

## **Paper Title: Power Dreaming: A Protocol for Decreasing Post-Traumatic Stress-Disorder (PTSD) Related Nightmares using Virtual Reality**

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### **ABSTRACT**

Power Dreaming (PD) is a demonstration project that augments the current behavioral health approaches for warrior trainees (WT) and other patients suffering from nightmares related to PTSD and/or traumatic brain injury (TBI). This treatment leverages leading edge technological advances in biofeedback and virtual reality (VR) to illicit adaptive responses to acute stress. Many behavioral health modalities that rely on “relaxation” and “imagery” as primary therapeutic components do not measure relaxation responses, nor do they address the fact that many patients do not have sufficient imagery skills to produce a change in behavioral conditioning. Power Dreaming directly improves on these therapeutic models by utilizing heart rate variability biofeedback to measure the relaxation response as well as virtual reality machinima to enhance imagery capability. The goal is to increase the locus of control and reduce allostatic loading (stress) associated with nightmare activity. Unlike virtual exposure therapy, the objective of the PD model is to develop imagery that is both customized by the trainee and neurologically “distracting” (with the desired outcome of stimulating the development of a clinical relaxation response). PD is a training system that puts behavioral health computer tools in the hands of the war fighters. This paper presents our approach to evaluating PTSD-related nightmares through a combination of behavioral health and VR Training within the context of a research and development protocol.

### **ABOUT THE AUTHORS**

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### **INTRODUCTION**

Anxiety disorders such as social phobias can make life difficult, or even unbearable, for many people. Treatment to overcome anxiety disorders has traditionally involved practicing new behaviors while being exposed to the situation that elicits the distress or fear. With repeated exposures, the distress or fear response is gradually replaced with the desired behavior. While effective, this approach often requires the therapist and patient to repeatedly venture out into the real world to encounter the fear-inducing experience. Power Dreaming therapy offers patients an alternative to this traditional treatment approach. Power Dreaming therapy utilizes guided imagery, traditional biofeedback and autonomic regulation therapy, and Virtual Reality to counter PTSD related nightmares. Specifically, PD augments Cognitive Behavioral Treatment (CBT) approaches for those suffering from PTSD with technological advances in biofeedback and virtual reality. The concept utilizes computer technology to augment the innate human ability to adapt to stress.

Nightmares, specifically those that are triggered by PTSD, create sleep deprivation and reinforce continued vulnerability to nightmares. Since 2001, an estimated 30% of individuals returning from Iraq and Afghanistan suffer from PTS and 65% also experience nightmares as a symptom. Studies have shown that there is a strong correlation between continued nightmares and a high level dysfunction in coping skills. As a result, coping with nightmares is a critical objective in the management of post-traumatic anxiety. Retrospective analysis of the literature in six major areas suggests Power Dreaming is an effective therapeutic tool: 1) Targeted treatment of trauma-related nightmares is effective in reducing symptomatology, 2) Treatment protocols using imagery and relaxation pre-date Imagery Rehearsal Therapy (IRT) 3) The established practice of IRT, as a supplemental modality to CBT, 4) The successful integration of *Heart Rate Variability (HRV)* biofeedback into IRT to improve autonomic regulation, 5) Studies validating the successful use of immersive modalities and virtual components into PTS exposure therapy, and 6) “Distractive Virtual Reality” is a useful adjunctive treatment for pain management.

### **Nightmares and Trauma/PTSD**

The National Center for PTSD reports that although only 5% of the population complains of nightmares, the incidence of this symptom exceeds 50% for Vietnam Veterans. They also report other research citing over 70% of those experiencing trauma report nightmares. (Schreuder JN, 2001) One report found that 56% of those who experienced war related trauma still had nightmares forty years later, indicating that if untreated, nightmares can be a lifelong affliction. (Ibid). Polysomnographic studies have shown that those experiencing trauma have poor sleep maintenance, increased eye movement density, decreased percentage of rapid eye movement sleep (REM) and an increased tendency to have REM sleep at sleep onset similar to that occurring in patients with narcolepsy (Mellman, 1995). Pagel found characteristic replaying of the trauma incident with themes of both rage and grief. He noted that this usually occurred in REM sleep but may intrude early in the sleep process causing sleep onset insomnia (Pagel, 1989). Ross described nightmares as the “hallmark” symptom of PTSD (Ross and Sullivan, 1989).

### **Traditional Standard of Care-Relaxation and Imagery**

In addition to therapies that emphasize cognitive reframing as a fundamental modality, many of the other traditional psychotherapeutic approaches for nightmares involve a simple combination of relaxation and imagery (Arntz, A., Tiesema, 2007). These techniques employ a combination of scripts, sleep logs, breathing and muscle relaxation to achieve the desired parasympathetic state. Imagery is the most utilized technique and the ability to relax is the fundamental pre-condition to facilitating focus and change. These studies report significant variability in the ability of patients to produce sufficiently impactful imagery to counteract arousal. However, the fact remains that these two simple techniques, in addition to more focused cognitive approaches, provide the foundation upon which the more recent clinical interventions are based.

### **Imagery Rehearsal Therapy (IRT)**

IRT is a more structured and focused approach that incorporates all of the traditional modalities mentioned above. The model emphasizes the need for relaxation and repetitive practice to habituate skills. The most comprehensive and recent publications regarding behavioral health and nightmares involve IRT, a term coined by Krakow (Krakow, B, 1993) and similar to the relatively ancient concept of "lucid dreaming", conceptualized by LaBerge (LaBerge, 2000). IRT is essentially recording nightmare activity, changing the scenario and then rehearsing it daily with imagery. Most recently, studies focused on the use of IRT for the US Military and Veteran populations (Forbes, 2001). IRT comprehensively summarized in Krakow's most recent publication (Krakow, 2010), provides a foundation for the PD concept and utilizes relaxation, specifically unique imagery and repetitive practicing to achieve mastery of the technique. However, unlike IRT, PD does not require the trainee to integrate the nightmare scenario into the therapeutic imagery since this may create unnecessary anxiety and increased sympathetic reactivity. PD focuses on developing distractive imagery.

### **Heart Rate Variability (HRV) Biofeedback**

Relaxation training is commonly a component of clinical work with anxiety disorders, especially nightmares. In fact, even the exposure therapy model and the virtual augmentation of that approach include relaxation as an essential capability due to potential reactions to exposure (Tan, 2011). Krakow addresses the need for this skill set as an integral element for the IRT structure. However, relaxation is more accurately autonomic regulation--- the ability to reduce counter- productive sympathetic activity. Focusing on relaxation is more than just a subjective state of mind; it is a calibrated ability to change physiological function adding credibility to the exercise. Since the trainee sees shifts in heart rate and variability in real time they continue to adjust their technique based on biological data ---not unlike firing a weapon. Research has focused most often on autonomic activity related to certain medical conditions: asthma (Lehrer, 2006), cardiovascular disease/blood pressure (Moravec, 2007) and mental health (Henriques, 2011). However there are several publications that have addressed HRV biofeedback for PTSD (Ginsberg, Wood, Zucker). To various degrees, all of these studies consistently validate HRV training as an effective method for achieving parasympathetic tone (decrease in heart rate and blood pressure as well as more efficient digestion.) Regarding the operational use of HRV biofeedback, McLay and Spira comment on a single case of utilizing HRV biofeedback to address insomnia in an operational setting (McLay & Spira 2011). The premise of the PD study is to provide data that will calibrate the relaxation response, provide concrete evidence to the trainee, and reinforce motivation for behavior change, which would be manifested in the degree to which they practice and utilize the tools provided.

### **Virtual Exposure Therapy**

Prolonged virtual exposure therapy (VRE) is often prescribed as a viable approach to dealing with traumatic experiences (Berlin, Forbes, McLay, Reger, Rizzo). The goal of VRE is to help reduce fear and anxiety by actively confronting feared situations, thoughts, and emotions. Treatment is performed in the clinic under the direct supervision of a therapist. VRE does not directly address nightmares and may even be contraindicated in the non-clinical setting for patients already in a high state of anxiety (allostatically loaded).

While PD does not utilize exposure therapy, this virtual modality is being aggressively studied, supporting the perspective that these models offer significant promise for clinical applications. Similar to PD, VRE is based on an

existing standard of care and the principles of that model and the objective is to create a virtual immersion that will provide the trainee opportunities for developing more adaptive coping behaviors. The primary focus of all virtual therapy is generally the concept of resiliency- the ability to recover. In PD therapy, resiliency is the ability to utilize customized imagery to autonomically regulate and return to a high locus of control when challenged by disruptive nightmares.

### **Distractive Exposure for Acute Pain Management**

Guided virtual imagery has also been used as distractive exposure in the management of acute pain (Maani, McCaul, 2011). It is counter-intuitive to intensify sympathetic reactivity when the human system is already highly stressed, the locus of control is low and anxiety is high. Using a similar approach to the treatment of acute pain, PD guided imagery is used to reduce arousal and increase confidence (locus of control) that the subject can cope. Several researchers have employed virtual distraction therapy in hospital settings to reduce the sympathetic reactivity associated with acute pain stemming from difficult procedures. Although Hoffman's Snow World is the most recognized, there have been over thirty studies in the past ten years that address the role of virtual reality and distraction, and highlight the emergence of immersive technology as a clinical tool. The seminal paper by Gold is especially compelling because it illustrates the relationship between the neurobiology of attention and pain, and refers to the key role of several brain centers in the attenuation of this acute allostatic process (Gold, 2007). The primary hypothesis is that the brain can be distracted from pain reactivity if stimulated by a sufficient level of visual and auditory stimuli. Even though there are additional physical pain attenuation processes, PD applies this same neuro-physiological premise to the emotional pain associated with intense arousal resulting from traumatic nightmares. The key difference between these studies and PD (other than the etiologic causes of reactivity) is that their work utilizes canned virtual scenarios while PD allows the user to create unique customized virtual scenarios.

### **APPROACH**

PD is designed to address two primary endpoints for existing PTSD therapy, namely the ability to relax the mind in order to adjust its ability to cope with cortical overload, and the ability to use imagery to engender a sense of control over PTSD nightmare states. The goal of the model is to provide a training structure in which the WT can develop a higher locus of control when acute stress compromises the system, such as being startled out of sleep by a nightmare. PD is based on the scientific principles of allostasis and neuroplasticity. Allostasis refers to the inherent sympathetic/parasympathetic stress response and what happens when this system becomes "loaded" and reactive. Neuroplasticity refers to the fundamental tenets of how the brain works and learns. Specifically, there are three principles of neuroplasticity which underlie the concept:

- 1) *The brain must "be in the mood.* We learn best when we are relaxed (in a parasympathetic state).
- 2) *What fires together, wires together.* Adaption demands that we actively associate new more effective behavioral responses to neuro-physiological triggers that in the past have created nonfunctional behaviors.
- 3) *Habituation requires repetition.* To accomplish both above requires that we engage in this reconditioning exercise on a daily and continuing basis until the more adaptive behavior is mastered. The Power Dreaming training is designed to create a guidance structure which emphasizes personal responsibility and resiliency. Power Dreaming software training complements the traditional mental health model that emphasizes therapy, diagnostics and pharmacology. In addition to therapies that emphasize cognitive reframing as a fundamental modality many of the traditional psychotherapeutic approaches involves simple combinations of relaxation and imagery.

Power Dreaming approach contains five fundamental components that are essential to achieving neuroplasticity and allostasis: 1) autonomic regulation- breathing practice to increase heart rate variability and enhance the parasympathetic response to prepare and maintain optimal allostasis for new habituation, 2) active engagement - scenarios require interaction with virtual entities, thereby enhancing attention, 3) atypical association- combining known cues but associating them in unusual combinations to create novel networks and enhancing distraction, 4) personalized dream experience design, and 5) assessment methods – evaluation of effectiveness of use of the aforementioned steps.

### Step 1: Autonomic Regulation Training (ART)

The technological foundation of PD consists of two dynamic training protocols designed for application in a home training environment. ART is accomplished with the utilization of an electrocardiography (EKG) heart rate variability home training module, which feeds back shifts in heart rate as the warrior trainee (WT) applies breathing and muscle relaxation techniques. Trainees are given EMG heart rate monitors, taught relaxation responses and asked to participate in training for 20 minutes three times per week. After mastering the training and relaxation techniques, ART is then administered within the VR environment.

*Breathing Pacer:* The virtual breathing pacer (see Figure 1) allows the WT to consciously seek out the immediate and/or long term effects of paced breathing. The Breathing Pacer is a meditation hut or room containing a device that is designed to assist the WT in controlled, paced breathing. The device resembles an anachronistic “Jules Verne” style machine with lots of brass pipes and a bellows. When the device is activated, the bellows expand and contract rhythmically at a pre-determined rate, and slows down over the course of a few minutes to 6 “breaths” per minute.

*Music:* Regulation is also reinforced through the use of relaxation, calming and meditative music. At various places within the PD environment, the WT can select from a set number of music tracks via atypical image elements within the GUI. For example, the WT may click on strange fruits hanging from a tree in a meadow and select new music tracks to their taste. At a specific location within the world, the WT discovers a “Musical Tree” with luminescent fruit. The WT is able to click on each piece of fruit that plays a specific musical note.



Figure 1: Breathing Pacer

### Step 2: Active Engagement (Virtual Reality Training or VRT)

Active Engagement areas are used to enable the WT to attain a calmer state and in many cases satisfy the perceived need to fight or flee. The active engagement areas are purely optional areas for the WT’s use; they are not forced upon the WT and there is no requirement to complete a quest, task or activity. These areas are not designed to add additional stress to the WT, e.g. there are not timed games or a need to dodge bullets but rather to create a natural curiosity about their environments thus engaging the WT into a natural distraction from themselves. The types of areas that the WT may choose to enter in these situations are similar to obstacle courses and involve the need to get from “point A” to “point B.” The WT may avoid these areas by taking alternate routes on the ground, flying or teleporting.

*Enhancing Proteus Effect:* A concept that usefully frames this virtual learning experience is called the Proteus Effect and has been most recently studied at the Stanford Virtual Human Interaction Lab and more dramatically portrayed in the movie Avatar. The essential premise is that thru an avatar’s interaction in a virtual world the individual may change their self-representation or identity. For instance, a short person interacts within a competitive situation as a tall, handsome avatar and gradually acquires the attributes of that digital persona and then transfers those characteristics into practical challenges. This protean transformation is also evident in more traditional military training models such as learning to fly- the trainee enter a virtual world with very few skills and a high degree of anxiety created by the intensity of the learning challenge. However, after hundreds of hours in the simulator this novice gradually acquires knowledge and experience emerging eventually with the identity of a competent pilot. In the case of PD the premise is that the WT is challenged regarding his ability to cope with severe stress, possessing a low locus of control (confidence) which is reinforced when he fails to control fear and rage. For the WT this problem is compounded by the fact that his predisposition and training as someone with a high locus of control is so contrary to the person he has become...someone he doesn’t know anymore. PD first distracts the brain so the WT can focus on parasympathetic cues he controls and then provides a training environment in which he can maintain this entrained immersion and recover the high degree of self- efficacy the military trained him to manifest before trauma assaulted his warrior identity.

*Treasure Hunting:* The Proteus Effect is further reinforced through ability to collect gems whose powers are associated with light and energy. Gems of various colors are made available at select points throughout the Power Dreaming software and provide the WT with a variety of powers/abilities as noted below. WTs are provided with access to an online tutorial that they can reference at any time to help them understand when/how to use the various gems. Once a gem has been collected, the WT will retain that specific power until they collect a different colored gem or upon being disabled by the WT. This in effect, changes the type of power they now possess. WTs retain one specific power at a time.

- *Green Gems:* Green gems provide the WT with the power to heal and repair objects, animals and other elements within the environment. For example, if an animal is in obvious distress and is in close proximity, the WT could heal that animal with the green gem. This power associated with the green gem would also provide the WT with the ability to repair buildings, environments, and other elements within the PD world.
- *Blue Gems:* Blue gems provide the WT with telekinesis abilities. For example, while exploring the environment, the WT may encounter a large boulder on a pathway that needs to be moved. A close proximity blue gem provides the WT with telekinetic powers that could displace the boulder. Particle-based beams of light emanating from the avatar's head, hand or elsewhere are generated in order to visually represent the telekinesis effect.
- *Yellow Gems:* Yellow gems provide the WT with the ability to fly. In the original software, a WT could opt to fly throughout the entire environment at any time. In the new environment that is to be created, WTs earn the ability to fly through the collection of yellow gems.
- *White Gems:* White gems provide the WT with the ability to teleport instantly to any other area in the environment. Once the gem is in hand, the WT can teleport within the PD world by clicking on a specific area of a map.
- *Orange Gems:* Orange gems provide the WT with the ability to change the color of specific objects within the environment. Once the gem is in hand, the WT use its power to cycle through a range of hues on the object, thus changing its color.

When a gem is collected, the overall attributes of the avatar remains intact but includes an "appearance" or "aura" matching the color of the gem they have collected. When the gem power is used, particle beams of light emanating from the avatar's hand appear. Once a gem has been collected, the WT may use its abilities to initiate a "Power Move" and affect an object's color, audio, and health; their own physical position in the world through teleportation; or affect an object through telekinesis. As a pre-cursor to a Power Move, the player, upon activating the gem's power, is prompted to enter into a state of relaxation using the breathing techniques they learned in the Pagoda.

### **Step 3: Atypical Association**

The creation of mental confusion to induce the hypnotic trance is generally attributed to Milton Erickson. Here the therapist will intersperse his suggestions for going into hypnosis with instructions or ideas that do not make sense. Here is a short example: "whilst you are sitting there, your left hand may begin to feel lighter and lighter, whilst your right hand becomes heavier and heavier and as you feel your right hand becoming lighter so your left hand can continue to press down...". Normally, one expects information to be logical. As the mind focuses more and more endeavoring to make sense of the information, the client will tend to go inside searching for understanding. Thus, the state of absorption is increased and the client readily moves into the hypnotic state.

Confusion can also be created through pattern interruption. A recognized pattern that is interrupted unexpectedly can cause sudden trance. The handshake is an example of a pattern with which most people are familiar. Erickson sometimes created this pattern interruption by removing his hand extremely slowly from his client's. The unfamiliarity of the disengagement would create the desired confusion and trance state.

The following atypical imagery elements are examples within the Power Dreaming environment:

- Old archaic machinery that may or may not activate and/or serve a purpose

- Animals that are of unusual size and/or color
- Anthropomorphic, normally inanimate objects (Furniture or rocks that talk, plants that have human qualities)
- Luminescent objects. (Plants, animals, rocks, etc.)
- Things that defy the laws of physics (Upwards waterfalls, bouncing stones, levitating buildings, islands floating in the sky, etc.)
- Audio cues that are mismatched such as a horse with the growl of a tiger.

**Step 4: Developing a Personalized Dream Experiences**

The WT is first trained to utilize customized PD software to create a personalized dream experience. The VR training occurs in two primary phases, the development of the user defined imagery or dream experience, and the replay of that dream experience in bed after a PTSD nightmare has occurred. The WT is given a laptop with the PD software, a head mounted display (HMD), and instructions on how to design and record the dream experience. The software allows the WT to choose from several pre-selectable environments and set weather, time of day, and add objects, animals, and avatars to the scene. Once those elements are added to the dream scenario, the WT can enter the virtual world, walk, run, fly and record the experience for later playback.

The User Interface has been developed and designed to be both straightforward and customizable. A “Book of Dreams” Interface, a metaphorical book, is created with the intent of providing a visually simple way of organizing and presenting the dream materials. Table 1 presents content available within the dream experience, and visual representations of the virtual worlds.

**Table 1: Dream Experience Elements**

<b>Environments:</b> Island, underwater, fantasy environments		
<b>Dream Symbols:</b> Archetypical environments and symbols for personalized dream experience		
<b>Transformational Avatars:</b> guides, friends, family, deities, fantasy characters (tailored user experience)		
<b>Animals:</b> Animals, fantasy animals, pets, and unique scenarios.		
		
<b>Dusk Beach Area</b>	<b>Winter Forest</b>	<b>Underwater Dreamscape</b>

*Recording Dream Experience:* Once the dream environment is generated, the WT immerses within the virtual dreamscape and interacts freely. The WT walks, flies, swims, and interacts with objects in the scene. When the WT is ready to record the dream experience, the PD technology is placed in Record Mode and the interaction is saved to a log file. Any number of scenes and interactions could be saved to a local file directory for later playback. Several features with Power Dreaming and available to the WT are described below:

*Playback Mode:* Upon awakening from disturbed sleep by a PTSD nightmare, the WT uses ART techniques to regulate breathing, calm the body and prepare to be immersed into the recorded dream state created during the production mode. The computer is turned on and HMD glasses are placed on the head. The WT then chooses the pre-recorded dream state from his computer and re-experiences the recorded dream experience.

### **Step 5: Assessment Methods:**

The analysis phase of the program will test the significance proposed for the study. A key component of this assessment involves volunteer participants' perception and feedback of the computer and Power Dreaming software experience. The intent is to collect their subjective evaluations regarding ease-of-use as well as log their input regarding how to improve the software. The analysis will consist of preparing the data and inspecting the characteristics to assure that the planned descriptive statistics will indeed be appropriate for this data set. Each posttest question can be examined alone or in combination with any one of the others: by cross-tabulation tables. For example, in our study the combined number of volunteer participants can be compared to their answers to the post test questions and their sex, or participants might be compared in terms of age or the proportion that have identified as having various levels of computer and virtual world experience.

The following evaluative measures are administered pre & post participation within the Power Dreaming protocol:

*Clinician Administered PTSD Scale (CAPS)* - The CAPS is the gold standard in PTSD assessment. The CAPS is a 30-item structured interview that corresponds to the DSM-IV criteria for PTSD. The CAPS can be used to make a current (past month) or lifetime diagnosis of PTSD or to assess symptoms over the past week.

*Pittsburgh Sleep Quality Index (PSQI)* -The PSQI is an effective instrument used to measure the quality and patterns of sleep. It differentiates "poor" from "good" sleep by measuring seven areas: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction over the last month. The WT self-rates each of these seven areas of sleep. Scoring of answers is based on a 0 to 3 scale, whereby a "3" reflects the negative extreme on the Likert Scale. A global sum of "5" or greater indicates a "poor" sleeper. We have acquired permission to utilize this instrument from the University of Pittsburgh Sleep Medicine Institute.

*Post-traumatic Symptom Scale-Interview version (PSS-I)* - The PSS-I is a semi-structured interview for PTSD assessment and diagnosis. It consists of 17 items corresponding to the DSM-IV PTSD symptoms, assessing re-experiencing, avoidance and hyperarousal symptoms. Items are rated on a 0-3 scale for combined frequency and severity, yielding one score per item. A score of 0 corresponds to "not at all"; 1 corresponds to "once per week or less/a little"; 2 corresponds to "2 to 4 times per week/somewhat"; 3 corresponds to "5 or more times per week/very much." It takes 15-25 minutes to administer, (depending on the level of disturbance) and less than 1 minute to score. Some training is required to administer this test, although a very detailed, self-explanatory manual is provided. Both the scale and the manual are free. We have selected the interview method in order to maintain a more accountable trainee/trainer structure.

### **CONCLUSION**

The Power Dreaming project is a unique and innovative integration of behavioral health and computer technology that could be applied to other behavioral health and co-morbid conditions. The versatility and portability of the solution could also allow its use in deployed or remote locations for more immediate support for the behavioral health and resiliency of active duty personnel.

Active duty military and veterans often do not seek care or they terminate treatment prematurely due to perceived stigma, concerns surrounding fitness for duty or ineffective treatment. Traditional talk therapy and other treatment modalities (CBT, relaxation, and imagery) do not include biofeedback or objective evidence that patients are actually developing parasympathetic tone (relaxation), and most do not possess innate imagery skills to achieve therapeutic change. In addition, most therapeutic encounters occur in the hospital or clinic and may not be maximally effective in treating patients at the moment they awake from a trauma-related nightmare.

*Value to the Military:* The PD is a home-based therapeutic model that can be used alone or integrated into established treatment programs. On demand access to PD therapy outside the hospital or clinic setting can reduce the stigma and enhance access to care leading to greater resiliency and coping skills. Since this training model could be easily deployed with the warrior it also provides them the opportunity to address stress-related issues and reduce

negative impact as they are encountered. One of the primary variables affecting the severity of stress disorders (especially PTSD) are the complications created when we ignore or delay care and dysfunctional neurophysiology becomes habituated. The Power Dreaming project has generated significant interest in both the clinical and information technology (IT) communities. Clinicians embrace the potential to augment our limited behavioral health and modification capabilities to improve adaptive habituation with a home-based technology and methodology founded upon the science of neurological and autonomic regulation. IT communities (especially DoD and Telehealth)) see the opportunity to help those impacted by wartime operational stress. Both professional populations strongly support extending the model (HRV training/ distractive virtual immersion within in a home training system) to a larger military and veteran population and to treat other medical conditions where autonomic arousal is a primary obstacle to health (e.g. chronic pain management.)

### Future Work: Power Healing (PH)

In our technology development and research study, we intend to evaluate effectiveness of a mobile and cost effective form of self-administering protocols designed to lessen the effectiveness of emotional (PTSD) and physical (Chronic Pain (CP)) symptomatology prevalently found in warfighters who have recently returned from Iraq and Afghanistan. Power Dreaming (PTSD) and Power Healing (Chronic Pain) respectively are tools designed to encumber emotional activity stressors with the use of immersive VR technologies. The tools are designed as self-administering research protocol based approaches to combat symptoms of emotional and physical traumas. Our approach is to examine the effectiveness of these two technologies on symptoms of chronic pain and PTSD outcomes. The PH Toolkit's premise is based on the following behavioral therapy components:

*The ability to visualize healing game based scenarios* - with repetition, overrides the dysfunctional pain signal. Also, patients vary regarding their ability to visualize, a capability that is inherently essential to develop parasympathetic imagery and reframe cognition.

Potentially, a mobile game based VR solution will be derived from Power Dreaming Software that applies a) autonomic regulation training (ART) and b) use of VR technology training (VRT) to minimize symptoms of PTSD/CP. Lastly we evaluate effectiveness (motivational efficacy) of self-administered protocols. The proposed ART/VRT approach is evaluated for its ability to provide motivating, self-administering, low-cost rehabilitation tools for PTSD/Chronic Pain. The existing technologies are currently designed as a pilot treatment study for the use of VR to combat PTSD. We believe the existing technology can be expanded to a) low cost mobile devices, and b) addressing the co-morbid chronic pain condition.



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