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The Study of Neurological Response in Art Therapy and Trauma: A Literature Review

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Abstract

This review will focus on neurological research and art therapy practice to consider benefits of the integration of science and the creative therapies. These topics will be addressed through a trauma informed theoretical lens, focusing on Post-Traumatic Stress Disorder and Traumatic Brain Injury diagnoses in the US military veteran population. Arts-based, qualitative, and quantitative research were correlated within this review to discover links between neurology and art therapy's unique impact on trauma, and the outcome of combining these practices. The conclusions found that, with limited research connecting these two fields, there is a possibility for enhanced trauma treatment through the integration of neurological research and art therapy practice.

Keywords: trauma, art, brain, therapy, research, traumatic, treatment, processing, neurology, art therapy, post-traumatic stress disorder, PTSD, traumatic brain injury, TBI, dissociation, sensorimotor, top-down, bottom-up, trauma theory, veterans, US military, expressive therapies continuum, ETC

Introduction

The expressive therapies have grown through observational analysis within the US veteran population while a wealth of information has been accumulated with respect to the quantitative characteristics of Post-Traumatic Stress Disorder (PTSD) and Traumatic Brain Injury (TBI) within various regions of the brain. With the intention of drawing conclusions from documented evidence, this review will consider whether the applied use of neurological studies to art therapy practice can facilitate improved outcomes for individuals impacted by PTSD and TBI. The research used will focus in large part within the military veteran population, including all genders and ages, as well as individuals with and without military combat experience. Research studies on individuals without veteran status will be used to determine the diverse effects of trauma on psychological, cognitive, executive, and emotional functioning for comparison purposes. Various resources will be critically analyzed to determine connections between the arts and sciences, exhibiting the benefits of combining these two fields of study. Both quantitative and qualitative research within the arts, neuroscience, and trauma will be employed for a comprehensive evaluation.

Applying a critical analysis of trauma theory, focusing on its developmental parallel to the diagnostic criteria for PTSD, correlations will be explored between the tenets of this theory and the concept of dissociation in relation to trauma (Radstone, 2007). Studies concentrating on the foundational models of trauma theory, most notably presented by Freud's psychoanalytic theory, provide further understanding into the growing realm of the human psyche and the existent relationship to trauma (Mészáros, 2010). Within this realm of thought, the sensorimotor experience of trauma will be introduced to exhibit the interconnectedness of

mind and body. Ogden, Minton, & Pain (2006) stated that "attempts to process traumatic events by describing them in words or venting the associated feelings can precipitate "somatic remembering" in the form of physical sensations, numbing, dysregulated arousal, and involuntary movements" (p. 4). Acknowledgement of the physical involvement of traumatic experience affords researchers the ability to further understand the true nature of trauma.

Once the theoretical framework for this research has been established, an overview considering the evolution of the diagnostic criteria for PTSD will be presented. The up to date criterion for PTSD diagnosis will be discussed using the *Diagnostic and Statistical Manual of Mental Disorders V* (DSM-5). Importantly, Young (1995) stated that "the workability of the PTSD classification as a source of stable and universal knowledge depends on effective control over the meaning of the traumatic event criterion, its most typical feature" (p. 124). Further, the diagnostic processes for TBI will be discussed briefly to provide insight for the research being used. While the quantitative research allows for the provision of empirical data and scientific proof, traumatic experience is subjective and therefore supports the analogous impact that qualitative research has within the realm of trauma treatment in art therapy.

Following the establishment of present-day identifications for both PTSD and TBI, statistical data for diagnosis in the military veteran population will be presented. Comparisons will be made between the prevalence of diagnosis in both the veteran and civilian populations, and will include data outlining common symptomology within the veteran population. Ethical concerns will also be touched upon in this section to outline limitations when working within the veteran population. The importance of this data arises when considering cultural competence; Moore & Barnett (2013) stated that "For the military and veteran population

there is a significant stigma associated not only with seeking behavioral health care but also with seeking any medical care" (p. 31). Addressing the stigma attached to seeking mental health care will provide greater understanding for the reliability of data in the diagnosis of PTSD and TBI within the veteran population.

The neurological perspective regarding the impact trauma has on the brain will be reviewed to provide a basic understanding for the concepts presented within this research. A brief analysis of the techniques employed to measure brain activation will be provided based upon the processes used within the research being assessed. Studies conducted by Fonzo et. al. (2017), Wrocklage et. al. (2017), and Cortese et. al. (2018) have identified regions of the brain in the processing of emotional response, olfactory response, and PTSD. Various research has also suggested that the main areas of the brain impacted by traumatic stress syndromes include, but are not limited to; the amygdala, medial prefrontal cortex, anterior cingulate gyrus, hippocampus, insula, and the orbitofrontal cortex (Ogden, 2006; Hass-Cohen & Carr, 2008; King, 2016). A psychological perspective on executive, cognitive, and emotional functioning will be integrated with the information provided to promote an informed approach concerning the treatment of trauma from a neurological perspective.

Once the basics of neurological response to trauma has been established, an introduction to the concepts of top-down and bottom-up processing, as well as neuroplasticity, will be outlined. As stated by Ogden (2006), "Top-down and bottom-up processing represent two directions of information flow, and their interplay holds significant implications for the occurrence and treatment of trauma" (p. 23). Exploration in neuroplasticity has enabled researchers to understand more about brain functioning, identifying impact of environment

and the potential for neural regeneration following trauma (King, 2016). Assessing the need for the neurological integration of trauma through these processing techniques, the Expressive Therapies Continuum (ETC), presented by Hinz (2009), will be discussed with the support of a neurological perspective by Kruk, Aravich, Deaver, & deBeus (2014) to introduce the use of art therapy in practice with trauma treatment.

Research focusing on the influence that art therapy treatment has on the symptoms of traumatic stress syndromes exists largely within the realm of qualitative analysis and self-reports. These studies will be analytically integrated within the scope of symptom reduction in veterans diagnosed with PTSD or TBI. Many applications of art therapy treatment with service members focus on symptom reduction when neurological information is not readily available or accessible. Frequently, art therapy research with veterans provides an opportunity to utilize self-expression in response to traumatic experiences (Walker, Kaimail, Gonzaga, Myers-Coffman, & DeGraba, 2017; Walker, Kaimal, Koffman, & DeGraba, 2016; Artra, 2014). Lande, Tarpley, Francis, & Boucher (2010) conducted research to develop a Combat Trauma Art Therapy Scale to better identify trauma using "a systematic approach with service members' artwork to identify common themes and graphic elements" (p. 43). Enabling those impacted by trauma to identify where they fall within the stages of trauma enables both client and care provider to develop a comprehensive treatment plan.

Following will be a critical review of the impact that art therapy has on trauma with an integration of neurological traumatic underpinnings. The research used consists of quantitative data collection, neurological response to art expression, and the art therapy relational neuroscience (ATR-N) principles (Hass-Cohen & Carr, 2008). Various research studies have

sought to explore whether involvement in art activities can positively influence brain regions effected by trauma, and the analysis of these studies will be used to develop conclusions related to whether there is a benefit to be found in the integration of art therapy practice and neuroscience (Kruk, Aravich, & Deaver, 2014; Spring, 2004; Belkofer & Konopka, 2008; Belkofer, Van Hecke, & Konopka, 2014). The effects of visual art on improved neural activity in veterans with PTSD and TBI within art therapy practice, therapeutic relationship, group dynamics, and applied techniques will be explored (Vessel, Starr, & Rubin, 2012; Kline, 2016; Kaplan, 1998; Lusebrink, 2014; Gantt & Tinnin, 2009; Lusebrink, 2010).

Theoretical Approach to Trauma Treatment

Trauma Theory and the Development of PTSD

Trauma theory has been a constantly evolving component within the field of psychological thought since its conception; psychoanalytic theory's contributions and the current interpretations of this theory in relation to the research being conducted are influential to the diagnostic criteria for PTSD. In Freud's theory of the unconscious, it was originally thought that trauma existed dormant within the mind and was unattainable by the conscious mind. This evolved as trauma was researched and understood to exist within the conscious mind, albeit separate from conscious thought through dissociation (Radstone, 2007). Radstone (2007) stated that:

> Trauma theory's topography of the inner world dispenses with the layering of conscious/subconscious and unconscious, substituting for them a conscious mind in which past experiences are accessible, and a dissociated area of the mind from which traumatic past experiences cannot be accessed. (p. 16).

This exemplifies the ability for one to access traumatic events through memory recall once the trauma has been integrated through a neurological approach to trauma, to be discussed.

Freud's initial theory for those who exhibited symptoms of trauma, then defined as hysteria, focused on the idea, as stated by Berzoff, Flanagan, & Hertz (2011), that "symptoms of hysteria were caused by internal intrapsychic conflicts between traumatic events that were out of consciousness and feelings that remained conscious but that were not integrated with the trauma" (p. 441). This internal conflict posits that individuals were expressing traumatic stress symptoms with no conscious understanding of the trauma. In current trauma theory, it has been developed that, both parallel and contradictory to Freud's concept, individuals have the potential to experience dissociation following trauma with the new understanding that traumatic experience can be integrated into conscious thought, providing a better possibility for remission of symptoms.

The development of trauma theory parallels with the development and integration of PTSD diagnostic criteria into the DSM, although the diagnostic criteria was not assembled until the third edition. PTSD has been known by many names throughout history in relation to military veterans and their traumas post-war; irritable heart, shell shock, war neurosis, and soldier's heart, to name a few (Berzoff, Flanagan, & Hertz, 2011). With the continued study of trauma came a better understanding of how to develop a reliable psychological theory to identify trauma, in turn improving treatments. Stated by Berzoff, Flanagan, & Hertz (2011), "As each psychodynamic theory model focuses on different aspects of the legacies of trauma, each perspective must be synthesized with contemporary trauma theories to yield a more complex assessment" (p. 460). Trauma theory provides a unique consideration for trauma, across a

range of experiences, and allows research to focus on the individual and trauma response within varying cultures for competent assessment and treatment.

Dissociation and Somatic Experience of Trauma

The concept of dissociation identifies an inability to integrate traumatic experience, resulting in physical and emotional response to trauma. As described by van der Kolk (2014), "Dissociation is the essence of trauma. The overwhelming experience is split off and fragmented, so that the emotions, sounds, images, thoughts, and physical sensations related to the trauma take on a life of their own" (p. 66). Dissociation can cause symptoms that the individual is unaware of, such as general change in body posture, and can affect overall physical health in the process. Dissociative states can also cause an individual to experience varying levels of hyper- or hypo-arousal exhibited by a lack of control within those situations; some may become stuck within increased hyper- or hypo-arousal once they have entered these states (Ogden, 2006). Concepts rooted in the development of trauma theory's representation of dissociation in relation to trauma focus on reliving the experience through flashbacks, heightened or suppressed arousal, and night terrors; research has found that without integration of traumatic experience, the reliving of trauma cannot be resolved successfully (Leys, 2000; van der Kolk, 2014).

The development of trauma theory has also supported the emergence of a sensorimotor approach within psychotherapy practice. The sensorimotor approach allows for consideration of how the mind, brain, and body interpret traumatic experiences and, rather than focusing solely on verbal language, provide an alternative approach to treatment (van der Kolk, 2014; Ogden, 2006). Individuals who have experienced trauma may find themselves

caught within the fight or flight mentality, unable to differentiate reality from perception within their environments. Ogden (2006) stated that "Dysregulated arousal may drive a traumatized person's emotional and cognitive processing, causing emotions to escalate, thoughts to spin, and misinterpretation of present environmental cues as those of a past trauma" (p. 7). Trauma response is a complex field that requires extensive research and practice to understand; what was once believed to be an inability to control unconscious emotional arousal continues to evolve as more research is conducted (Radstone, 2007).

Post-Traumatic Stress Disorder and Traumatic Brain Injury

Current Diagnostic Criteria for PTSD and TBI

The most recent criteria for PTSD, presented by the American Psychiatric Association (APA) (2013), stated that it is "the development of characteristic symptoms following exposure to one or more traumatic events" (p. 274). The characteristic symptoms for PTSD vary from level of exposure to trauma, age of individual exposed to traumatic event, environmental factors, predisposition to trauma, culture, and gender, among many others. Symptom presentation includes a wide range of psychological, emotional, and somatic functioning interferences, and diagnosis is determined through careful consideration of criterion presented in eight different sections in the DSM-V. In reflection of the neurobiological aspect of trauma, Leys (2000) stated that "Another component of the biological theory of traumatic memory is connected to the fact that the anterior hypothalamus, amygdala, and hippocampus also have high densities of opioids receptor cells. Exposure to certain stressful events is said to activate these receptors and stimulate the secretion of endorphins (endogenous opioids) in the brain" (p. 256). The connection of results from brain imaging studies with psychological diagnoses and

symptom presentation may provide more informed practices for those in the mental health field.

While TBI is not represented within the DSM-V as a stand-alone diagnosis, the definition that will be used for the purposes of this research will relate to the major or mild neurocognitive disorder due to traumatic brain injury (APA, 2013). TBI, as defined by the APA (2013), is represented as "a brain trauma with specific characteristics that include at least one of the following: loss of consciousness, post-traumatic amnesia, disorientation and confusion, or, in more severe cases, neurological signs" (p. 625). Kennedy & Moore (2010) stated that "injuries can be categorized as mild, moderate, or severe based on associations between early indicators of injury severity and long-term outcomes" and "are usually categorized by the Glasgow Coma Scale" (p. 103). Taking these basic definitions into consideration, it is necessary to note that many traumatic brain injuries can go undiagnosed, especially when they would be categorized as mild, due to a lack of immediate symptom presentation.

PTSD and TBI Statistics within the US Military

The statistics for PTSD and TBI in the US veteran population are not available as one cohesive number; due to the changes in criteria for PTSD over the past century, varying weaponry and physical involvement in combat, and the availability of data collection, the current data is presented as per which era the military veteran is a member of. The presented data has also been accumulated using population-based studies, providing an approximate figure for those diagnosed as well as an educated guess for those impacted by PTSD and/or TBI (U. S. Department of Veterans Affairs, 2018). The prevalence of these diagnoses is magnified within the military population due to the increase in exposure to trauma and lack of immediate

interventions. As with most diagnoses, environmental factors play an important role in the development of PTSD in veterans, namely that their traumas are often experienced in foreign nations.

Due to the amount of time that has lapsed in data collection for Vietnam War veterans, the research available can only estimate the rate at which this group of individuals have experienced PTSD within their lifetimes; a 1986 study, known as the National Vietnam Veterans Readjustment Study (NVVRS), estimated that 30.9% (male) and 26.9% (female) Vietnam veterans have a "lifetime prevalence" of PTSD, while 15.2% (male) and 8.1% (female) met diagnostic criteria for PTSD at the time of the study. Another research study conducted between 1995 and 1997 utilized a self-report survey, the PTSD Checklist (PCL), to determine the number of Veterans meeting criteria for PTSD diagnosis in Gulf War veterans. The results exhibited that 12.1% of these veterans met criteria, with an estimated 10.1% of the overall Gulf War veteran population to be affected by PTSD. Research focusing on Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) veterans, also assessed using the PCL, resulted in a finding of 13.8% impacted by PTSD (U.S. Department of Veterans Affairs, 2018).

The prevalence of TBI within the military population is much higher than that of PTSD due to the variance of injury necessary to inflict physical trauma versus that which inflicts psychological trauma. Individuals within the military are conditioned to develop psychological resistance to traumatic experiences, and compared with the statistics of TBI, are successful in their endeavors. The following statistics are representative of veterans assessed between 2000 and 2018, broken down into branch of military service, and differentiated between status of service and severity of brain injury. For this research, all classifications of TBI diagnoses will be

presented through the percentages within each branch of service and quantity of individuals affected. Army; Active, 76.9% (173,151); Guard, 15.8% (35,489); Reserve, 7.3% (16,504). Navy; Active, 92.5% (48,220); Reserve, 7.5% (3,928). Air Force; Active, 84.7% (44,308); Guard, 9.6% (5,023); Reserve 5.6% (2,951). Marines; Active, 92.0% (50,026); Reserve, 8.0% (4,347) (Defense and Veterans Brain Injury Center, 2018). The CDC, NIH, DoD, and VA Leadership Panel (2013) determined that "from 2000 through 2011, a total of 235,046 service members (SMs) (4.2%) of the total 5,603,720 who served in all components of the Army, Air Force, Navy, and Marine Corps were diagnosed with a TBI" (p. 54). This provides some insight to the situation military personnel face when entering combat situations and the risk for higher prevalence of TBI diagnoses within the veteran population.

When comparing the statistical data available for the overall US population it becomes evident that the veteran population suffers from symptoms of PTSD and TBI at a much higher rate due to increased exposure. In a National Comorbidity Survey Replication (NCS-R), conducted between 2001 and 2003, lifetime prevalence was estimated at 6.8% for the general adult population in the US. Gender differences between the diagnosis of PTSD was estimated at 3.6% for men and 9.7% for women (U.S. Department of Veterans Affairs, 2018). Considering the statistical data provided for the military, it is evident that there is a great need for comprehensive care development for veterans with PTSD as they are at a higher risk for diagnosis within their lifetimes. While there is no current data estimating the prevalence of TBI diagnoses in the civilian population, documentation shows that at least 80% of TBI diagnoses are classified as mild (mTBI). With the limited research, an estimate of 3.2 million (0.97%) to 5.3 million (1.6%) of civilians will live with a TBI-related disability, as compared to the 4.2% of

veterans diagnosed between 2000 and 2011; that number is increasing as more cases are discovered (CDC, 2015).

Neurological Perspective on Trauma

Brain Imaging Techniques

Various methods have been employed in the evaluation of cognitive functioning to determine which areas of the brain have been impacted by trauma, how the brain operates while re-experiencing trauma, and what type of damage has been caused to various brain regions. Functional magnetic resonance imaging (fMRI) is one of the primary methods used in the research studies focusing on this topic. Thomas & Tseng (2008) stated that:

> Magnetic resonance imaging capitalizes on the observation that the molecules and atoms that compose the body are sensitive to the magnetic properties of their environment. In the presence of an ambient magnetic field, the constantly spinning and moving atomic particles tend to become highly organized and assume specific behavioral states. (p. 312).

The functional component of the fMRI technique associates changes in structural brain activity to fluctuations in blood flow and oxygen levels. Assessments are conducted in both active and at rest states to provide comparative data for various regions of the brain (Thomas & Tseng, 2008).

Another primary method, the electroencephalogram (EEG), measures changes in the firing of neurons by applying a series of electrodes to the surface of the scalp. Thomas & Tseng (2008) identified that “One of the main parameters that modulate the rate and amplitude of the EEG waves is the general alertness of the person” (p. 247), differentiating between delta,

theta, alpha, beta, and gamma waves. The quantitative EEG (qEEG), used in Kruk, Aravich, & Deaver's (2014) research posited that "these frequencies can be examined qualitatively from their visual display or averaged by repeated sampling known as quantitative EEG (qEEG)" (p. 53). The benefits of the qEEG in relation to this research are represented in the ability to measure region-specific characteristics of the brain, supporting researcher focus on the emotional response to stimulus. The qEEG also provides empirical evidence for the benefits of art-making based on the reduction of traumatic stress symptoms exhibited by neurological response patterns.

The final neuroimaging technique that will be discussed is the positron emission tomography (PET), which shares similarities with the fMRI but is considered a more invasive procedure. King (2016) presented that a radioisotope, an atom bound to a molecule known as a tracer, is administered to a patient and is then tracked while it circulates throughout the body. After the tracer permeates the tissues, "the imaging process begins" (p. 19). There are a variety of tracers manufactured, which gives researchers the ability to "evaluate the brain's glucose metabolism, oxygen utilization, or blood flow" (p. 19). The systematic application of the PET scan provides the researchers with the capability to focus on specific brain regions, as is also possible with the less invasive qEEG reported above.

Brain Regions Impacted by Traumatic Stress Syndromes

The Amygdala

The amygdala, part of the limbic system, plays a central role in emotional regulation, particularly in response to fear. Its composition consists of, as presented by Ratey (2001), "a dozen different clusters of neurons that have different functions…The amygdala has been

found to regulate autonomic, endocrine, somatosensory, and motor functions, as well as reproduction, memory, sleep, and orientation" (p. 312). The amygdala is responsible for interpretation of social cues, such as facial expressions, which governs the individual's ability to understand human emotions. More importantly is the amygdala's role in recognizing danger and its ability to communicate with the sensory cortex, thalamus, and hypothalamus to moderate responses to situational threats (Ratey, 2001).

The impact that traumatic stress syndromes can have on the amygdala's ability to function properly are evidenced through various neuroimaging studies, although Ogden's (2006) findings have shown that "increased amygdala activation in PTSD has not always been consistent" (p. 147). The inconsistency in findings may relate to individuals who have a history of neglect or abuse prior to the traumatic event, resulting in PTSD or TBI diagnoses due to a predisposition to trauma. Research within this field should be focused on a case by case basis, as trauma impacts individuals differently. Some individuals who have experienced trauma may have also developed an adaptive way of functioning in response to trauma, whereas the amygdala is shown to be functioning at decreased levels interfering with the fight or flight response necessary in situations of actual versus perceived danger.

Medial Prefrontal Cortex (mPFC)

The prefrontal cortex (PFC), associated with the mammalian brain, is described by Hass-Cohen and Carr (2008) as being:

> the seat of consciousness and responsible for subjective reactions that shape personality. Through its control of lower order processes, it creates more self-regulation through the planning and execution of behavior. PFC executive functions include not

> only working memory, attention, memory, and choice, but also the control of emotion. (p. 70).

The medial prefrontal cortex (mPFC), located in the left hemisphere, is responsible for decision-making and long-term memory (Euston, Gruber, & McNaughton, 2012). The cognitive functions associated with the mPFC include conditioned fear responses and influence the reactionary components associated with the amygdala (Ogden, 2006).

As part of the limbic system, along with the amygdala and hippocampus, trauma to this region of the brain can inhibit the appropriate fear response when faced with danger. Individuals may present dementia-like symptoms due to an inability to recall conditioned reactions caused by a hindrance in communication between the various networks of the brain. Ogden (2006) presented that "medial prefrontal cortex dysfunction has been consistently described in much of PTSD neuroimaging studies and has been hypothesized to be associated with attentional and frontal deficits" (p. 149). Delays in the processing and response to situations, as well as the inability for memory recall, represent common symptoms observed in both PTSD and TBI diagnostic cases.

Anterior Cingulate Cortex (ACC)

The anterior cingulate cortex (ACC) consists of both the ventral, or affective, and the dorsal, or cognitive, regions. It is responsible for the sympathetic and parasympathetic functions and is activated during tasks that involve awareness, attention, and behavioral engagement. Ogden (2006) noted that the anterior cingulate gyrus plays a key role in the regulation of emotion, much like the amygdala and prefrontal cortex, as they are all components of the limbic system. Various brain regions work together to curb the immediate

fear response activated through the amygdala's reaction; the limbic system integrates various brain functions to allow for a fully developed response to stimuli. The anterior cingulate cortex enables the individual to decipher pertinent versus impertinent information (Hass-Cohen & Carr, 2008) and "seems to be involved in regulating the emotional content of physical pain in three ways: by determining the emotional meaning of the pain; by initiating a motor response to the aversive stimulus; or by learning how to predict and avoid the pain" (Ratey, 2001, p. 319). The sensorimotor response to outside stimuli is necessary to note here, as it plays a key role in the development of the symptoms associated with PTSD and TBI.

When considering the role that the ACC has within the limbic system and its functional response to trauma, it is important to focus on both the mental and physical symptom presentation if this region of the brain becomes impacted. Ogden (2006) stated that:

> it is possible that disruption in its functioning, as observed in PTSD, may provide a neural basis of emotion dysregulation, including extremes of re-experiencing and avoidance of emotionally distressing memories, as well as generalized problems with physiological hyperarousal and emotional numbing. (p. 150).

The concept of dissociation in trauma becomes apparent when considering the effects that trauma can have on this region. Individuals may find that they cannot integrate their traumatic experience(s), therefore limiting their abilities to respond in an emotionally regulated way when presented with traumatic stimulus.

Hippocampus

As with the previously discussed brain regions, the hippocampus is partially responsible for conditioned responses to environmental and situational factors. Ogden (2006) noted that

"the hippocampus, most commonly associated with memory function, is part of the temporal lobe and receives input from, and sends efferents to, both the amygdala and the cortex" (p. 151). With this information, brain functionality can be evaluated; various regions communicate with one another to receive and send out information regarding appropriate responses, whether physical or emotional, to various situations. The hippocampus, as it is associated with memory, can store long-term information and events. Assuming there is no damage to this region of the brain, neurons will continue to communicate appropriate conditioned responses; once exposed to trauma, though, the system begins to break down.

Trauma's impact on the hippocampal region of the brain can cause multitudes of misfiring output neurons as well as an inability to fully process received information. Cognitive and emotional functioning begin to deteriorate as the hippocampus is no longer capable of sending signals to the amygdala and cortices with the conditioned response to environmental stressors, hindering the fight or flight response (Ratey, 2001). The hippocampus is also one of the key regions addressed when it comes to traumatic stress syndromes, as various studies have presented results depicting shrunken hippocampal volumes when exposed to chronic stress. It has also been noted that while chronic stress may be a factor in "shrunken hippocampal volumes", it may also be a preexisting condition that causes individuals to have a predisposition to experience and respond poorly to chronic stress (Ogden, 2006, p. 151). Ratey (2001) presented that:

> a traumatic experience or painful memory – or a high incidence of stress, for that matter – causes the level of cortisol in the brain to rise. Cortisol, the stress hormone, works by

> binding to receptor sites in the hippocampus, but when emotion gets too high too much cortisol binds to each neuron. (p. 211).

The cortisol levels are an important factor when considering traumatic experience, and will be discussed further using research conducted by Wrocklage et al. (2017).

Insula

The insula is involved in the processing of bodily signals, such as reports of physical pain and muscular sensations, integrating the concept of sensorimotor approaches to therapy for traumatic stress syndromes. The insula communicates with the amygdala and participates in the perception, cognition, and emotional response to physical distress. In research conducted by Fonzo et al. (2017), it was presented that "although this region is involved in processing fear and is known to be hyperactive across anxiety manifestations (32, 33), it is involved in numerous processes, including attention, working memory, language, and perceptual processing" (p. 1170). Due to the various roles this region plays in the processes involved in stress response, the infliction upon it through trauma has far reaching implications.

Various studies have identified the impact that trauma can have on the insula, most notably the inability to name and regulate emotional sensations being felt within the body. In consideration of a sensorimotor approach to therapy, Ogden (2006) noted that:

> as traumatized clients learn to slowly increase awareness of body sensation, movement, and impulses to tolerate sensation and emotional arousal, changes in activation of the insula and medial prefrontal cortex may take place, thus increasing their ability for self-referential-processing of bodily states and emotions. (p. 153).

Unlike the previous brain regions discussed, the insula is largely responsible for the physical attributes to trauma response and should be addressed as such. Implications for the treatment of the whole individual within the psychotherapeutic setting has the potential to enhance brain functioning and improve cognitive and emotional response post-trauma.

Orbitofrontal Cortex (OFC)

The orbitofrontal cortex (OFC) resides in the lower portion of the prefrontal cortex and is largely responsible for emotional processing. As part of the default mode network, the OFC receives communications from the ACC, as well as the insula, to aid in the processing of emotional encounters (Hass-Cohen & Carr, 2008). This region also receives direct input from various other regions, such as the olfactory system. Cortese et al. (2017) found that their "observations suggest a linkage between the neurobiology of olfactory function and anxiety-fear systems," and further discovered that "odor processing is tightly linked to emotion and memory" (p. 378). The connections between odor processing, emotion, and memory can be impacted when communication breaks down between the orbitofrontal cortex and the rest of the default mode network, causing hindered emotional response to outside stimuli. The importance of olfactory response exists within the military population due to the possibility of triggering post-traumatic experiences from combat situations.

Aside from the OFC's role in mediating the "autonomic and behavioral responses organized by the amygdala," it is also considered to "play an important role in the regulation of arousal within the window of tolerance" (Ogden, 2006, p. 153). Considering psychosomatic response to trauma, the orbitofrontal cortex is regarded as the most responsible for regulated arousal response when faced with chronic or traumatic stress. Ogden (2006) continued that "an

interference in development or activation of this part of the brain may therefore contribute to the autonomic, emotional, and cognitive dysregulation observed in our traumatized clients" (p. 154). As a part of the default mode network, all systems working in tandem with one another is key in the successful processing of traumatic stress syndromes. Assisting an individual to develop emotional regulation to return to baseline processing and conditioned fear response can provide the ability to stop living in a state of hypo- or hyper-arousal, which involves the prolonged increase of stress hormones.

Trauma Treatment: Integrating a Neurological Perspective with Art Therapy

Top-Down and Bottom-Up Processing

Top-down processing refers to how "higher-level cognitive processes modify those occurring on the lower levels" (Lusebrink, 2010, p. 169). This concept focuses on cognitive functioning and the ability to integrate and respond to occurrences and sensations that have already been experienced by lower level brain regions, such as the amygdala. Ogden (2006) stated that "psychotherapy has traditionally harnessed top-down techniques to manage disruptive bottom-up processes through the voluntary and conscious sublimation of sensorimotor and emotional tendencies" (p. 23), enabling the individual to gain control over their reactive predispositions. This process also empowers the individual to modify hyper- or hypo- arousal caused by stimuli or triggers related to the original trauma. The top-down process incorporates verbal response into the processing of traumatic experiences and can be integrated into various forms of psychotherapy to alter these responses, such as cognitive behavioral therapy (CBT).

Bottom-up processing is the sensory-based response to a stimulus or trigger related to the original trauma, and refers to lower brain region processing. This method focuses more on the nonverbal, rather than the verbal, cognitive aspects of processing information. King (2016) contends that the areas dictating emotional response and speech tend to become activated when faced with a trauma, and therefore "the traditional "top-down" approaches that are reliant on language and verbalization may not be adequate for the resolution of trauma" (p. 182). Understanding present sensations associated with trauma can enable an individual to modify future response to similar stimulus through behavior modification exercises and recognition of how the body is responding.

Neuroplasticity

"Neuroplasticity," per King (2016) "reflects the dynamic neuronal response to environmental and intrinsic stimuli that gradually alter cellular structure and function" (p. 13). Neuroplasticity in the treatment of trauma becomes a necessary consideration due to the ability of neurons to evolve and form new connections where others were damaged through repetitive processes. In other words, when there is damage caused to specific brain regions causing communication to break down and monopolize emotional regulation and processing, repetitive treatment targeting these brain regions provide opportunities for cell regrowth. Once the neurotransmitters create new connections between regions, the individual can reach an equilibrium of cognitive and emotional functioning because there is no longer a disconnect. Communication between the default mode network is imperative for symptom reduction in both PTSD and TBI, and the ability that neurons have for evolution and formation of new bonds

provides a positive outlook for those impacted by trauma with structural damage to various brain regions (King, 2016).

Expressive Therapies Continuum (ETC)

The expressive therapies continuum (ETC), developed by Sandra Kagin and Vija Lusebrink, was published in 1978 and provides a structure for the creative therapies practice congruent with an individual's level of cognitive functioning. From a neurological perspective, the ETC provides a framework for the scientific practice of art therapy utilizing both top-down and bottom-up processes. Lusebrink (2010) indicated that "the three levels of the Expressive Therapies Continuum (ETC) (kinesthetic/sensory, perceptual/affective, and cognitive/symbolic) parallel the three hierarchical levels of sensory information processing in the occipital, temporal, and parietal lobes" (p. 170), presenting viable structural support for art therapy practice. The benefits of the ETC involves the trained therapist's ability to recognize the strengths and weakness of the individual in a creative capacity, and ability to adjust to meet the client's needs and abilities.

Art Therapy and Trauma Treatment

Once a basic understanding of neurological functioning has been developed consistent with the impact of trauma, there are various treatments to be considered. Art therapy has been used for the treatment of traumatic stress syndromes and has largely depended upon arts-based and qualitative research, utilizing client self-reports, to determine validity within the field. Integrating a neurological perspective requires the use of brain imaging techniques and research to determine how art therapy can influence changes within the brain following trauma. Kline (2016) stated that "a comprehensive approach needs to include several

components: practitioner knowledge of the mechanisms of brain injury rehabilitation, the careful development of a safe therapeutic space, an understanding of the distinctive role of the art therapist, and the ability to establish rapport" (p. 69). As the field of art therapy continues to grow and integrate its practice within the realm of scientific study, continued education regarding prior research and support for ongoing investigations may provide significant insight for the improvement and development of trauma treatment practices and diagnoses leading to successful outcomes.

In arts-based and qualitative research, correlations can be made to potential neurological improvement in the treatment of both PTSD and TBI within the military population. Several studies have addressed the benefits of art therapy while utilizing self-reports and trauma scales to determine impact of treatment. In Artra's (2014) study, both changes in complicated grief as well as researcher bias are explored through the creative process, determining that "evidence for emotional processing was found in those participants who later described making the art and the impact of that process on their emotional awareness" (p. 225). Various materials were used throughout the process presented, and an integration of storytelling coupled with therapeutic support to provide traumatic experience with a new narrative was applied. This process can be assessed as providing a locus of control for the individual participants, prompting top-down processing. Response art used within this study is representative of bottom-up processing, as individuals were invited to respond with in-the-moment emotional connections.

An important component represented within qualitative and arts-based methods for the evaluation of art therapy involves the group dynamic within treatment. Many studies have

shown that a sense of community has an impact on treatment outcome, such as the results presented by Lobban & Murphy (2018). Unique to the military population, a sense of unit cohesion is present within treatment groups, and it was found that "at the outset of the admission, there was already a level of group bonding" (p. 110). The impact of this statement revolves around the therapeutic space as well as the population being served. The group space provides an opportunity to reestablish self-concept and identity, decrease isolation, while increasing community supports within the environment. Focusing on the group art therapy experience, Mandić-Gajić & Špirić (2016) reported that "war veterans are often socially isolated based on negative experiences they had with civilians, so participating in the group analysis of drawings was a chance to correct that [sic] experiences in a controlled and protected environment" (p. 761). Specific to this population, veterans seeking treatment for PTSD and TBI can find connections through experience with other group members, enabling a more beneficial therapeutic experience and higher engagement in treatment.

A critical review of Lusebrink's (2010) development of a neurological perspective while using the ETC provides a framework through which art therapists can both assess and treat trauma.

> Client areas of strength indicate a lack of difficulty in processing visual information on levels of the ETC. These areas provide secure bases from which to explore other areas that may contain psychopathology or to address "missing links" in the sequence of visual information processing. (p. 171).

Individuals impacted by trauma are exposed to the potential experience of a variety of processing issues; developing the ability to determine which functions are not operating

properly, as well as what stage of trauma, will enable more structured treatment (Lande, Tarpley, Francis, & Boucher, 2010). These struggles can also be associated with brain regions impacted by trauma, and the validity in practice can be documented through brain imaging techniques.

Considering the various levels of the ETC, Lusebrink (2010) provided insight for emotional, cognitive, and executive functioning in relation to brain regions. Focusing on the affective level of the continuum, Lusebrink found that it "appears to primarily reflect the processing of emotions in the amygdala and its influence on the ventral visual stream" (p. 171). Amygdala response is impacted by trauma, hindering an individual's ability to process traumatic experience and regulate emotion, triggering states of either hypo- or hyper-arousal. Working at this level of the ETC allows the individual to recognize emotional processing and regulation difficulties, and encourages a top-down approach to the therapeutic method. As the amygdala lies within the lower level of cognitive processing, it can therefore be influenced by art therapy techniques developed to encourage higher-level brain functioning.

Research conducted within the fields of neuroscience and art therapy have also presented various results that suggest a possibility for informed trauma treatment through thoughtful integration. Vessel, Starr, and Rubin (2012) developed a hypothesis regarding the aesthetic impact that art can have on the brain, as well as differential processing for aesthetics caused by various brain regions within the default mode network and limbic system. Their research identified that outcomes should be considered on a person-to-person basis, as everyone interprets and responds to visual imagery differently. They found "with the most moving artworks leading to a selective activation of central nodes of the DMN (namely, the

aMPFC…)" that "also activate a number of other frontal and subcortical regions, including several which reflect the evaluative and emotional dimensions of aesthetic experiences" (p. 9). These findings support the concept that art impacts the brain, as different aesthetics can activate areas of the brain directly related to emotional regulation, traumatic memory, and cognitive functioning.

In another study conducted by Kruk, Aravich, Deaver, and deBeus (2014), researchers used brain imaging techniques to differentiate neurological response to both drawing and clay sculpting to determine if active engagement could be found within brain regions. Prior research has found that both sides of the brain become activated during art processes, while this research found that there were "statistically significant differences in brain activity after art making, with increased higher brainwave…activity in the occipital, parietal, and temporal lobes. Increased beta activity was found in the left medial temporal, left frontal, and left prefrontal lobes" (p. 53). This information is important when considering that the left brain is associated with verbal processing; art therapy is more frequently recommended for trauma treatment due to the individual's inability to verbalize traumatic memory relative to the nature of the trauma. These results lead toward the concept that art can help activate the left brain, integrating right and left brain activity through improved communication, and support cognitive processing of traumatic experience in ways that verbal processing lacks the ability.

The different art techniques used within the Kruk, Aravich, Deaver, and deBeus (2014) study suggests connections to the ETC and applications for art therapy practice. Drawing is representative of a controlled medium, typically used when working within the cognitive component of the continuum, and functions within the top-down processing of traumatic

experience. In this framework, Lusebrink (2010) presented that it "appears to involve the regulatory "top-down" influences of the prefrontal cortex, especially the dorsolateral prefrontal cortex and possibly the anterior part of the cingulate cortex" (p. 171). Approaching treatment in this context allows an individual to process and develop cognitive functions by exploring experiences and develop an understanding through a controlled method. The prefrontal cortices responsible for subjective reaction may be inhibited due to failure to send or receive appropriate signals when faced with an external stimulus; art therapy provides the possibility to 'exercise' these regions and further develop the neural communication between networks that may have been damaged.

Using a different approach, such as the bottom-up processing of trauma, involves the integration of kinesthetic and sensory components of the ETC to gain access to somatic experiences. McNamee (2004) explored the use of the kinesthetic component with a client experiencing anxiety and depression, and through a series of scribble drawings, discovered that "it was the nonverbal process driving the verbal process" (p. 141). When considering the neurological impact of the kinesthetic/sensory level, Kruk, Aravich, Deaver, and deBeus (2014) found that "the profile for the Clay condition elicited a general bilateral increase in theta power, a right medial parietal increase in gamma power, and a right medial frontal decrease in gamma power" (p. 57). The comparison between the use of scribble drawing and clay sculpting is indicative of movement but not solely dependent upon movement. Both components provide a nonverbal exploration of bodily sensation and experience, exploration of control relative to the materials provided, and more abstract thought processes when considering the results.

To discern differences in neurological activation using artistic expression, Belkofer, Vaughn Van Hecke, and Konopka (2014) compared the results of individuals with no artistic experience to those who have had access to the arts. This research explored the meditative association art-making has within neurological functions and its ability to support individuals in emotional regulation as well as executive functioning. Increases in alpha activity following the art-making were found, indicating that "the association of alpha with resting and relaxing states of consciousness implicated self-regulation in neurobiological systems as influenced by the creative behaviors involved in art therapy" (p. 65). This research supports Vessel et al. (2012) in the discovery that aesthetically pleasing images processed through the visual cortex can activate various brain regions responsible for emotional processing.

Dissociation following trauma can also be resolved through neurological processing using art therapy, focusing on right and left brain integration as well as psychosomatic experiences. Individuals impacted by trauma have the potential to dissociate from their bodily experiences as a protective response to the trauma; providing individuals access to sensorimotor psychotherapy encourages the re-experiencing of trauma in a controlled environment. Avrahami (2005) found that the "process enables dissociated materials stored as visual memories to reach consciousness and be expressed" (p. 8) when exploring trauma through art-making. Hass-Cohen & Carr (2008) stated that "colors and textures easily arouse affectively laden limbic memories while purposeful art-making provides a here and now opportunity to express, understand and integrate emotional reactions" (p. 31). Understanding the neurological basis of dissociation and the impact that visual processing can have on

traumatic memory can provide improvement in symptom presentation and diagnosis associated with PTSD and TBI depending upon the nature of the trauma.

The art therapy relational neuroscience assessment protocol (ATR-N), presented by Hass-Cohen & Findlay (2009), explored the conclusion that "the shared neuropathways of sensory pain and emotional experiences suggest the advantages of employing a non-verbal sensory assessment and treatment approach" (p. 175). This theory posits that the treatment of emotional, cognitive, and executive functioning through non-somatic experience to develop an understanding of the somatic experience can work to help pain management and lower symptomology. This assessment may prove to be beneficial to individuals diagnosed with TBI due to the physical nature of the trauma and the physical pain that is experienced post-injury. Allowing the body to physically experience pain through sensorimotor exploration within a structured process, such as working with clay, can enable a different perspective on experience and encourage a bottom-up processing of trauma and its impact.

When considering that individuals with traumatic stress syndromes present with altered fear responses, Hass-Cohen & Findlay stated that:

> an immediate threat of pain contributes to fear reaction and may evoke a short-term stress response. The fear pain may therefore activate the flight or fight response within the autonomic nervous system, enacting cardiovascular, respiratory, gastrointestinal, renal, and endocrine changes. (p. 177).

Sensorimotor psychotherapy supports physical and emotional exploration of experiences, both of which are made possible with the integration of art therapy treatment. Utilizing the ETC, meeting the client at the necessary stage, and encouraging a strengths-based processing of

trauma can aid in improved neurological functioning. Using art to make meaning out of traumatic experiences, such as creating a visible object to represent an internal trauma and rebuild self-identity, helps to decrease PTSD and TBI symptomology such as depression and anxiety (Hass-Cohen & Findlay, 2009; Walker, Kaimal, Koffman, & DeGraba, 2016; Walker, Kaimal, Gonzaga, Myers-Coffman, & DeGraba, 2017). Research within the realm of art therapy treatment and its positive impact on trauma is ongoing, utilizing neurological research when possible to improve diagnosis and treatment options.

Discussion

This critical review of literature and research presented through a trauma informed lens within the fields of neuroscience and art therapy exhibited the possibility for integrated practice in the treatment of U.S. military veterans diagnosed with PTSD or TBI. As demonstrated in the literature, the integration of neurological study and expressive therapy practice has been explored to gain a better neurological understanding in relation to trauma and traumatic stress syndromes. The expressive therapies provide a unique opportunity to explore and improve neurological function by targeting brain regions through nonverbal technique.

Current Integrated Practice

The object of this literature review was to evaluate the current practices that exist in the field of neurology and how it has been assimilated as a resource within art therapy treatment. Based on the current review, neurologically based art therapy treatment does not exist outside of controlled studies seeking to form connections and innovations within these two fields.

Need for Development and Supported Practice

In support of a more comprehensive practice is the continued development of trauma theory, analyzed by Radstone (2007), Mészáros (2010), and Leys (2000), as well as continuous research into the causes, effects, and evolution of diagnostic criteria for PTSD and TBI (Young, 1995). As indicated through the statistics provided for the rate of diagnosis within the U.S. military, there is a growing need for informed care within treatment centers for this population to minimize the impact of symptomology and provide support for the processing of trauma. Educating mental health practitioners to understand the brain region(s) impacted by traumatic experience through basic knowledge of neuroimaging techniques, and utilizing available research regarding art therapy practice and its impact on neurological function, can provide a more direct and potentially more cost-effective method for the treatment of PTSD and TBI.

Barriers to Research

A significant limitation when considering research with active military veterans, presented by Moore & Barnett (2013), stated that "Approval for research is not only required from the appropriate regulatory and oversight bodies (e.g., institutional review boards), but also from local commanders, who must be willing to authorize or otherwise support the study with the personnel under their charge" (p. 132). When utilizing research for psychological practice, it is ethically responsible to use the most recent data available for assessment and treatment purposes. Another limitation exists within the realm of funding due to the high cost of neuroimaging techniques, ability to gather willing and able participants, and the longevity of the studies that will be necessary to collect accurate data. Considering the limitations, the research provided opens the door to informed application of art therapy technique for individuals with PTSD and TBI by utilizing the ETC and ATR-N as well as the Combat Trauma Art

Therapy Scale for referential purposes (Lusebrink, 2010; Hass-Cohen & Findlay, 2009; Lande, Tarpley, Francis, & Boucher, 2010).

Conclusion

Presented thorough analysis of research, connections have been drawn between the benefits of both quantitative and qualitative studies to exhibit the parallels within trauma treatment. Neurologically based research exhibited that both PTSD and TBI negatively impact brain functioning in various regions, causing symptoms to present through cognitive and executive functioning as well as behavioral changes. Arts based quantitative research, as that of Belkofer, Van Hecke, & Konopka (2014) and Kruk, Deaver, & deBeus (2014), presented evidence based data showing differential neurological reactivity when individuals engage with art-making and provided various hypotheses related to neurological improvement following traumatic injury. Individuals practicing art therapy would benefit from continued research within the scope of neurological study to develop a cohesive and fully informed approach. The statistical data acquired through continued quantitative research would enable health care providers to develop neurologically based treatment plans with the ability to target specific brain regions for improved neuroplasticity and communication for symptom reduction. In consideration of the focus of provided research within the veteran population, controlled studies may enable patterns of traumatic stress and traumatic brain injury response to emerge.

The quantity of reliable research available for the informed integration of art and science in psychology has been presented by various authors, although there is still much growth to be exhibited through evidence-based practices. Kaplan (1998) presented that:

> it bears emphasizing, however, that the art therapy literature alone does not contain sufficient studies to determine the better way of working. Without incorporating the scientific perspective – that is, without conducting more studies and examining the research of relevant disciplines – art therapists will continue to spin their wheels and frustrate themselves and each other in regard to this issue. (p. 97).

There is a need within the field of art therapy practice that can be resolved through further scientific research as evidenced by statistical data, such as that presented within this review. The continued integration of scientific study and the expressive therapies in practice can enhance treatment options for those seeking mental health care through the provision of a basic education on brain function and how an array of diagnoses have patterns of impact within specific brain regions. Continued research into this topic falls within the ethical responsibility of those practicing as mental health counselors, as it is an obligation to both practice within the scope of knowledge and provide the best possible care to those seeking therapeutic support. With the addition of neurological study, mental health care providers will be in a better position to provide an integrated and informed approach in practice with the main goal of improving treatment outcomes, targeting higher instances of symptom reduction and improved neurological functioning.

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