Running Head: TRAUMA-INFORMED WOMEN'S ROCK CLIMBING

Trauma-Informed Women's Rock Climbing: Applications of Neurobiology and Trauma Care Best Practices to the Treatment of Women with PTSD.

Aleya Littleton

Submitted in partial fulfillment of the requirements for the degree of

Master of Arts from Prescott College

in Counseling Psychology: Adventure Based Psychotherapy

December 2013

Abstract

This paper uses what is known about trauma-informed care and how traumatic experience affects the brain to create a trauma-informed rock climbing program for female survivors. Trauma affects at least 70% of the population, with one out of four women experiencing sexual or domestic violence. The prevalence of traumatic experience in the general populations makes it highly likely that adventure therapists will work with affected individuals. Research has shown that effective trauma treatment requires a unique set of conditions which can be easily incorporated into adventure therapy programs. After an extensive review of current literature, this paper synthesizes the information and outlines how these principles are applied to rock climbing, and creates interventions to enhance neuroplasticity and regeneration using rock climbing techniques.

Keywords: Rock climbing, mindfulness, counseling, psychotherapy, trauma, women

Aleya J. Littleton

913 Arapahoe St

Golden, CO 80401

aleya.littleton@gmail.com

Table of Contents

Trauma-Informed Women's Rock Climbing: Applications of Trauma Recovery and Care Best Practices to the Treatment of Women with PTSD.

The current study will investigate the application of neurobiological and trauma recovery research findings to a rock climbing program designed to reduce symptoms of Post Traumatic Stress Disorder (PTSD) in female participants. This use of adventure therapy seeks to combine trauma best practices with new discoveries in body-based psychotherapy and neurobiology. Unique from wilderness therapy, adventure therapy has begun to define itself through the development of professional competences and specialized academic programs that combine clinical skill and adventure activity (Gass, Gillis, & Russell, 2012). Adventure therapy is the skilled use of activity to achieve the treatment goals of the client (Gass, M., Gillis, L., & Russell, K. 2012). Broadening its definition in this way, the clinical use of adventure therapy can be informed by traditional psychotherapy, experiential and body-based psychotherapy, and neurobiology (Gass, & Gillis, 1995). Current research in the adventure therapy field is focusing on measuring the efficacy of specific treatment models, and examining those models to identify the most effective elements. This study seeks to contribute to that body of knowledge by creating a program for female PTSD clients based on an extensive review of neurological findings related to PTSD, movement and exercise.

Trauma is one of the most common psychiatric disorders, with traumatic experiences being reported by half of women in the general population (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). PTSD, the prolonged experience of traumatic response symptoms, is present in about 40 percent of people who experience a traumatic incident (Kessler, 1995). Complex

trauma is defined as prolonged or cumulative traumatic experience, and can manifest in symptoms of PTSD as well as in social and personality disorders (Herman, 1992). This program is designed to target the symptoms of PTSD as they manifest in daily life and may also be effective in addressing the constellation of symptoms present in complex or prolonged trauma. In particular, it has a focus on "bottom-up" interventions, which are hypothesized to work well with PTSD as well as complex trauma. van der Kolk (1996) describes the way that trauma is remembered in the body as the disconnection between body sensations and the ability to process traumatic memory. He theorizes that the "top-down" approach of talk therapy may not be the most effective way to treat trauma. A "bottom-up" approach includes the use of body movement, interoceptive awareness and kinesthetic metaphor as a way to re-learn how to engage with the body and the environment. The model for psychological trauma used in this program is based on Herman's (1992) work, Trauma and Recovery, in which she describes what is lost when a traumatic event occurs: Safety, a sense of self and autonomy, trust, the ability to self regulate and the ability to access an external social support system. It is theorized that rock climbing provides the opportunity to reestablish these lost elements through bottom-up channels. (Piranian, 2007; Steinberg, 2011; Emmerson, 2011).

The bottom-up approach has been incorporated into several trauma treatment models currently in use, from the more skill-based Dialectical Behavior Therapy (Linehan, 1993), to Trauma-Informed Yoga Therapy (Emmerson, 2011). Mindfulness practices are used in both of the formerly referenced trauma treatment programs and are an effective way of increasing internal awareness and affect regulation (Siegel, 1999). Traditionally, mindfulness is taught through meditative practices. However, rock climbing may have a similar effect in increasing

mindfulness (Piranian, 2007). Not only is participating in rock climbing linked to higher overall life satisfaction, but it is also being investigated as an alternative method for cultivating mindfulness (Steinberg, 2011).

Rock climbing is a versatile activity which provides opportunity for both indoor and outdoor use, precise calibration of difficulty, low physical risk as well as a peak experience. Studies have shown that rock climbers experience less anxiety and more self confidence in daily life (Robinson, 1985), as well as less tension and depression after climbing (Motl, Berger, Leuschen, 2000). Climbers also have a higher endorsement of mindfulness and report the connection between mind and body as motivation to pursue the activity (Steinberg, 2011). Transformative experiences are also among the top motivators for rock climbers (Steinberg, 2011). Traditionally, rock climbing has been used in therapy for the aspects of challenge and novelty. In order to accommodate trauma informed best practices, this aspect of challenge and risk must be questioned (Mitten, D., personal communication, April 12, 2013). The traditional language of climbing instructors and guides must also be changed. For this program, trauma-specific climbing exercises and corresponding interventions have been created with the intention of reducing the presence of symptoms in women who have survived trauma, increasing their overall quality of life.

Literature Review

This program is built on best practices in trauma treatment as well as mindfulness, neurobiology, adventure therapy and somatic psychotherapy. Trauma-informed best practices will be applied to rock climbing to create a trauma-sensitive women's adventure therapy program.

Theory of Trauma

This program is primarily informed by Judith Herman and Pat Ogden's models of trauma, its effects and treatment. Herman (1992), addresses the results of trauma in five categories: Autonomic Dysregulation, Intrusion, Constriction, Disconnection and the Damaged Self. Herman's (1992) definition of the distinct effects of each category are described below.

- Autonomic Dysregulation: This category of trauma effect is characterized by an increase in autonomic nervous system activity, an imbalanced oscillation between sympathetic and parasympathetic responses. Hyperarousal (sympathetic nervous system activity) is catalyzed by the brain's belief that danger continues to be imminent. The continual state of arousal manifests in the individual being easy to startle, irritable and having trouble sleeping.
- Intrusion: This category reflects the intrusive nature of trauma memories stored in explicit memory, rather than implicit memory. Symptoms include flashbacks and nightmares, reenacting the traumatic event or withdrawing from life as a form of protection.
- Constriction: Constriction describes the numbing that occurs when the individual is

overwhelmed and unable to escape the traumatic event. In this state individuals will dissociate, or "zone out" into a trance like state that is useful during the actual traumatic event, but not useful after the event has ended. After the traumatic event the individual may seek to prevent any further triggering or retraumatization by the constriction of the scope of their life or through further numbing of traumatic memories through alcohol or drugs.

- Disconnection: Traumatic events have far reaching social implications as well as personal and physical ones. For example, the event of incest in a family may leave the survivor without the support of their immediate family. The social ramifications of those who survive political imprisoning may leave them without home or social connections. Additionally, the traumatic event itself shatters the basic belief in trust and any secure attachment the individual may have possessed, leaving them disconnected from humanity at large.
- Damaged Self: This effect of trauma refers to the event's ability to alter the developmental progress of the individual. Trauma alters one's sense of power and autonomy, as well as damages the sense of individuality and the ability to form intimate relationships. This change forces the adult survivor to relive the struggles of earlier developmental stages, and interferes with the normal development of the child survivor.

In Ogden's work on sensorimotor psychotherapy (2006), she describes three distinct phases in trauma recovery. The first phase focuses on developing resources for stabilization. In this phase the survivor learns to tolerate distress while keeping themselves safe. They learn grounding techniques and coping strategies for the overwhelming emotions they feel. The

strategies of distress tolerance taught in Dialectical Behavior Therapy (DBT) (Linehan, 1993) target the feelings of overwhelm while also giving the client a sense of control. This is done through mindfulness and Cognitive Behavior Therapy (CBT) exercises. Clients also begin to establish a feeling of safety and security in their life. The second phase focuses on processing traumatic memory (implicit and explicit) and restoring acts of triumph. Several leading trauma therapists, including Levine (1997) and Rothschild (2010) believe that directly processing the traumatic memory is not necessary for healing. Levine places less emphasis on the accuracy of the traumatic memory in favor of the fact that, regardless of form, the individual has indeed experienced trauma and that is the only thing that matters (Levine, 1997). Rothschild (2010) states, "The goal of trauma healing must be to *relieve,* not intensify, suffering. Common sense requires that improving the quality of life be the primary goal. Revisiting the horrors of the past should only be part of the process of it serves this goal" (Kindle Locations 97-98).

Congruent with this theory of trauma treatment is the physical activity and metaphor available in the adventure therapy modality (Gass, 2012). Through adventure therapy, somatic triggers can be addressed and held in a kinesthetic metaphor that allows the client to process the experience without directly recounting the traumatic event. The third and final phase of recovery strives to create integration and success in normal life. The phases of recovery are thought to happen in a spiral pattern, where the distressing work of the second phase requires moving back into the stabilizing work of the first phase before being able to move forward, etc. (Ogden, Minton & Pain, 2006).

A synthesis of the theoretical elements presented above create a lense through which trauma is viewed in this program:

1. Trauma affects core issues of self and self in the world.

2. Trauma creates new behaviors that are adaptive when in present moment traumatic experience, but are disruptive when not in the experience.

3. Trauma recovery comes in stages that begin with a foundation of safety that must be tended to with consistency throughout the healing process.

4. Respect and autonomy of the survivor are core values that must be held even as directive work is being done with the survivor.

Trauma Best Practices

The next step in creating a holistic trauma-informed program is the incorporation of "trauma best practices," which operationalize the theory and values described in previous sections. Trauma-informed services are those in which service delivery is influenced by an understanding of the impact of interpersonal violence and victimization on an individual's life and development (Elliott, Bjelajac, Fallot, Markoff, & Reed, 2005). Furthermore, these best practices seek to rely on procedures and programmatic elements that are growth-promoting for trauma survivors, and avoid those elements that are retraumatizing and harmful. In order to do this, organizations and programs must have a comprehensive knowledge of the bio-psycho-social effects of trauma on survivors. In 1998, a significant study was undertaken to generate knowledge on the effectiveness of comprehensive, integrated service models for women with co-occurring disorders and histories of trauma, called "The Women, Co-Occurring Disorders and Violence" (WCDVS) Study (National Center on Family Homelessness, 2003), funded by the Substance Abuse and Mental Health Service Administration (SAMHSA), National Center for Trauma Informed Care. This study produced information that led to the creation of

trauma-informed care best practices, and ten principles of trauma informed care for women. These principles, developed through consensus, are considered beneficial for all populations, but are especially critical for trauma survivors (Elliott, Bjelajac, Fallot, Markoff, & Reed, 2005). Without these elements, survivors are significantly less likely to access and benefit from mental health services or programs:

- Principle 1. Trauma-informed services recognize the impact of violence and victimization on development and coping strategies.
- Principle 2. Trauma-informed services identify recovery from trauma as a primary goal.
- Principle 3. Trauma-informed services employ an empowerment model.
- Principle 4. Trauma-informed services strive to maximize a woman's choices and control over her recovery.
- Principle 5. Trauma-informed services are based in a relational collaboration.
- Principle 6. Trauma-informed services create an atmosphere that is respectful of survivors' need for safety, respect, and acceptance.
- Principle 7. Trauma-informed services emphasize women's strengths, highlighting adaptations over symptoms and resilience over pathology.
- Principle 8. The goal of trauma-informed services is to minimize the possibilities of retraumatization.
- Principle 9. Trauma-informed services strive to be culturally competent and to understand each woman in the context of her life experiences and cultural background.
- Principle 10. Trauma-informed agencies solicit consumer input and involve consumers in designing and evaluating services.

This study seeks to embody these principles, and is designed around the empowerment model listed in Principle 3. Elliott, Bjelajac, Fallot, Markoff, & Reed, in their work "Trauma-Informed or Trauma-Denied" (2005), describe this empowerment model as having the following elements:

> 1. There is a partnership between the woman seeking services and the helper in which both participants are valued for the knowledge base they bring to the problem.
> 2. The goals of the work are mutual and established collaboratively.
> 3. A woman's issues are understood as created or influenced by the sociopolitical context.
> 4. The program facilitates the formation of a forum where women can relate to each other in a mutually supportive way.
> 5. The woman feels her experience and choices are validated.
> 6. The experience of collaboration provides both the woman and the helper with increased knowledge of self and others, increased self-worth, and increased competence and comfort in taking action on personal goals.
> 7. The ultimate goal of the empowerment model is to expand a woman's resources and support network such that the woman becomes less and less reliant on professional services...and more able to find meaning in re-connection to community (p. 465 - 466).

These elements correlate heavily with the Herman (1992) model of trauma recovery described previously, with an emphasis on empowerment and social connection. Upon examination of programs that work with trauma survivors (including those that are not therapeutic, but educationally or socially-based), like rock climbing or other adventure therapy

interventions, it is clear that not all of these elements are present. The current study transforms rock climbing into a trauma-informed activity. This transformation includes the intentional development of interventions that seek to reduce symptom severity through neurobiologically and somatically-informed activities.

Somatic Trauma Treatment

The body as an entry point for trauma treatment is the premise of this rock climbing program, specifically the application of sensorimotor psychotherapy. This theory, developed by Ogden, Minton and Pain (2006), was chosen specifically for its application of mindfulness, another core component of this program:

> The clinical practice of sensorimotor psychotherapy blends techniques from both cognitive and psychodynamic therapies (such as attention to cognitive schemata and putting language to felt experience) with somatically-based interventions (such as learning to track bodily sensations and working with movement). This combination is thought to foster the client's ability to engage the frontal lobes in mindful self-witnessing and in practicing new actions that promote empowerment and success (Kindle Locations 4332-4334).

The narrative re-creation of events is a successful therapeutic treatment strategy, and specifically, constructing trauma narratives in an emotionally-supportive environment supports the psychological and neurobiological integration required to avoid dissociative reactions (Cozolino, 2010). This is only one method, commonly referred to as a "top-down" approach to treatment. In the brain, the cortex is engaged in the storytelling process, and communication channels filter information down to affect the lower mammalian and reptilian functions. Conversely, a

"bottom-up" approach uses physical sensation and movement to access and process traumatic experience. Ogden's focus on the body as the primary entry point for trauma treatment is echoed in the work of somatic therapists like Levine (1997), Porges (2011) and Rothschild (2010). Bessel van der Kolk (2006) explains:

> For therapy to be effective it might be useful to focus on the patient's physical self-experience and increase their self awareness, rather than focusing exclusively on the meaning that people make of their experience—their narrative of the past. If past experience is embodied in current physiological states and action tendencies and the trauma is reenacted in breath, gestures, sensory perceptions, movement, emotion and thought, therapy may be most effective if it facilitates self-awareness and self-regulation. Once patients become aware of their sensations and action tendencies they can set about discovering new ways of orienting themselves to their surroundings and exploring novel ways of engaging with potential sources of mastery and pleasure (p. 13).

While a complete overview of somatic trauma treatment is beyond the scope of this work, the influence of somatic work is paramount to this study. The somatic evidence of trauma has its roots deep in the neurological processes which respond automatically when faced with perceived life-or-death stress. To create a complete theory of trauma through which to practice rock climbing (or any other adventure therapy sport or intervention), the neurobiological effects of trauma and how they present in a survivor's life must also be investigated (Rothschild, 2010)

Neurobiology of Trauma

When an experience overwhelms the brain's capacity to cope, our traumatic response system activates the amygdala, the center for fear responses. Several key changes that may

become chronic occur in this activated state, depending on the initial resilience of the individual and how the trauma is dealt with in the immediate time frame (Levine, 1997). As a general rule, the earlier, more severe, and more prolonged the trauma, the more negative and far-reaching its effects (Cozolino, 2010). This point was highlighted by the ACE study, which found that exposure in childhood to trauma significantly increases the instance of chronic adult illness, risky health-related behavior in adolescence, and early death by an average of 10 years (Felitti, & Anda, 1997). Functional neuroimaging has helped to identify three brain regions that may be involved in the pathophysiology of PTSD: the amygdala, medial prefrontal cortex, and hippocampus (Shin, Rauch, & Pitman, 2006). The amygdala is involved in the assessment of threat-related stimuli. The medial prefrontal cortex, which includes the anterior cingulate cortex, subcallosal cortex, and medial frontal gyrus, is involved in the inhibition and extinction of the fear response.The hippocampus, which is involved in explicit memory processes and in the encoding of context during fear response (Shin, Rauch, & Pitman, 2006). The hippocampus also appears to interact with the amygdala during the encoding of emotional memories (Shin, Rauch, & Pitman, 2006). Trauma-induced neural changes will be discussed in this section, including: 1. Amygdala activation, 2. Suppressed neo-cortex function 3. Brain lateralization, 4. Structural volume changes, and 5. Inter-structural communication.

The triune brain and amygdala activation. Popular in the description of trauma and the brain is the theory of the triune brain. The three "layers" of the brain represent distinct and interrelated areas of evolution. The lower, or reptilian, brain is responsible for instinctual behavior and control of the autonomic nervous system. The middle, or mammalian, brain incorporates emotion and social learning which complements the instinctual nature of the

reptilian brain, including the flight, fight and freeze mechanism. The high brain, or cortex, contains the executive functions that allow for reason, insight, empathy and emotion regulation, and also the inhibition of lower brain structures. During a traumatic event, the reptilian and mammalian brains are activated and action is taken instinctually, while the cortex is suppressed (Jackson, 1958). The activation of the amygdala has a significant impact on the function of other areas of the brain. Neuroimaging studies of human beings in highly emotional states show that intense emotions of fear, sadness, anger, and happiness cause increased activation in subcortical brain regions and significant reductions of blood flow in various areas in the frontal lobe (Damasio, Grabowski, Bechara, Damasio, Ponto, Parvizi, Hichwa, 2000). Essentially, the executive function and critical thinking capacity of the cortex is suppressed and vertical (bottom-to-top) brain structure communication as well as lateral (side to side) integration is interrupted (Siegel, 2007).

Limbic brain structures, such as the amygdala, tag incoming stimuli and determine their emotional significance. Emotional significance, in turn, determines the response and what physical action will be taken (van der Kolk, 2006; Siegel, 1999), and primes the body to act through sympathetic nervous system activation. The amygdala is the primary processor of danger and the area that alerts the body that there is something to be feared. The reptilian brain stem then creates the appropriate reaction in the body, either hyper or hypo arousal. In 60% of trauma survivors, this reaction is able to successfully resolve (Kessler, 1995). The individual moves out of the flight, flight or freeze reflex and regains cortical function and the ability to regulate emotions and physical responses through parasympathetic nervous system activation (Porges, 2011). In the other 40% of trauma survivors, however, symptoms persist long after the event

(Kessler, 1995). These symptoms of autonomic dysregulation are the criteria for PTSD.

Flashbacks. Trauma's profound effect on the brain is highlighted by the difference between the recall of regular memories and the recall of traumatic memories. Regular autobiographical memories are easily accessed and recounted with a story-like quality, normal emotion modulation and an ever-fluctuating narrative as the memory changes over time. Traumatic memories, often called "flashbacks," stay the same over time, and have a non-linear and highly sensory quality (Cozolino, 2010). Flashbacks are re-experienced in real time rather than simply recalled and described. This is an important element in the persistence of trauma symptoms in individuals with PTSD, as the survivor continually lives in a state of present danger despite the fact that the traumatic incident has passed (van der Kolk, 2006). This difference in recall is thought to occur because of disruption in brain lateralization (left and right communication) and disruption in the function of the thalamus, cortex and hippocampus (top and bottom communication). The acute activation of the amygdala, which is biased in communicating with the emotional right hemisphere of the brain as well in the occipital, or visual, centers, also disrupts the function of the hippocampus (Cozolino, 2010). The integration of memory that naturally happens between the left and right hemispheres of the brain does not occur in the highly stressful environment of a traumatic incident. Rather, the memories are stored primarily in the right hemisphere in the form of timeless images and emotions. Studies that examine activation and blood flow in the brain during traumatic reexperiencing show increased stimulation in the right hemisphere and in the amygdala (Ogden, Minton & Pain, 2006). The reason for this is not completely understood (Ogden, Minton & Pain, 2006).

The top-down communication system of the brain, minus the olfactory system, runs

primarily through the thalamus. The thalamus, responsible for communication between the limbic and cortical regions of the brain and located at the juncture of both, also shows evidence of disruption in traumatic experience, interfering with the relay of sensory information (Ogden, Minton & Pain, 2006). This disruption in communication between the lower and upper brain may also be responsible to the persistent symptoms of PTSD. Interestingly, disruptions in thalamic function and sensory integration may intrude into the time processing dimension. The thalamus mediates a function called temporal binding. Temporal binding is the oscillation of thalamic neurons at 40 Hz, which creates a sympathetic resonance in neurons in other regions of the brain such as the cortex. Temporal binding has been suggested to be "a temporally-coherent event that binds, in the time domain, the fractured components of external and internal reality into a single construct…the 'self'" (Ogden, Minton & Pain, 2006, Kindle Location 3449). A breakdown of temporal binding and the resulting lack of thalamocortical dialogue may be a process that accounts, among others, for flashback experiences in PTSD (Lanius, Bluhm, & Pain, 2005).

Structural volume. Neuroimaging shows that the volume of the corpus callosum, the thick band of neurons that connects the right and left brain hemispheres, in PTSD patients is significantly reduced compared to non-PTSD control patients (Villarreal, Hamilton, Graham, Driscoll, Qualls, Petropoulos, & Brooks, 2004). Interestingly, childhood neglect is also correlated with reduced corpus callosum volume (Teicher, Dumont, Ito, Vaituzis, Giedd, & Andersen, 2004) This may imply increased susceptibility to risk factors throughout life. The ACE study discussed earlier, which includes neglect in the assessment tool, made a similar statement about the effects of childhood trauma over the course of a lifetime (Felitti, & Anda, 1997).

Additionally, studies have discovered that individuals with chronic PTSD also show lower hippocampal volume (Ogden, Minton & Pain, 2006). The hippocampus is the region responsible for memory, which may account for the both vivid or amnesiac qualities of trauma survivor memories as discussed above. A recent study by Chao, Weiner, & Neylan, (2013) measured structural volumes of veterans with PTSD, remittent PTSD, and no PTSD, and found that in PTSD test subjects the hippocampal, caudal anterior cingulate, insula, and corpus callosum volumes were smaller than in the unexposed controls. Two studies have reported that severity of PTSD is also inversely correlated with anterior cingulate cortex volume (Shin, Rauch, & Pitman, 2006). This creates two hypotheses for volume changes and trauma exposure: smaller initial structural volume leads to increased vulnerability to PTSD, or exposure to trauma causes structural shrinkage. In this study they also found that, while smaller than the unexposed controls, the structures of veterans with remittent PTSD were larger than those with PTSD, indicating that recovery means regeneration of brain matter (Chao, Weiner, & Neylan, 2013) In the case of volume reduction due to trauma exposure, the changes in measurable volume of brain structures may be attributed to the altered neurochemical reactions that occur during trauma. Glucocorticoids like cortisol are released in excess during traumatic experience. Cortisol, the stress hormone, mediates some of the physiological reactions to trauma and promotes the breakdown of substances for immediate energy use (Cozolino, 2010). When present for long periods of time, this hormone contributes to lower hippocampal volume, as well as the sensitizing of the hippocampus to react with smaller amounts of the hormone (Cozolino, 2010).

Integration and lateralization. Overall integration of discrete brain structures leads to increased internal complexity and higher neural functioning (Cozolino, 2010). The term

integration refers to the transferring of information across systems (Schore, 1994). The *disintegration* of discrete brain structures in those with PTSD, as shown by reduced volume and disrupted communication patterns, can be said to play a role in the persistent nature of PTSD symptoms. In addition to the disrupted left-right lateralization that may account for the flashback nature of traumatic memory, the anterior cingulate cortex (ACC) is theorized to play a critical role in the left-right. brain break in communication as well (Hamner, Lorberbaum, & George, 1999). This structure surrounds the corpus callosum and is integral in a wide variety of autonomic functions, such as regulating blood pressure and heart rate, as well as rational cognitive functions like reward anticipation, decision-making, empathy, impulse control and emotion (Hamner, Lorberbaum, & George, 1999). The structure itself has connections to both the cortical regions and to the brain stem. This connection between cognitive function and autonomic regulation seems to hold the key to meaning making in traumatic experience processing. A study by Critchley et al. (2003) found that the ACC does not simply regulate autonomic arousal separately from its cognitive functioning roles, but with effortful cognitive and motor behavior the ACC supports the generation of cardiovascular arousal. The authors also suggest that ACC function mediates context‐driven modulation of bodily arousal states (Critchley, et al. 2003). In other words, it has an influence on the state of the body based on the context that cognition creates. This knowledge may provide a door into directly regulating autonomic nervous system functions through the use of cognitive and motor system interventions.

Mindfulness and Neurobiology

The use of cognition to regulate anxiety is most evident in the practice of meditation and

mindfulness. In individuals who report a high level of anxiety, a negative correlation exists between the ventromedial prefrontal cortex (vmPFC) and the amygdala, even in a state of rest (Kim, Gee, Loucks, Davis, & Whalen, 2011).

Baer (2003) defined mindfulness as "the non-judgmental observation of the ongoing stream of internal and external stimuli as they arise" (p. 125). Shapiro, Carlson, Astin, & Freedman (2006) suggest that there are three main components of mindfulness: intention ("doing on purpose"), attention ("paying attention" to the moment), and attitude (how one pays attention, "in a particular way"). The core technique used in DBT to manage overwhelming emotions is the practice of mindfulness (Linehan, 1993). Meditators have been shown to have lower reactivity to stress (Kabat-Zinn, Lipworth, & Burney, 1985), as well as increased cortical thickness (Lazar et al., 2005). In the study by Lazar, et al. (2005), cortical thickness was measured using magnetic resonance imaging. Cortical brain regions associated with attention, interoceptive, and sensory processing were found to be thicker for a group of experienced meditation practitioners than for the control subjects. Other neuroimaging studies demonstrate a link between meditation and regulation of brain regions involved in affect regulation and attention control (Rubia, 2009). The ACC discussed earlier is instrumental in these functions, and has been the topic of investigations seeking to learn the neurological mechanisms behind anxiety reduction and meditation. Activation of the ACC appears to be enhanced in meditation practices that train attentional focus on breathing or internal body states, such as Kundalini Yoga or mindful observation of the breathing (Farb, Segal, Mayberg, Bean, McKeon, Fatima, & Anderson, 2007; Hoelzel et al., 2007). Teper, & Inzlicht (2013) conducted a study that showed that anxiety reduction in meditation is directly related to activation of the prefrontal cortex and the ACC. These links

imply a promising connection between the use of mindfulness and meditation and the treatment of trauma survivors and possible restoration of affected neural structures. Mindfulness by its definition seeks to create a state of observation, awareness and acceptance without judgement—to change the way that the brain self-references. This observational stance, the ability to notice and reflect on internal states, activates the medial prefrontal cortex and ACC, the regions which extinguish the fear response of the amygdala (Ogden, Minton & Pain, 2006; Siegel, 2007). Over time, the practice of activating this area through mindfulness creates new neural pathways or strengthens existing ones, mitigating the damage done by exposure to traumatic experience. A study done by Farb, et al. (2007) identified two ways that human brains self-reference. The first is through the narrative pathway, which focuses on the self and narrative experience. The second is through direct, or mindful, experience. In the direct form of self-reference, the circuitry that creates a narrative around stressful events is deactivated in favor of a more global awareness. This allows for cognitive reframing of experience and regulation of emotion (Farb et al., 2007). The psychological variable most associated with the increased resistance to pathology after mindfulness-based cognitive therapy is metacognitive awareness, the shift toward experiencing negative thoughts as observable mental contents rather than the self (Teasdale et al., 2002). The goal of the mindfulness interventions and exercises in this study are to pair the grounding effects of mindfulness with rock climbing movement, gradually increasing direct self-referential ability and allowing participants to create new response options in the moment. Essentially, this program seeks to increase the brain's ability to integrate experience and self-regulate by creating new neural pathways through mindfulness and novel experience.

Meditation is not the only way, however, to train attentional focus. Exposure to nature

gently grabs attention and allows the self-referential parts of our brain, such as the ACC, to regenerate and restore, improving overall cognitive function (Berman, Joindes, & Kaplan, 2008). Rock climbing has also been investigated as a way to increase mindfulness (Steinberg, 2011), and combines the benefits of exposure to nature with mindfulness training and movement. The roots of trauma symptoms lie in neurobiological mechanisms, physical structures of the brain activated and changed through experience, and the influence of the mind. The proposed mechanism for symptom reduction in this program will directly address these changed physical and cognitive systems through body-based trauma treatment techniques adapted and applied to rock climbing.

Rock Climbing and Mindfulness

Mindfulness and rock climbing are two closely linked topics, and have been written about by authors such as Arno Ilgner (2003) in "The Rock Warrior's Way," as well as elite training manuals and biographies of mountaineering adventures. Ilgner (2003) specifically outlines a plan for increasing mindfulness as a way to improve climbing ability and move past plateaus:

> Knowing there is an inner you independent of any beliefs or thoughts gives you the power to change. As the Witness position creates a place for you to conduct your observations, it also affects the thoughts and feelings you're observing. By itself, it will not reverse self-limiting thoughts, but it does help these thoughts be less overwhelming (Kindle Location 524).

In 2011, Rachel Steinberg investigated the hypotheses that rock climbers will score higher on mindfulness measures than the general population, and that mindfulness in rock climbing will show a positive correlation to life satisfaction. Her work showed that rock climbers

had a higher endorsement of mindfulness, positive affect, and life satisfaction than the general population:

> This suggests that mindfulness and psychological well-being are correlated with the activity of rock climbing and may be an important key to motivation worth further exploration. The significant endorsement of mindfulness by the rock climbers in this study provides statistical evidence for the potential benefit of using rock climbing as an activity to help facilitate mindfulness (p. 62).

Another approach to mindfulness in climbing is through Flow theory. Flow theory was first described by Csikszentmihalyi in 1965 in his study of artists. Flow experiences have been characterized as: merging of action and awareness; centering of attention on a limited stimulus field; letting go of self-consciousness; a feeling of competence and control; having specific goals and receiving immediate feedback; and being intrinsically motivated—a peak experience (Csikszentmihalyi, 1990). Flow also depends on achieving the right balance between how challenging one's goals are and how effective one's skills are in meeting those challenges (Csikszentmihalyi, 1990). Csikszentmihalyi began investigating experiences that naturally lend themselves to this match of skill and challenge, and in 1969 identified rock climbing as a Flow-inducing sport.

In addition to being a descriptor of peak experience, Flow is also a way to understand consciousness. According to Parr, Montgomery and DeBell (1998):

> Flow is 'A phenomenological model of consciousness based on information theory.' The phenomena of interest to Flow theorists is what people experience and how those experiences are interpreted. Consciousness refers to the ordering of information

> (internally and externally). Order develops from one's intentions and the goals they form; order is achieved when attention, also called psychic energy, acts in service of one's goals (Flow Theory, para. 12) .

Siegel (2006) calls this internal order "integration." Integration is the state in which all parts of the brain work together in regulated harmony and, according to Siegel, is an important element in achieving mental health. Mindfulness, where attention is applied in an intentional way, is said to increase this internal order and integration (Siegel, 2007). In rock climbing, attention is concentrated outward toward the environment in search of opportunities for action. A state of Flow emerges from this concentration of attention, and consciousness is ordered, allowing the individual to develop self-assurance (Parr, Montgomery & DeBell, 1998). Through the process of learning to rock climb, and applying the learned skill to appropriately challenging "routes" and "problems," Flow state can be achieved. According to the definition of Flow as a match between skill and challenge, achieving Flow state while rock climbing does not require the climber to be a master of the sport, but rather the master of a particular level of the sport. Beginner climbers can master particular routes chosen at a level appropriate for their skill, and increase the challenge as their skill develops. Flow state can even begin in the initial phase of the climbing process during the focused attention and awareness of route selection, training, and preparation for the climb. In this way, rock climbing not only reinforces the components of mindfulness, but engages the body in a psychological process to enhance mindfulness.

While no record exists that compiles the mindful aspects of climbing, this researcher has created the following list of generalizable mindfulness skills in rock climbing based on personal experience as a climber and instructor:

- Learning to listen to and care for the body through: the completion of climbing moves, failure to complete climbing moves, warm-up and training routines, and the time spent in the wilderness.
- Focus on the present moment. Climbing requires a focus on the present moment in order to be successful, as no coordinated upward movement can be made without a clear mental concept of the position on the climb, the climber's own body position, and the available options for action.
- The awareness of available options for each move requires the climber to be in an observational, or mindful, position in relation to the climb.
- To make fluid and efficient movements while climbing, the climber must be able to sense and change interoceptive factors such as their balance and center of gravity. This sense allows the climber to choose new body positions to help achieve their goal. This sensorimotor approach to rock climbing can cultivate better body awareness both on and off the rock.

There are several techniques to increase mindfulness in rock climbing that will be incorporated into the program's curriculum. They include:

- Slow climbing
- Silent climbing
- Traversing
- One-handed climbing
- Climbing while holding an object in one hand

Mindfulness exercises will be intentionally incorporated into the beginning of each

session. The mindfulness exercises will be directly linked to the movement objectives of the rock climbing lesson, thereby providing a real-time platform for practicing the concepts while in a state of mild arousal induced by rock climbing. Mild arousal is a key catalyst in the change process. In challenge course work this is called stepping out of your comfort zone and into your learning zone (Gass, M., Gillis, L., & Russell, K. 2012). Ogden (2006) also discusses therapy conducted within the "window of tolerance," where the edges represent the border of what is tolerable, and the center represents a situation that is too safe and does not provide enough stimulus and novelty to effect change.

The goals of the climbing exercises developed for this study are to increase the following:

- Breath awareness,
- Interoceptive awareness,
- Attentional focus,
- and the ability to "SIFT," (Sensations, Images, Feelings and Thoughts) through overwhelming scenarios.

SIFT originates from Siegel's (2007) work on mindfulness and the brain, and is a model for understanding and developing mindfulness. Siegel describes the "Wheel of Awareness," where the individual learns to take an observational stance from the center of the wheel where they are able to SIFT through the information on the rim of the wheel. In addition, the elements of mindfulness in rock climbing will be emphasized through lessons on technique and thoughtful reflection on the experience of climbing.

Neurobiology and Rock Climbing

While research has been accumulating around the mechanisms through which the brain

affects movement, there is little literature on how movement affects the brain. This concept is known intuitively through areas of study such as somatic psychology, developmental movement, and yoga, but we are not yet to the place where interventions can be developed using empirically-studied brain-body systems. However, enough is known about the functionality of the brain to postulate connections and mechanisms through which movement can be used to stimulate neurogenesis and healing in the brain. As Roger Sperry said: "the brain is an organ of and for movement: The brain is the organ that moves the muscles. It does many other things, but all of them are secondary to making our bodies move" (Ogden, Minton & Pain, 2006). Sperry states that the function of perception may even be secondary to movement:

> Insofar as an organism perceives a given object, it is prepared to respond to it … The presence or absence of adaptive reaction potentialities, ready to discharge into motor patterns, makes the difference between perceiving and not perceiving. (Ogden, Minton & Pain, 2006, Kindle Locations 7331-7332)

This section will connect what is known about brain function and movement with rock climbing as a potential mechanism for healing the brain by discussing the following topics: neuroplasticity and exercise, and motor-emotional structural connections.

Neuroplasticity and Exercise. The term neuroplasticity refers to the brain's ability to create new pathways at any stage in life. Research indicates that Brain-Derived Neurotrophic Factor (BDNF), a growth protein responsible for nerve growth in the brain and periphery, plays a role in the growth of new neurons in the hippocampus and cortex. One known way to increase levels of BDNF in the brain is through moderate physical exercise (Cozolino, 2010). Physical exercise does more than promote growth, however—it can produce new neurons in the brain. A

study done at Princeton University investigated why exercise, which produces the right physiological state to increase arousal and anxiety, is such a source of calm for those who engage in it (Schoenfeld, Rada, Pieruzzini, Hsueh, & Gould, E., 2013). Researchers studying mice discovered that exercise caused growth of new neurons that both respond to stimulus and then induce inhibitory mechanisms in the ventral hippocampus, quieting the anxious areas of the brain. Research has also shown that areas of the brain associated with music and composition are measurably more dense in musicians than in non-musicians (Gaser, & Schlaug, 2003), specifically an increase in the size of the corpus callosum in those who began musical training before age 7 (Schlaug, Jäncke, Huang, Staiger, & Steinmetz, 1995). These findings indicate that repetition and practice encourages neuronal growth.

Structure. The areas of the brain responsible for refining and controlling or inhibiting motor function are the cerebellum and the basal ganglia. The basal ganglia is a bundle of nuclei located on either side of the thalamus, and connected to the cerebellum and the cortex. It is part of the limbic system, and the amygdala, discussed earlier, is located below each lobe. The basal ganglia is said to play a role in procedural memory and emotion, as well as fine motor control. The effects of a dysfunctional basal ganglia can be seen in Parkinson's disease patients, who often exhibit an inability to recognize emotion in speech vocalizations, and involuntary movements such as "pill rolling." Increased arousal in the basal ganglia are also associated with the increased states of arousal seen in trauma survivors. This increased arousal may also account for some of the somatic symptoms of trauma, such as muscle tension (Amen, 1999). One treatment for basal ganglia disruption issues (such as Parkinson's disease and ADD) is dopamine-enhancing medication. Exercise is also a reliable, non-medicated method of increasing

dopamine production in the brain (Garland, Schutz, Chappell, Keeney, Meek, Copes, Acosta, Drenowatz, Maciel, van Dijk, Kotz, & Eisenmann, 2011). Exercise is commonly recommended as a natural antidepressant, and improving muscle tone can mitigate the feelings of vulnerability and lack of self confidence experienced by trauma survivors (Rothschild, 2010).

Rock climbing as exercise makes use of controlled, precise, movement (activating the basal ganglia and cerebellum), sustained effort (mild aerobic exercise that increases neuron growth as well as dopamine and BDNF production), and focused attention (mindfulness, which activates the ACC, prefrontal cortex, and executive functions). The euphoric and satisfying effects of this kind of movement and effort are previously defined as "Flow." Flow is a distinct emotional state in which attention is freely invested in the accomplishment of goals. In the brain, emotional responses constitute a primary value system that ingrains patterns of neural firing and shapes the emergent states of activation of the system (Siegel, 1999). As neural states become ingrained through repeated experience and emotional intensity, they become more likely to be activated (Cozolino, 2010). Rock climbing engages the whole body in focused movement. Intricate body movement is controlled by the cerebellum, a small region of the brain that is the most dense in neural connections (Ghez & Fahn, 1985). The cerebellum's structure is such that it interfaces with the frontal cortex, through the basal ganglia, linking movement and exercise to changes in learning (Steinlin, 2007). Exercise, particularly bilateral coordinated movement, has been shown to significantly increase attentional performance in students (Budde, Voelcker-Rehage, Pietraßyk-Kendziorra, Ribeiro, & Tidow, 2008). Through practice of rock climbing exercises, a state of awareness, control, confidence, and intrinsic motivation can theoretically be reinforced in the brain. While no literature on this topic can be found, it seems

that the intentional refinement of fine motor skills in an environment that promotes dopamine production and interhemispheric communication will improve emotion regulation circuits and cortical-limbic communication. The structure of the rock climbing program in this study takes advantage of this increased post-exercise neuroplasticity by arranging for moments of reflection and new concept introduction after physical activity. Through repeated experience, the application of mindfulness skills, and the thoughtful arrangement of activities, optimal learning conditions will be created to achieve the goal of trauma-related symptom reduction.

Creating optimal conditions includes more than attending to the physiological states described above, it means addressing the social and environmental context as well.

Women in Wilderness Therapy

The difference in wilderness experiences between men and women has been a discussion for at least the last 20 years (Cole, Erdman, Rothblum, 1994). Women report several reasons for wanting to be in single-gender groups. The traditional patriarchal approach to wilderness therapy utilizes an extreme power differential between client and staff, and the perceived risk of activities as catalyst for new behavior and change (Mitton, 1994). Mitton postulates that the manipulations of wilderness and "risk" activities to make the client feel a sense of overcoming true difficulty is reminiscent of the untruths that have been told to women in our culture, robbing them of their power and authentic choice. She advocates instead for clients to know the real and perceived risks, and for them to be empowered to make authentic choices for themselves. This approach reflects the empowerment model in trauma treatment best practices (Elliott, Bjelajac, Fallot, Markoff, & Reed, 2005), as well as the principles of feminist counseling theory, ecofeminism, and relational-cultural theory (RCT).

Relationship in Wilderness. Wilderness and adventure therapy experiences provide women with the opportunity to change not only the relationship that they have with themselves and others, but with the earth (Mitton, 1994). Wilderness settings have the potential to be uniquely impactful to women's groups, allowing them to reconnect with an authentic self derived from their innate femininity (Powch, 1994). Spiritual traditions view the earth as "mother," "life-giving," and "the goddess" (Cole, Erdman, Rothblum, 1994), and feminine energy is often compared to water and wind, seasonal cycles and yield, or surrender (Deida, 2004). Ecofeminism connects the domination and exploitation of women with that of the environment (Powch, 1994). Basic principles of ecofeminism assert that one cannot ensure the liberation of women without re-valuing the natural world, and that there is an intrinsic relationship between the way in which we treat the natural world and the way in which we treat one another (Holden, 2010). Emphasizing these commonalities and connections in a trauma-informed program can foster empowerment and create a therapeutic alliance between a woman and nature, and become a metaphor for personal transformation and change.

Bialeschki and Henderson (1993) convey the value of outdoor experiences in relationship to the world around us: "In a society where being a woman is often perceived as a weakness, successfully facing challenges encountered in outdoor settings may help women rid themselves of self and socially imposed limitations." Two points of empowerment in relationship emerge in women survivors of trauma: the survivors trust in their own capability, and in their ability to trust others (and discern who cannot be trusted as well). Through a self-competitive activity like rock climbing, the client is able to identify their own goals and define their own success. The feelings of empowerment then do not come from making it to the top. They come from learning that their

body, which has betrayed them through the many physiological symptoms of trauma, can actually function as it is intended and help them to achieve goals. One rape survivor, upon hearing of this study, shared her experience. She stated that it was not until she gave birth to her first child that she began to feel trust and connection again with her body. She recounted that her youth was spent doing things to get herself out of it, and that with the birth of her daughter she and her body became friends again. She stated that she would have loved to be part of a climbing group, and could see the healing that could come from learning to trust and connect with her body on the rock and in a natural setting (Anonymous, personal communication, May 2013). Ending Violence Effectively co-founder and rape survivor Mary Hughes says: "I can do things even when I am frightened. My body is shaking and I can still trust my body. It still works" (Powch, 1994, p. 16). Once a woman has the skills to practice emotion regulation and the mindfulness needed to approach the rock, climbing offers the opportunity to create a mildly stressful situation where the woman can choose to enter a "fight, flight or freeze" state and successfully negotiate the resolution of that stress through her body (Herman, 1992).

Method

This study proposes a trauma-informed rock climbing program to treat the symptoms of traumatic response. The program utilizes current knowledge of trauma neuro-biology, neuro-regenerative movement, and trauma best practices to create an environment that promotes integration of traumatic experience and symptom reduction.

Program Outline

This program is designed to take place over the course of eight weeks. Participants will

meet once per week for four hours. The agenda of each session is designed to maximize learning through scaffolding, activation of prior knowledge, and conditions that encourage enhanced neuroplasticity. New interventions will be introduced using an experiential, inquiry-based approach, and then practiced for the majority of the session. The agenda of each session is outlined below, and the schedule and progression of interventions is outlined in Table 1. A broader outline of trauma treatment goals matched with climbing movements and concepts is included in Table 2.

Rock Climbing in Relationship

While the science behind rock climbing, movement and empirically-tested trauma treatment has been discussed above, a central linking theme is still needed to guide the intention of the participants in the program, as well as the facilitators. This philosophy of trauma-informed, mindfulness-based rock climbing can be summed up in the word "relationship." This word embodies the primary effect of trauma, which is to sever or change the relationship of the individual to themselves, to others, and to the physical world (Herman, 1992), as well as the context in which recovery occurs through empowerment and relational connection (Elliott, Bjelajac, Fallot, Markoff, & Reed, 2005). Rock climbing provides the opportunity to recreate these relationships through the physical, mental, and relational aspects of the sport.

Pirinian (2007) describes rock climbing in terms of relationship. A hold may be good, but if the body is just six inches too far to the left, the hold loses its value. A good hold may also become a bad hold when one's center of gravity shifts. The climb is done in relationship to the rock. In trauma recovery, the restorative aspects of the work (work done beyond establishing safety and security) focus on reconnection with the self and others, and integration of the

dispersed elements of memory and sensation (van der Kolk, 2006; Siegel, 2006; Herman, 1992). Climbing with relationship in mind provides a gentle opportunity to learn about the self in relationship to the rock and gravity, as well as immediate feedback that the climber can use to change un-useful behavior.

In addition to the metaphoric relational value in rock climbing, the models of interpersonal neurobiology and relational-cultural theory (RCT) are also relevant. The focus of RCT is the centrality of relationships. That is, relationships are the indicators of mental health, as well as the mechanism in therapy that allows one to move toward that health. In interpersonal neurobiology, the mechanism for relationship and change is attributed to mirror neurons (Siegel, 2006). The mirror neuron system is said to create empathy through shared internal experience between two people, and by perceiving the expressions of another person, the brain is able to create an internal state that is thought to "resonate" with that of the other person (Siegel, 2006). One of the core tenets of RCT is the central relational paradox (CRP). The CRP assumes that we all have a natural drive toward relationships, and in these relationships we long for acceptance. Whereas traditional theories view mature functioning as characterized by movement from dependence to independence, RCT suggests that maturity involves growth toward connection and relationship throughout the lifespan. Jordan (2001) states:

> Relational-cultural theory suggests that the primary source of suffering for most people is the experience of isolation and that healing occurs in growth-fostering connection. This model is built on an understanding of people that emphasizes a primary movement toward and yearning for connection in people's lives. It is posited that women grow through and toward connection rather than toward separation, and that their sense of

meaning and well-being is anchored in relationships throughout the lifespan (p. 95). Principles of RCT in therapy include examination of connectedness and disconnectedness, empathetic connection and internal integration, and the reinforcement of skills and beliefs that lead to healthy interdependence (Jordan, 2001). Herman (1992) describes constriction and disconnections as direct effects of traumatic experience, and major focuses of treatment. Siegel (1999) describes the neurobiological effects of trauma as the dis-integration of parts. The theoretical framework and relational focus of this study strives to interrupt and reverse the disconnection that serves to continue traumatic response.

Mindful Rock Climbing Techniques

Rock climbing provides an external stimulus that requires the climber to be in the present moment, as well as the opportunity to build internal resources such as resilience, positive self image and mastery (Ilgner, 2003). As discussed earlier, it also provides the opportunity to cultivate enhanced mindfulness and healing connections between emotional, perceptual, and executive parts of the brain. The curriculum for this study contains several climbing-specific and movement-based exercises (Tables 2 and 3) based on relationship, as well as on attentional focusing techniques such as the somatic satisfaction cycle and Porges's (2011) Polyvagal theory.

Porges' (2011) work supports the direct connection between the body and the brain through input from sensory systems that direct autonomic nervous system regulation. While highly simplified, in application to rock climbing what is useful is to focus on the messages that sensory input sends to the brain, and vice versa, via the vagus nerves. Social engagement systems, such as the resourcing of relationships when in distress, are driven by the body's visceral state (Porges, 2011). Additionally, the vagus nerves that regulate the face are the same

nerves that regulate the heart and lungs. This implies that the facial muscles can be used to calm down and allow us to access social resources, such as climbing partners (Porges 2011). It also implies that through increased body awareness and differentiation between proprioceptive (external in space) and interoceptive (originating internally) messages we can increase the time between stimulus and response (Frankl, 1984), thereby increasing our choice and control in a given situation (Linehan, 1993).

Finally, rock climbing allows for the full experience of a "yield" state, which is associated with parasympathetic activation and visceral actions of safety such as rest and digestion (Porges 2011). In rock climbing, "yield" is operationalized in how the climber is able to weight the harness and be lowered, how they find rest stances in between strenuous movements, and how they take a fall. Overstimulation of the sympathetic nervous system reduces the climber's comfort and ability to participate in these aspects of climbing. In this program, yield opportunities provide the climber the chance to mindfully regulate their nervous system and generalize that skill to other life circumstances, as long as the activation occurs within the window of tolerance (Ogden, Minton & Pain, 2006).

Trauma-Informed Practices in Rock Climbing

There are no best practices yet established for trauma-informed rock climbing. The following principles are suggested based on current trauma-informed activities like yoga, the best practices stated in the previous section, and the wilderness therapy model of challenge by choice. These best practices have informed the course curriculum through an alternative layout (Table 1) and intentional climbing-specific interventions (Table 2).

Challenge by Choice: "Challenge by choice" is a term coined by Karl Rhonke, an Outward Bound veteran staff member and one of the four founding Project Adventure staff (Schoel, J., Prouty, D., & Radcliffe, P., 1988). Kurt Hahn, founder of Outward Bound, described his philosophy as the impelling of individuals into new experiences. This impelling is not forceful, but rather is the presenting of an opportunity and the allowance of a decision on how to approach it. Rhonke further developed the concept through his experience with urban youth in adventure activities. Within the context of this climbing program, participants will not be forced into action, but rather presented with an opportunity to decide how they would like to participate. This prioritization of client choice and control is in line with trauma-informed practice. This principle will be evidenced by the language of the program facilitators, and the focus on mindfulness. Participants will receive instruction in mindfulness, and will be encouraged to incorporate the principles of mindfulness into their rock climbing and decisions around how they participate. The client will have full choice of what activity to participate in, and to what degree they will participate. They will also have full control over when the activity or climb ends.

Language: Language in the recreational climbing world can be aggressive, disempowering and dismissive. Phrases such as, "Just take one more step and I will let you down!" and, "Come on, don't give up now, this is easy!" or, "Just sit back in your harness for me!" are commonly heard in gyms and outdoor climbing locations. This program will employ only language that is neutral and objective, non-coercive, invites rather than commands, and focuses on the client rather than the instructor. This participant-centered language will also translate into the method for coaching and the application of physical touch. Touch without permission will not occur; rather, facilitators will be mindful of the participant's autonomy, and

the possibility of touch as a trigger for traumatic memories.

Safety: Special emphasis will be placed on exploring the safety systems present at the climbing site. Participants will be given instruction in those systems, as well as time to explore their effectiveness and uses. This competence in safety systems will fulfill the need for physical safety in the individual, as well as establish a sense of autonomy and control. In addition, it will contribute to a balance of power between the facilitators and the participants, as the facilitators will no longer be the sole keepers of safety knowledge and procedures.

Belaying: The diminished ability to trust in others is common among survivors of trauma. Being belayed requires this ability. In recreational or instructional climbing situations it is common for people who have just met to begin belaying each other. Through necessity or social pressure, the ability to choose a climbing partner is not guaranteed. In trauma-informed climbing, the process of belaying will be altered to include the following: the addition of a second person to create a "belay team" with one primary and one backup belayer, and the opportunity to partake in trust-building exercises prior to the creation of the three person climbing team. This will satisfy not only the need for safety and security, but also the need for opportunities to form pressure-free, trusting relationships. Additionally, the physical movement as part of a belay team will create an explicitly synchronous relationship among the belay team, and the opportunity to connect at a somatic level, satisfying the need for reconnection with others (Herman, 1992; Emmerson 2011).

Climbing commands: Traditional climbing commands are comprised of a set of call and responses: "On belay?" "Belay on!" "Climbing!" "Climb on!"—clear requests, followed by clear acknowledgement of that request and the appropriate action. This communication provides an

opportunity to explicitly state the intent and need to create a trusting relationship between the climber and the belayers. The following script will be used as a substitute for the traditional beginning commands: "Are you ready to keep me safe?" "Yes, I am ready to keep you safe!" The brevity of traditional climbing commands is intended to complement the rather long distance that can be created between the belayer and the climber. Multi-syllabic phrases are not easily heard over an echoing canyon or on a windy peak. This leads to a discussion of the type of climbs that will be used in this trauma-informed climbing program.

Types of climbs: Climb selection is usually based on skill, interest, challenge and peer pressure. Climbers often attempt one hard route just to say that they did it. The intent of climbing in this program is divided between the sense of accomplishment felt as a result of the climb, as well as the actual movement of the climb. The specific aspects of climbing movement will be discussed later. Subsequently, the types of climbs chosen will be based on the following elements: Inclusive difficulty level that allows for the participation of everyone in the program; Short length, to accommodate clear communication and easy rescue or coaching if needed; Easy accessibility; Clear staging area at the base for group activity facilitation.

Additionally, climbs in this program will be time limited. This serves the purpose of creating a clear ending for which the climber can prepare, instilling a sense of time which traumatic experience can alter (Emmerson, 2011), and allowing for the gradual increase of tolerance to potentially stressful situations.

Gear: When working with survivors of trauma there is the possibility that restraint has been used in an abusive manner (Emmerson, 2011), and may be a sensitive issue for program participants. Since climbing safety systems rely on the use of ropes and harnesses, this program

will attempt to mitigate this issue through the reframing of the relationship with the climbing gear. Participants will be encouraged to name the climbing gear, to call it "mine," and to be protective of it as it protects them. This is a facilitation technique used by guides of large groups. The guide instructs the members of the group to "kiss" the rope if they step on it, and to take ownership of their gear. In this program facilitators will invite participants to create their own ways of showing care for the gear, including naming it and creating other rituals of care.

Empowerment: Finally, the issue of overall empowerment at the climbing site will be addressed through the client's ability to participate via challenge by choice, and through the ultimate respect of the climber's requests. When the climber requests to come down, this request will immediately be granted and reflection will occur on the ground, not on the wall. This will also be reflected through the language of the facilitators and the initial training of the belay teams.

Course Curriculum

Participants

Participants will be selected based on the following exclusionary criteria:

1. Female
2. 18 years of age or older.
3. Screened by a physician and able to participate in a physical activity.
4. In weekly individual counseling.
5. Fit into one or more of the following categories: 1) Have a diagnosis of PTSD, 2) are survivors of domestic violence, 3) or have experienced other adult trauma.

Session Agenda

- Mindfulness, practicing attentional focusing.
- Check in with each participant
- Warm up
- Homework review
- New concept or activity
- Activity practice
- Homework assignment
- Check out with each participant

Program Schedule

The following table outlines the skill progression over the course of the program:

Week	General Activity Outline
Week 1	Group Introductions, Gear Safety
Week 2	Belay Team Assignments, Low-angle Rappelling
Week 3	Belaying
Week 4	Single-Movement Climbing
Week 5	Energy Conservation
Week 6	Balance
Week 7	Footwork, Prep for End of Program
Week 8	Goal Setting, Closure

Table 1.

Climbing Interventions

The climbing and movement interventions seen below have been developed based on best practices of trauma-informed care, the recovery methods of mindfulness, and brain-body psychotherapy. These elements of climbing will be emphasized and taught as part of the program curriculum with the intent of satisfying the related recovery goal:

Climbing Skill	Correlated Intervention Goal
Safety Planning: Learning how to tie knots, the math of falling, and weight limits of gear.	To increase feelings of safety and security through empirical testing of the systems on which they will rely. To increase feelings of mastery and self confidence.
Safety Planning: Climbing commands.	To increase feelings of safety. To create opportunities to create connection with others through a common language.
Belaying, Purpose of: The purpose of belaying is to ensure the safety of the climber by reducing the likelihood of injury as a result of falling, thereby increasing the climber's ability to take risks and gain mastery of the sport.	To increase feelings of self-efficacy and mastery, and to provide opportunities to form trusting relationships.
Belaying, *Movement of:* The movement of belaying creates a natural rhythm. As part of a belay team, two group members will belay and move in synchronicity with each other.	To reduce feelings of isolation and disconnection common among trauma survivors. To restore synchronicity and connection with others.
Climbing Movement: Resting and energy-conservation techniques.	To create opportunities to practice yielding, arousal moderation, and emotion regulation.
Climbing Movement: Balance and center of	To increase somatic awareness, mindfulness,

gravity.	and distress-tolerance skills.
Climbing Movement: Footwork and types of holds.	To increase somatic awareness, mindfulness and distress tolerance skills. To facilitate mastery.
Rappelling: Controlled descent of oneself along a fixed rope.	To facilitate mastery. To increase participants' sense of autonomy, safety, and security.

Table 2.

Movement Interventions:

Combining knowledge of the neurobiological effects of exercise, mindfulness, and movement, the following exercises have been developed:

Exercise	**Correlated Treatment Goal**
Ball Belt - Sensing the center of gravity	Proprioceptive awareness, mindfulness.
Slow Climbing - Slow, smooth motion - Controlled breathing	Proprioceptive awareness, mindfulness. Modulating aerobic activity to increase BDNF.
Silent Climbing - Must look at the target to ensure accuracy	Cultivates a pause before reaction (distress tolerance), spatial awareness, and mindfulness.
Breath in Effort - Practice in maintaining awareness of breath while under strain	Proprioceptive awareness, mindfulness. Modulating aerobic activity to increase BDNF.
Single Move Climbing - One full completion of a move and a return to rest or yield	Pausing in the yield position (distress tolerance), proprioceptive awareness, and mindfulness.

"Rock Warrior" Stance - Somatic embodiment of the desired outcome, including visualization of that outcome	External regulation of affect through vagus nerve.
Step Through/Reach Through - Bilateral coordinated movement	Strengthening attentional focus through bilateral coordinated movement.
Zig-Zag Climbing - Traverse while climbing up, utilizing step through and reach through.	Strengthening attentional focus through bilateral coordinated movement.

Table 3.

Limitations and Future Work

The limitations of this study lie in the current research available for its construction, as well as in the socio-economic needs of the population this program seeks to serve. Current scientific literature has much information to offer about how the brain affects movement, but limited research as to how movement affects the brain. The mechanisms through which climbing affects mental health are theoretical. Future work could potentially look at the areas of the brain that are active during climbing, and compare the active areas to those that are known to become dysfunctional through traumatic experience. Another limitation of this study is that the current format of eight consecutive weekly sessions of four hours each is incompatible with the schedules of women survivors. This study does not account for the need women may have for child care, or their weekend working schedule. To test the efficacy of this study it may be necessary to work with inpatient populations or students, or to design a program schedule which allows for flexible attendance or shorter sessions.

Conclusion

Using current research, it is possible to create a program that capitalizes on what is

known about PTSD and the brain and trauma-informed recovery. Trauma-informed practices create an environment that minimizes retraumatization and maximizes the potential for healing. Rock climbing, and adventure therapy programs in general have the potential to cause more harm due to the stressful nature of the programs. Using trauma-informed and brain-based practices may significantly improve the outcomes of these programs. The percentage of the population that deals with symptoms of PTSD is great enough that trauma-informed practices are worth applying to adventure education and recreational guiding as well as therapeutic programs. What is not known, is the magnitude of the positive impact that trauma-informed practices will have on rock climbing programs. This study, and any other program that applies these principles, would benefit from an efficacy evaluation in the future.

Science research is not yet to the place where we can connect movements to specific areas of the brain and how the movements enhance or inhibit processing and connection. Many theories that claim to operate with this level of understanding, for example Brain Gym ©, but empirical research has not supported their claims (Hyatt, 2007). What we can do is take what is known about brain plasticity and function and create interventions based on that information. The goal of trauma treatment is to restore the survivor to a level of functioning that allows for not just fewer symptoms, but integration of the experience and meaning making. Holistic, trauma-informed programs that address the physical, spiritual and social components of healing have the greatest chance to affect change and improve overall quality of life.

> *Once a woman understands how her life experiences have affected her and accepts herself as she is, she begins to move forward and become excited about the future. ... Transforming her from powerless to powerful, she gains self-respect, as well as*

respect throughout the community (Elliott, Bjelajac, Fallot, Markoff, & Reed (2005).

References

Amen, D. (1999). *Change your brain, change your life.* New York, NY: Three Rivers Press.

Baer, R.A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clinical Psychology: Science and Practice,* 10, 125–143

Berman, M., Joindes, J., & Kaplan, S., (2008). The cognitive benefits of interacting with nature. *Psychological Science, 19*:12, 1207‑1212.

Bialeschki, M., & Henderson, K. (1993) Expanding outdoor opportunities for women. *Parks and Recreation.* 8: 36-40.

Budde, H., Voelcker-Rehage, C., Pietraßyk-Kendziorra, S., Ribeiro, P., & Tidow, G., (2008). Acute coordinative exercise improves attentional performance in adolescents. *Neuroscience Letters*, *441*(2), 219–223

Chao, L., Weiner, M., Neylan, T. (2013). Regional cerebral volumes in veterans with current versus remitted posttraumatic stress disorder. *Psychiatry Research - Neuroimaging, 213* (3), pp. 193-201

Cole, E., Erdman, E., & Rothblum, E. D. (1994) *Wilderness Therapy for Women: The Power of Adventure*. Binghamton, NY: Hawthorn Press, Inc.

Cozolino, L. J. (2010). *The neuroscience of psychotherapy: Healing the social brain*. New York, NY: W.W. Norton & Co.

Critchley, H., Mathias, C., Josephs, O., O'Doherty, J., Zanini, S., Dewar, B., Cipolotti, L., Shallice, T., Dolan, R. (2003). Human cingulate cortex and autonomic control: converging neuroimaging and clinical evidence. *Brain 126* (10): 2139-2152.doi:

10.1093/brain/awg216

Csikszentmihalyi, M. (1990). *Flow: the psychology of optimal experience. Steps toward enhancing the quality of life.* New York: HarperCollins Publishers.

Damasio, Grabowski, Bechara, Damasio, Ponto, Parvizi, & Hichwa, (2000). Subcortical and cortical brain activity during the feeling of self-generated emotions. *National Neuroscience*, 3: 1049–1056.

Deida, D. (2004). *The Way Of The Superior Man A Spiritual Guide to Mastering the Challenges of Woman, Work, and Sexual Desire*. Riverside: Sounds True.

Elliott, D. E., Bjelajac, P., Fallot, R. D., Markoff, L. S., & Reed, B. (2005). Trauma-informed or trauma-denied: Principles and implementation of trauma-informed services for women. *Journal Of Community Psychology*, 33(4), 461-477. doi:10.1002/jcop.20063

Emerson, D., & Hopper, E. (2011). *Overcoming trauma through yoga*. Berkeley, CA: North Atlantic Books.

Farb, Segal, Mayberg, Bean, McKeon, Fatima, & Anderson. (2007). Attending to the present: mindfulness meditation reveals distinct neural modes of self-reference. *Social Cognitive and Affective Neuroscience*, 2 (2007), pp. 313–322

Felitti, V. J., & Anda, R. F. (1997). The Adverse Childhood Experiences (ACE) Study. Centers for Disease Control and Prevention. Retrieved from http://www.cdc.gov/ace/index.htm

Frankl, V. (1984). *Man's Search for Meaning*. New York: Washington Square Press.

Garland T Jr, Schutz H, Chappell MA, Keeney BK, Meek TH, Copes LE, Acosta W, Drenowatz C, Maciel RC, van Dijk G, Kotz CM, Eisenmann JC. (2011) The biological control of

voluntary exercise, spontaneous physical activity and daily energy expenditure in relation to obesity: human and rodent perspectives. *Journal of Experimental Biology, 214*(Pt 2):206-29. doi: 10.1242/jeb.048397.

Gaser, C., Schlaug, G., (2003). Brain structures differ between musicians and non-musicians. *Journal of Neuroscience,* 23(27): 9240-9245

Gass, M. A., Gillis, L., & Russell, K. C. (2012). *Adventure therapy: Theory, research, and practice*. New York: Routledge.

Gass, M. A., & Gillis, L., (1995). Changes: An assessment model using adventure experiences. *Journal of Experiential Education,* 18(1), 34-40.

Ghez, C., Fahn, S. (1985). *The cerebellum.* In Kandel, E.R., & Schwartz, J.H. Principles of Neural Science, 2nd edition. New York: Elsevier. 502–522.

Hamner, M. B., Lorberbaum, J. P. and George, M. S. (1999). Potential role of the anterior cingulate cortex in PTSD: Review and hypothesis. *Depression and Anxiety,* 9: 1–14

Herman, J. L. (1992). *Trauma and recovery.* New York, NY: Basic Books.

Hayat, K. (2007). Brain Gym® Building Stronger Brains or Wishful Thinking? *Remedial and Special*

Education. vol. 28 no. 2. 117-124

Hoelzel, B. K., Ott, U., Hempel, H., Hackl, A., Wolf, K., Stark, R., & Vaitl, R. (2007). Differential engagement of anterior cingulate and adjacent medial frontal cortex in adept Meditators and non-Meditators. *Neuroscience Letters, 421* (1) (2007), pp. 16–21

Holden, M., (2010) EcoFeminism. Retrieved from http://holdenma.wordpress.com/ Retrieved: September, 2013.

Ilgner, A., (2003). *The rock warrior's way*. La Vergne, TN: Desiderata Institute.

Jackson, J. (1958). Evolution and dissolution of the nervous system. *Selected Writings of John Hughlings.* J.J. Taylor, Ed.: 45–118. Stapes Press. London.

Jordan, J. V. (2001). A relational-cultural model: Healing through mutual empathy. *Bulletin Of The Menninger Clinic*, *65*(1), 92.

Kabat-Zinn, Lipworth, & Burney (1985). The clinical use of mindfulness meditation for the self-regulation of chronic pain. *Journal of Behavioral Medicine,* 8(2):163–90.

Kessler, Sonnega, Bromet, Hughes, & Nelson, (1995). Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry,* 52(12), 1048-1060.

Kim, M., Gee, D., Loucks, R., Davis, F., & Whalen, P. (2011). Anxiety dissociates dorsal and ventral medial prefrontal cortex functional connectivity with the amygdala at rest. *Cerebral Cortex* 21:1667–1673.

Lazar, S., Kerr, C., Wasserman, R., Gray, J., Greve, D., Treadway, M., McGarvey, M., Quinn, B., Dusek, J., Benson, H., Rauch, S., Moore, C., & Fischl, B. (2005). Meditation experience is associated with increased cortical thickness. *Neuroreport, 16(17)*:1893–7.

Levine, P. (1997). *Waking the tiger: healing trauma*. Berkeley, CA: North Atlantic Books.

Lanius, R. A., Bluhm, R., Pain, C. (2005). The origins of emotion regulation: Clinical presentation and neurobiology. In: *Women's Mental Health: A Life-Cycle Approach*. Romans S, Seeman MV eds. Lippincott Williams & Wilkins, Philadelphia, PA, Chapter 11, pp 147-160

Linehan, M. (1993). *Cognitive-behavioral treatment of borderline personality disorder*. New

York, NY: Guilford Press.

McGuire, R. & Priest, S. (1994). The treatment of bulimia nervosa through adventure-based therapy. *The Journal of Experiential Education*, *17*(2), 44-48.

Mitton, D. (1994). Ethical considerations in adventure therapy: a feminist critique. *Women in Therapy, 15*(3/4), 55-84.

Motl, Berger, & Leuschen, (2000). The role of enjoyment in the exercise-mood relationship. *International Journal of Sport Psychology,* 31:3, 347-363

National Center on Family Homelessness. (2003). *Trauma-specific and trauma-informed services*

for women with co-occurring disorders and histories of violence: Experiences from the SAMHSA WCDVS. Newton Centre, MA: Author

Ogden, P., Minton, K., & Pain, C. (2006). *Trauma and the body: a sensorimotor approach to psychotherapy*. New York, W.W. Norton.

Parr, G. D., Montgomery, M., & DeBell, C. (1998). Flow theory as a model for enhancing student

resilience. *Professional School Counseling,* 1(5), 26.

Porges, S. (2011). *The polyvagal theory: Neurophysiological foundations of emotions, attachment, communication, and self-regulation.* New York: Norton.

Powch, I. 1994. Wilderness therapy: What makes it empowering for women? *Women & Therapy*,

15(3-4). 11-27.

Prinian, D. (2007). Rock climbing and meditation: Can it be a spiritual path? *AHP Perspectives.*

June/July 2007.

Robinson, D. (1985). Stress seeking: Selected behavioral characteristics of elite rock climbers. *Journal of Sport Psychology, 7,* 400-404.

Rothschild, B. (2010). *8 Keys to Safe Trauma Recovery.* New York: NY, Norton & Company.

Rubia, K. (2009). The neurobiology of Meditation and its clinical effectiveness in psychiatric disorders. *Biological Psychology*, 82:1, 1–11

Russell, Hendee, & Phillips-Miller. (1999). How Wilderness Therapy Works: An Examination of the Wilderness Therapy Process to Treat Adolescents with Behavioral Problems and Addictions. In: Cole, D. N.; McCool, S. F. 2000. Proceedings: *Wilderness Science in a Time of Change.* Proc. RMRS-P-000. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Schlaug, G., Jäncke, L., Huang, Y., Staiger, J., Steinmetz, H. (1995). Increased corpus callosum size in musicians. *Neuropsychologia, 33*:8, 1047–1055

Schore, A. (1994). *Affect regulation and the origin of the self: The neurobiology of emotional development*. Hillsdale, N.J: L. Erlbaum Associates.

Schoel, J., Prouty, D., & Radcliffe, P. (1988). *Islands of healing: A guide to adventure based counseling.* Hamilton, MA: Project Adventure.

Schoenfeld, T. J., Rada, P., Pieruzzini, P. R., Hsueh, B., & Gould, E. (2013). Physical exercise prevents stress-induced activation of granule neurons and enhances local inhibitory mechanisms in the dentate gyrus. *Journal of Neuroscience*. 33(18):7770-7. doi: 10.1523/JNEUROSCI.5352-12.2013.

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

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

Shin, L., Rauch, S., & Pitman, R. (2006). Amygdala, medial prefrontal cortex, and hippocampal function in PTSD. *New York Academy of Sciences.* doi: 10.1196/annals.1364.007

Siegel, D. J., (2007). T*he mindful brain: reflection and attunement in the cultivation of well-being.* New York, NY: W.W. Norton & Co.

Siegel, D. J., M.D. (2006). An interpersonal neurobiology approach to psychotherapy. *Psychiatric Annals, 36*(4), 248-256.

Siegel, D. J. (1999). *The developing mind: How relationships and the brain interact to shape who we are*. New York, NY: Guilford Press.

Steinberg, R. (2011). *Mindfulness, psychological well being and rock climbing: an exploration of mindfulness in rock climbing and the potential for psychological benefit.* (Doctoral Dissertation) UMI 3471594

Steinlin, M. (2007) The cerebellum in cognitive processes: supporting studies in children. *The Cerebellum, 6*(3), 237-241

Teasdale, J. D., Moore, R. G., Hayhurst, H., Pope, M., Williams, S., & Segal, Z. V. (2002). Metacognitive awareness and prevention of relapse in depression: Empirical evidence. *Journal of Consulting and Clinical Psychology*, *70*, 275– 287.

Teicher, M. H., Dumont, N.L., Ito, Y., Vaituzis, C., Giedd, J. N., Andersen, S. L., (2004) Childhood neglect is associated with reduced corpus callosum area. *Biological*

Psychiatry, 56:80–85

Teper, R., & Inzlicht, M. (2013). Meditation, mindfulness and executive control: the importance of

emotional acceptance and brain-based performance monitoring. *Journal of Social Cognitive and Affective Neuroscience,* 8(1): 85-92.doi: 10.1093/scan/nss045

Villarreal, G., Hamilton, D., Graham, D., Driscoll, I., Qualls, C., Petropoulos, H., & Brooks, W. (2004) Reduced area of the corpus callosum in posttraumatic stress disorder. *Psychiatry Research: Neuroimaging*, 131:3, 227–235

West, J. I. (2011). *Moving to heal: Women's experiences of therapeutic yoga after complex trauma.* (Boston College). ProQuest Dissertations and Theses, , 261.

Wright, A. (2013). Limbic System. *Neuroscience Online*, Retrieved from: http://neuroscience.uth.tmc.edu/index.htm

van der Kolk, B. (2006). Clinical implications of neuroscience research in PTSD. *New York Academy of Sciences*. doi: 10.1196/annals.1364.022

van der Kolk, Pelcovitz, Roth, Mandel, McFarlane & Herman. (1996). Dissociation, Affect dysregulation & somatization: the complex nature of adaptation to trauma. *American Journal of Psychiatry, 153*(7), Festschrift Supplement, 83-93