5-2015

Mindfulness as a Treatment Component for Adults Suffering from Post-Traumatic Stress Disorder

Johanna L. Hauck
St. Catherine University

Mindfulness as a Treatment Component for Adults Suffering from Post-Traumatic Stress Disorder

By

Johanna L. Hauck, LSW

MSW Clinical Research Proposal

Presented to the Faculty of the
School of Social Work
St. Catherine University and the University of St. Thomas
St. Paul, Minnesota
In partial fulfillment of the requirements for the degree of

Master of Social Work

Committee Members
David Roseborough, Ph.D.,
Kathleen Fargione, LICSW
Uta Wolfe, Ph.D.

The Clinical Research Project is a graduation requirement for MSW students at St. Catherine University/University of St. Thomas School of Social Work in St. Paul, Minnesota and is conducted within a nine-month time frame to demonstrate facility with basic social research methods. Student must independently conceptualize a research problem, formulate a research design that is approved by a research committee and the university Institutional Review Board, implement the project, and publicly present the findings of the study. This project is neither a Master's thesis nor a dissertation.

Table of Contents

Acknowledgements:

This nine-month project has taken me on a whirlwind through vast amounts of research studies and literature. I would like to thank everyone present for the ride – especially my amazing committee: David, Kathleen, and Uta. I would also like to recognize my Mom, Dad, and dear friends Cynthia and Fritz for listening to me chatter about PTSD and mindfulness with every opportunity I could; they never got tired of it. Most importantly, I'd like to acknowledge everyone who struggles with PTSD. Hopefully this paper will allow some comprehensive insight behind why the body functions as it does and ways to help combat the invisible pain many suffer. Cheers to you all!

Abstract

Mindfulness as a Treatment Component for Adults Suffering from Post-Traumatic Stress Disorder
By Johanna L. Hauck, LSW

Research Chair: David Roseborough, Ph.D
Committee Members: Kathleen Fargione, LICSW; Uta Wolfe, Ph.D

Post-Traumatic Stress Disorder has become a widely recognized and accepted mental health concern affecting many individuals. Various treatment approaches are used to alleviate the symptomology of this mental health condition including: different therapeutic approaches, psychotropic medication, and mindfulness. The purpose of this research project was to analyze and distill existing research pertaining to the neurological implications of trauma and mindfulness, with emphasis on how the latter is an effective treatment approach for the former. Data were analyzed in three phases: one, PTSD and Mindfulness; two, Mindfulness and the Brain and; three, Mindfulness and its Impact on the Brain for adults with PTSD. Findings show how that trauma not only impacts the three regions of the brain (hindbrain, midbrain, and forebrain), but a person's body as a whole. Findings suggest that mindfulness may positively counteract the effects of PTSD due to activating and influencing different areas of the brain, which have been deregulated after encountering trauma, with particular impact upon the structure and function of the brain.

Introduction

Mindfulness is a practice, or way of life, that has been embraced for over 2,500 years (Kabat-Zinn, 1990). Often practiced through meditation and yoga, this Eastern tradition has had a recent surge in Western society. Now more than ever, there are varieties of yoga classes, relaxation retreats, mindfulness-based stress reduction programs (MBSR), and other methods used to tame the calamities of everyday life.

In today's world, especially the Western world, the pace of life is fast and stressors are abundant. Mindfulness is a useful tool one may use to find their inner center throughout the day. This practice is used to promote an essence of calm and serenity within one's body even in the face of never ending work responsibilities, errands, familial obligations, and mental stressors.

Mindfulness, in the most basic term, is a moment-to-moment awareness, which focuses on both the good and bad (Kabat-Zinn, 1990). On an even more simplistic level: it is paying attention and being nonjudgmental. As this tradition has been practiced for centuries and has been shown to reduce stress, it may be surmised that something about being fully present benefits the human body (Kabat-Zinn, 1990).

Research has found that focusing and cultivating attention changes the neural and structural firing patterns in the brain (Siegel, 2012). When a person has control over their body they are better able to handle negative emotions, including stress and anxiety, which impact health and wellbeing. It has been found that anger and stress increase the amount of stress hormones throughout the body, which weakens a person's immune system causing more instances of heart disease and illness (Goleman, 1994). These discoveries suggest that learning to be mindful can be beneficial to all people regardless of age, race,

gender, or national origin, and empower individuals to take control of their life (Siegel, 2012).

Mindfulness and meditation practice involve a specific way of living. When one hears the word meditation they may envision yogis sitting in a crossed legged lotus position, or the image of the Buddha and eight-fold path. While the roots of these traditions stem from Eastern religion there is no standard of practice - but rather need to be viewed as ways in which one looks through his/her individual lens and interprets life. This includes being fully present in the moment and paying attention to thoughts, feelings, and physical sensations (Kabat-Zinn, 1990). Yes, this may be cultivated via yoga or sitting meditation, but also may be cultivated at the grocery store or within a crowd.

Scientific research shows that awareness practices produce changes within the human brain that may positively benefit the practitioner. The following research project strives to understand what those implications are. In the subsequent sections the reader will be introduced to mindfulness, how it works; associated neurological changes to the brain; and how it is beginning to be understood as beneficial as a treatment approach for adults with post-traumatic stress disorder (PTSD).

In 1980, PTSD was first recognized as a mental health disorder the Diagnostic and Statistical Manual (DSM) 3rd edition (Bremner, 2013). However, while the diagnosis may be more recent, the illness itself is not, and has been studied for decades. In North America during the Civil War it was determined that when some (not all), are exposed to trauma, they are subjected to psychological distress that could produce long lasting symptoms (Newport & Nemeroff, 2003). Authors Lipov and Kelzenberg (2012) discuss

how ‘soldiers Heart’ or ‘irritable heart’ were the terms used to describe the symptoms associated with PTSD during the Civil War (hyper arousal, heart arrhythmia, and startle response) (p. 2). This is an important consideration given the fact that the past decades have been filled with an abundance of global conflict (wars, ethnic cleansing, natural disasters, and more).

The Nobel Committee highlights Elie Wiesel’s (awarded the Nobel Peace Laureate’s in 1986), efforts as an inspirational spiritual leader to promote peace, “in an age when terror, repression and racial discrimination still exist in the world” (Nobel Prize, 2014, paragraph 7). The global conflict throughout the 20th century has impacted both the victims of conflict and those engaged directly. This age of conflict and trauma inspired professionals to begin research on PTSD and the effects of trauma. Despite the high propensity of soldiers experiencing PTSD (also known as shell shock, war neurosis, and battle fatigue), it was not until the 1980s that this diagnosis was introduced into the DSM 3rd edition, and recognized as a psychiatric disorder (Newport & Nemeroff, 2003).

With the acceptance of PTSD into the scientific community as a psychiatric disorder, it was found that anyone who has experienced trauma might be subject to developing the illness. Siegel (2012) describes how mental health concerns develop due to, “impaired integration [which] results in chaos and/or rigidity” (p. 4.4). Trauma is a form of impaired integration, and may be exhibited in various forms including abuse, rape, isolation, exposure to a disaster, witnessing crimes, and may be a either a single event, or exposure to a cruelty over a period of time (Goleman, 1995).

PTSD develops when there is a more specific and intense experience that affects a person after encountering a traumatic event. The National Association of Mental Health (NAMI, 2014) indicates that:

> Because the body is busy increasing the heart rate, pumping blood to muscles for movement and preparing the body to fight off infection and bleeding in case of a wound, all bodily resources and energy get focused on physically getting out of harm's way. This resulting damage to the brain's response system is called posttraumatic stress response or disorder, also known as PTSD (paragraph 2).

According to NAMI (2014), PTSD affects about 7.7 million American adults, but it can occur at any age, including childhood (although symptoms vary from adults). Also, women are more likely to develop PTSD than men, and the average age of onset is in the early 20s (NAMI, 2014, paragraph 3). When trauma is encountered, the brain changes in response to the event in order to cope and adapt to the situation (Goleman, 1995). One question addressed in this paper is why and how this happens, specifically to how the brain's neurochemical construction makes symptoms (example: hyper vigilance and re-experiencing trauma), remain in effect even after a person is safe and not in danger.

The heart of this research surrounds the question: "What are the positive benefits of mindfulness for adult patients suffering from PTSD in relation to the brain?" This theoretical paper first aims to gather, distill, and organize emerging findings regarding the impact of mindfulness on the brain for adults with PTSD; and second, to offer a beginning theory or model to understand some of the ways mindfulness is beneficial for these clients. The following information has been gathered from a variety of resources

including medical journals, educational studies, books, and published research experiments.

Working as a social worker allows for a broad range of clients with differing mental health and physical concerns. Social workers have the responsibility to understand and comprehend the neurological changes that occur in the brain when working with mental health illnesses. By understanding the components of the brain and what is biologically occurring within their clients, social workers are better able to understand and provide treatment for their clients. With this heightened sense of understanding, treatment plans may be created that cater to the neurological implications of the respective illness, and offer a sense of understanding over what is happening throughout the client's body. Werklund School of Education (2004) notes how Harriet Johnson argues that within the biopsychosocial model, helping professionals have not fully integrated a biological approach to working with their clients. Using this model provides professionals with the ability to understand the relationship between body and mind and how they are connected. Thus, integrating concepts of the brain and gaining a basic sense of neuroscience is necessary to provide the most effective treatment for clients.

Literature Review

This section presents literature and information regarding mindfulness as a beneficial treatment component for adults diagnosed with PTSD. The review first discusses the brain and neuroplasticity followed by the components of PTSD (its history, causes, and neurological components), and mindfulness (its history, how it is practiced, and its neurological implications).

Neuroplasticity of the Brain

The notion of neuroplasticity, or the brain's ability to change, is a significant scientific discovery. The idea that an experience such as a traumatic event or a treatment approach may change a human's brain is paramount for helping professionals to understand. This concept brings light to the client's ability (or inability) to promote change, and details of their neurological functioning.

For hundreds of years scientists thought that, like physical development, once the brain reached maturity it ceased to change (Doidge, 2007). On the contrary, Baldini, Parker, Nelson, and Siegel (2014) argue, "The past decade of neuroscience research shows that the human brain is in a constant state of change, with new experiences continually reshaping neural circuitry and impacting emotions, cognitions, and behavior" (in Davidson and Begley, 2012, p. 218). This wave of scientific exploration has allowed for the discovery of four components of brain functioning. Baldini et al. (2014) write:

> The brain is part of a complex system that has four important qualities critical to its functioning. First, it is dynamic; functionally and structurally in an ongoing state of change. The brain is also open; it interacts with and is affected by environmental influences. The brain is also nonlinear; seemingly minor inputs have the ability to cause large and unpredictable changes in the whole system's performance. Finally, because it is also capable of entering chaotic stats, the brain can be considered a complex system (p. 219).

Humans are amazing, resilient creatures. This is evidenced in positive examples such as the ability to learn new languages, develop more attuned senses (e.g. learning braille), and socially extending boundaries in new situations. On the other hand,

negatively viewed behaviors exist including rigidity and overactive stress regulation. As Doidge (2007) argues, "The brain is a far more open system than we ever imagined, and nature has gone very far to help us perceive and take in the world around us. It has given us a brain that survives in a changing world by changing itself" (p. 26). This suggests that throughout the course of a human's life brain pathways and connections change dependent upon personal experiences (Doidge, 2007).

Brain studies on animals have shown similar discoveries. Laboratories have shown that stimulating environments lead to brain growth, increased brain weight, and more brain connections in rats and other animals (Doidge, 2007). Doidge (2007) also discusses research showing more connections, increased volume, and thickness of the brain in postmortem studies with people who had received a higher education. This implies the concept of a constantly working and growing brain, versus a stagnant machine structure.

Daniel Siegel is a forerunner in the field of interpersonal neurobiology and neuroplasticity. He highlights the need for increased education on these topics because 95% of therapists, counselors, and others in similar roles have never been trained (Siegel, 2012). Ultimately, the goal of psychotherapy is to alter cognitive and brain functions leading to a better quality of life. Siegel (2012) proposes the idea that:

> The mind is an emergent, self-organizing process that shapes how energy and information move across time. This aspect of mind is a natural energy, and self-organizing dynamic process that arises as a fundamental property of the system of energy and information flow that is created in both the body and in interactions with others and our environment. This emergent process arises from energy and

> information flow and then also shapes energy and information flow across time. (p. 1.6)

Many scientists now adhere to the theory of neuroplasticity meaning, "*Neuro* for 'neuron,' the nerve cells in our brains and nervous system and *plastic* for 'changeable, malleable, modifiable" (p. xix), recognizing the idea that the brain changes its structure dependent upon the activities it performs, the environment it experiences, and constantly rewires its circuitry to better complete a given task (Doidge, 2007). Doidge (2007) also writes that scientists:

> showed that children are not always stuck with the mental abilities they are born with; that the damaged brain can often reorganize itself so that when one part fails, another can often substitute; that if brain cells die, they can at times be replaced; that many 'circuits' and even basic reflexes that we think are hardwired are not…thinking, learning, and acting can turn our genes on or off, thus shaping our brain anatomy and our behavior. (p. xix)

Regarding the adult brain, Begley (2007) concisely writes, "The adult brain, in short, retains much of the plasticity of the developing brain, including the power to repair damaged regions, to grow new neurons, to rezone regions that performed one task and have them assume a new task, to change the circuitry that weaves neurons into the networks that allow us to remember, feel suffer, think, imagine, and dream" (p. 8). These findings suggest that throughout the entire lifespan the brain is growing, changing, and repairing itself in relationship to the environment, genetics, thought processes, and other mental activities. Without conscious awareness, "the actions we take can literally expand or contract different regions of the brain, pour more juice into quiet circuits and damp

down activity in buzzing ones" (Begley, 2007, p. 8). Siegel (2012) emphasizes this when he writes, "Experience activates neurons, which then can turn on genes that enable structural changes to be made that strengthen the connections among activated neurons…in this way, the mental process of focusing attention can change the physical structure of the brain" (8.1).

Experience and stimuli may also negatively change the neurobiology of a person. As Begley (2007) writes, "So, too, has nature equipped the human brain, endowing it with the flexibility to adapt to the environment it encounters, the experiences it has, the damage is suffers, the demands its owner makes of it. The brain is neither immutable nor static but is instead continuously remodeled by the lives we lead" (p. 130). Trauma may impact a person's neurobiology, which may not heal correctly, and thus a 'psychological wound' is formed (Siegel, 2012, 39.1). This is what happens when a person develops PTSD. The symptoms of avoidance, hyper vigilance, etc. are defense mechanisms to help protect the person against further trauma.

Distinguishing the roles between the left and right hemispheres is also instrumental in understanding neurophysiology. Schore (2004) notes that the right brain, which develops early, is more connected to the body than the left and promotes the sense of inner cohesion (p. 438). He also discusses how the right hemisphere is largely responsible for controlling emotional communication while the left hemisphere dominates linguistic behaviors (Schore, 2004). The right hemisphere is responsible for interpreting emotions, facial expressions, analyzing direct information, and thus responsible for how information is perceived (Schore, 2004). Schore (2004) describes this phenomena when he writes, "…this hemisphere [right], more so than the left,

contains extensive reciprocal connections with the autonomic nervous system (ANS), which regulates the functions of every organ in the body" (p. 445). This information suggests that the right brain largely dictates functions of the various systems in the body including physiological, cardiovascular, immune, neuroendocrine, and endocrinological systems (Schore, 2004, p. 446). When the right brain is not functioning correctly or is impaired, it is unable to interpret information correctly, and studies have shown that this contributes to the symptoms of PTSD (Schore, 2004).

Ranges of treatment approaches are used to treat PTSD including psychotropic medications that target anxiety and depression. Propranolol is a beta-blocker in which is a, "pharmacological interruption of memory might dampen emotional response to the information" (Johnson, 2010, paragraph 3). This drug acts not to erase a traumatic memory, but to limit the emotional response to it. Other methods include cognitive behavioral therapy (CBT), eye movement desensitization and reprocessing (EMDR), exposure therapy, and mindfulness to treat psychological distress.

History of PTSD

PTSD has been given particular scientific attention following the Vietnam War, and was first defined by the American Psychological Association (APA) in the DSM 3rd Edition in 1980 (Bremner, 2013). During this time it was recognized that psychological trauma could lead to mental disturbances and biological changes, with the body unable to heal from the trauma (Bremner, 2013; NAMI, 2014; Howard & Crandall, 2007). Even before it was considered a mental health concern, professionals worked with PTSD for many years, including the first documentation as a conversion disorder reaction to trauma in 1900 BCE, by an Egyptian physician (Howard & Crandall, 2007).

While PTSD is widely stigmatized as a war injury, it affects many different people, including about 10% of women and 5% of men within their lifetimes (Duckworth, 2014, p. 3). This mental health concern is an abnormal result of the body's inability to accurately distinguish a perceived versus real threat after encountering something viewed as traumatic towards the individual. Trauma may be experienced in a variety of situations and is unique and complex, dependent upon each individual.

Causes, Signs, and Symptoms of PTSD

Encountering trauma is defined as experiencing an event causing fear, helplessness, or horror while feeling threatened, and may happen to any person and at any time (Bremner, 2013; Howard & Crandall, 2007). This does not mean that everyone who experiences a traumatic event will develop PTSD. Some threatening situations include (but are not limited to): war, abuse, rape, robbery, witnessing a crime, kidnapping, car accidents, natural disasters and may involve, "An event that threatens injury to self or others and a response to those events that involves persistent fear, helplessness or horror" (Duckworth, 2015, p. 3). Additionally, according to the DSM-5, having an immediate and extreme emotional reaction to the trauma is not necessary for a PTSD diagnosis, but that symptoms may emerge over time (APA, 2013). A person is considered to have PTSD when their fight-or-flight system is being activated despite being removed from the traumatic experience, resulting in cognitive and physiological response changes evidenced by symptoms of hyper arousal, avoidance, and intrusion (Friedman, 1995; Bremner, 2013).

Howard and Crandall (2007) argue that just as, "Every physical disorder has a mental component, every mental disorder has a physical component. Together they form

the two interlocking pieces of the whole person" (p. 2). This means that those with PTSD struggle both mentally and physically from re-experiencing, avoidance, and hyper arousal symptoms (NIMH, 2014). An adult experiencing these symptoms may experience distress in all areas of his/her life.

According to the APA (2013), as presented in the DSM-5, PTSD (309.81) is related to specific diagnostic criteria including:

a. Exposure to a traumatic event;
b. One or more intrusion symptoms;
c. One or more persistent avoidance of stimuli related to traumatic event;
d. Two or more negative cognitive and mood changes associated with the traumatic event;
e. Two symptoms of hyper arousal

People will experience symptoms differently, with some presenting higher severity on some criteria versus others (APA, 2013, p. 271).

Intrusion symptoms include: dreams, flashbacks, and anything resembling intrusive and recurrent re-experiencing of the traumatic event through visual and other senses such as smell and sounds (APA, 2013). Avoidance criteria consist of avoiding any type of stimuli related to the trauma including thoughts, feelings, memories, situations, activities, people who are reminders of the event, and more (APA, 2013).

Negative cognition and mood changes are witnessed through memory loss (only remembering certain aspects of the traumatic event); negative views of oneself, one's life, and the future; continuous negative mood states; and depressive symptoms (APA, 2013).

Depressive symptoms include: marked disinterest in other people and activities, being unable to feel positive emotions, and feeling detached from other people (APA, 2013).

In addition to concerns with sleep and concentration, the premise of hyper arousal symptoms consist of being, "very reactive to unexpected stimuli, displaying a heightened startle response, or jumpiness, to loud noises or unexpected movement," (APA, 2013, p.276). The symptoms normally begin within three months of the traumatic event, but may develop over time, which is called 'delayed expression' (APA, 2013, p. 276). PTSD should not be confused with other stress-related disorders such as Acute Stress Disorder (308.3), which lasts three days to one month after the traumatic event, versus a long-term impact (APA, 2013).

For the majority of cases (eighty percent), individuals are able to cope with negative experiences, albeit some experience depression, anxiety, stress, sleep disturbances, and anger, which often resolve without therapeutic intervention (Siegel, 2012). But for the other twenty percent, "One-time overwhelming events may disrupt normal functioning in a persistent manner…the body's normal responses to stress are not released, prolonging acute reactions that then become chronically maintained stances of vigilance" (Siegel, 2012, 39.3).

Neurological Components of PTSD

Siegel (2012) describes the brain as, "The skull-based cluster of cells, the top of the central nervous system we commonly call the brain, and is inextricably interconnected with the whole of the body through the peripheral nervous system and all the signals from the body's physiological process" (p. 3.1). The three predominant areas of the brain affected in persons with PTSD include the amygdala, hippocampus, and the

pre-frontal cortex (PFC). Siegel (2012) emphasizes the importance of brain connectivity and highlights how different brain regions are linked to one another, which reinforces the necessity of a basic understanding of these areas to comprehend the neurological impact of trauma.

Neuroimaging techniques have allowed scientists to examine brains of patients suffering from PTSD. These techniques involve looking at the brain through magnetic resonance imaging (MRI), magnetic resonance spectroscopy (MRS), positron emission tomography (PET), functional MRI (fMRI), and single-photon emission computed tomography (SPECT) (Shin, Rauch, & Pitman, 2006). These tools "bear the structure, neurochemistry, and function of the three brain regions [hindbrain, midbrain, forebrain]" (Shin et al., 2006, p. 67). When a person is exposed to trauma their brain reacts in primitive ways to help them adapt to a situation. However, these adaptations "can be sustained over long periods of time in ways that are no longer adaptive" (Siegel, 2012, 39.1).

When a person is exposed to a traumatic stressor, their sympathetic nervous system (SNS) is activated. Stress may be defined as "the nonspecific response of the body to any demand made upon it" (Kalat, 2013, p. 380). The SNS (part of the autonomic nervous system [ANS]) is responsible for preparing the body's organs for vigorous activity, including the fight-or-flight response (increased breathing and heart rate, and a decrease in digestive activity) (Kalat, 2013, p. 89).

With PTSD, the SNS is chronically activated and this is, "accomplished by the increase of catecholamine's, mainly epinephrine and norepinephrine" (Lipov & Kelzenberg, 2012, p. 2). These neurotransmitters account for vigilance, selective

attention and arousal, and studies have shown that these levels of are much higher for people with PTSD (Lipov & Kelzenberg, 2012, p. 2). The second part of the ANS is the parasympathetic nervous system (PSN), which induces the opposite responses of the SNS (Kalat, 2013). In essence these two systems have opposite functions and, "the parasympathetic nervous system increases digestion and other processes that save energy and prepare for later events" (Kalat, 2013, p. 356).

The term fight-or-flight refers to how the brain reacts to a perceived threat stimuli. Fight describes staying to face the situation and fight it, whereas flight refers to fleeing, or surviving through escape. Freezing, becoming immobilized, is a third reaction used in the face of distress in which a person becomes incapacitated and does not have control of their actions. These are two responses developed to help a person survive. When a person suffers from PTSD their SNS is activated in response to a non-traumatic stressor is evidence that the body has become abnormally regulated (Friedman, 1995). Three of the areas impacted by trauma include the hippocampus, amygdala, and frontal lobe.

The basic function of the hippocampus is to record and store memories (Howard & Crandall, 2007). When a traumatic event occurs it may be stored for later retrieval. The role of the hippocampus is to coherently piece together memory, knowledge, and feeling (Siegel, 2012). If experiences, feelings, and factual knowledge are not correctly integrated, there may be flukes upon retrieval, which could be distressful to the individual. The hyperactive amygdala that is sensitive to external reminders of the trauma is constantly interacting with the hippocampus for memory retrieval (Howard & Crandall, 2007). Evolutionarily speaking, the amygdala and hippocampus are continually working together to protect the human from danger. When a traumatic event has negatively

impacted the neurological functioning of these areas, the system becomes deregulated. Siegel (2012) writes that: “Memory integration involves focusing a spotlight of attention on elements of implicit memory that have not yet been integrated. Attention engages the hippocampus, and this involvement can enable previously disconnected representations to become part of an integrated whole” (p. 41.10)

The role of the hippocampus is central to memory formation (Gushen, 2014). When a person experiences trauma their hippocampus, “creates and stores the memory, retrieves the memory, [and] calms the amygdala alarm circuit” (Gushen, 2014, paragraph 7). Some research shows that those who develop PTSD tend to have a smaller than normal sized hippocampus (Kalat, 2013). However, this has been refuted by other studies, which do not show a decreased size of the hippocampus (Shin et al., 2006). The signs and symptoms related to the dysfunction of the hippocampus include disorientation, difficulty sleeping, confusion, reoccurring thoughts, flashbacks, and nightmares (Gushen, 2014).

While the hippocampus records memories, the amygdala responds to them. The amygdala “is direct, quick, highly emotional, and inflexible. It keys more to instinct and is less subject to easy control” (Howard & Crandall, 2007, p. 12). Authors Koenigs and Grafman (2009) describe the amygdala as, “a subcortical collection of nuclei within the anterior temporal lobe of each hemisphere” (p. 541). When distressing memories are activated or external stimuli encountered, a person with PTSD experiences responses that are inappropriate to the situation and invoke abnormal fear responses (Bremner, 2013).

The essential function of the amygdala is to evaluate emotional stimuli to determine whether the person is safe or if the flight-or-flight system needs to be activated

(Howard & Crandall, 2007). This small area determines when to react to a situation and when threat is perceived it, "sends out a danger signal, initiates the fight-or-flight response, stores stimuli associated with memory such as sights, sounds, smells, etc. and produces calming thoughts where there is no longer danger" (Gushen, 2014, paragraph 4).

Symptoms associated with abnormal functioning of the amygdala include: hyper vigilance, anxiety, a heightened startle response, and avoidance (Gushen, 2014). Research shows that the amygdala remains overactive even when not in a traumatic situation, exhibits exaggerated responses to stimuli, and remains in alert mode (Shin et al., 2006; Howard & Crandall, 2007; Gushen, 2014). The amygdala is defective when it unnecessarily activates the fight-or-flight response system despite being safe (Howard & Crandall, 2007).

The third area of the brain affected by trauma is the frontal lobe; specifically the PFC. Essential functions of this region, located within the frontal lobe behind the forehead are to, "control behavior, emotions, and impulses [executive functions]" (Gushen, 2014, paragraph 10). The PFC sends signals to the amygdala letting it know the danger has passed and everything is safe. According to Gushen (2014),

> In those with PTSD, the prefrontal cortex is less active, which likely correlates with symptoms of social withdrawal, avoidance of reminders of the trauma, end emotional numbing. Therefore, the prefrontal cortex is unable to override the hippocampus, as it flashes the memory, so it cannot signal to the amygdala that there is no real danger (paragraph 12).

Authors Shin et al., (2006) report that with PTSD, “Functional neuroimaging studies have also yielded findings consistent with decreased activation and/or a failure to activate medial prefrontal cortex” (p. 70). The PFC is unable to function properly does not send proper signals to the amygdala and hippocampus letting them know they are not in danger.

While the amygdala is hyperactive (over-active), the medial pre-frontal cortex (mPFC) is hypoactive (under-active) (Koenigs & Grafman, 2009). This is a critical finding as a, “defect in mPFC function impairs the amygdala inhibition, resulting in unchecked amygdala activity and pathological distress” (Koenigs & Grafman, 2009, p. 541). MRI studies have shown that in PTSD the volume of the mPFC is less than normal (Shin, et al., 2006). In a sense, the amygdala is over stimulated and its ‘monitor’, the mPFC, is not working properly and this creates emotional chaos. Despite the need for future studies, “There is evidence for structural, neurochemical, and functional abnormalities in medial prefrontal cortex, including anterior cingulate and medial frontal gyrus, in PTSD” (Shin et al., 2006, p. 70).

One study by Hopper & Lanius (2008) consisted of eighteen patients suffering from trauma due to sexual abuse or motor vehicle accidents. Nine of the patients had developed PTSD whereas the other nine had not. Hopper and Lanuis (2008) discuss the different subtypes of PTSD and how, “Persons with PTSD tend to exhibit greater brain activation in the amygdala and insula than persons without PTSD; these structures are involved in fear conditioning and the perception of bodily states (among other functions), respectively” (p. 31). It was found that, “…patients who relived their traumatic experience and had a hyper aroused response to the traumatic script exhibited

significantly less activation in the rostral ACC and medial prefrontal cortex as well as in the thalamus and occipital cortices" (Hopper & Lanius, 2008, p. 31).

In their second study the patients who dissociated showed, "…higher levels of brain activation in the rostral ACC and dorsal ACC, medial prefrontal cortex, and areas in the superior and middle temporal cortices" (Hopper & Lanius, 2008, p. 31). The findings from these two studies show how the opposite occurs in brain activation when a patient experiences hyper arousal or dissociative symptoms (Hopper & Lanius, 2008). Hopper & Lanius (2008) later suggest that patients who experience trauma in earlier years are more prone to experience dissociative symptoms than if trauma is incurred in adult years.

Physiological components of PTSD.

The SNS and PSN are in charge of the physiological responses which happens when one of these systems are activated (Howard & Crandall, 2007). When the SNS is activated it gets the body ready to fight or flee. It does this through dilating pupils, dilating blood vessels, increasing heart rate, and halting digestion (Howard & Crandall, 2007, p.6). By activating this system the body is ready to handle danger. When the situation is assessed and the body is believed to be safe, the PNS is activated. This system does the opposite of the SNS including, "slowing down the heart, constricting the pupils, and stimulating the digestion" (Howard & Crandall, 2007, p. 6). These two systems work together to keep the body safe and in equilibrium.

The role of cortisol within the human body plays a huge part in the stress response. The adrenal cortex is the gland that releases cortisol into the body (Kalat, 2013). According to Kalat (2013), cortisol "stimulates liver to elevate blood sugar, [and] increase [the] metabolism of proteins and fats" (p. 67). Cortisol is activated through the

body's response to modulate stress, specifically when the fight-or-flight system is activated, which helps promote survival (Ranabir & Reetu, 2011). However, when too much cortisol is secreted it may actually impair immune function activity and memory/hippocampal functioning (Kalat, 2013; Siegel, 2012).

Research shows that those who are suffering from PTSD have lower levels of cortisol (Kalat, 2013). Cortisol is a hormone secreted (or released into the blood stream), by the hypothalamic pituitary axis (HPA), which is responsible for the slower, longer lasting response to stress. The function of this hormone is to keep the body alert, heal wounds, and fight infection (Kalat, 2013). When there are low levels of cortisol in the system at the time of trauma, one may be more likely to develop PTSD (Sherin & Nemeroff, 2011). Sherin & Nemeroff (2011) found that, "Exogenously administered hydrocortisone shortly after exposure to psychological trauma can prevent PTSD" (p. 265). Atypical levels of cortisol in a person's system may contribute to an abnormal stress response in any given situation.

As the above research suggests the brain may respond to trauma, causing lasting changes wherein PTSD develops. The SNS and certain areas of the brain become deregulated and thus do not function correctly. It is of grave importance for social workers and other helping professional to understand and comprehend the neurobiological implications for victims and survivors of trauma.

Mindfulness

Mindfulness is an art that has been practiced for centuries, originating in Asia, and has become part of numerous cultures (Garland, 2013). Since John Kabat-Zinn started his Mindfulness Based Stress Reduction (MBSR) program, studies have been

tracking the benefits of this practice, which have been documented in research for more than thirty years (GreaterGood, 2014; Somerday, 2013; Brown, Marquis, & Guiffrida, 2013). This way of being is accomplished by, "maintaining a moment-by-moment awareness of our thoughts, feelings, bodily sensations, and surrounding environment" (GreaterGood, 2014, paragraph 1). Despite sounding simple, mindfulness requires much practice and intense focus to cultivate deep feelings of presence. When a person has a chance to analyze their thoughts they discover how irrelevant they are because they are thinking about what happened in the past or are looking ahead to plan for the future (instead of being in the moment). As Garland (2013) suggests, "Mindfulness is a state, a naturalistic mindset characterized by an attentive and nonjudgmental metacognitive monitoring of moment-by-moment cognition, emotion, perception, and sensation without fixation on thoughts of past and future" (p. 440).

Mindfulness has to be cultivated and practiced due to the skill it takes to focus on the present moment (rather than looking ahead or to what has already passed), and with this is evidence of psychological, physical, and social benefits (GreaterGood, 2014; Baldini et al., 2014). In any given day a person feels a range of emotions from anger to happiness, but the purpose is to be in tune with your state of being at any moment. Not only is being aware part of the practice, but also to experiencing sensations without judgment and letting them pass.

People experience any number of emotions ranging from anger to sadness. Regardless of what is felt, "Every emotion you feel causes changes in your body which in turn affects your ability to renew your mind and body...the more intense an emotion (positive or negative), the more activity it causes in the nervous system, requiring greater

use of energy" (The Institute of Heartmath, 2012). Negative emotions such as anger and frustration increase a person's stress hormones, whereas positive emotions such as courage and dignity increase dehydroepiandrosterone (DHEA) hormones (The Institute of Heartmath, 2012). Research shows that the stress hormone cortisol negatively impacts metabolism, the immune system, and sleep/wake cycles, and DHEA hormones foster resiliency (The Institute of Heartmath, 2012). Since both of these hormones come from the same parent chemical, The Institute of Heartmath (2012) has proposed that there is a balancing effect, and if there is too much of one hormone there will automatically be less of the other. If a person is circulating too many stress hormones throughout their system, they cannot produce enough resilience and 'happiness' hormones.

How to Practice Mindfulness

According to Kabat-Zinn (2005) there are seven attitudes necessary for mindfulness including: non-judging (accepting something as it is), patience (open and accepting to each moment without agenda), a beginner's mind (ability to see things for the first time), trust (in oneself and one's feelings), non-striving (ability to 'just be' without intention to fix something), acceptance (seeing something as it is), and letting go (despite the mind wanting to hold on, and experiencing the present). With Kabat-Zinn's MBSR program several ways to experience mindfulness are focused upon. These practices include: a person's breathing, sitting meditation (with the breath, body, sound, or thoughts and feelings), body-scan (feeling and sitting with each region in the body), yoga (unifying body and mind through movement), and walking meditations (Kabat-Zinn, 2005). During these practices mindfulness is emphasized as a way of life and can be utilized in any moment.

Other forms of mindfulness have been applied to the treatment of mental health concerns. These include Mindfulness-Based Cognitive Therapy (MBCT), which combines MBSR therapy with cognitive behavioral therapy (CBT), and has been shown to be more effective than only antidepressant medication for adults diagnosed with chronic depression (Hick & Chan, 2010; Garland, 2013). This program focuses on depression reduction by targeting the attitudes and feelings towards thoughts and body (Hick & Chan, 2010). In a research study conducted by Hick & Chan (2010), the authors found that, "MBCT has the potential to positively contribute to interventions directed at relapse prevention for patients with a history of depression" (p. 225). These tools are important for recognizing negative thought patterns that have become natural and destructive thus influencing the illness.

Benefits of Mindfulness

Mindfulness has been associated with physical, psychological, and social benefits in as little as eight weeks (Baime, 2011; GreaterGood, 2014). The goal is to live in a way that promotes attention to thoughts, feelings, and emotions, while being attuned with the environment. It is important to note that mindfulness does not mean ignoring or pushing away negative feelings. Rather, the purpose is to feel the emotion, accept the thought, and then let it go. As Hick & Chan (2010) address in their research, stepping away from thoughts and feelings allows a person to relate differently to their mind, which helps override the negative thought and belief patterns that are enabling and influencing the depressive symptoms.

The integration of mindfulness within one's life has demonstrated physiological and neurological benefits including: boosting the immune system; increasing positive

emotions; decreasing negative emotions (including stress); increasing in gray matter; positively correlation to learning, memory, emotion regulation, and empathy; better ability to focus; better ability to foster compassion and altruism; enhanced relationships; positive prenatal effects; reducing problem behavior and aggression within the classroom; reducing anger within prisons; decreasing rumination; decreasing relapses of depression; and reducing anxiety (GreaterGood, 2014; Baldini et al., 2014; Hick & Chan, 2010).

Many of these benefits are due to the awareness of emotion, finding inner cohesion and focusing on the present. Another idea supported by research is what, "Buddhist meditation adepts have long maintained: that the mental training that lies at the core of meditative practice can alter the brain and thus the mind in an enduring way - strengthening connections from the thoughtful prefrontal lobes to the fear-and anxiety-generating amygdala, shifting activity in the prefrontal cortex from the discontented right side to the eudemonic left side" (Begley, 2007, p. 241). Additionally, Baldini et al. (2014) writes, "Research has found that therapists who practice mindfulness are better able to pause before reacting, accept their emotions, and have increased awareness of patients' non-verbal signals."

Neuroplasticity and Mindfulness

The brain has gone from being viewed as a fixed structure (with things being unable to change), to the idea of plasticity (able to reshape itself). Authors Baldini et al. (2014) note, "The human brain is in a constant state of change, with new experiences continually reshaping neural circuitry and impacting emotions, cognition, and behavior" (p. 218).

With a constantly changing brain, interventions such as mindfulness help to engage different regions and promote change. Research has found that practicing mindfulness, "Promote[s] a wide array of benefits, from improving immune function and gene regulation, to enhancing our capacity to regulate emotions and attention and to engage with others, and ourselves, with more compassion and kindness (Siegel, 2012, p. 37.8). Begley (2007) discusses how research has shown that mental aspirations (meditation/mindfulness) physically alter strength and signals in the amygdala and increases gamma-wave activity through fMRI technology and physiological changes occur.

Hick and Chan (2010) note how MBCT is still in the early stages of research and definitive conclusions may not be drawn to its effectiveness. A second limitation of mindfulness is its applicability with currently depressed patients. It has been indicated that MBCT is targeted to work with people who have been previously depressed but are better before starting the program (Hick & Chan, 2010). Patients need to have a basic ability to concentrate and to focus, which are core skills of MBCT and, "therefore, MBCT does not target patients who are acutely depressed because poor concentration and higher intensity of negative thinking among those patients would affect their focus and attention required to develop the core skills for MBCT" (Hick & Chan, 2010, p. 233).

Research also emphasize that mindfulness should not replace other therapeutic techniques, but needs to be incorporated into treatment (Brown et al., 2013). Brown et al. (2013) also highlight a call for more studies to determine the efficacy of mindfulness within the realm of counseling. Therefore, while it has been shown to enhance treatment

approaches and provide positive benefits to clients, there is still much research to be conducted regarding mindfulness as a counseling technique.

The Impact of Mindfulness on the Brain

With advances in neuroscience researchers have found tangible implications of mindfulness. Different parts of the brain are activated and, "Mindfulness increases gray matter in the insula and decreases the size of the amygdala, the primitive part of our brains responsible for the reactive 'fight-or-flight' response (Somerday, 2013, paragraph 8). In a *mindful* mind, the lateral prefrontal cortex (LPFC; emotional regulation and control), the insula, and the secondary somatosensory area (SII; detects stimuli inside and outside the body) are active, whereas in a *narrative* mind (busy, talkative), the posterior cingulate cortex (PCC; associated with memory retrieval and understanding of what other people believe) and the medial pre-frontal cortex (mPFC; associated with complex cognitive and emotional process) are activated (Somerday, 2013).

As Baime (2011) writes, "Meditation practice is associated with changes of specific brain areas that are essential for attention, learning, and the regulation of emotion" (p. 46). Increased activation in the PFC through meditation allows the strengthening of executive functions such as decision-making, planning, and judgment (Baime, 2011). A second region activated through meditation is the region of the cortex called the insula (Baime, 2011). This region is responsible for integrating and processing emotions and sensations (Baime, 2011).

The key to achieving a state of mindfulness is taking time to acquire the skill and being cognizant of changing brain composition (Somerday, 2013). As with other skills and activities, the more a person practices, the better they will get. Research has shown

that the implications of mindfulness interventions have had positive outcomes for up to three years after due to a cognitive change in self (Brown et al, 2013). Baldini et al. (2014) emphasize:

> Training to be present in moment-to-moment experience literally shifts brain activity from a centralized neural circuit consisting of an observing and narrating self to a lateral circuit associated with non-conceptual sensory experiences-the sensing self. This differentiation of the sensing self from the observing self helps disengage the mind from rumination and perseveration...In addition to reducing destructive thought patterns, research has indicated that presence can even lead to greater happiness by counteracting mind wandering and unhappy moods, which can create and reinforce each other. (p. 222)

Using mindfulness-based interventions has become accepted and positively viewed as a therapeutic approach in a variety of social work domains (Garland, 2013). Thus, understanding how mindfulness impacts a person is necessary in the field and needs to be integrated into treatment versus replacing current therapeutic approaches (Brown et al., 2013). This modality is widely used in many populations including: groups, individuals, and communities (Hick & Chan, 2010). These therapeutic interventions allow patients to think in new and accepting ways about their thoughts and feelings, which would hopefully lead to better emotional health (Begley, 2007).

The goal of the above literature review was to present information to the reader regarding neuroplasticity of the brain, PTSD and its components, and mindfulness as a

restorative practice. The following theoretical framework aims to unearth discoveries of mindfulness as a beneficial treatment component for adult patients diagnosed with PTSD.

As social workers and other helping professionals are constantly striving to provide the best care for their clients, learning about different and new methods is necessary and beneficial for clients in order to provide optimal service. It is an ethical obligation to learn about new treatment modalities, their practicality, and how they may help in service provision.

Conceptual Framework

This literature review has documented the devastating and pervasive physiological and neurological effects of trauma, the calming and potentially healing effects of mindfulness, and the lifelong plasticity of the brain, leading to the question: Can mindfulness be an effective tool in the treatment of PTSD? And, if so, what changes might we see in the brains and bodies of those suffering from PTSD and subsequently practicing mindfulness?

Research has already found that, "There are strong connections between the thinking, prefrontal part of the brain and the feeling part of the brain – and an intriguing possibility arises: that you can voluntarily shift the ratio of right-to-left activation in your prefrontal region, altering not only happiness but a whole suite of emotions" (Begley, 2007, p. 228). Mindfulness is a tool requiring much focus and attention, and is a way to rewire the brain to promote an inner stability. When practicing mindfulness the brain is also in a state of change that may in fact counter the effects of PTSD. Siegel (2012) writes,

> We also now know that the brain changes in response to experience throughout the lifespan, and we can say that a mind-training exercise that builds the capacity to be aware of awareness and pay attention to intention will strengthen the circuits of executive functions, sustain attention, to avoid distractions, to selectively change attention and then focus on the designated target, and to allocate the resources necessary to accomplish a task. (p. 25.2)

Methodology

Research Design

The aim of this research was to develop a beginning theoretical framework/model with the goal of better understanding how mindfulness positively affects the brain for adults experiencing PTSD. The research website at the University of Southern California (2014) describes this methodology in a concise fashion:

> Theories are formulated to explain, predict, and understand phenomena and, in many cases, to challenge and extend existing knowledge, within the limits of the critical bounding assumptions. The theoretical framework is the structure that can hold or support a theory of a research study. The theoretical framework introduces and describes the theory, to explain why the research problem under study exists (paragraph 1).

I analyzed content across a sample of studies in an effort to organize an initial theory or model, which begins to explain how mindfulness is a beneficial treatment component for patients with PTSD, paying particular attention to how it positively impacts the brain.

The targeted population for this study consists of participants suffering from PTSD who practice mindfulness, while paying attention to the neurological evidence of

its effectiveness. A content analysis of existing literature was used versus human participants. Institutional Review Board (IRB) was not needed as this project did not directly involve human subjects and the studies reviewed already were peer reviewed.

Selection Methodology

This theoretical framework included analyzing and synthesizing existing research to form a consensus explaining why mindfulness is an effective treatment approach in terms of its impact on the brain. However, there was insufficient literature including all three themes of the project (PTSD, the brain, and mindfulness), and thus three different research phases were created. The chosen articles were all scientific in nature, published, and peer reviewed. The articles included attention to PTSD, mindfulness, or its impact on the brain. The goal of this research project was to synthesize emerging findings in the literature regarding mindfulness as a treatment component for adult patients suffering from PTSD with particular attention to its impact on the brain.

Search Strategy

Various strategies were utilized in order to find the most applicable articles for this study. As a student of St. Thomas University and St. Catherine University, I had access to journal articles and academic databases through the universities' library holdings. Several options were available to use when finding articles.

The first strategy was to use the 'summon' strategy (a library search feature) through the St. Thomas library's home page. In the search field, under the 'summon' tab, I initially used the terms 'mindfulness and PTSD.' This search provided 2,436 results. To further enhance the quality, filters of scholarly research, peer-reviewed, and full text online were used and produced 842 results.

The second search technique used specific databases listed under the neuroscience heading available through the St. Thomas library. These included PsycINFO (PsychNet) and ScienceDirect. The terms 'mindfulness and PTSD' were again used in the easy search tab, sorting through the articles by their titles. The PsycINFO database produced 72 journal results whereas the ScienceDirect database produced 654 articles. I filtered through these results in order to gather the most relevant articles. To narrow down the number of articles from 654 to 15, I chose to concentrate on a variety of different populations. The populations experiencing trauma and using mindfulness as a treatment component include: firefighters, police officers, abused women, veterans, victims of a natural disaster, and more. The diverse group of research studies allowed for a more rounded conceptualization of mindfulness and how it is beneficial towards many people.

The third strategy utilized the World Wide Web, specifically Google. I researched the three key terms along with other phrases and terminology that were applicable to my goal (brain structure, scientific terms, etc.). Thousands of articles were available and much browsing was required in order to find peer reviewed and credible sources that discussed what I was searching for. Another technique included reading recommended articles, books, and journal studies from various sources (professors, psychologists, therapists).

Data Analysis

The data analysis involved synthesizing findings related to mindfulness as a treatment component for adults suffering from PTSD. Finding key themes such as brain composition, neurobiological changes, and neurochemical changes as a result of mindfulness were targeted within these articles. The goal was to understand what

happens on a neurobiological and neurochemical level when practicing mindfulness. These findings were used to generate themes with the goal to create an initial model or theoretical framework describing how mindfulness positively affects the brain for adults with PTSD. Additionally, key terms were recognized in an effort to promote as much organization of the articles as possible including the generation of themes. Research was gathered in two phases: one, PTSD and mindfulness, and two, Mindfulness and the brain. These phases led to the creation of a model depicting the neurological implications of PTSD and mindfulness. These themes all included interrelated subheadings.

Strengths and Limitations

This research project had both strengths and limitations. Strengths included: the topic of mindfulness as an emerging area of interest within the scientific community, the ability to synthesize literature that has not yet been synthesized, and using research which has already been peer reviewed and vetted for legitimacy. The committee for this research project was wisely chosen as Prof. Kathleen Fargione and Prof. Uta Wolfe bring expertise to the areas of mindfulness, PTSD, and the brain.

The past decade has led to a growing fascination with mindfulness in the Western world. In addition, with growing technology, scientists are able to physically witness changes in neurological composition for both mental health illnesses and mindfulness. The ability to see evidence of neurological changes tangibly, using tools such as MRI's and positron emission tomography (PET) scanning, is an asset to many professions (especially those who are working with invisible health concerns).

Limitations are inherent in any given research project. Limitations for this study include: possible lack of data, findings that differ from given research objective, and a

single researcher which may prove to be a limitation do due lack of a reliability check, second coder, etc. Another limitation to this study is the potential publication bias of PTSD as it is studied widely within the veteran population. This may raise questions about the generalizability of these findings to other populations. Because I wanted to focus on PTSD in adult populations more broadly, without focusing solely on veterans, I carefully selected articles that related to the various adult populations with PTSD.

Timeline

Articles were found and reviewed from October through February. Data were analyzed and written up in the form of the results and discussion sections from February through April. The research committee met in both November and April to discuss the project before the final project presentation, which took place in May 2015. Due to the nature of this research project, I was held accountable for gathering, organizing, and analyzing data independently, but utilized input and suggestions from my committee.

Methodology Summary

A theoretical framework/model was the selected research approach tin order to explore the question, "How does mindfulness benefit the brain in adult patients with PTSD?" I gathered peer reviewed and published studies using academic databases. Data were analyzed, distilled, and organized into themes and presented to the public. The goal of this research study was to shed light on what occurs on a neurological level when adult patients who suffer from PTSD practice mindfulness.

Results

The goal of this research project was to find literature pertaining to PTSD and mindfulness, while largely focusing on the neurophysiology behind the two. The end

result was to summarize these findings in the form of an initial 'model' of how mindfulness might impact the brain for this group of people. It proved difficult to uncover the complexity of these relationships when using the three components as search terms (PTSD; mindfulness; and neurological data pertaining to the two). There were not sufficient articles that addressed all three categories and thus my search strategy was modified.

Two phases of research gathering were implemented: (a) reviewing articles reporting positive correlations between PTSD and mindfulness; (b) reviewing publications describing the impact of mindfulness on the brain, and this was followed by offering a potential model synthesizing the above components to provide some tentative ideas about how mindfulness impacts the brain for patients with PTSD. Figure 1 shows this process:

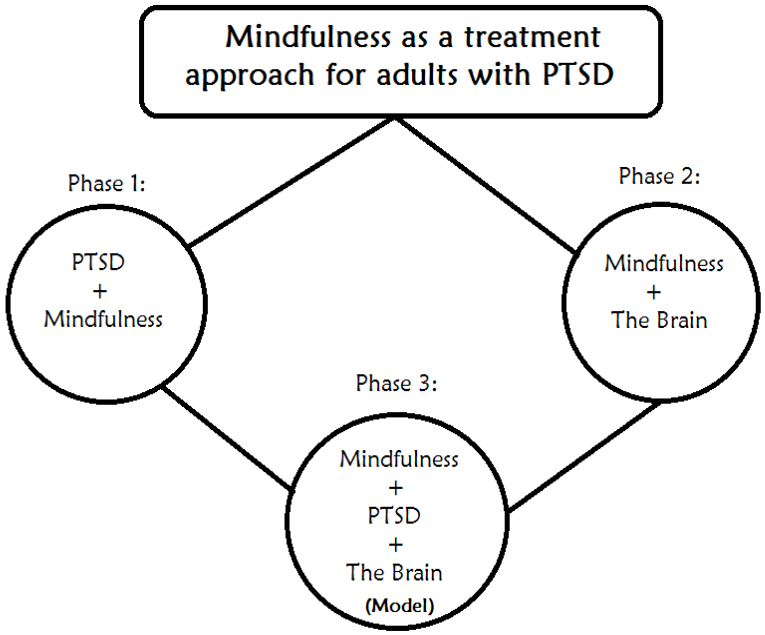

Figure 1:

Phase 1: PTSD and Mindfulness

A large quantity of journal articles showed positive correlations between practicing mindfulness and reduction of PTSD symptoms. Using the initial search terms I chose five studies that discussed the topic of mindfulness and how this technique was used as a treatment approach for patients with PTSD. These studies showed similar results: a reduction of PTSD symptoms (including depression and anxiety), primarily through the practice of MBSR programs. The following pages present the reader with a brief overview of these five studies.

The first study by Vujanovic, Niles, Pietrefesa, Schmertz, and Potter (2011), was titled: *Mindfulness in the Treatment of Posttraumatic Stress Disorder Among Military Veterans.* These authors note that, "…approximately 25.5% of returning Veterans presenting to VHA [Veterans Health Administration] meet diagnostic criteria for PTSD" (Vujanovic et al., 2011, p. 24). In this study, Vujanovic et al. (2011) discovered three ways mindfulness improved the quality of life for people with PTSD. One, participants who practiced regularly were able to maintain a more balanced center and were able to accept and recognize trauma-related triggers and understand distressing internal states; two, patients were more able to engage in various treatment methods, and exhibited a decrease in hyper arousal symptoms and stress reactivity; three, psychological flexibility was similarly cultivated which helps to recognize and deal effectively with internal states (Vujanovic et al., 2011, p. 25-27).

The second study titled: *Mindfulness Is Associated With Fewer PTSD Symptoms, Depressive Symptoms, Physical Symptoms, and Alcohol Problems in Urban Firefighters*,

by Smith, et al. (2011), consisted of 124 firefighters in the Albuquerque, New Mexico area. This cross-sectional, quantitative study explored the positive impact of meditation and showed a reduction in: alcohol problems; depressive symptoms; firefighter stress; physical symptoms; PTSD symptoms, and also an increase in optimism and a sense of personal mastery (Smith, et al., 2011). The authors concluded, "Mindfulness may allow greater cognitive flexibility and improve emotion regulation amidst stressful experiences [Coffey & Hartman, 2008; Follette et al, 2006; Shapiro et al., 2006]" (Smith et al., 2011, p. 615). In addition, mindfulness may increase the ability to tolerate emotional arousal associated with recalling traumatic events; facilitate the healthy engagement with and processing of distressing emotions; and reduce the tendency to dissociate during traumatic events [Per Follette et al., 2006; Ozer et al., 2008]" (Smith et al., 2011, p. 615). This article suggested that mindfulness allows a person more control over their mental and emotional wellbeing even while distressed.

A third article by King, et al. (2013) titled: *A Pilot Study of Group Mindfulness-Based Cognitive Therapy (MBCT) for Combat Veterans with Posttraumatic Stress Disorder (PTSD)* suggested that, "An MBCT group therapy targeted for combat-related PTSD is acceptable and a potentially effective novel therapeutic approach for PTSD symptoms and trauma-related negative cognitions" (p. 642). This eight-week intervention consisted of various veteran groups mostly identifying as older and with long-term PTSD (King et al., 2013). It was shown through clinician-administered interviews and self-report PTSD diagnostic scales that in comparison to other treatment groups (PTSD psychoeducational and skills groups, Imagery Rehearsal Therapy Groups, psychotropic medications), a significant number of veterans experienced a reduction with avoidance

cluster symptoms by participating in MBCT (King et al., 2013). King et al (2013) also discovered a, "decrease in PTSD intrusive symptoms (CAPS intrusive subscale) in MBCT completers which was correlated with reported average time per week spent on mindfulness practice using audio recordings…" (p. 642).

The fourth article studied a different form of trauma. This article, *Mindfulness Intervention for Child Abuse Survivors,* by Kimbrough, Magyari, Langenber, Chesney, and Berman (2009) studied 27 adult survivors of childhood sexual abuse throughout an eight-week mindfulness based stress reduction (MBSR) program and home assignments. Kimbrough et al. (2009) wrote, "Assessment of depressive symptoms, post-traumatic stress disorder (PTSD), anxiety, and mindfulness were conducted at baseline, 4, 8, and 24 weeks" (p. 17). It was found that improvements were made in all symptom areas (i.e. a reduction of 65% for depressive symptoms), and sustained until 24 weeks (Kimbrough et al., 2009). Authors also found that while all three of the PTSD symptoms criteria (avoidance/numbing, hyper arousal, and re-experiencing), were reduced, avoidance and numbing were impacted the most (Kimbrough et al., 2009).

The fifth article: *Mindfulness-Based Stress Reduction for Low-Income, Predominantly African American Women with PTSD and a History of Intimate Partner Violence*, written by Dutton, Bermudez, Mata, Majid, and Myers (2013) was a study using MBSR, home practice, and a five hour retreat. For this study the researchers changed the structure of the program to be more flexible (pre-orientation, shorter length of sessions, a reduced number of sessions, increased support to participants, and more leniency with responsibilities) (Dutton et al., 2013). Dutton et al. (2013) found, "The most frequently reported positive benefits were a sense of increased awareness, self-

acceptance, self-empowerment, non-reactivity, and self-care, as well as decreased distress. Some participants also reported an increased sense of belonging and compassion" (p. 296). Findings showed that this method of treatment was both, "feasible (of initial interest to and completed by most participants) and acceptable (congruent with and relevant to match their needs)" for this population (Dutton et al., 2013, p. 30).

The above five articles showed positive benefits from using mindfulness as a treatment approach for adults suffering from PTSD. Each population was unique except the commonality of having experienced trauma (albeit differed forms). Despite the knowledge gained from these studies, most authors failed to mention the neurological changes that occur during the mindfulness process for their participants. The following second phase explored the effects of mindfulness on the brain from a neurological perspective, which will then be used to suggest a beginning model as to the impact of mindfulness on the brain that may account for the reduction of symptoms of PTSD.

Phase 2: Mindfulness and the Brain

When exploring the research on mindfulness, my goal was to find studies relating to concrete information regarding the neurophysiological changes that occur due from the practice. Two dominant themes from the literature emerged, changes in brain structure and changes in brain function. I found six articles which linked mindfulness with changes in brain structure and six linking mindfulness with brain and physiological functioning. A third theme emerged addressing mindfulness, PTSD, and self-awareness. Overall, research findings suggest that practicing mindfulness impacts a person's neurological and physiological states.

Theme 1: changes in brain structure. In one article Ryback (2006) reported that through mindfulness, psychotherapy, and healthy relationships, the brain is modified by, "building stronger integrative fibers, resulting in more balanced emotional states…" (p. 487). This is completed through attending to the amygdala, promoting balance through both hemispheres, and strengthening connections between the different systems (Ryback, 2006).

In 2010 Chiesa and Serretti reported write that neuroimaging studies have found that mindfulness meditation activates the anterior cingulate cortex (ACC) and PFC, strengthens the areas related to attention (when practiced over time), showing thicker subcortical and cerebral areas associated with attention.

Harvard Health Publications (2011) found changes in gray matter when practicing mindfulness. An increase in gray matter was found "in several brain areas, including the hippocampus (a deep brain structure important for learning, memory, and the regulation of emotions) and other regions associated with remembering the past and imagining the future, as well as with introspection, empathy, and the ability to acknowledge the viewpoints of others" (paragraph 5). The report continues and research also "found that meditation practice reduced the concentration of gray matter in the amygdala, a region associated with fear, anxiety, and stress - and that this reduction was correlated with lower stress levels ("Harvard Health Publication", 2011, paragraph 5).

Nolfe (2011) heightens this finding by reiterating the positive shift towards the left hemisphere when he writes, "…a specific therapeutic intervention based on meditation is associated with increased gray matter concentration in left hippocampus, posterior cingulate cortex, temporal-parietal junction and cerebellum. These areas are

involved in learning and memory processes, emotion regulation and self-referential processing" (p. 631). A study conducted by Holzel et al. report congruent findings and discusses how the hippocampus is associated with areas of cortical arousal and responsiveness, emotional regulation, generating new neurons, and remodeling synapses (p. 7). Chiesa and Serretti (2010) also discuss how meditation reduces gray matter in the areas associated with aging and protects against cognitive decline.

Not only have stress reduction techniques been associated with changes in the left hippocampus, there have been findings, albeit mixed, pertaining to changes in the amygdala (Holzel et al., 2009). In a study done by researchers Holzel et al. (2009), it is written, "Our results indicated an association between changes in stress levels and morphometric changes in the right, but not the left amygdala" (p. 14). They go on to discuss how the right amygdala is associated with the automatic stimulus response whereas the left amygdala is associated with discerning response (Holzel, 2010).

Theme 2: changes in brain and physiological functioning. A second theme that emerged was the change in brain activity associated with meditation. EEG measures electrical activity in the cortex, specifically beta activity (associated with characteristics of wakefulness) and theta and alpha activity (associated with relaxation) (Chiesa & Serretti, 2010).

Studies done using EEG have found that when practicing mindfulness alpha and theta activity are increased and enhanced in the left hemisphere (Chiesa & Serretti, 2010; Ahani, Wahbeh, Nezamfar, Miller, Erdogmus, & Oken, 2014). Keune et al. (2013) found that stimulation in the left hemisphere is associated with a more positive affect and a reduction of avoidance and withdrawal symptoms.

Additionally, using EEG discovered a change in respiration rates accompanying mindfulness. Authors Ahani et al. (2014) discuss how experienced meditators have slower respiration rates, which causes a decrease in blood pressure, heart rate, and oxygen levels, and an increase in heart rate variability. Slower breathing and a relaxed body allow for a calmer and balanced physiological and cognitive state.

Authors Keune et al. (2013) from the German Department of Clinical Psychology and the Institute of Medical Psychology and Behaviors Neurobiology in Tubingen, Germany also reported that there was more brain symmetry within the hemispheres for patients who were previously suicidal and practiced mindfulness, whereas the control group had more left-hemisphere alpha activity.

Practicing mindfulness has been shown to help reduce negative physical ailments such as anxiety, stress, high-blood pressure, and cholesterol (Ryback, 2006; "Harvard Health Publication", 2011). Authors from "Harvard Health Publication" (2011) write that, "Some studies suggest that it can improve immune function. And recent research has found an association between mindfulness meditation-induced improvements in psychological well-being and increased activity of telomerase, an enzyme important to the long-term health of cells" (paragraph 3).

Theme 3: mindfulness and self-awareness. In order to effectively practice mindfulness, a person has to be motivated and dedicated to the process. With this practice, one is allowing thoughts to come and go without paying attention to or holding onto them. Authors Goodman and Calderon (2012) write:

> Controlled body awareness and sensation exercises can help trauma survivors to decrease hyper arousal symptoms, reconnect when dissociated from their body,

> and differentiate past trauma memories from here and now sensations. Through mindfulness, trauma survivors may build strength and resilience by acquiring a sense of control, developing internal resources for symptom reduction and healing, and facilitating the meaning-making process. (p. 254)

With mindfulness person has to be committed and attuned to their willingness to foster attention and focus, be able to adhere to feelings, thoughts, and sensations of the present moment, and promote their practice with an attitude of openness and acceptance to the experience (Holas & Jankowski, 2013). Avoidance and numbing are common for those who have experienced trauma and inner awareness allows for the experience of these symptoms to occur non-judgmentally and in a safe environment (focusing on the here and now versus what happened in the past) (Goodman & Calderon, 2012). Holas and Jankowski (2013) write that unique characteristics of mindfulness practice include the less frequency of mind wandering and disassociation, the ability to recognize intrusive or thoughts unrelated to the present, and focus back on the current experience.

Not only are mindful individuals more attuned to their thought patterns, they also have the ability to recall experiences more clearly; and are more in touch with and understand their emotions, thoughts, and sensations better than treatment as usual (TAU) approaches (Holas & Jankowski, 2013). Individuals are less immersed in themselves and more in tune with simply being in the moment (Holas & Jankowski, 2013). The ability to consciously change thought patterns and feeling leads to control and self-determination of an individual (Ryback, 2006). When individuals are empowered to make changes and can help alter negative symptomology (cognitive distortions), they are able to grasp some semblance of control over a seemingly uncontrollable environment.

Theoretical Model

The above research provides a significant amount of data supporting mindfulness as a treatment approach for patients with PTSD. Alterations were found in brain structures, brain functions, self-awareness, and attunement to one's body. Neuroplasticity reinforces the idea that the brain is an ever-changing organ that constantly perceives information from the environment. Research shows that mindfulness is positively correlated with decreasing symptoms of PTSD, and may be a beneficial treatment approach.

Deregulation of the brain connected with emotional regulation and memory are key contributors to the symptoms associated with PTSD. Practicing mindfulness promotes cohesion and balance within the brain so one may efficiently and correctly regulate their emotions. In a study published in *Asian International* it was found that:

> When an individual experiences stress, activity in the prefrontal cortex-responsible for conscious thinking and planning-decreases, while activity in the amygdala, hypothalamus, and anterior cingulate cortex-regions that quickly activate the body's stress response-increases. Studies have suggested that mindfulness reverses these patterns during stress; it increases prefrontal activity, which can regulate and turn down the biological stress response. (Mindfulness training influences, 2013, paragraphs 5 & 6)

These studies show that mindfulness can in essence calm the amygdala so it can function properly. An amygdala that is under control and not deregulated will be less likely to send out fear signals and activate the fight or flight response.

PTSD, mindfulness, and the brain are complex topics which all are benefitting from past and current research. The brain is a complicated system and powerhouse to all aspects of our being. The goal of this research project was to uncover information on how and why mindfulness may alleviate suffering for adults suffering from PTSD. As this was a theoretical model-building project, the amount of research and information available is never-ending, and new information is constantly being discovered. The previous information showed that PTSD deregulates the brain, mindfulness has been shown to be a successful treatment approach for PTSD, and that mindfulness regulates and calms neurological and autonomic functioning. There, I propose there is a causal relationship created by mindfulness that may help to calm a brain deregulated by PTSD.

Discussion

The aim of this research project was to analyze mindfulness as a treatment approach for adults with PTSD. I researched the components of mindfulness and PTSD aspiring to learn about the neurophysiological implications of both, specifically how mindfulness counteracts the symptoms of PTSD. There was insufficient information regarding the neurophysiological implications for adults with PTSD when practicing mindfulness. Thus, this research was broken into three phases: PTSD and mindfulness; mindfulness and changes in the brain; and a beginning model of why mindfulness impacts the brains of adults with PTSD.

As there were limitations to the types of journal articles and findings I had hoped for, the initial idea of analyzing the neurophysiological implications of adults with PTSD when practicing mindfulness was not achievable. Instead, the results consisted of and were organized in three phases: (1) literature pertaining to PTSD and mindfulness; (2)

mindfulness and the changes in brain; and (3) mindfulness and its impact on the brain for adults with PTSD.

Interpretation of Findings

When searching for articles there was sufficient evidence supporting mindfulness as a treatment approach for adults with PTSD, but insufficient literature pertaining to their neurological implications. Various populations who have experienced differing traumatic experiences have been studied throughout the course of mindfulness based treatment. Research has found positive implications including a reduction in PTSD symptoms throughout the various populations studied. Mindfulness, in addition to treatment as usual (medication; group work; therapy), was found to be beneficial. Additionally, those who spent more time practicing mindfulness also showed better results.

Ryback (2006) discussed how mindfulness practice promotes a greater sense of connectivity throughout the brain and (especially through targeting and calming the amygdala). Chiesa and Serretti (2010) also show that this practice of calming the calamities in the human brain impacts the anterior cingulate cortex, prefrontal cortex, and areas in the brain relating to attention. Mindfulness meditation also showed an increase in gray matter in the hippocampus, a decrease of gray matter in the amygdala, a change in brain activity, and slower respiration rates ("Harvard Health Publication", 2011; Chiesa & Serretti, 2010; Ahani et al., 2014).

Implications for: Teaching, Practice, and Research

This topic, despite emerging research, is still in need of further study. Newer technology has the ability to study the tangible effects of mindfulness on the brain. While

research has shown that mindfulness is an effective treatment approach for adults with PTSD, it is important to understand the reasoning behind that.

Future practitioners will benefit from knowledge on the brain and interpersonal psychology. With the advancements in neuroscience and the capability to observe and detect changes in the brain, it will be necessary for clinicians to understand and comprehend the complexities occurring with respect to mental health concerns. This will promote a more collaborative method of working with patients to help them understand the nuances of their mental health to ensure optimal treatment.

Incorporating mindfulness is a holistic and inexpensive way to help patients with their treatment. It may be practiced in the office, at home, during retreats, in groups, or independently. With research showing positive results for this treatment, it would be beneficial for clinicians to learn and research this subject to strive for success with their clients. The goal of treatment is to help a patient restructure and process memories and emotions. A large part of this includes targeting the right hemisphere of the brain that is responsible for the human unconscious and emotional self (Shore, 2004). Clinicians need to understand that their role is to help positively restructure their client's brain chemistry, which will help decrease pathology. Imagine if clinicians started incorporating more neuroscience into their work with patients – what a change it would be!

Strengths and Limits of the Study

As with any research project there are strengths and limitations throughout the process; this project is no different. To start, the biggest strength was research topic I chose. There is an abundance of research on PTSD, mindfulness, and the brain. In fact, this was also a limitation. There was so much literature to choose from that it was hard to

know where to start and when to stop. All the preexisting literature had knowledge to offer; at times it was overwhelming.

Mindfulness has become a popular topic to study in the western world. However, the specifics of mindfulness that I was searching for were difficult to find. Altogether, my initial research proposal was unachievable because I was unable to obtain enough literature to unveil a 'complete' picture of the neurophysiology of mindfulness' impact on adults with PTSD. A vast amount of literature is available showing that adults with PTSD who practice mindfulness are successful in lessoning their symptoms of PTSD, but the articles rarely delve into why this occurs. Thus, I broke the results sections into three phases and discussed my individual observations on why this treatment approach is useful for working with adults who suffer from PTSD, in terms of its potential impact on the brain.

Another strength, but also limitation, was the amount of research on the brain. This has been a booming topic for the past decade or so and there is a copious amount of data and information. With the scientific advancement in technology, researchers are able to physically see the brain through instruments such as MRI and PET scans. The limitation to these phenomena is the language in which researchers articulate their findings. When reading about the brain, I often found myself having to look up meanings and diagrams in order to understand the information. Much of the brain literature was not written for the ordinary layperson to read, but rather for other scientists in the field. This is perhaps an invitation for scientists to translate their works, even in summary form, in lay language and a reminder of the importance of writing for larger and for popular audiences.

The final limitation to make note of is the concept of mindfulness. In general, mindfulness is subjective. Each person cultivates mindfulness in his or her own unique way. Articles questioned whether people were actually practicing correctly to achieve desired results. This is why technology that can see the changes occurring physically is beneficial – because practitioners know it is working. Additionally, many of the articles had participants that did group work for their MBSR course. Was it consistently practicing mindfulness, being involved in a treatment program, or working in a group that accounted for the lessoning of symptoms? Future studies would benefit from more controlled designs to increase confidence in the initial findings.

Overall this was a topic with teeming information. Despite the strengths and limitations, much was gained from putting together this research project. It was apparent that these topics are important and will continue to be researched.

Suggestions for Future Research

Much more research needs to be conducted regarding the neurophysiology of mindfulness and PTSD. There is published information regarding PTSD and mindfulness, but there is limited information behind why mindfulness is useful as a treatment approach. Advanced technology needs to be utilized throughout the eight-week MBSR program to physically see the changes that occur throughout the process. Brains could to be analyzed before, after, and several times throughout the process to see the correlate changes within the program.

Throughout the research I found the two subtypes of PTSD interesting. While the criteria are listed as such in the DSM, it would be beneficial to learn about how different

forms of trauma impact individuals, and how trauma effects people differently throughout their development and age process.

Studies also need to include more participants using both genders, and larger numbers. As PTSD symptoms are many times subjective, it would be beneficial to use more technology to help people understand their mental health concern (such as using an EEG and brain scanning). By doing this, people become cognizant of their brain reactions and what happens when they experience a trigger or biofeedback. With mindfulness and meditation, oftentimes people use guided imagery and send positive and calming thoughts to different areas of their bodies. It would be beneficial for patients to understand where their source of distress is coming from and try to focus their energy in that area. Additionally, numerous variables such as diet, exercise, work adaptations, familial stressors, and the prognosis of co-morbid physical and psychological disorders may account for changes in symptomology but are not accounted for.

In an article by Ryback (2006): *Self-Determination and the Neurology of Mindfulness*, a different perspective was lent towards mindfulness as a treatment approach. In this article the importance of finding inner motivation to cultivate mindfulness, which empowers the individual to take control of their thoughts and feelings, is emphasized (Ryback, 2006). Clients receiving social services often have lost a sense of control over their life and body especially when experiencing trauma. When practicing mindfulness they are gaining control over their thoughts (which are many times negative and self-diminishing). Mindfulness is a proven practice that may help to empower individuals and help in their journey throughout their struggles. Evidence is

accumulating to suggest how this might apply, in particular, for adults diagnosed with and recovering from PTSD.

References

Ahani, A., Wahbeh, H., Nezamfar, H., Miller, M., Erdogmus, D., & Oken, B. (2014). Quantitative change of EEG and respiration signals during mindfulness meditation. *Journal of Neuroengineering and Rehabilitation, 11*(87), 1-11.

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders Fifth Edition.* Virginia: American Psychiatric Association.

Baime, M. (2011). This Is Your Brain on Mindfulness. *Shambhala Sun,* July 2011. Retrieved from: http://shambhalasun.com/index.php?option=com_content&task=view&id=3717&Itemid=0

Baldini, L., Parker, S., Nelson, B., & Siegel, D. (2014). The Clinician as Neuroarchitect: The Importance of Mindfulness and Presence in Clinical Practiced. *Clinical Social Work Journal, 42*, 218-227. doi:10.10007/s10615-014-0476-3

Begley, S. (2007). *Train Your Mind Change Your Brain*. New York: Ballantine Books.

Bremner, J. (2013). Post-Traumatic Stress Disorder (PTSD). *The Oxford Handbook of Cognitive Neuroscience, 2.* doi:10.1093/oxfordhb/9780199988709.013.0027

Brown, A., Marquis, A., & Guiffrida, D. (2013). Mindfulness-Based Interventions in Counseling. *Journal of Counseling & Development*, *91*, 96-104.

Chiesa, A., & Serretti, A. (2010). A systematic review of neurobiological and clinical features of mindfulness meditations. *Psychological Medicine*, *40*, 1239-1252. doi:10.1017/S0033291709991747.

Doidge, N. (2007). *The Brain that Changes Itself.* New York: Penguin Books.

Duckworth, K. (2015). Post traumatic stress disorder. http://www2.nami.org/Template.cfm?Section=Post-Traumatic_Stress_Disorder&Template=/ContentManagement/ContentDisplay.cfm&ContentID=68535

Dutton, M., Bermudez, D., Mata, A., Majid, H., & Myers, N. (2013). Mindfulness-Based Stress Reduction for Low-Income, Predominantly African American Women with PTSD and a History of Intimate Partner Violence. *Cognitive and Behavioral Practice. 20*, 23-32.

Friedman, M. (1995). Neurobiological Research on PTSD. *PTSD RESEARCH QUARTERLY*. *6*(4), 1-8.

Garland, E. (2013). Mindfulness Research in Social Work: Conceptual and Methodological Recommendations. *Social Work Research 37*(4), 439-448. doi:10.1093/swr/svt038

Goleman, D. (1994). *Emotional Intelligence*. New York: Bantam Dell.

Goodman, R., & Calderon, A. (2012). The Use of Mindfulness in Trauma Counseling. *Journal of Mental Health Counseling, 34*(3), 254-268.

GreaterGood Science Center. (2014). *What is Mindfulness?* Retrieved from: http://greatergood.berkeley.edu/topic/mindfulness/definition

Gushen, B. (2014). *The Anatomy of PTSD.* Retrieved from: http://www.brainlinemilitary.org/content/2014/06/the-anatomy-of-ptsd.html

Harvard Health Publication. (2011). Mindfulness meditation practice changes the brain. *Harvard's Women's Health Watch*. Retrieved from: http://www.health.harvard.edu/mind-and-mood/mindfulness-meditation-practice-changes-the-brain

Hick, S., & Chan, L. (2010). Mindfulness-Based Cognitive Therapy for Depression: Effectiveness and Limitations. *Social Work in Mental Health. 8*, 225-227. doi:10.1080/15332980903405330

Holas, P., & Jankowski, T. (2013). A cognitive perspective on mindfulness. *International Journal of Psychology*, *48*(3), 232-243.

Hopper, J., Lanius, R. (2008). Reexperiencing/hyperaroused and dissociative states in posttraumatic stress disorder: no established therapy; combined drug, psychosocial intervention may help. *Psychiatric Times. 25*(13), 31.

Howard, S., & Crandall, M. (2007). Post Traumatic Stress Disorder, What Happens in the Brain. *Washington Academy of Sciences, Fall 2007*, 1-18.

Holzel, B., Carmody, J., Evans, K., Hoge, E., Dusek, J., Morgan, L., Pitman, R., & Lazar, S. (2009). Stress reduction correlates with structural changes in the amygdala. *Oxford University Press, SCAN 2010* (5), 11-17.

Holzel, B., Carmody, J., Vangel, M., Congleton, C., Yerramsetti, S., Gard, T., & Lazar, S. (2010). Mindfulness practice leads to increases in regional brain gray matter density. *Psychiatry Res., 191*(1), 36-43. doi: 10.1016/j.pscychresns.2010.08.006.

Institute of HeartMath. (2013). *PTSD May Be Greatest Injury of War Today*. Retrieved from: http://www.heartmath.org/free-services/articles-of-the-heart/ptsd-may-be-greatest-injury-of-war.html

Institute of HeartMath. (2012). *Resilience and the Emotional Landscape.* Institute of Hearthmath.

Johnson, H. (2004). *Psyche and Synapse Expanding Worlds: The Role of Neurobiology in Emotions, Behavior, Thinking, and Addiction for Non-Scientists.* Massachusetts: Valley Publishing.

Johnson, K. (2010). Propranolol shows early promise for PTSD. *Clinical Psychiatry News, 38*(12), 10.

Kabat-Zinn, J. (2005). *Full Catastrophe Living*. New York: Bantam Dell.

Kalat, J. (2013). *Biological Psychology Eleventh Edition*. California: Wadsworth, Cengage Learning.

Keune, P., Bostanov, V., Hautzinger, M., & Kotchoubey, B. (2013). Approaching dysphoric mood: State-effects of mindfulness meditation on frontal brain asymmetry. *Biological Psychology 93*, 105-113.

Kimbrough, E., Magyari, T., Langenber, P., Chesney, M., & Berman, B. (2009). Mindfulness Intervention for Child Abuse Survivors. *Journal of Clinical Psychology*. *66*(1), 17-33. doi:10.1002/jclp.20624.

King, A., Erickson, T., Giardino, N., Favorite, T., Rauch, S., Robinson, E., Kulkarni, M., & Liberzon, I. (2013). A Pilot Study of Group Mindfulness-Based Cognitive Therapy (MBCT) for combat Veterans with Posttraumatic Stress Disorder (PTSD). *Depression and Anxiety. 30*, 638-645.

Koenigs, M., & Grafman, J. (2009). Post-traumatic stress disorder: The role of medial prefrontal cortex and amygdala. *Neuroscientist 15*(5), 540-548. doi:10.1177/1073858409333072.

Lipov, E., & Kelzenberg, B. (2012). Sympathetic system modulation to treat post-traumatic stress disorder (PTSD): A review of clinical evidence and neurobiology. *Journal of Affective Disorders, 142*(2012), 1-5.

Mindfulness training influences health via 'stress reduction' pathways. (2015, Feb 13). *Asian News International* Retrieved from http://ezproxy.stthomas.edu/login?url=http://search.proquest.com/docview/1655008685?accountid=14756

National Alliance on Mental Illness. (2014). *Posttraumatic Stress Disorder* Retrieved from: https://www.nami.org/Learn-More/Mental-Health-Conditions/Posttraumatic-Stress-Disorder

National Institute of Mental Health. (2014). *What is Post-traumatic Stress Disorder (PTSD).* Retrieved from: http://www.nimh.nih.gov/health/topics/post-traumatic-stress-disorder-ptsd/index.shtml

National Institute of Neurological Disorders and Stroke. (2014). *Brain Basics: Know Your Brain.* Retrieved from http://www.ninds.nih.gov/disorders/brain_basics/know_your_brain.htm

Newport, D., & Nemeroff, C. (2003). Neurobiology of Posttraumatic Stress Disorder. *FOCUS: The Journal of Lifelong learning in Psychiatry*, *1*(3), 211-218. doi:10.1016/S0959-4388(00)00080-5

Nobel Prize (2014). *Nobel Peace Prize 1986 Elie Wiesel*. Retrieved from: http://www.nobelprize.org/nobel_prizes/peace/laureates/1986/presentation-speech.html

Nolfe, G. (2012). EEG and meditation. *Clinical Neurophysiology*, *123*(4), 631-632. doi:10.1016/jclinph.2011.08.016.

Peterson, A., Thome, J., Frewen, P., Lanius, R. (2014). Resting-State Neuroimaging Studies: A New Way of Identifying Differences and Similarities Among the Anxiety Disorders? *The Canadian Journal of Psychiatry. 59*(6), 294-300.

Ranabir, S., & Reetu, K. (2011). Stress and hormones. *Indian Journal of Endocrinology and Metabolism Jan-Mar, 15*(1), 18-22.

Ryback, D. (2006). Self-Determination and the Neurology of Mindfulness. *Journal of Humanistic Psychology, 46*(4), 474-493. doi:10.1177/0022167806290214

Siegel, D. (2012). *Pocket Guide to Interpersonal Neurobiology.* New York: W.W. Norton & Company

Sherin, J. & Nemeroff, C. (2011). Post-traumatic stress disorder: the neurobiological impact of psychological trauma. *Dialogues in Clinical Neuroscience. 13*(3), 263-278.

Shin, L., Rauch, S., & Pitman, R. (2006). Amygdala, Medial Prefrontal Cortex, and Hippocampal Function in PTSD. *Annals New York Academy of Sciences. 107*, 67-79. doi:.1196/annals.1364.007

Shore, A. (2004). Advances in Neuropsychoanalysis, Attachment Theory, and Trauma Research: Implications for Self Psychology. *Psychoanalytic Inquiry, 22*(3).

Smith, B., Ortiz, J., Steffen, L., Tooley, E., Wiggins, K., Yeater, E., & Montoya, J. (2011). Mindfulness Is Associated With Fewer PTSD Symptoms, Depressive Symptoms, Physical Symptoms, and Alcohol Problems in Urban Firefighters. *Journal of Counseling and Clinical Psychology. 79*(5), 613-617.

Somerday, M. (2013). *The Neuroscience of Mindfulness.* Retrieved from: http://www.astd.org/Publications/Blogs/Human-Capital-Blog/2013/11/The-Neuroscience-of-Mindfulness

University of Southern California. (2014). *Organizing You Social Sciences Research Paper.* Retrieved from: http://libguides.usc.edu/content.php?pid=83009&sid=618409

Vujanovic, A., Niles, B., Pietrefesa, A., Schmertz, S., & Potter, C. (2011). Mindfulness in the Treatment of Posttraumatic Stress Disorder Among Military Veterans. *Professional Psychology: Research and Practice. 42*(1), 24-31.

Werklund School of Education. (2014). *Harriet Johnson*. Retrieved from: http://werklund.ucalgary.ca/node/2411