completed pre- and post-treatment. Table 5 indicates individual scores pre- and post-treatment. The mean group score for the FFMQ was *M* = 115.67 (*SD* = 14.75) at baseline and *M* = 122.00 (*SD* =15.54) after the intervention, demonstrating an insignificant change (*d* = 0.392; *t* = -0.9500; *p* = .363) in mindfulness scores as a result of the yoga intervention.

The unbiased effect size for the FFMQ of the yoga intervention (*d*_{yFFMQ}) is:

$$d_{y(FFMQ)} = 0.392 \text{ and the corresponding variance } \sigma_{dy(FFMQ)}^2 \text{ is:}$$

$$\sigma_{dy(FFMQ)}^2 = .012$$

Table 5

Individual Five Facet Mindfulness Questionnaire scores

Subject	Pre	Post	Pre-post Difference
1	119	119	0
3	123	133	10
5	102	118	16
8	125	116	-9
12	98	108	10
13	113	125	12
14	136	134	-2
16	120	112	-8
17	134	120	-14
20	88	161	80
25	125	118	-7
38	105	100	-5

Note. *M* Pre: 115.67 (*SD* = 14.75); *M* Post: 122(*SD* = 15.54); *d* = 0.392

Mindfulness scores change ranged from -14 (indicating a reduction in mindfulness) to $+80$ (showing an increase in mindfulness). The individual data from the FFMQ, much like as is seen in the RS data, displays a large amount of within group variability in scores, which is of vital importance when interpreting the data and is often overlooked when simply reviewing pre-post mean change.

Benchmarking: Example of formula calculations

Unbiased effect size d and the variance of the unbiased effect size d were computed for the CAPS, RS, and MMFQ measures in the current study as well as for the studies included in the benchmarking. The calculations for the CAPS measure are outlined as an example to clarify these computations. The 10 participants who completed the pre-post CAPS measure had a mean baseline CAPS score $M = 70.2$ ($SD = 21.56$) with a mean post treatment score of $M = 52.2$ ($SD = 24.1$).

Hence, the unbiased effect size for the CAPS of the yoga intervention (d_{yCAPS}) is:

$$d_{y(CAPS)} = \left(1 - \frac{3}{4n_y - 5}\right) \cdot g_y = \left(1 - \frac{3}{4 \cdot 10 - 5}\right) \cdot 0.840 = 0.768$$

Variance calculations as described in Morris (2000) were computed as well. In the current study, the correction for the effect size [$c(n-1)$] was .914 and the correlation coefficient (ρ) was .668. The number of study subjects, n , was 10, and unbiased estimator, d , was .768. These values were computed in the equation for variance and the resulting variance equaled .220, as shown below:

$$\sigma_{dy(CAPS)}^2 = [c(n-1)]^2 \left(\frac{2(1-\rho)}{n} \right) \left(\frac{n-1}{n-3} \right) \left(1 + \frac{n}{2(1-\rho)} d^2 \right) - d^2$$

$$\sigma_{dy(CAPS)}^2 = (.914)^2 \left[\frac{2(1-.668)}{10} \right] \left[\frac{10-1}{10-3} \right] \left[1 + \frac{10}{2(1-.668)} \cdot .768^2 \right] - .768^2$$

$$\sigma_{dy(CAPS)}^2 = .220$$

The unbiased estimator effect size (d_{yCAPS}) and concomitant variance (σ_{dyCAPS}^2) were compared to the clinical trials benchmarks calculated from the values in Table 6.

Table 6

Studies and data for calculating effect size and variance

Aggregated treatment benchmark $d = 1.074$

<u>Study name</u>	<u>n</u>	<u>M Pre</u>	<u>M Post</u>	<u>SD Pre</u>	<u>D</u>	<u>var d</u>
Beidel et al., 2011						
TMT with Exposure	14	84.90	69	14.30	1.047	0.101
Exposure alone	16	90.60	65.50	14.40	1.650	0.151
Chard et al., 2010						
OEF/OIF	51	71.88	31.50	16.41	2.424	0.075
Vietnam veterans	50	66.48	42.50	16.58	1.424	0.035
Frueh et al., 1996						
TMT	11	82.46	65.55	19.23	0.812	0.107
Jakupcak et al. 2006						
Behavioral Activation	9	74.66	60.44	22.11	0.581	0.110
*Jakupcak et al, 2010						
Behavioral Activation	5	71	49.40	16.87	1.024	0.464
McLay et al., 2011						
Virtual Reality Exposure	10	83.5	48.10	18.10	1.788	0.310
Treatment as usual	10	89.13	80.80	24.32	0.313	0.077
Rothbaum et al., 2001						
Virtual Reality Exposure	9	68	57.78	15.26	0.605	0.112
Tan et al., 2011						
Heart rate variability biofeedback	10	86.41	71.24	19.32	0.718	0.110

Treatment as usual	10	89.13	80.80	24.32	0.313	0.077
Waitlist benchmark $d = 0.156$						
<u>Study name</u>	<u>n</u>	<u>M Pre</u>	<u>M Post</u>	<u>SD Pre</u>	<u>D</u>	<u>var d</u>
Monson et al., 2006						
Waitlist	30	79.1	76.03	19.18	0.156	0.023
Current study $d = 0.768$						
<u>Study name</u>	<u>n</u>	<u>M Pre</u>	<u>M Post</u>	<u>SD Pre</u>	<u>D</u>	<u>var d</u>
Yoga Intervention	10	70.20	52.20	21.56	0.768	0.220

Benchmark: comparison of efficacy

The efficacy benchmark from the current yoga study (d_{yCAPS}) was compared to the treatment benchmark (d_{tCAPS}) and control (d_{cCAPS}) conditions. Specifically, the difference between the current study and the efficacy benchmark was:

$$d\Delta(d_{yCAPS} - d_{tCAPS}) = 0.768 - 1.074 = -0.306, \text{ and,}$$

$$d\Delta(d_{yCAPS} - d_{cCAPS}) = 0.768 - 0.156 = 0.612$$

Following guidelines for the lowest meaningful significant change indicated in Minami et al. (2008) and described by Cohen (1988), a minimum difference for effect size was decided to be .2. Therefore, the current protocol was considered to have a treatment effect if it demonstrated it is at least above .2 from the waitlist control and comparable treatment efficacy with the treatment benchmark if it is within .2 of the effect size.

The above values demonstrate that as compared to the aggregated efficacy benchmark, the current study's treatment effect was significantly (-0.306) lower. Compared to the waitlist control benchmark the treatment effect in the current study was

significantly (0.612) higher. However, results of these comparisons need to be interpreted cautiously given the across group variation (i.e., individual effect size of condition, length of treatment, and study design).

Chapter Five: Discussion

The primary aims of this study were to evaluate the efficacy of the intervention as related to PTSD, mindfulness, and resilience scores and to compare the efficacy demonstrated in this study with the efficacy of other clinical efficacy trials conducted in the military population with PTSD. The latter aim was completed by benchmarking the pre-post effect size observed in the current study against effect sizes obtained from a comprehensive literature search of clinical trials conducted with people in the military who have PTSD.

Findings of this study support the hypothesis that the yoga intervention would significantly reduce PTSD symptoms; participants who undertook the intervention experienced a significant reduction in PTSD scores on the CAPS. Total CAPS scores and also the criterion D (arousal) subscale decreased significantly, despite the small sample size. However, the hypothesis that the intervention would increase mindfulness and resilience scores was not supported. The findings and implications of the results are discussed in detail below.

Overview of Results of Current Study: Within-Subjects

The pre-post changes seen on the total CAPS scores as well as the significant reduction in cluster D (arousal) scores in particular are encouraging and demonstrate the feasibility of yoga as an efficacious intervention for PTSD symptoms. It is particularly impressive that significant findings emerged given the small sample size. Of particular note is that there were significant individual differences among participants in terms of impact of the intervention on symptoms. This highlights the fact that it is unlikely that there will ever be a “one size fits all” intervention for healing PTSD sequelae in the

military population. While the study overall suggests that yoga can be effective with these individuals, yoga may be extremely helpful in combating symptoms for some and less so for others. Also of note for this feasibility study is that although there was a wide range of compliance regarding attendance and home practice, nine of the twelve participants attended over half of the in-person sessions. Also, six of the subjects not only practiced regularly at home, but also elected to practice well beyond the 15 minutes requested for the study (which is 17.5 hours in total over ten weeks), indicating that for these individuals, substantial home practice is viable. However, it is difficult to interpret the relationship between home practice, attendance, and changes on the outcome measures given the range of practice and attendance compliance. For example, some individuals who attended 17 or more classes were non-complaint with home practice. There were no adverse events in this study and there are no known negative side effects with this treatment. Given the reduction in CAPS scores and no adverse events in this study as well as the lack of side effects from yoga interventions, yoga may be valuable as one of the first interventions included in working with veterans with PTSD.

CAPS within-subjects total score. The PTSD changes were both clinically and statistically significant, demonstrating yoga is potentially an effective treatment for PTSD symptoms in people in the military.

CAPS within-subjects subscale data. A significant decrease was observed on the Criterion D (arousal) subscale, which supports data from other protocols using yogic practices in a veteran population with PTSD (i.e., Brown & Gerbarg, 2005) and which is congruent with the extant research on yoga and its impact on stress physiology (Khalsa, 2005). Avoidance and re-experiencing symptoms did decrease but did not attain

statistical significance ($p = .055$ and $p = .076$, respectively). Given the reduction in symptoms from this study, it may be worthwhile to consider the value of yoga as a complementary intervention for people undergoing other treatments (i.e., prolonged exposure or CPT), which have less of an impact on hyperarousal. It may also be considered as a standalone treatment, given its potential to impact all symptom clusters, although more research is required in this domain.

Benchmark interpretations. Impact of this intervention was less than the aggregated treatment benchmark. However, when compared to the control benchmark the effect size of this study was significantly larger. Results need to be contextualized, given the heterogeneity of studies (i.e., demographics, length of intervention, sample size, inclusion and exclusion criteria, intervention type/approach, amount of subject burden, life stressors/events, and research design). It is potentially misleading to assume that the intervention was not beneficial since it was lower in effect size than the treatment benchmark, especially given the effect size on the CAPS even with the small number of subjects and heterogeneity of home practice and attendance compliance. Future studies are needed to clarify this empirical question, but it is possible that the current study would be comparably efficacious to other studies if it were matched with regards to the parameters of the other studies (i.e., age, type of trauma, inclusion and exclusion criteria, and length of intervention).

Also noteworthy is that there were no adverse events or reported difficulties in the current intervention, whereas some treatments (i.e., exposure treatments) that have larger effect sizes in general in the literature have been seen in the literature to exacerbate symptoms for some veterans (Pitman, et al., 1991). If an intervention is difficult for some

veterans to undertake and tolerate, even if large effect sizes are demonstrated in efficacy studies, its full value may not be exploited. Yoga offered concurrently or preceding these types of interventions may enable people to better tolerate and integrate these interventions by reducing, for example, hyperarousal, which may increase drop-out rates and treatment failure.

Resilience. The non-significant findings on the resilience measure may be attributable to a number of factors, with likely contributors being small sample size in the study and individual variation among subjects, both in terms of scores on outcome measures as well as compliance in class attendance and home practice. It is also possible that resilience is not impacted by yoga in this population.

One challenge in interpreting the data is the varied manner in which the construct of resilience is conceptualized and measured. This variability regarding construct measurement and definition is evidenced in the research. As to the definition of the construct, in some research, resilience is viewed as the absence of psychiatric symptoms given traumatic stressors; in others, resilience is described as superior coping while in others it is viewed as a behavioral or personality variable (Agaibi & Wilson, 2005). Some protocols assessing risk and protective factors for resilience have evaluated biological (Feder, Nestler, & Charney, 2009) and psychological (Malta et al., 2009) resiliency factors in reducing the likelihood of PTSD in people who have experienced trauma; others have looked at post-deployment resilience factors (Whealin et al., 2008) reducing the likelihood of PTSD. All of these seemingly relate resilience to the absence of a diagnosis of PTSD, as if PTSD and resilience were dichotomous constructs. Few studies have been intervention studies assessing resilience changes in people who already have

PTSD, and particularly those, like the subjects in this study, who have had long term PTSD symptoms often related to chronic and severe traumatic stressors. This is problematic, as participants are seen as either meeting the diagnostic criteria for PTSD *or* potentially resilient; there is no category for resilient individuals *with* PTSD.

It is possible that for future studies another measure would better capture the resilience construct for this population and in a clinical trial. However, a construct which specifically measures resilience before and after interventions with military personnel who have PTSD and may be resilient is as yet not available. One study (Davidson, Payne, Connor, Foa, Rothbaum, Hertzberg, and Weisler, 2005) evaluated a pharmacological intervention in civilian patients with PTSD and demonstrated a significant increase in resilience scores. This study used the Connor Davidson Resilience Scale (CD-RISC; Connor & Davidson, 2003), which has been used in the military population in descriptive studies. Therefore while it is possible that the selection of construct impacted the results, the paucity of research evaluating nonpharmacological interventions measuring resilience renders this unclear. It may also be that the construct of resilience needs to be more specifically defined in the military population, whose job responsibilities often include exposure to chronic, severe stressors and increased psychophysiological responding (i.e., reduced sleep, hypervigilance) as part of the training and work responsibilities.

One cautious but theoretically feasible interpretation of the results regarding resilience in this study is that the lack of significance on the RS may be temporary, and may increase as they move toward recovery. The hypothesis is that the reduction of PTSD-related symptoms may lead to re-engagement in previously avoided activities and increased emotional processing of traumatic events. As avoided activities are

reincorporated, it is possible that resilience increases temporally follow the reduction of PTSD symptoms. Therefore, an issue to be considered is that the non-significant findings on resilience in this study indicate that the measure was prematurely instituted and future studies which measure resilience at later time points than PTSD symptom reduction are warranted. It is theoretically possible (especially given the reduction of PTSD symptoms), that the reduction of symptoms from the intervention will increase resilience-enhancing behavior, such as increased social engagement and metabolism of emotional experience. Studies (i.e., Koenen, Stellman, Stellman, & Sommer, 2003; Pietrzak, Johnson, Goldstein, Malley, & Southwick, 2009) have evidenced positive social support and engagement as protective factors against PTSD. Therefore, future studies reviewing yoga and the temporal course of resilience factors (increased social engagement and increased ability to construct, seek out, and sustain social networks; increased ability to tolerate and manage emotions) and PTSD symptom reduction longitudinally are warranted.

Mindfulness. Similar to the other measures utilized in the current study, issues of sample size and individual variation of scores among subjects, as well as amount of yoga practice completed, likely impacted FFMQ results. Also challenging clear interpretation of results is the fact that this measure does not have any type of descriptive or clinical scales with which to contextualize the data. While it is possible that results indicate that mindfulness is not impacted by this intervention, extant research on yoga and mindfulness warrants alternate explanations. As with resilience, it may also be that the measure utilized was inappropriate for this population, but, as with resilience, there is as yet no measure specific to this population.

While recent publications (Vujanovic, Niles, Pietresa, Schmertz, & Potter, 2011; Cuellar, 2008) provide a theoretical rationale and Vujanovic, Youngwirth, Johnson, and Zvolensky (2009) provide data evidencing the value of mindfulness in a non-clinical population who have been exposed to trauma, unfortunately, as yet there are no published studies evaluating mindfulness in people with PTSD or in military personnel with PTSD. As a result, comparing results with other relevant studies is challenging. However, Vujanovic et al. (2011) presents a comprehensive overview of the theoretical rationale of mindfulness practices, many of which are integral to a yoga practice, as a viable treatment for individuals who have experienced trauma. Also, component practices that include mindfulness training, much like as in yogic practices, have frequently been subsumed into treatments for PTSD, such as DBT, exposure treatment, and stress inoculation. These studies both provide a further theoretical basis for the value of mindfulness practices and also confound comparisons of mindfulness in the literature. For example comparing a “mindfulness” intervention with “stress inoculation” training may well be comparing very similar or largely dissimilar interventions depending on how each construct is defined and intervention is constructed.

Therefore, as suggested for the RS scores, comprehensive interpretation of the mindfulness data will be informed by future studies that assess the construct of mindfulness in this population specifically as well as the temporal relationship between the reduction of PTSD symptoms and mindfulness changes.

Individual Variation

Individual variation was noted in particular with the RS and FFMQ measures. Given the reduced PTSD symptoms in this cohort, the fact that both the mindfulness and

resilience measures showed significant individual variation highlighted that at least for the time points measured, for some individuals, the yoga intervention appears to have had a positive impact on self-reported mindfulness and resilience measures, while for others there was a decrease or no change in these measures. This may indicate that for some yoga is helpful for increasing mindfulness and resilience and is less so for others, or that the constructs themselves or time points selected for administration warrant revising for this population. Also important to clarify for future studies is the differential impact of class attendance and home practice, as parsing out these issues will be of substantial value when designing future mind-body research protocols.

Attrition and Retention of Participants

A primary concern was the attrition that occurred after participants consented to take part in the study and while awaiting the group intervention. Of 38 individuals initially consented to participate in the study, 15 (39% of those consented) attended one or more classes; of these 15 who attended at least one class, 12 (80%) completed the self-report questionnaires and 10 (67%) completed the CAPS.

One concern potentially related to retention of participants was the issue of burden. Although for this protocol there were only three outcome measures assessed, this study was completed within the context of a larger grant, which involved multiple measures and several assessments, which may have impacted results. Another important factor was the time it took to accrue enough subjects to create a group for intervention. Given difficulties with recruitment, it took several months to create a group. This in turn impacted burden, as those who had already consented were asked to maintain sleep logs while awaiting the group's inception. The intervention itself was 10 weeks, during which

time participants were asked to complete two in-person 90-minute yoga classes and perform 15 minutes of yoga daily, which is longer than many PTSD treatments. For example, Bradley et al. (2005) indicated in their meta-analysis of 44 treatments from 1980-2003 that the average length of treatment was 15.64 hours (SD=10.52). Participants were also required to complete sleep and practice diaries and self-report questionnaires, pre- and post-intervention EKG and 24-hour urine assessments, as well as pre- and post-intervention CAPS interviews. This may well have impacted the results of this study, both in terms of recruitment, attrition, and retention.

The order of the questionnaires may have also impacted the participants' responses to the measures for this study. The resilience and mindfulness questionnaires were at the end of a packet of 11 psychological questionnaires, all of which took about an hour to complete at each administration. It is possible that by the time the individuals completed the resilience and mindfulness measures at the end of the packet they were less attentive to the task.

Limitations

There were several limitations in this study:

- 1) One limitation was small sample size, which impacted the power of the study.
- 2) As the study was an uncontrolled trial, there was the potential impact of such factors as non-specific therapeutic effects of social support, the passage of time, natural course of the disease, interactions with research staff, awareness of treatment condition, and regression to the mean, which makes it difficult to state that the reduction in symptoms was specifically due to the intervention.

3) One yoga instructor conducted the intervention. This raises the issue of whether results are attributable to the teacher rather than the intervention. Having more than one instructor with equivalent skill and ability conducting the intervention would reduce potential bias.

4) Research team members who were aware of the goals of the study oversaw self-report assessments, also creating a potential for bias.

5) As to completion of measures, participant burden was potentially an issue, as well as the practice effects of repeat assessments.

Potential confounds were that subjects with psychiatric comorbidity and a variety of medical concerns as well as those taking psychotropic medication or in mental health treatment were allowed in the study, which makes the study far from an assessment of yoga intervention alone. It is certainly possible that results of measures were impacted by other concurrent pharmacological or psychological interventions. However, there is much comorbidity of PTSD with other psychiatric disorders (i.e., substance abuse and depression) and prevalence of suicidality in military personnel with PTSD. Therefore, the fact that individuals with these issues were eligible for inclusion in this protocol makes the participants more representative of the population.

Strengths of Study

Despite the limitations enumerated, there were many strengths in this study.

1) The protocol is a comprehensive intervention that is straightforward to learn and practice. It is strength-based, positively focused, and relatively risk-free, which makes this an important addition to treatments for people with PTSD.

2) Although many of the participants in this study had chronic and entrenched mental and physical health concerns, the large effect size on the CAPS measure demonstrated that these subjects experienced significant change on symptoms that had been present for many years.

3) Yoga has not only been found in this intervention to reduce PTSD symptoms but has been found to be helpful for many other issues that impact veterans, such as anxiety and depressive symptoms (Descilo, et al., 2009), attentional difficulties (Zylowska, et al., 2008), and cardiovascular concerns (i.e., Grossman, et al., 2001), as well as increase psychophysiological well-being (Khalsa, 2004; Malathi et al., 2000).

4) It can be practiced with or without continual professional help, allowing the participants to experience themselves as people who are able to maintain a positive lifestyle in sync with the general population. As noted earlier, much like other interventions with this population, results also suggest that while some may not benefit or at least may not demonstrate immediate benefit, others may benefit immensely from a yoga intervention. The lack of side effects and lack of adverse events demonstrates the even though some may not derive benefit, they also not experience negative impacts.

5) Methodological strengths include the use of a primary outcome measure (CAPS), which is high in sensitivity and specificity.

6) Also, clinicians who assessed the primary outcome measure (CAPS) were unaware of treatment assignment of the subjects. These attributes increase the likelihood that the assessment of PTSD symptoms and changes therein are both valid and reliable.

7) Further strengthening this protocol is the statistical comparison of the intervention with other clinical trials. This is critical in clarifying and contextualizing the

impact of this study on extant research literature of interventions for PTSD specific to the unique issues of the military population.

Summary

Current results support yoga as a feasible, safe, and effective intervention for PTSD military personnel and suggest that further study of this type of intervention is warranted. Reduction of PTSD symptoms is significant, and, while not as high as seen in the treatment benchmark, heterogeneity within the studies in the benchmark and the small sample size in this study requires careful interpretation of these results. Although this protocol is longer than many interventions for PTSD, its positive focus (rather than sole focus on reduction of psychopathology) and integrative approach may well be helpful for the physiologically and psychologically mediated symptoms in PTSD. As yoga is for many an ongoing life-skills practice rather than solely an intervention for psychopathology, the ongoing application of yoga in the life of the service personnel may well impact their ability to manage future life stressors and add to positive gains and psychological symptom reduction. Also possible is the utilization of yoga in conjunction with other interventions for PTSD, for example, using yogic practices of self-acceptance and psychophysiological regulation to help manage the negative emotions which are often increased but not assisted by effective exposure therapies. This is of particular value in the veteran population where exposure treatments are widely utilized and are also less effective than in other populations exposed to trauma. Finding acceptable, strength-based treatments that are tolerable for both the short- and long-term application is critical for service personnel and this intervention has demonstrated its potential utility to this population.

While the mindfulness and resilience scores did not significantly increase as a result of the intervention, small sample size and the paucity of clinical trials using these constructs in this population necessitate cautious interpretation of these results. Future studies evaluating the temporal course between PTSD symptoms and these scales in the military population as well as research to empirically validate the constructs of mindfulness and resilience as related to this population are greatly needed.

Ideally, future research will include longitudinal, randomized, controlled trials of yoga with military personnel using highly sensitive and specific physiological and psychological outcome measures, as well as self-report measures. These studies will further elucidate the role that yoga may play in helping service men and women heal from PTSD.

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Appendix A

5-FACET MINDFULNESS QUESTIONNAIRE

Please rate each of the following statements using the scale provided. Write the number in the blank that best describes your own opinion of what is generally true for you.

1	2	3	4	5
never or very rarely true	Rarely true	Sometimes True	often true	very often or always true

_____ 1. When I'm walking, I deliberately notice the sensations of my body moving.

_____ 2. I'm good at finding words to describe my feelings.

_____ 3. I criticize myself for having irrational or inappropriate emotions.

_____ 4. I perceive my feelings and emotions without having to react to them.

_____ 5. When I do things, my mind wanders off and I'm easily distracted.

_____ 6. When I take a shower or bath, I stay alert to the sensations of water on my body.

_____ 7. I can easily put my beliefs, opinions, and expectations into words.

_____ 8. I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted.

_____ 9. I watch my feelings without getting lost in them.

- _____ 10. I tell myself I shouldn't be feeling the way I'm feeling.
- _____ 11. I notice how foods and drinks affect my thoughts, bodily sensations, and emotions.
- _____ 12. It's hard for me to find the words to describe what I'm thinking.
- _____ 13. I am easily distracted.
- _____ 14. I believe some of my thoughts are abnormal or bad and I shouldn't think that way.
- _____ 15. I pay attention to sensations, such as the wind in my hair or sun on my face.
- _____ 16. I have trouble thinking of the right words to express how I feel about things
- _____ 17. I make judgments about whether my thoughts are good or bad.
- _____ 18. I find it difficult to stay focused on what's happening in the present.
- _____ 19. When I have distressing thoughts or images, I "step back" and am aware of the thought or image without getting taken over by it.
- _____ 20. I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.
- _____ 21. In difficult situations, I can pause without immediately reacting.
- _____ 22. When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words.
- _____ 23. It seems I am "running on automatic" without much awareness of what I'm doing.
- _____ 24. When I have distressing thoughts or images, I feel calm soon after.
- _____ 25. I tell myself that I shouldn't be thinking the way I'm thinking.
- _____ 26. I notice the smells and aromas of things.

- _____ 27. Even when I'm feeling terribly upset, I can find a way to put it into words.
- _____ 28. I rush through activities without being really attentive to them.
- _____ 29. When I have distressing thoughts or images I am able just to notice them without reacting.
- _____ 30. I think some of my emotions are bad or inappropriate and I shouldn't feel them.
- _____ 31. I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow.
- _____ 32. My natural tendency is to put my experiences into words.
- _____ 33. When I have distressing thoughts or images, I just notice them and let them go.
- _____ 34. I do jobs or tasks automatically without being aware of what I'm doing.
- _____ 35. When I have distressing thoughts or images, I judge myself as good or bad, depending what the thought/image is about.
- _____ 36. I pay attention to how my emotions affect my thoughts and behavior.
- _____ 37. I can usually describe how I feel at the moment in considerable detail.
- _____ 38. I find myself doing things without paying attention.
- _____ 39. I disapprove of myself when I have irrational ideas.

Appendix B

Resilience Scale

Name: _____ Date: _____

Disagree-----Agree

1. When I make plans I follow through with them.

1 2 3 4 5 6 7

2. I usually manage one way or another.

1 2 3 4 5 6 7

3. I am able to depend on myself more than anyone else.

1 2 3 4 5 6 7

4. Keeping interested in things is important to me.

1 2 3 4 5 6 7

5. I can be on my own if I have to.

1 2 3 4 5 6 7

6. I feel proud that I have accomplished things in my life.

1 2 3 4 5 6 7

7. I usually take things in my stride.

1 2 3 4 5 6 7

8. I am friends with myself.

1 2 3 4 5 6 7

9. I feel that I can handle many things at a time.

1 2 3 4 5 6 7

10. I am determined.

1 2 3 4 5 6 7

11. I seldom wonder what the point of it all is.

1 2 3 4 5 6 7

12. I take things one day at a time.

1 2 3 4 5 6 7

Disagree-----Agree

Please circle a number indicating how much you agree or disagree with each statement.

RS Page 2

Name: _____ Date: _____

Disagree-----Agree

13. I can get through difficult times because I've experienced difficulty before.

1 2 3 4 5 6 7

14. I have self-discipline.

1 2 3 4 5 6 7

15. I keep interested in things.

1 2 3 4 5 6 7

16. I can usually find something to laugh about.

1 2 3 4 5 6 7

17. My belief in myself gets me through hard times.

1 2 3 4 5 6 7

18. In an emergency, I'm somebody people generally can rely on.

1 2 3 4 5 6 7

19. I can usually look at a situation in a number of ways.

1 2 3 4 5 6 7

20. Sometimes I make myself do things whether I want to or not.

1 2 3 4 5 6 7

21. My life has meaning.

1 2 3 4 5 6 7

22. I do not dwell on things that I can't do anything about.

1 2 3 4 5 6 7

23. When I am in a difficult situation, I can usually find my way out of it.

1 2 3 4 5 6 7

24. I have enough energy to do what I have to do.

1 2 3 4 5 6 7

25. It's okay if there are people who don't like me.

1 2 3 4 5 6 7

Disagree-----Agree

Appendix C

Demographic Information Form

Name: _____ Birth Date: _____

Female

Male

Hispanic or Latino

Not Hispanic or Latino

American Indian or Alaskan native

Asian

Black or African American

Native Hawaiian or other Pacific Islander

White, not of Hispanic origin

Phone Numbers: _____

Email Address: _____

Address: _____

Comments:

The section below to be completed by study staff only:

Has received signed copy of the consent form

Subject Code: _____

Appendix D

Personal and Medical History Form

Subject ID: _____ Date: _____

Previous diagnosis of PTSD or belief of having PTSD

Current mind-body intervention > 1 hour per week, on average _____

Occupation _____

Referral source _____

Military history _____

Medical history _____

Medications:

Substance use

Current treatment for PTSD:

Stressors (family, relationships, illness, job, financial, legal) _____

Psychological/behavioral conditions
