YOGIC BREATHING FOR POST–TRAUMATIC STRESS DISORDER:

DESIGNING AN APPLICATION TO SUPPLEMENT LEARNING AND OVERCOME

A STRESS STATE

by

Jennifer Renee Creighton

_____

A DNP Project Submitted to the Faculty of the

COLLEGE OF NURSING

In Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF NURSING PRACTICE

In the Graduate College

THE UNIVERSITY OF ARIZONA

2 0 1 4

THE UNIVERSITY OF ARIZONA
GRADUATE COLLEGE

As members of the DNP Project Committee, we certify that we have read the DNP Project prepared by Jennifer Renee Creighton, entitled "Yogic Breathing for Post–Traumatic Stress Disorder: Designing an Application to Supplement Learning and Overcome a Stress State" and recommend that it be accepted as fulfilling the DNP Project requirement for the Degree of Doctor of Nursing Practice.

_____ Date: November 17, 2014
Kate Sheppard, PhD, RN, FNP, PMHNP-BC, FAANP

_____ Date: November 17, 2014
Brian Buchner, DNP, RN, ACNP-BC

_____ Date: November 17, 2014
Mary Doyle, PhD, RN, CPHQ

Final approval and acceptance of this DNP Project is contingent upon the candidate's submission of the final copies of the DNP Project to the Graduate College.

I hereby certify that I have read this DNP Project prepared under my direction and recommend that it be accepted as fulfilling the DNP Project requirement.

_____ Date: November 17, 2014
DNP Project Director: Kate Sheppard, PhD, RN, FNP, PMHNP-BC, FAANP

STATEMENT BY AUTHOR

This DNP Project has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this DNP Project are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his or her judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: Jennifer Renee Creighton

ACKNOWLEDGMENTS

For her patience, kindness, understanding, and never-ending support for my relentless questions, I would like to express heartfelt appreciation to my Committee Chair, Dr. Kate Sheppard. Her warm nudges and acceptance have helped me work through my own stubbornness by creating a positive environment of personal growth. Without her, I would have likely given up on this dream a long time ago. Similar sentiments go to my committee members, Dr. Brian Buchner and Dr. Mary Doyle, for providing their expertise and guidance to turn a project into a passion. Doctors Sheppard, Buchner, and Doyle, watch me grow!

To my husband Allan I say, if success is determined by what was given up to attain it, then all the lost date nights, long hours, and tears will add up to great success. You listened when I complained, encouraged me when I didn't believe in myself, and held me when I cried in frustration. I cannot wait to celebrate this success and open a new chapter in our lives. Thank you for always being there for me. I love you so much!

To my friends, those I have known a lifetime and those I have made through this program, know that I could not have done this without your support. Many long hours on the phone talking about everything and nothing helped keep the light in my eyes. Special thanks to Tyah Haro for always answering the phone when I needed a sympathetic ear, someone to share my excitement with, or someone to bounce an idea on. You are an angel.

Lastly, to my very first preceptor, Dr. Sean Gorman, I say thank you. You may never know the full impact you have had on my path. I can only say thank you for reminding me that at the center of my being, I had the answer, and that I have always known who I am and what I want, because there are no other words that come close to showing my gratitude for your influence. Someday, I hope to be just like you.

DEDICATION

To all who walk in darkness, know you need only reach out your hand, and your brothers and sisters in arms will light the way home. Let this be the beginning of the light and endure as a means to reduce your stress until you seek professional care.

TABLE OF CONTENTS

TABLE OF CONTENTS – *Continued*

LIST OF TABLES

ABSTRACT

Many who suffer with Post-Traumatic Stress Disorder (PTSD) fear the stigma associated with seeking treatment. Often the stigma even prevents sufferers from reaching out for support, resources, or education. The purpose of this project was to design an application (app) to bridge the gap between patient and provider by supplementing patient learning and teaching a yogic breathing technique to overcome an acute stress state. To accomplish this, an extensive literature review sought to determine the viability of pairing complimentary alternative methods (CAM) of treatment with application-based interventions. A specific aim also included evaluation of an app available on the market using industry standard tools, the Systems Usability Scale and HONcode measures, to determine areas for improvement.

Applications can present a viable alternative to reaching patients who are unable or refuse to seek provider assistance. There are few apps to address mental health concerns; furthermore, patients may not use applications because they fear bias within the content or the lack of a quality product. Of the applications available on the market created by professional providers, there is a noted lack of aesthetics, user-friendliness, and reliability.

To address aesthetics and user-friendliness, the new application is module based and incorporates basic web-application design principles. To address reliability, the new application answered all the objective criteria in the HONcode and scored higher on the subjective Systems Usability Scale than a leading app on the market, as evaluated by the project lead. This application presents an opportunity to determine the success of pairing patient education and CAM with technology. While it is beyond the scope of this project, the new application is ready

for a pilot testing to obtain feedback on the content, structure, and usability, before launching on

GoogleApps™ for open access.

CHAPTER 1: BACKGROUND

Post-Traumatic Stress Disorder (PTSD), a continued stress state after exposure to a traumatic event, remains the focus of concern for current and former Armed Forces members due to potential adverse events experienced during service. Returning from such volatile locations, bearing witness to traumatic events, permanently changes service members and increases their risk of mental health disorders (Kudler, 2012). Moreover, recent shootings at Army posts and Naval yards have increased public concern for under-diagnosis and under-treatment of mental health issues among this population.

Current literature varies regarding the exact consequences veterans and service members experience with PTSD. Many believe persons with PTSD are predisposed to concurrently experience psychological and physiological consequences such as depression, suicidal ideations, aggression, sleep disturbances, substance abuse, chronic pain, coronary artery disease, hypertension, diabetes, and obesity (Germain & Zadra, 2009; Stander, Thomsen, & Highfill-McRoy, 2014; Taft, Vogt, Marshall, Panuzio, & Niles, 2007; Rojas, Bujarskia, Babsonb, Duttona, & Feldnera, 2014; Angkaw, et al., 2013). The symptoms associated with PTSD frequently overlap and become indistinguishable from other disorders.

Unfortunately, the feared stigma and retribution of coming forward with such expressions of trauma is cause for many to refuse to seek treatment or confide in healthcare professionals about their traumatic experiences. Many service members believe that needing help is a sign of weakness, and that seeking help would cause leadership to lose faith in their abilities, which could be detrimental to their careers (Nash, 2013; Watson, 2013). As such, PTSD among veterans and service members is often undiagnosed and untreated, impairing access to much

needed support, resources, and education to overcome the traumatic event.

The purpose of this project was to design an application (app) to bridge the gap between patient and provider by supplementing patient learning and teaching a yogic breathing technique to overcome an acute stress state. The app does not replace the therapeutic relationship between patient and provider. It is meant to supplement learning and teach a relaxation method to overcome a stress state.

Etiology

There are many beliefs surrounding the etiology of PTSD and research varies on risks for development. Examples include susceptibility to conditioned fear, maladaptive reinforcement, perceptions of control/powerlessness and self-sufficiency during the event, acute stress changing amygdala, prefrontal cortex, and hippocampal sizes, maternal diet lacking omega-3 fatty acids during fetal brain maturation, genetic predisposition to anxiety, inherent risk by gender, and/or prior exposure to trauma (Johnson, Krystal, & Southwick, 2008; Segman & Shalev, 2003; Tyagi, et al., 2013; VanElzakker, Dahlgren, Davis, Dubois, & Shin, 2014; Stander, Thomsen, & Highfill-McRoy, 2014; Olff, Polak, Witteveen, & Denys, 2014). As the debate continues, so does the research among multi-disciplinary fields searching for a cause.

Diagnostic Classification

Criteria are often used to make a diagnosis of PTSD. According to the latest *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-V), eight criteria help identify PTSD (American Psychiatric Association (APA), 2013). Collectively, the criteria necessitate exposure to a stressor, with resultant persistent memories, nightmares, or flashbacks, and subsequent avoidance of stressor reminders to such extent that it interferes with daily life and

affects the patient's mood (National Center for PTSD, 2014; APA, 2013). The resulting stress state must persist past one month, impair function, and have no other explanation (National Center for PTSD, 2014).

Prevalence

Prevalence rates of PTSD have become an increasing concern to government officials. This may be because it is the government's responsibility to monitor and maintain the health of its service member population. Current estimates indicate nearly three million people serve in the U.S. military, with 73 percent having seen tours in Iraq or Afghanistan (Bureau of Labor Statistics, 2014). Current estimates of returning service members suggest PTSD prevalence rates between 14-27 percent; however, rates are likely underestimated (National Center for PTSD, 2014; Angkaw, et al., 2013; Back, Killeen, Teer, & Hartwell, 2014; Baiocchi, 2013; Kudler, 2012). Calculating the accurate prevalence of PTSD is difficult, as many studies generally only include those officially diagnosed with PTSD. Data indicates a greater number of Americans experience PTSD from current war efforts versus estimates for prior wars (National Center for PTSD, 2013). The prevalence difference likely relates to the length of deployment, combined with repeated return to hostile territories.

Problem Statement

There are a great number of Americans experiencing PTSD or PTSD-like symptoms, yet fear of career repercussions and the stigma associated with diagnosis prevent them from accessing much needed support, resources, and education to overcome the stresses related to traumatic event exposure. Repercussions related to untreated PTSD are complex and can be life threatening. A possible solution to bridge the gap between patients and providers is to provide

reliable user-friendly education and relaxation techniques to the patient and in a manner that ensures anonymity. In addition, the education should be provided through a means that reaches a great number of patients in the most convenient way possible. Right now, the application-based education methods available are of poor quality and unknown reliability according, to industry standards. Users place little faith in such tools, thus not accessing education and relaxation materials needed to reduce the risks associated with untreated PTSD. A new PTSD app may address the needs and improve access to education. I proposed to research the feasibility of designing an app to address the deficits found in the major app on the market.

Purpose and Aims

The purpose of this project was to design an application (app) to bridge the gap between patient and provider by supplementing patient learning and teaching a yogic breathing technique to overcome an acute stress state. This app will cover PTSD symptoms, treatment, and comorbidities, as well as teach yogic breathing, a technique that is empirically shown to promote relaxation. Specific aims include:

(1) Evaluate *PTSD Coach* (Department of Veterans Affairs, n.d.), a current app on the market, using the Systems Usability Scale (Sauro, 2011) and Health on the Net Code (HONcode) (HONcode, 2014); these tools are industry standards that measure usability and reliability.

(2) Design an app to address current intervention deficiencies, provide PTSD education, and teach a yogic breathing method.

(3) Evaluate the new app using the Systems Usability Scale and HONcode measures.

Theoretical Framework: Roy's Adaption Model

Sister Callista Roy's Theory of Adaptions Model guided this project. Many studies and insights into genetics and underlying biology have suggested a theory of cause related to an individual's failure to adapt and overcome to a traumatic event. Based upon that premise, Roy's Adaptions Model (RAM), used in numerous qualitative and quantitative studies, provides a unique perspective on adaption as a state and process within an ever-changing environment (Perrett & Biley, 2013). The RAM describes four modes of adaption: a) physiological, the requirement for basic needs fulfillment, b) self-concept, psychological needs fulfillment, c) role function, interaction of the individual and perceived role changes throughout life, and d) interdependence, individual concepts of reliance upon others, which define either successful adaption or ineffective behavioral responses based upon a feedback loop in response to a stressor (Perrett & Biley, 2013; Nursing Theories, 2013). A stimulus that causes failure to adapt to one mode essentially leads to chain reaction failure of subsequent modes, as all modes are interconnected and essential for individual growth.

According to RAM, change is not automatic; change requires planning and thought, promoting confidence in self-coping abilities as time passes (Perrett & Biley, 2013). It is based upon this concept that this theoretical framework laid the foundation for this project. This project will use RAM to promote individual PTSD awareness and discover a self-coping mechanism to overcome stress states.

Summary

Persons suffering with PTSD symptoms often fail to seek treatment, at great risk to their personal well-being and the well-being of those around them. Advanced Practice Nurses can help

bridge the gap between patient and provider by recommending the use of technology, as a means to reach out to vulnerable populations. The purpose of this project was to design an application (app) to bridge the gap between patient and provider by supplementing patient learning and teaching a yogic breathing technique to overcome an acute stress state. The next section discusses the current state of the science on PTSD and apps to address this important issue.

CHAPTER 2: LITERATURE REVIEW

To develop a greater understanding of PTSD, psychological comorbidities,

Complimentary Alternative Medicine (CAM), and the feasibility of application-based

interventions, a methodical review of prevailing literature assessed study design, validity,

statistical significance, and applicability to this DNP project. Search term compilation was a

three-part process. Databases utilized included Published International Literature on Traumatic

Stress (PILOTS) Database, US National Library of Medicine National Institutes of Health, Ovid

by Wolters-Kluwer Health, and ScienceDirect by Elsevier.

Search Terms and Results

First, to gather sufficient data regarding PTSD and its common comorbidities, search

terms included PTSD and depression, suicidal ideations, aggression, sleep disturbances, and

substance abuse. Specific descriptive search term modifiers, such as *adult* and *veterans* or

military, narrowed results to military stress. This eliminated PTSD related to children and other

forms of PTSD, such as PTSD related to natural disasters or criminal activity.

Second, to overcome the limited availability of studies regarding adult PTSD, military

stressors, and alternative therapies, and gather sufficient data regarding PTSD and CAM, I

removed "*military stressors*" as a descriptor. This effectively opened greater results for literature

in alternative therapies unrelated to military stress. Further, using key words, such as *yoga*,

meditation, and *deep breathing*, helped hone the results to the specific intervention in this

project.

Lastly, a third search used terms such as *app*, *mHealth*, *medical apps*, and *internet*, to

discover literature on the use of apps in healthcare. Initially, there were no limitations placed on

the category of apps or its use. From here, literature was cross-referenced with PTSD or CAM to develop the literature base. Of the three searches performed, this search returned the most limited results.

Initial results of the first search returned between 20,000 and 25,000 articles. To narrow the results further, exclusionary criteria included articles written in languages other than English, case reports of single participants, autobiographies, biographies, editorials, interviews, and newspaper articles. Additional exclusionary criteria included articles referring to the age of the study participants, as the scope of practice for an acute care nurse practitioner begins at age 18. This excluded articles studying the effect of PTSD on 17 years of age and younger.

Limitations

Ultimately, since the thorough search-term list and abstract review resulted in preview of several hundred articles, the chance that a significant study or review was missed remains. This is in relation to the brief information presented in the abstract of the original work. Thorough cross-referencing and review of reference section sources attempted to mitigate this limitation; however, in the instance an abstract referred to children, or met other exclusionary criteria, the article was ultimately excluded.

<center>**Comorbidities**</center>

Depression is often a comorbid condition of many physical and emotional or psychiatric conditions. The most common co-occurring disorder coupled with PTSD is depression, which presents with its own stigma and under-diagnosis dilemmas (Stander, Thomsen, & Highfill-McRoy, 2014; Cole, Christensen, Raju, Cohen, & Feldman, 2008). Many of the symptoms of PTSD and depression overlap, making differentiating between the diagnoses difficult. New onset

of depression rates in previously deployed personnel with exposure to traumatic combat events range between 5.7 percent and 24 percent, whereas rates for those who did not experience traumatic events during deployment represented smaller instances (Wells, LeardMann, Fortuna, Smith, & Smith, 2010; Angkaw, et al., 2013). The risk of developing post-combat exposure deployment depression increased in those with PTSD, or PTSD like symptoms, prior to deployment (Wells, LeardMann, Fortuna, Smith, & Smith, 2010).

Alcohol abuse and PTSD may go hand in hand. Veritably, the second most commonly occurring PTSD-associated disorder is substance abuse, with alcohol being the preferred substance (Rojas, Bujarskia, Babsonb, Duttona, & Feldnera, 2014). Persons with PTSD are more likely to use alcohol to self-medicate stressful symptoms, with fluctuations in use related to worsening symptoms (Back, Killeen, Teer, & Hartwell, 2014; Jacobson, et al., 2008). Those with PTSD and depression had increased odds of concurrent substance abuse (Jacobson, et al., 2008; Wells, LeardMann, Fortuna, Smith, & Smith, 2010). Results from a study of the Millennium Cohort participants indicated a rise in alcohol consumption per day post-deployment/traumatic exposure (Jacobson, et al., 2008). In addition, susceptibility varies and corresponds with service branch type; notably Reservists and National Guardsmen experience higher rates of substance abuse post-traumatic exposure (Jacobson, et al., 2008).

Other comorbidities complicate PTSD, and research continues to grow on contributing factors. Evidence suggests a relationship between PTSD and sleep disruption, hyper-arousal, depression, and violence (Taft, Vogt, Marshall, Panuzio, & Niles, 2007; Angkaw, et al., 2013; Reardon, et al., 2014; Taft, et al., 2009). Williams, Collen, Orr, Holley, and Lettieri, (2014) report nearly 41 percent of service members get less than five hours of sleep a night. Sleep

disruption negatively effects physical and mental well-being and continued sleep disruption and deprivation of Rapid-Eye Movement sleep leads to fatigue, irritability, inattention, impaired judgment, disorientation, motor dysfunction, and hallucinations (Ropper & Samuels, 2014). Irritability and impaired judgment lead to aggression and violence, which is of great interest to the public as a potential cause of public shootings and intimate partner violence (Taft, et al., 2009). Since sleep disturbances experienced with PTSD often overlap with depression, substance abuse, and chronic pain, suicidal ideation is a great concern. Unfortunately, we will never know what causes a veteran or service member takes his or her own life.

Limitations

First, recalling that the largest hurdle among veterans and service members is the refusal to seek treatment, and thus diagnosed with PTSD, the largest limitation noted related to official diagnosis. For several studies, the lack of a diagnosis prohibited inclusion in the study. For others, participants without an official PTSD diagnosis responded to self-assessment questionnaires to determine inclusion. These questionnaires comprised a variety of versions, civilian and military, and a shortened version for use in primary care. The lack of a standardized instrument presents a significant gap in diagnostic and inclusion abilities, and makes data collection on all persons with PTSD, regardless of official diagnosis, difficult.

<div align="center">

Complimentary Alternative Medicine (CAM)

</div>

As there is no distinct etiology underlying PTSD, treatment options usually focus on symptom management. Options include medications to suppress PTSD symptoms, professional counseling, group therapy sessions, and CAM. The National Center for CAM aims to increase research into alternative interventions to enable evidence based practice improvements and

enhance health outcomes in a variety of clinical conditions (U.S. Department of Health and Human Services, 2014). Specifically, the Department of Veterans Affairs seeks evidence of successful CAM use to apply future funding towards PTSD CAM research (Strauss & Lang, 2012). CAM can be used in conjunction with, or prior to, pharmacologic treatment modalities for a variety of disorders and a number of those with PTSD currently use some form of CAM to reduce stress and improve their quality of life (Kim, et al., 2013). CAM encompasses five classifications of methods: 1) natural products, 2) mind-body medicine, 3) body manipulation, 4) movement and energy therapies, and 5) whole body medicine (Strauss & Lang, 2012). Examples of CAM methods include meditation, yoga, deep breathing, herbal remedies, acupuncture, massage, Pilates, Native American and traditional Chinese medicine, and light therapy, among many others (Haija & Kolasinski, 2013; Strauss & Lang, 2012).

Yoga and deep breathing, practiced by millions of people worldwide, are popular alternative methods of stress reduction and possible methods of reducing some PTSD symptoms Both yoga and deep breathing improve awareness of body mechanics and stress-states (van der Kolk, et al., 2014). Of particular interest is the use of deep breathing techniques, known as pranayama, to calm anxiety, lift depression, and decrease hyperarousal.

Research findings describe breathing techniques ranging from simple inhalation and exhalation exercises to complex breathing, timed to muscle contractions. A number of research teams have demonstrated that breathing exercises can significantly reduce both symptoms of PTSD and the severity of comorbid disorders (Kim, et al., 2013; Seppala, Nitschke, Tudorascu, Hayes, & Goldstein, 2014; Mitchell, et al., 2014; van der Kolk, et al., 2014; Dick, Niles, Street, DiMartino, & Mitchell, 2014; Descilo, et al., 2010; Zope & Zope, 2013). With practice, yoga

methodology allows the individual to become aware of internal stress-states through introspective reflection (van der Kolk, et al., 2014; Mitchell, et al., 2014; Kim, et al., 2013; Zope & Zope, 2013). Such mindfulness influences changes in behavior.

Noted throughout several studies is a principle of yoga which indicates the ability of the individual to break the pose and simply perform breathing exercises (Mitchell, et al., 2014; van der Kolk, et al., 2014); thus, its success at reducing stress may not hinge upon the use of yoga poses. One study in particular used breathing exercises only, termed Sudarshan Kriya Yoga (S.K.Y.). S.K.Y. requires intense concentration on rhythmic breathing, abdominal muscle contraction, and internal mantra chanting. Participants in the S.K.Y study engaged in 3-hour sessions for 7 days, for a total of 21 hours of instruction (Seppala, Nitschke, Tudorascu, Hayes, & Goldstein, 2014). Other simpler yoga breathing studies included participation in sessions of variable length (60 to 75 minutes) weekly or bi-weekly for 6 to 12 weeks (Dick, Niles, Street, DiMartino, & Mitchell, 2014; Kim, et al., 2013; Mitchell, et al., 2014).

Application-Based Interventions

There is varying evidence on the success of an app for many areas of healthcare. Some healthcare areas, such as weight management and medication reminders, are more suited to apps than would be complicated issues, such as cancers. Major concern lies in an absence of regulation, lack of reliability, and obvious bias in presentation (Eysenbach, 2014; Mobasheri, et al., 2014; O'Neill & Brady, 2012; Kamel-Boulos, Brewer, Karimkhani, Buller, & Dellavalle, 2014). Currently, the Food and Drug Administration only regulates applications deemed medical devices as those that modify or accessorize current devices (U.S. Food and Drug Administration, 2014).

Unfortunately, the lack of regulations regarding mHealth means some information presented through apps have not been vetted for ethical transparency of author qualifications, accuracy/up-to-datedness, bias disclosure, user privacy, and financial disclosures. Examples of agencies that validate ethically transparent websites include the HONcode, Net Scoring, IMS Health, and DISCERN; however, I was unable to locate a certification or scoring agency specifically for apps. Unfortunately, HAPPTIQUE, which had offered certification specifically for applications, ceased certification in December 2013 after security concerns surfaced over two apps it had certified (Dolan, 2013; CGFNS International, 2013).

Lastly, a review of Android™ and Apple™ markets noted many apps available to guide the user through yoga breathing. However, a review of multiple journal databases noted there are no studies published on the success of yoga breathing presented using a smartphone app. This presents an opportunity to augment CAM and mHealth research with this DNP project.

Limitations

I identified two gaps in the literature. These gaps relate to a lack of apps for mental health and a lack of apps created by healthcare professionals. Ultimately, because of a lack of apps created by healthcare providers, some sufferers place little value in using apps in support of their needs. Users also refuse to buy apps unless they are sure it is shown to work. Bridging this gap presents an opportunity for healthcare professionals to provide veterans and service members with tools created from reliable sources.

PTSD Coach **Evaluation**

A search of available apps on the Android™ market noted unknown authors create many apps, with few citing content sources. I chose to evaluate an intervention by a known author, the

Veterans Administration's *PTSD Coach* application. *PTSD Coach* is the number one PTSD application available on the Android platform with over 50,000 downloads (Department of Veterans Affairs, n.d.). Upon reviewing this application, deficits were noted in the following categories: an overall lack of information sources, credentials of the author, consideration for patient privacy, and user-friendliness.

To address reliability, applying the Health on the Net (HONcode) criteria helps to determine if the application appears to provide quality, trustworthy information. The eight HONcode principles are authoritative, complementarity, privacy, attribution, justifiability, transparency, financial disclosure, and advertising policy (HONcode, 2014). This scale is objective, as the criteria are addressed or absent. *PTSD Coach* failed five of the eight principles required in the HONcode. Table 1 identifies the criteria, description, rational for the result and the pass/fail response. Additionally, the application required users to agree to a license agreement upon startup; however, the license agreement is blank, leaving the user unaware of the terms of agreement before use.

To address usability, the System Usability Scale (SUS), developed in 1986, provides a quick tool to measure website and application usability. It is still used today as an industry standard to validate systems (Sauro, 2011b). The SUS scale collects ordinal data from 10 standardized questions using a LIKERT scale ranging from Strongly Disagree (1) to Strongly Agree (5). A score <68 is considered a below-average percentile and a poor application. *PTSD Coach* received a 50 on the SUS, when evaluated by the primary author. This scale is subjective with scoring dependent upon the question number and the response of the scale position minus one point, or five minus the scale position, accordingly. For a total score, the results are then

multiplied by 2.5. Table 2, System Usability Scale Evaluation Results of Current Interventions, identifies the SUS questions and the scores, with further description of the scoring in the notes section.

TABLE 1. HONcode Criteria Evaluation Results of *PTSD Coach*.

Criteria	Description	Rationale	Pass/Fail
Authoritative	Author qualifications[1]	The application opens to a startup screen with seals of the contributing agencies as the National Center for PTSD and the National Center for Telehealth and Technology.	Pass
Complementarity	Supports seeking professional assistance[1]	The link to 'Find Professional Care' leads to a blank page with no options for how to select a provider. There is no information that leads the user to believe this information should support the doctor-patient relationship.	Fail
Privacy	Protects data, respects privacy[1]	The information infrequently offers the option to read content, rather than provide it aloud. The application also tracks assessment history.	Fail
Attribution	Cites sources[1]	Selecting 'learn' provides links to listen to information. The information does not state its source after the content finishes.	Fail
Justifiability	Supports claims[1]	The application makes no claims to the benefits of its use.	Pass
Transparency	Provides contact information[1]	The application does not contain information for how to contact the application contributing agencies or webmaster.	Fail
Financial Disclosure	Reports sources of funding[1.]	The application does not contain information on the source of funding.	Fail
Advertising	Makes user aware of content that is ad material[1]	The application does not contain ads.	Pass

[1] (HONCode, 2014).

TABLE 2. System Usability Scale Evaluation Results of Current Interventions.

Question Number	Question	Scale Position	Points
1	I think that I would like to use this system frequently.	3	2
2	I found the system unnecessarily complex.	3	2
3	I thought the system was easy to use.	3	2
4	I think that I would need the support of a technical person to be able to use this system.	1	4
5	I found the various functions in this system were well integrated.	1	0
6	I thought there was too much inconsistency in this system.	5	0
7	I would imagine that most people would learn to use this system very quickly.	3	2
8	I found the system very cumbersome to use.	3	2
9	I felt very confident using the system.	3	2
10	I needed to learn a lot of things before I could get going with this system.	1	4
Total			20

Notes. Scale Position: Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree (5). Score calculation: "For items 1,3,5,7, and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position. Multiply the sum of the scores by 2.5 to obtain the overall value of SU" (Sauro, 2011b). Total score: 50.

Summary

The use of the PILOTS database, as well as other leading databases housing innumerable references and sources, provided information with which to develop a greater understanding of PTSD and its concurrent psychological consequences, complimentary alternative medicine, and application based health interventions. The literature review noted a lack of mental health apps and apps created by professional providers. Since the use of complimentary alternative therapies have indicated successful resolution or lessening of symptoms in numerous case studies and there is a noted lack of reliable mental health apps, a combination app may present a viable option of bridging the gap from patient to provider. This presents a method of providing education and relaxation techniques in the same tool. The following sections discuss the proposed development and planning of the proposed application and evaluation survey.

CHAPTER 3: METHOD

The following section discusses developing the application. Specific topics

include a brief description of the implementation framework, defining the target audience

and stakeholders, and the protection of human subjects. This section also discusses the

new intervention development and describes how I propose to evaluate its effectiveness.

Plan, Do, Study, Act

Plan, Do, Study, Act (PDSA) change implementation framework guides this quality

improvement project. The PDSA model assists with quick implementation of evidence-based

practice on a small scale by streamlining the cyclic process of allowing for implementation

adaption as new knowledge is learned (AHRQ, 2008). Recognizing and identifying the ever-

changing relationship between original inquiry ideas and learned awareness is crucial to quality

improvement. This type of process bridges the focus of bench-to-bedside practice

implementation using real-world settings and natural contexts, as this model allows for idea

evolution as new information emerges (AHRQ, 2008).

Target Audience and Stakeholders

Service members and veterans are the population of concern, with stakeholders identified

as the general public, participants themselves, and participant family members. The target

audience is any adult, 18 years and older, who has served in the military and believes they are

experiencing PTSD, PTSD-like symptoms, or are in need of a method to enhance relaxation.

Sample

To obtain statistical significance with a prospective population of nearly between

250,000-500,000 persons with PTSD, the requisite sample size would indicate a need for a

minimum of 384 persons to respond to all the questions in the proposed survey. This would provide 95 percent confidence level, and a margin of error of ±5 percent. The construct of the survey requires answering all the questions before submission, thus ensuring a complete survey.

Ethical Issues

This DNP project involves reviewing current literature and developing a tool to improve upon current methods. Following the University of Arizona Human Subjects Review guidelines, there is no need for IRB oversight and Form F-309 is included in Appendix G. This project is not intended to cure PTSD or replace licensed behavioral health professionals. Rather, it is meant to supplement patient learning and teaching a yogic breathing technique to overcome an acute stress state.

Patient Safety

To addresses a user's need for immediate assistance, an option to direct dial to the Department of Veteran Affairs Crisis Hotline will be visible within the application at all times. This allows immediate contact with a licensed professional should a mental health crisis arise. This function is disabled in the parallel app at this time to prevent unintentional dialing.

Most individuals can safely use yoga deep-breathing exercises without physician approval. Yoga breathing has not been deemed harmful in persons with chronic breathing issues (Saxena & Saxena, 2009; Sodhi, Singh, & Bery, 2014). All persons with concerns should discuss the breathing exercises with a provider before starting the exercise, if needed.

Patient Privacy

To address privacy concerns within the application, users may read or listen to content. This prevents the app from being unintentionally overheard during its use, and provides the

choice to read the content if the user is not in a quiet location. The app, by construct of its design, does not save individual history or require a login to view available content. Tracking of IP addresses and e-mail addresses upon app download is disabled.

Bias

To present an unbiased approach, treatment modalities discussed within the app includes medications, counseling, as well as alternative therapies. The app includes gender-neutral language. An expert, neutral party has also reviewed this app for content validity. She holds a PhD and has extensive experience working with PTSD and Traumatic Brain Injuries. Her written impression of the app is included in Appendix F.

<div align="center">

Application Planning

</div>

The plan for design includes building upon a platform that is viewable on a personal computer. This is called the creation of a parallel design (U.S. Department of Health & Human Services, n.d.). The use of a parallel design saves time, money, and effort by creating an evolving concept changed at any time during the design process (U.S. Department of Health & Human Services, n.d.). It also helps to uncover flaws in the plan while the app is still forming, thus providing time to address the needs before the product is permanent (U.S. Department of Health & Human Services, n.d.). Defining the requirements of the app is especially critical in mHealth app development, and consideration is given to app usability, reliability, and safety.

Usability

Consideration is given to the user experience of the application or website as useful, usable, desirable, findable, accessible, credible, and valuable (Morville, 2004). The functional requirements addressed in app usability will indicate an awareness of buttons, text boxes and

sizes, icons, tooltips, and purposeful layout (U.S. Department of Health & Human Services, n.d.). Keeping the design simple and aesthetically pleasing improves the chances the user will be comfortable enough with the application to use it again.

Authoritative, Complementarity, and Justifiability

Elements of the HONcode are necessary to assure the user of quality information. First, to address Authoritative, Complementarity, and Justifiability HONcode principles, the application will provide a notice of the content contained within the app, author, target audience, disclosure of no intent to diagnose or treat, and date of the last update. Clicking to continue indicates the desire to use the application.

Attribution

To address Attribution, a major concern for patient usage, all modules will finalize with complete references to direct the user to the content source. The symptom checker consists of questions directly from the PTSD Checklist for DSM-5 (military version). Results are not tallied; rather the individual is encouraged to recognize his or her own affirmative answers, and directed to seek professional help as needed.

Advertising, Disclosure, and Transparency

To address Disclosure and Transparency principles, the application provides the author contact information and reports the source of funding. Ads are not authorized in this app, thus Advertising is not applicable.

<div align="center">

Survey Planning and Execution

</div>

Users access three surveys hosted by SurveyMonkey™ by clicking a decision button available within the app. The three surveys comprise a pre-test, exit survey, and an evaluation

survey of the usability and reliability. The use of SurveyMonkey™ allows for data collection integrity and offers data analysis. Participation in the evaluation surveys is voluntary. To continue honoring privacy concerns, the survey settings for collecting IP addresses are disabled.

Pre-Test and Exit Survey

Prior to reviewing the education and relaxation techniques, users take a three-question pre-test. The three questions in the pre-test include gender, age, and a five LIKERT scale response to "*I am currently experiencing an elevated stress level*". The LIKERT scale includes the values Strongly Disagree to Strongly Agree, with a neutral middle. Using an odd-numbered scale allows the user to select a neutral response rather than forcing a positive or negative response (Dawson & Trapp, 2004).

The responses create ordinal data to evaluate a statistical comparison to symptom improvement after reviewing the app. After reviewing the education and relaxation techniques, users repeat the survey and answer questions regarding symptom improvement, in addition to increased PTSD understanding, where to get help, likelihood of using the new technique learned in the future, and likelihood of using the app again or recommending it to others (Appendix A). The LIKERT scale repeats for statistical analysis.

Evaluation Survey

Users have the opportunity to evaluate the app for usability and reliability. The evaluation covers the System Usability Scale and the HONcode reliability criteria (Appendix B). Review of the responses in this survey determines the need for changes in the application design.

User Burden

The primary survey instrument contains 9 questions and is written at a 6th grade reading level. The usability survey instrument contains 20 questions, also written at a 6th grade reading level. Effective health materials need written below the 8th grade reading level to ensure comprehension by the average reader (U.S. National Library of Medicine, 2013; Rudd, n.d.). Estimates of survey completion times indicate it would take approximately 20 minutes to complete this survey.

<center>**Summary**</center>

The previous section discussed developing the application, addressing deficiencies noted in the current PTSD application available through the Veterans Administration. While resource constraints prevent this application from being launched at this point, planning for the implementation included defining the target audience, the protection of human subjects, and designing a survey for the evaluation of the application after it has been piloted. The results of the new application design are discussed in the following section.

CHAPTER 4: RESULTS

Creating the application required the use of Microsoft PowerPoint™ as the parallel design platform. This platform is easy to use, provides the ability to imbed and play audio files, is compatible with current computer operating systems, and presents overall ability to display graphics and controls without the interruption of ads or other for-profit content. This is the best approximation of the subsequent application. The following discussion includes how a name was chosen for the app, how the app was designed, and includes a proposal for its evaluation once the full study is implemented.

Name

The name chosen for this application rests upon the need for an individual suffering with PTSD to become self-aware through education and enhance personal coping mechanisms through self-affirmation techniques. This follows Sister Roy's Theory of Adaption over time by hopefully interrupting the negative feedback loop created from exposure to a traumatic event and subsequent stress state. This application is hereafter referred to as SAM ♦ SAT (Self-Awareness Modules: Self-Affirmation Technique). This acronym also helps maintain anonymity when placing the app on the user's smartphone.

Usability

The plan for SAM ♦ SAT design includes being aesthetically pleasing, readable, uniform, interactive, and simple to use. To accomplish this goal, the following sections define the color, font size, spacing template, and dashboard navigation found within the application. The reader should note that the "skin" on the outside of the simulated "screen" seen in the application is

purely for the aesthetics of this project to give the reader an understanding for what it will look like on a smartphone.

Readability

Similar to the requirements of the survey to be written at an average reading level, the SAM ♦ SAT is written at approximately the 8th grade reading level. Avoiding technical jargon, maintaining consistent word use, and using simple sentences helps assure the user will understand the information presented (Rudd, n.d.). Additionally, the relax section is written in step-by-step instructions and includes a picture for demonstration of the beginners pose.

Color

The color scheme is a basic element of visual design. Choosing to use color adds emphasis to important key points (U.S. Department of Health & Human Services, n.d.). As each military branch has its own color association, a neutral color scheme of grey shades, white, and black prevents unintentional bias towards a particular branch. The background is a muted camouflage created by the project lead and toned in similar shades of grey and white. The navigation buttons and decision buttons are toned a dark grey with black text. The content text is black with a few exceptions—the VA Crisis Hotline number presents in red to call attention to its placement and blue denotes a hyperlink.

Font

The location and size of the text is consistent throughout to present a uniform appearance. The uniformity enhances visual appearance and prevents distraction from the content (U.S. Department of Health & Human Services, n.d). The page titles display in a Stencil font type, size 36, to mimic a font commonly found on military utility items and equipment. The remaining text

displays in "Calibri (Body)" font type, size 11.5. Decision buttons are "Calibri (Body)" font type, size 11.

Spacing Template

 An application spacing template applied to the pages maintains uniformity and is built on a simulated screen that approximates the dimensions of the latest Android™ smartphone (2.45" x 4.3"). The uniformity enhances visual appearance, emphasizing that all the elements belong together, and prevents unnecessary bias of any piece of information given greater weight than another simply due to the text size or placement (U.S. Department of Health & Human Services, n.d). The largest portion of text content is center aligned and contained within a text box measuring approximately 2.15" x 2.65". With the template in place, all text locations and navigation buttons remain static throughout the pages.

Command Buttons

 User-interface control buttons define the optimum navigation pathway and ensures the user lands in the correct location after selecting the learning path. The click-pathway should present the easiest method of navigation to reach the desired location in the shortest amount of time (Sauro, 2011a). Each page in the app is equipped with static user-interface control buttons. The user should easily recognize the navigation functions demarcated with icons similar to those found on standard remote controls. The navigation buttons represent *Return to Prior Decision Point*, *Back*, *Forward*, *Skip to Sources*, *Home*, and *Close*. The buttons are co-located in the upper right-hand corner for ease of access based upon where the thumb would naturally rest on the smartphone, with the exit button closest to the upper right margin for rapid access. The

navigation buttons are approximately the same size as the touch screen buttons found on the QWERTY keyboard of a smartphone, measuring approximately 0.25" x 0.25".

Decision command buttons are considerably larger than the navigation buttons, denoting their use in changing between module dashboards. These buttons change between module content and are labeled, for example, as *Learn, Relax*, *What is PTSD?*, *Treatment Options*, *Depression*, and *Suicide*, depending on the module location. The dashboard command buttons measure approximately 2" x 0.3" and appear no more than six to a page in a 2" x 2.26" area.

Depending on the module content and page, buttons are deactivated to control movement through the application. At this point, the first-click analysis ensures all linking structures are intact. Navigation through the app is functioning properly.

Dashboards

Dashboards consist of multiple decision command buttons to individualize the learning experience. A relationship hierarchy represents the decision points and defines what topics the reader would expect to find when selecting any of the decision command buttons. An example of this hierarchy (Appendix C) includes selecting *Agree* on the introductory page, then *Learn More* on the home screen, then *What is PTSD*?, for which information is presented on etiology, diagnosis criteria from the DSM-5, and prevalence.

<div align="center">

Content Development

</div>

SAM ♦ SAT includes nearly 100 pages of educational material. The sources are presented in Table 3, grouped according to module topic. Such sources include information found within scholarly addictive behavior, mental health, public health, alternative medicine, traumatic stress, and military trauma journals, and websites, such as the National Center for PTSD and the U.S.

Department of Health and Human Services. The survey questionnaire was taken directly from

PTSD Checklist DSM-V (PCL-5), and assists with a provisional diagnosis of PTSD, before

using the provider-administered PTSD scales. The PLC-5 "assessment tool [was] created by

government employees and therefore [is] not copyrighted" (Mott, 2014). Other informational

sources include behavioral health and internal medicine textbook citations. The yoga breathing

method was adapted from a yoga breathing guide for beginners.

TABLE 3. SAM ♦ SAT Sources.

Module	Sources
PTSD Basics	Angkaw et al., 2013; Back, Killeen, Teer, & Hartwell, 201; Baiocchi, 2013; Johnson, Krystal, & Southwick, 2008; Kudler, 201; Hoge, 2012; National Center for PTSD, 2013.
Treatment Options	Descilo et al., 2010; Haija & Kolasinski, 2013; Kim et al., 2013; Michels, Brown, & Steadman, 2011; Mitchell et al., 2014; Seppala, Nitschke, Tudorascu, Hayes, & Goldstein, 2014; van der Kolk et al., 2014; Zope & Zope, 2013.
Depression	Cole, Christensen, Raju, Cohen, & Feldman, 2008; Stander, Thomsen, & Highfill-McRoy, 2014; Wells, LeardMann, Fortuna, Smith, & Smith, 2010.
Substance Abuse	Back, Killeen, Teer, & Hartwell, 2014; Jacobson et al., 2008; Wells, LeardMann, Fortuna, Smith, & Smith, 2010.
Aggression and Violence	Angkaw et al., 2013; Reardon et al., 2014; Taft, Vogt, Marshall, Panuzio, & Niles, 2007; Taft et al., 2009; Thompson & Winstead, 2008.
Sleep Disturbances	Germain & Zadra, 2009; Seelig et al., 2010; Ropper & Samuels, 2014; Williams, Collen, Orr, Holley, & Lettieri, 2014.
Suicide	Crosby, Han, Ortega, Parks, & Gfroerer, 2011; Jakupcak et al., 2009; Rojas, Bujarskia, Babsonb, Duttona, & Feldnera, 2014.
PTSD Questionnaire	Weathers et al., 2013.
Relax	Rosen, 2012; Saxena & Saxena, 2009; Sodhi, Singh, & Bery, 2014.

Findable and Valuable

Veterans and service members can access the application through any smartphone with

Internet access. Plans require the final app to be uploaded to GoogleApps™ where persons can

download it free of charge, day or night, and can be used in any location with which the

individual feels comfortable. GoogleApps™ search tags include *SAM ♦ SAT*, *self-help*, *PTSD*,

depression, *anger*, *aggression*, *alcohol*, *insomnia*, *sleep*, *stress*, *yoga*, *deep breathing*, and

meditation. These tags enhance the likelihood of application search retrieval.

SAM ♦ SAT Usability and Reliability Evaluation

Evaluation of the new application noted a SUS score of 87.5 (Table 4: System Usability

Scale Evaluation Results of SAM ♦ SAT). Recall, the *PTSD Coach* app scored a 50 on the SUS.

Additionally, evaluation of the new application noted successful inclusion of all eight HONcode

criteria (Table 5). The evaluations were conducted by the project lead.

TABLE 4. System Usability Scale Evaluation Results of SAM ♦ SAT.

Question Number	Question	Scale Position	Points
1	I think that I would like to use this system frequently.	4	3
2	I found the system unnecessarily complex.	1	4
3	I thought the system was easy to use.	4	3
4	I think that I would need the support of a technical person to be able to use this system.	2	3
5	I found the various functions in this system were well integrated.	4	3
6	I thought there was too much inconsistency in this system.	1	4
7	I would imagine that most people would learn to use this system very quickly.	5	4
8	I found the system very cumbersome to use.	1	4
9	I felt very confident using the system.	4	3
10	I needed to learn a lot of things before I could get going with this system.	1	4
Total			35

Notes. Score: 35* 2.5 = 87.5. Scale Position: Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree (5). Score calculation: "For items 1, 3, 5, 7, and 9 the score contribution is the scale position minus 1. For items 2, 4, 6, 8 and 10, the contribution is 5 minus the scale position. Multiply the sum of the scores by 2.5 to obtain the overall value of SU" (Sauro, 2011b)

TABLE 5. HONcode Criteria Evaluation Results of SAM ♦ SAT.

Criteria	Description	Rationale	Pass/Fail
Authoritative	Author qualifications[1]	The application offers authors credentials on the home page.	Pass
Complementarity	Supports seeking professional assistance[1]	The first page presents the disclosure of no intent to treat.	Pass
Privacy	Protects data, respects privacy[1]	The app does not collect user data and offers the option to read or listen to the relax content.	Pass
Attribution	Cites sources[1]	Each section ends with sources.	Pass
Justifiability	Supports claims[1]	The application makes no claims to the benefits of its use.	Pass
Transparency	Provides contact information[1]	The author page includes how to contact the author.	Pass
Financial Disclosure	Reports sources of funding[1.]	The author page contains funding disclosures.	Pass
Advertising	Makes user aware of content that is ad material[1]	The application does not contain ads.	Pass

[1] (HONCode, 2014).

Data Collection and Analysis Proposal

It was beyond the scope of this DNP project to launch and evaluate the app. I do anticipate conducting a pilot test of approximately 10 users in order to obtain feedback on the content, structure, and usability. By doing this, I will have the opportunity to modify the apps design as new information evolves. After a series of small-scale implementation and adaption, the design would be launched on GoogleApps™ for open access.

Summary

Creating the PTSD application on the parallel design platform included addressing aesthetics, readability, and attempts to address reliability, uniformity, and simplicity. The use of navigation buttons, consistent design, and reading level geared to the average reader helps assure clear materials are presented to the patient. The entire app, including content, is contained in Supplement A.

CHAPTER 5: DISCUSSION

PTSD remains the focus of public and official concern for veterans and service members returning from current war efforts in Iraq and Afghanistan. The stresses of home life, deployment to hostile countries, and repeated combat exposure increases the risk of mental health disorders in those who have served. Many do not seek professional treatment for fear of career-ending repercussions, thereby lacking access to much needed resources to overcome the traumatic event. There is a noted lack of reliable, user-friendly, mental health apps available for PTSD information and there exists a need for a study to address the feasibility of using yoga-breathing techniques delivered by smartphone in PTSD symptom improvement.

Awareness of these deficiencies brought forth the idea used in the completion of this project. After a thorough literature review, evaluation of a current app on the market using industry standard measures for usability and reliability, it was determined there is a potential for an internet-based application to bridge the gap in care. This project presents SAM ♦ SAT to address these needs. SAM ♦ SAT offers nearly 100 pages of interactive, reliable, up-to-date information on PTSD, and presents a technologically advanced approach to the delivery of relaxation techniques through mHealth applications. This chapter discusses what I anticipate might discusses barriers to its use, study limitations, lessons learned, and implications for practice.

Barriers to Using SAM ♦ SAT

The use of the SAM ♦ SAT application is contingent on possessing a smartphone; without a smartphone the user is unable to download and use the application. I do make the assumption that many military and retired military personnel possess a smartphone, so my hope

is that this app will reach many of these veterans and service members. Unfortunately, I am also aware that veterans on limited incomes may not be able to afford such technology and consequently will not have access to the app. If there is concern for this problem, the parallel design is a viable alternative and can be released on file sharing platforms.

The app is presented in English, and designed to meet approximately an 8th grade reading level. Accordingly, those who do not read English may have difficulty understanding the content. If the app is successful, translation to an alternate language would be considered.

An additional barrier to SAM ♦ SATs use relates to user awareness of its existence. Even though plans call for the app to be available on GoogleApps™, and search terms increase the likelihood of retrieval when searching for PTSD apps, unless users are aware of its presence, it will be lost in the multitude of unreliable PTSD apps on the market. It is hoped that awareness of SAM ♦ SATs existence will begin with a social media campaign, because successful diffusion of innovation occurs through social connections spreading awareness and connecting users who know about the app to users who do not (Cain & Mittman, 2002).

Lessons Learned

The survey associated with the app will be used to evaluate stress improvement from an app that teaches a relaxation technique, specifically yogic breathing. Analysis of success hinges upon user reports of symptom improvement presented in the pre-test survey and the exit survey. Discoveries after building the surveys noted that, in order to maintain anonymity, the surveys needed to be combined into a single survey. Separate surveys do not force the individual to take both surveys, nor does it link noted improvement to an individual who reports a prior stress state.

This is correctable by correlating login or IP data to the same user for each test, but privacy concerns, the time required, and the potential for errors in linking results negate this.

To overcome this, the two surveys were redesigned into a single survey. Changes to the survey reflect the necessary updates and are marked by asterisks (Appendix D). This also necessitated a change in the app design and hierarchy (Appendix E). The changes can be seen in the *Home* decision point.

Implications for Practice

First, there exists a significant market for providing patient education through apps. An in-depth market analysis released this year indicates there are more than 100,000 mHealth apps available on either Android™ or Apple™ platforms, with numbers expected to climb in the next five years (Research2Guidance, 2014). Apps are gaining ground in underserved locations as a way to bridge the gap to providers in remote areas, and can help overcome high patient to provider ratios in underserved areas (World Health Organization, 2011; Jones, et al., 2014).

The use of an app also provides a gateway to treatment used when persons are unable or unwilling to connect directly with providers, as is often the case with PTSD sufferers. Use of SAM ♦ SAT has the potential to improve the lives of persons suffering with PTSD by not only providing education to answer questions regarding their own symptoms, or symptoms of others, and connecting persons to emergency resources for crisis aversion, but also by providing a tool with which to overcome the stress state *before* it becomes a crisis. Further, because the app contains a modular design, the modules essentially act as building blocks that are interchangeable with a variety of content, lending to app generalizability for other uses. If the results of the data collections and evaluation indicate the need, the relaxation method in the

current design has the potential for modification to suit other methods of relaxation easily lifting out and interchanging with another method. Change in the relaxation technique would initiate re-evaluation in the implementation framework process.

Lastly, this app can assist with research into alternative interventions to improve patient outcomes. Embedding surveys within SAM ♦ SAT, no matter which CAM method is used, provides a way to collect data anonymously, using limited resources. Collection of such data for each intervention deployment may present statistically and clinically significant findings of successful CAM use by PTSD sufferers to denote the need for more research in CAM and mHealth combinations.

Essentially, if yoga breathing does not work in this environment, this app is capable of lifting out that module and reconnecting a new CAM to evaluate. Or, if yoga breathing does work, but the PTSD information is too dense, this app is capable of lifting out the PTSD module and substituting smaller content like individual comorbidities. The cyclic nature of the PDSA model allows for such changes and re-evaluation, presenting an opportunity to find the right combination of mHealth and CAM.

Application Validation

SAM ♦ SAT was evaluated for validity by a specialist in rehabilitative psychology, Dr. Tamar Martin, Hunter College, City University of New York (Appendix F). Dr. Martin has experience as a senior psychologist working with Traumatic Brain Injury, founded Veteran Anglers of New York, and is the Regional Coordinator, Mid-Atlantic Region, of Project Healing Waters Fly Fishing, Inc., which helps veterans adjust to their new abilities. Dr. Martin believes

the application "incorporates valid and reliable information regarding an alternative approach to address the impact of PTS on members of our Military family" (Martin, 2014).

Limitations

A noted limitation relates to bias evaluation of the current intervention, *PTSD Coach*. As the SUS evaluation is subjective, initial measurement of the SUS criteria to determine usability of the *PTSD Coach* could have been affected by unintentional bias. To attempt to mitigate this bias, I took the questionnaire prior to reading the scoring guide. Applying the same method of evaluation to SAM ♦ SAT presents additional inherent bias, as the designer of the new application I would unconsciously favor my own design. Fortunately, applying the objective HONcode principles to both *PTSD Coach* and SAM ♦ SAT does not present a chance for bias, as the criteria are either addressed or not.

A second limitation noted with the creation of the application relates to implementation and survey participation. While resource constraints prevent the deployment of this new app to users now, the plan for data collection is in place to begin when the time is ideal. Unfortunately, since approximately 500 responses are to be collected prior to survey closure, and participation is voluntary through the Diffusion of Innovation process, it is unknown how long it would take to obtain 500 responses. Additionally, as this survey is anonymous, it is impossible to exclude participants from responding who are outside the target age range, and do not exhibit PTSD symptoms, or to prevent persons from responding multiple times. While the survey does require the participant to select an age range, there is no control to select the appropriate range. I hope that the outliers would be evident in data analysis.

In addition, as with any statistical analysis, the results are only as good as the data collected. Unfortunately, with a LIKERT scale, results may be rated agree, neutral, or disagree because of central tendency bias and respondent hesitance to use the extreme values of strongly agree or strongly disagree. This is an unfortunate part of such measurement scales, and attempts to overcome such biases mitigated with grouping positives and negatives for data analysis.

Recommendations

Based upon the literature review of complimentary alternative medicine, along with a review of PTSD applications available, I recommend piloting the use of this application to educate patients on PTSD prevalence, diagnosis, major comorbidities, and treatment options, as well as teach a yoga breathing technique to relax. I recommend the piloting of this application initially with 10 participants and evaluating the application design. Eventually, when the application is ready, I recommend opening the access to the app until there are approximately 500 survey responses (to account for potential outlier data corruption) and lessen the chance of statistical errors. Further, I recommend the results of the data analysis be reviewed for determination of further research in the combination of mHealth apps and CAM in the treatment of PTSD symptoms.

Summary

This DNP project created an app that addresses the deficits noted in the intervention available for providing education and reducing PTSD symptoms, after a literature review determined the potential need for apps in the mental health arena created by providers. The design is user-friendly, aesthetically pleasing, and based upon reliable information found in journals, medical text, and DSM-V questionnaires. The design of the survey embedded within

the app presents a method with which to evaluate the success of the application and can be applicable to any intervention imbedded within the app. Awareness of this apps existence will hopefully spread by social media, and its use by those experiencing PTSD/PTSD-like symptoms will bridge the gap from patient to provider, supporting the persons need for relaxation techniques and education until they are ready to seek professional care.

APPENDIX A:

SAM ♦ SAT POST-TEST

SAM: SAT POST-TEST

What is your age?
O 18 to 24
O 25 to 34
O 35 to 44
O 45 to 54
O 55 to 64
O 65 to 74
O 75 or older

What is your gender?
O Female
O Male

Evaluate the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I experienced a reduction in my stress level.	O	O	O	O	O
I learned a new method that will help me relax in the future.	O	O	O	O	O
I plan to use this relaxation method in the future.	O	O	O	O	O
I increased my knowledge on PTSD and related symptoms.	O	O	O	O	O
I learned where I can go for help if I am in crisis.	O	O	O	O	O
I will recommend this app to others.	O	O	O	O	O
I will use this app again.	O	O	O	O	O

APPENDIX B:

SAM ♦ SAT USABILITY AND RELIABILITY

SAM: SAT USABILITY AND RELIABILITY

Evaluate the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I think that I would like to use this system frequently.	O	O	O	O	O
I found the system unnecessarily complex.	O	O	O	O	O
I thought the system was easy to use.	O	O	O	O	O
I think that I would need the support of a technical person to be able to use this system.	O	O	O	O	O
I found the various functions in this system were well integrated.	O	O	O	O	O
I thought there was too much inconsistency in this system.	O	O	O	O	O
I would imagine that most people would learn to use this system very quickly.	O	O	O	O	O
I found the system very cumbersome to use.	O	O	O	O	O
I felt very confident using the system.	O	O	O	O	O
I needed to learn a lot of things before I could get going with this system.	O	O	O	O	O

	Yes	No
Does the app encourage you to seek professional assistance if needed?	O	O
Does the app maintain your privacy during its use?	O	O
Does the app list an author?	O	O
Does the app provide the authors' credentials?	O	O
Does the app provide the authors' contact information?	O	O
Does the app provide information on content sources?	O	O
Does the app provide information on the source(s) of funding?	O	O
Does the app provide the date of last content update?	O	O

APPENDIX C:

FIGURE 1. RELATIONSHIP HIERARCHY

FIGURE 1. Relationship Hierarchy

APPENDIX D:

UPDATED SAM ♦ SAT POST-TEST

UPDATED:

SAM: SAT POST-TEST

What is your age?
O   18 to 24
O   25 to 34
O   35 to 44
O   45 to 54
O   55 to 64
O   65 to 74
O   75 or older

What is your gender?
O   Female
O   Male

Evaluate the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
*Before reviewing the relaxation method, I was experiencing an elevated stress level.	O	O	O	O	O
*After reviewing the relaxation method, I experienced a reduction in my stress level.	O	O	O	O	O
I learned a new method that will help me relax in the future.	O	O	O	O	O
I plan to use this relaxation method in the future.	O	O	O	O	O
I increased my knowledge on PTSD and related symptoms.	O	O	O	O	O
I learned where I can go for help if I am in crisis.	O	O	O	O	O
I will recommend this app to others.	O	O	O	O	O
I will use this app again.	O	O	O	O	O

* denotes changed questions

APPENDIX E:

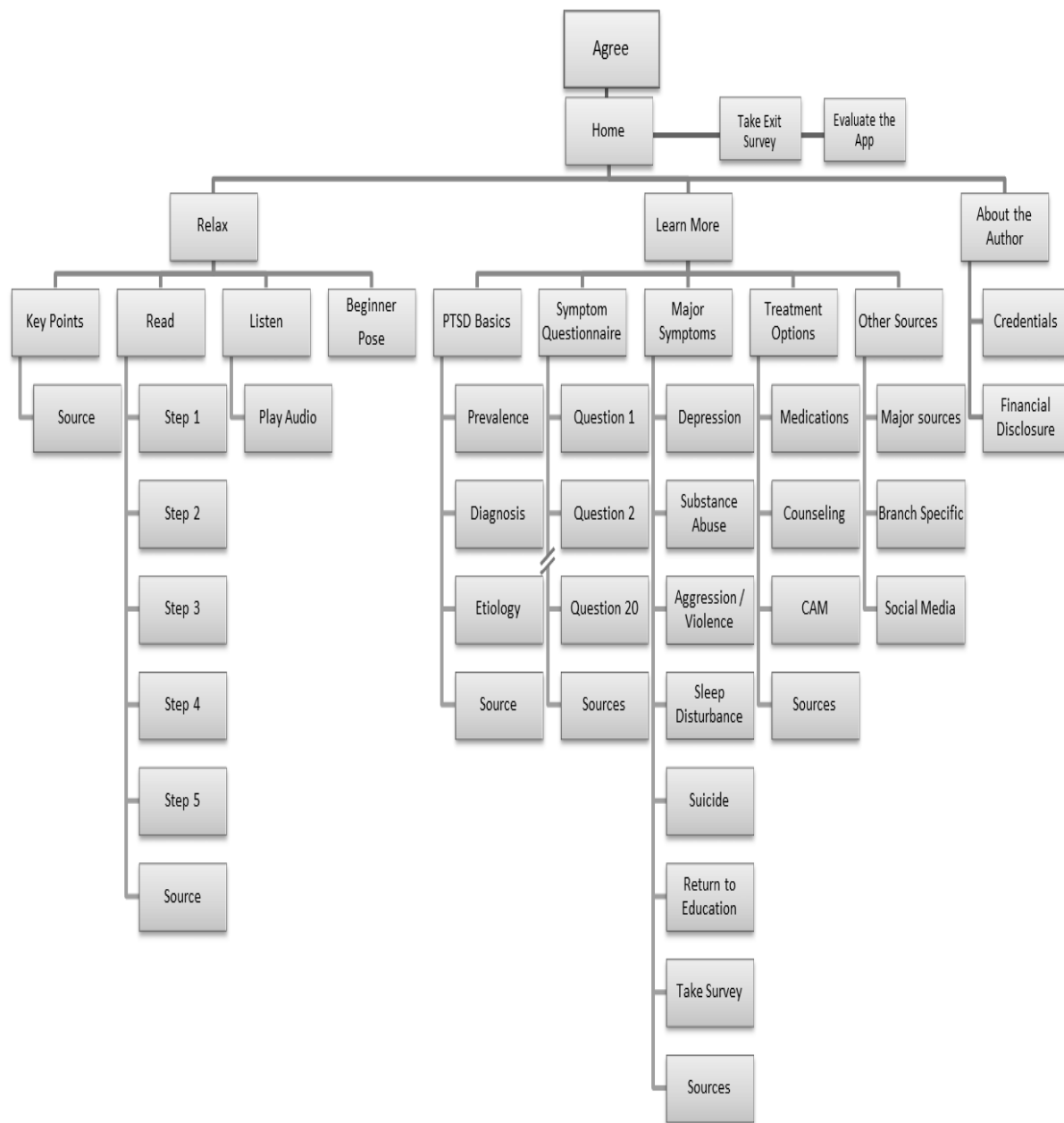FIGURE 2. CORRECTED RELATIONSHIP HIERARCHY

FIGURE 2. Corrected Relationship Hierarchy

APPENDIX F:

EXPERT VALIDATOR

HUNTER
The City University of New York

Department of Educational Foundations, Programs in Counselor Education

November 6, 2014

Jennifer Creighton, BSN, RN
AG/ACNP Doctoral Candidate
University of Arizona
jennifer.creighton@hotmail.com

Dear Jennifer,

Thank you for asking me to review your proposal for a new application to address the impact of PTS on our Service members. The SAM : SAT is a thorough document that includes relevant and current information regarding PTS, symptoms, treatment options, and comorbidity. I believe you are seeking an opportunity to address these issues through the use of an "application" that utilizes a complementary and alternative method (CAM) that is part of the emerging approaches to employ a more holistic approach to treatment for Veterans.

Based on my review, your proposal reflects current research and incorporates valid and reliable information regarding an alternative approach to address the impact of PTS on members of our Military family.

Sincerely,

Tamar C. Martin, Ph.D., CRC

APPENDIX G:

IRB FORM F-309

FORM: Human Research Determination	
NUMBER	**FORM DATE**
F309	01/2014

ARIZONA

SECTION 3: SIGNATURES

Note that any changes made to this protocol <u>after receiving Scientific/Scholarly Reviewer confirmation</u> will need to be re-submitted and re-reviewed

1. PRINCIPAL INVESTIGATOR (REQUIRED)

By signing below, I, the Principal Investigator, certify that I have accurately answered the items listed and believe that the proposed activity does not constitute engagement in Human Research according to DHHS or FDA regulations.

Signature	9/18/2014 Date	Jennifer Creighton, College of Nursing Print Name & Department
Advisor Signature	10/31/2014 Date	Kate Sheppard College of Nursing Print Name & Department

2. SCIENTIFIC/SCHOLARLY REVIEW (REQUIRED; CANNOT BE A MEMBER OF THE PROJECT)

Based on the information provided by the Principal Investigator, I have determined that this project does not constitute Human Research.

Signature	TED PIGNEY Print Name
Title	11/17/14 Date

Place this completed and signed form, along with the protocol, in your personal files and in other files as directed by your advisor or department authority. **DO NOT SEND TO HSPP.**

REFERENCES

AHRQ. (2008). *Plan-Do-Study-Act (PDSA) Cycle*. Retrieved from Agency for Healthcare Research and Quality: http://www.innovations.ahrq.gov/content.aspx?id=2398

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders.* Arlington: American Psychiatric Publishing.

Angkaw, A., Ross, B. S., Pittman, J., Kelada, A., Valencerina, M., & Baker, D. (2013). Post-traumatic stress disorder, depression, and aggression in OEF/OIF veterans. *Military Medicine*, 1044-1050.

Back, S. E., Killeen, T. K., Teer, A. P., & Hartwell, E. E. (2014). Substance use disorders and PTSD: An exploratory study of treatment preferences among military veterans. *Addictive Behaviors*, 369–373.

Baiocchi, D. (2013). *Measuring Army Deployments to Iraq and Afghanistan.* Santa Monica: RAND Corporation.

Bigelow, R. (2013). Chapter 5. Introduction to Clinical Experimentation. In R. Lopes, & R. Harrington, *Understanding Clinical Research.* New York: McGraw-Hill.

Bureau of Labor Statistics. (2014). *Occupational Outlook Handbook, 2014-15 Edition: Military Careers*. Retrieved from U.S. Department of Labor: http://www.bls.gov/ooh/Military/Military-Careers.htm#tab-3

Cain, M., & Mittman, R. (2002). *Diffusion of Innovation in Health Care.* Retrieved from Institute for the Future: http://www.chcf.org/~/media/MEDIA%20LIBRARY%20Files/PDF/D/PDF%20DiffusionofInnovation.pdf

CGFNS International. (2013). *Happtique Publishes Final Standards for Mobile Health App Certification Program*. Retrieved from CGFNS International: Global Credibility: http://www.cgfns.org/2013/02/happtique-publishes-final-standards-for-mobile-health-app-certification-program/

Cole, S., Christensen, J., Raju, C. M., Cohen, H., & Feldman, M. (2008). Chapter 22. Depression. In M. Feldman, & J. Christensen (Eds.), *Behavioral Medicine: A Guide for Clinical Practice.* New York: McGraw-Hill.

Crosby, A. E., Han, B., Ortega, L. A., Parks, S. E., & Gfroerer, J. (2011). *Suicidal Thoughts and Behaviors Among Adults Aged ≥18 Years --- United States, 2008-2009.* Atlanta: National Center for Injury Prevention and Control, Division of Violence Prevention.

Dawson, B., & Trapp, R. (2004). Chapter 11. Survey Research. In *Basic & Clinical Biostatistics.* New-York: McGraw-Hill.

Department of Veterans Affairs. (n.d.). PTSD Coach. National Center for PTSD.

Descilo, T., Vedamurtachar, A., Gerbarg, P., Nagaraja, D., Gangadhar, B., Damodaran, B., . . . Brown, R. (2010). Effects of a yoga breath intervention alone and in combination with an exposure therapy for post-traumatic stress disorder and depression in survivors of the 2004 South-East Asia tsunami. *Acta Psychiatrica Scandinavica*, 289-300.

Dick, A., Niles, B., Street, A., DiMartino, D., & Mitchell, K. (2014). Examining mechanisms of change in a yoga intervention for women: The influence of mindfulness, psychological flexibility, and emotion regulation on PTSD symptoms. *J Clin Psycho*, pub ahead of print.

Dolan, B. (2013, Dec). *Happtique Suspends Mobile Health App Certification Program.* Retrieved from MobiHealthNews: http://mobihealthnews.com/28165/happtique-suspends-mobile-health-app-certification-program/

Eysenbach, G. (2014). Development of an evidence-based mHealth weight management program using a formative research process. *JMIR Mhealth Uhealth*, ePub ahead of print.

Germain, A., & Zadra, A. (2009). Dreams and nightmares in PTSD. In L. Squire (Ed.), *Encyclopedia of Neuroscience* (pp. 665-661). Salt Lake City: Academic Press.

Haija, A., & Kolasinski, S. (2013). Chapter 74. Complementary & Alternative Therapies. In J. Imboden, D. Hellmann, & J. Stone (Eds.), *CURRENT Rheumatology Diagnosis & Treatment.* New York: McGraw-Hill.

Heavey, E. (2011). *Statistics for Nursing.* Sudbury: Jones & Bartlett Learning.

Hoge, C. (2012). Chapter e48. Neuropsychiatric Illnesses in War Veterans. In *Harrison's Principles of Internal Medicine, 18e.* (pp. Longo, D.L.; Fauci, A.S.; Kasper, D.L.; Hauser, S.L.; Jameson, J.; Loscalzo, J.). New York: McGraw-Hill.

HONcode. (2014). *The HON Code of Conduct for Medical and Health Web Sites (HONcode).* Retrieved from HONCode: http://www.hon.ch/HONcode/Patients/Visitor/visitor.html

Jacobson, I. G., Ryan, M. A., Hooper, T. I., Smith, T. C., Amoroso, P. J., Boyko, E. J., . . . Bell, N. S. (2008). Alcohol use and alcohol-related problems before and after military combat deployment. *JAMA*, 663–675.

Jakupcak, M., Cook, J., Imel, Z., Fontana, A., Rosenheck, R., & McFall, M. (2009). Posttraumatic stress disorder as a risk factor for suicidal ideation in Iraq and Afghanistan war veterans. *Journal of Traumatic Stress*, 303–306.

Johnson, D., Krystal, J., & Southwick, S. (2008). Chapter 20. Posttraumatic Stress Disorder and Acute Stress Disorder. In M. Ebert, P. Loosen, B. Nurcombe, & J. Leckman (Eds.), *CURRENT Diagnosis & Treatment: Psychiatry.* New York: McGraw-Hill.

Jones, S. P., Patel, V., Saxena, S., Radcliffe, N., Al-Marri, S. A., & Darzi, A. (2014). How Google's 'Ten things we know to be true' could guide the development of mental health mobile apps. *Health Affairs*, 1603-1611.

Kamel-Boulos, M. N., Brewer, A. C., Karimkhani, C., Buller, D. B., & Dellavalle, R. P. (2014). Mobile medical and health apps: State of the art, concerns, regulatory control and certification. *Online Journal of Public Health Informatics*, e1-23.

Kim, S. H., Schneider, S. M., Bevans, M., Kravitz, L., Mermier, C., Qualls, C., & Burge, M. R. (2013). PTSD symptom reduction with mindfulness-based stretching and deep breathing exercise: Randomized controlled clinical trial of efficacy. *J Clin Endocrinol Metab*, 2984-2992.

Kudler, H. (2012). Chapter 267. Combat Stress and Related Disorders. In S. McKean, J. Ross, R. D. Dressle, D. Brotman, & G. J. Ginsber (Eds.), *Principles and Practice of Hospital Medicine.* New York: McGraw-Hill.

Martin, T. (2014, Nov 06). (J. Creighton, Interviewer)

Michels, P., Brown, R., & Steadman, M. (2011). Chapter 53. Anxiety Disorders. In J. South-Paul, S. Matheny, & E. Lewis, *CURRENT Diagnosis & Treatment in Family Medicine.* New York: McGraw-Hill.

Mitchell, K. S., Dick, A. M., DiMartino, D. M., Smith, B. N., Niles, B., Koenen, K. C., & Street, A. (2014). A pilot study of a randomized controlled trial of yoga as an intervention for PTSD symptoms inwomen. *Journal of Traumatic Stress*, 121–128.

Mobasheri, M., Johnston, M., King, D., Leff, D., Thiruchelvam, P., & Darzi, A. (2014). Smartphone breast applications - What's the evidence? *Breast*, ePub ahead of print.

Morville, P. (2004). *User Experience Design*. Retrieved from Semantic Studios: http://semanticstudios.com/user_experience_design/

Mott, J. (2014, 9 16). PTSD assessments. (J. Creighton, Interviewer)

Nash, W. (2013, March). *Military Trauma: Combat Stress Injuries*. Retrieved from National Center for PTSD: http://www.ptsd.va.gov/m/Professional/PTSD_101/Transcripts/combat-stress-injuries.pdf

National Center for PTSD. (2013). *Epidemiology of PTSD.* Retrieved from Department of Veteran Affairs: http://www.ptsd.va.gov/m/Professional/PTSD_101/Transcripts/epidemiology.pdf

National Center for PTSD. (2014). *DSM-5 Criteria for PTSD.* Retrieved from U.S. Department of Veterans Affairs: http://www.ptsd.va.gov/professional/PTSD-overview/dsm5_criteria_ptsd.asp

Nursing Theories. (2013). *Sister Callista Roy - Nursing Theorist.* Retrieved from Nursing Theories: http://nursing-theory.org/nursing-theorists/Sister-Callista-Roy.php

Olff, M., Polak, A., Witteveen, A. B., & Denys, D. (2014). Executive function in posttraumatic stress disorder (PTSD) and the influence of comorbid depression. *Neurobiology of Learning and Memory*, 114–121.

O'Neill, S., & Brady, R. (2012). Colorectal smartphone apps: opportunities and risks. *Colorectal Disease*, e530-4.

Perrett, S. E., & Biley, F. C. (2013). A Roy model study of adapting to being HIV positive. *Nursing Science Quarterly*, 337-343.

Reardon, A. F., Hein, C. L., Wolf, E. J., Prince, L. B., Ryabchenko, K., & Miller, M. W. (2014). Intermittent explosive disorder: Associations with PTSD and other Axis I disorders in a US military veteran sample. *Journal of Anxiety Disorders*, 488–494.

Research2Guidance. (2014). *mHealth App Developer Economics 2014.* Berlin: Research2Guidance.

Rojas, S. M., Bujarskia, S., Babsonb, K. A., Duttona, C. E., & Feldnera, M. T. (2014). Understanding PTSD comorbidity and suicidal behavior: Associations among histories of alcohol dependence, major depressive disorder,and suicidal ideation and attempts. *Journal of Anxiety Disorders*, 318–325.

Ropper, A., & Samuels, M. (2014). Chapter 19. Sleep and Its Abnormalities. In A. Ropper, & M. Samuels (Eds.), *Adams & Victor's Principles of Neurology, 10e.* New York: McGraw-Hill.

Rosen, R. (2012). *The Yoga of Breath: A Step-by-Step Guide to Pranayama .* Boston: Shambhala Publications.

Rudd, R. E. (n.d.). *Guidelines for Rewriting Materials: Resources for Devloping and Assessing Materials.* Retrieved from Harvard School of Public Health: http://cdn1.sph.harvard.edu/wp-content/uploads/sites/135/2012/09/resources_for_rewriting_materials.pdf

Sauro, J. (2011a). *Getting the First Click Right*. Retrieved from Measuring Usability : http://www.measuringu.com/blog/first-click.php

Sauro, J. (2011b). *Measuring Usability with the System Usability Scale (SUS)*. Retrieved from Measuring Usability : http://www.measuringusability.com/sus.php

Saxena, T., & Saxena, M. (2009). The effect of various breathing exercises (pranayama) in patients with bronchial asthma of mild to moderate severity. *Int J Yoga*, 22–25.

Seelig, A. D., Jacobson, I. G., Smith, B., Hooper, T. I., Boyko, E. J., Gackstetter, G. D., . . . Smith, T. C. (2010). Sleep patterns before, during, and after deployment to Iraq and Afghanistan. *Sleep*, 1615-1622.

Segman, R., & Shalev, A. (2003). Genetics of posttraumatic stress disorder. *CNS Spectrums*, 693-8.

Seppala, E. M., Nitschke, J. B., Tudorascu, D. L., Hayes, A., & Goldstein, M. R. (2014). Breathing-based meditation decreases posttraumatic stress disorder symptoms in U.S. military veterans: A randomized controlled longitudinal study. *Journal of Traumatic Stress*, 397–405.

Sodhi, C., Singh, S., & Bery, A. (2014). Assessment of the quality of life in patients with bronchial asthma, before and after yoga: A randomised trial. *Iran J Allergy Asthma Immuno*, 55-60.

Stander, V., Thomsen, C., & Highfill-McRoy, R. (2014). Etiology of depression comorbidity in combat-related PTSD: A review of the literature. *Clinical Psychology Review*, 87–98.

Strauss, J., & Lang, A. (2012). Complementary and alternative treatments for PTSD. *PTSD Research Quarterly, 23*(2), pp. e1-7.

Taft, C. T., Vogt, D. S., Marshall, A. D., Panuzio, J., & Niles, B. L. (2007). Aggression among combat veterans: Relationships with combat exposure and symptoms of posttraumatic stress disorder, dysphoria, and anxiety. *Journal of Traumatic Stress*, 135–145.

Taft, C. T., Weatherill, R. P., Woodward, H. E., Lavinia A. Pinto, M. L., Miller, M. W., & Dekel, R. (2009). Intimate partner and general aggression perpetration among combat veterans presenting to a posttraumatic stress disorder clinic. *American Journal of Orthopsychiatry*, 461–468.

Thompson, J., & Winstead, D. (2008). Chapter 28. Impulse-Control Disorders. In M. Ebert, P. Loosen, B. Nurcombe, & J. Leckman (Eds.), *Current Diagnosis & Treatment: Psychiatry, 2e.* New York: McGraw-Hill.

Tyagi, E., Agrawal, R., Zhuang, Y., Abad, C., Waschek, J., & Gomez-Pinilla, F. (2013). Vulnerability imposed by diet and brain trauma for anxiety-like phenotype: Implications for post-traumatic stress disorders. *PLoS One*, e57945.

U.S. Department of Health & Human Services. (n.d.). *User-Centered Design Process Map*. Retrieved from Usability.gov: http://www.usability.gov/how-to-and-tools/resources/ucd-map.html

U.S. Department of Health and Human Services. (2014). *Facts-at-a-Glance and Mission* . Retrieved from National Center for Complementary and Alternative Medicine: http://nccam.nih.gov/about/ataglance

U.S. Food and Drug Administration. (2014). *Mobile Medical Applications*. Retrieved from U.S. Food and Drug Administration: http://www.fda.gov/medicaldevices/productsandmedicalprocedures/connectedhealth/mobilemedicalapplications/default.htm

U.S. National Library of Medicine. (2013). *How to Write Easy-to-Read Health Materials*. Retrieved from MedLine Plus: http://www.nlm.nih.gov/medlineplus/etr.html

van der Kolk, B., Stone, L., West, J., Rhodes, A., Emerson, D., Suvak, M., & Spinazzola, J. (2014). Yoga as an adjunctive treatment for post traumatic stress disorder: A Randomized control trial. *Journal of Clinical Psychiatry*, e559-565.

VanElzakker, M. B., Dahlgren, M., Davis, C., Dubois, S., & Shin, L. M. (2014). From Pavlov to PTSD: The extinction of conditioned fear in rodents, humans, and anxiety disorders. *Neurobiology of Learning and Memory*, 3–18.

Watson, P. (2013, March). *Understanding Military Culture*. Retrieved from National Center for PTSD: http://www.ptsd.va.gov/m/Professional/PTSD_101/Transcripts/military_culture.pdf

Weathers, F., Litz, B., Keane, T., Palmieri, P., Marx, B., & Schnurr, P. (2013, August 14). *The PTSD Checklist for DSM-5 (PCL-5)*. Retrieved from National Center for PTSD: http://www.ptsd.va.gov/professional/assessment/documents/PCL-5_081413_508.pdf

Wells, T. S., LeardMann, C. A., Fortuna, S. O., Smith, B., & Smith, T. C. (2010). A prospective study of depression following combat deployment in support of the wars in Iraq and Afghanistan. *American Journal of Public Health*, 90-99.

Williams, S., Collen, J., Orr, N., Holley, A. B., & Lettieri, C. J. (2014). Sleep disorders in combat-related PTSD. *Sleep Breath*, 1-8e.

World Health Organization . (2011). *mHealth: New Horizons for Health Through Mobile Technologies*. Geneva: World Health Organization Global Observatory for eHealth.

Zope, S. A., & Zope, R. A. (2013). Sudarshan kriya yoga: Breathing for health. *International Journal of Yoga* , 4-10.