The Role of Acupuncture in Treating Acute Stress Disorder: A Literature Review

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To the faculty of American College of Traditional Chinese Medicine at CIIS, DAOM Program:

The undersigned find that the capstone research of Nicole Anderson is satisfactory and recommend it be accepted.

Capstone research project title:

The Role of Acupuncture in Treating Acute Stress Disorder: A Literature Review

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Acknowledgements

This paper is dedicated to survivors of trauma. May we stand together and never give up hope.
Abstract

Acute stress disorder (ASD) is a lead indicator of the future development of Post-Traumatic Stress Disorder (PTSD) in traumatized people. This literature review investigates how acupuncture can be used to treat ASD and potentially ameliorate the onset of PTSD. Current research on the physiology of the acutely traumatized brain was reviewed to determine the areas of the brain that are most active within days to months after a traumatic experience. Next, studies on how acupuncture affected those areas of the brain were reviewed to assess which points or protocols were most effective in balancing those areas of the brain. Afterwards, acupuncture theory was examined to see how it aligns with ASD brain research to direct best practices in treating ASD. This review highlights the ability of acupuncture to positively impact areas of the brain affected by ASD. Potentially significant point protocols and treatment strategies are presented. Future research studies on ASD using appropriate protocols are needed to further our understanding of the impacts of acupuncture on the acutely traumatized brain.

Keywords: Acute stress disorder, ASD, Post-traumatic stress disorder, PTSD, acupuncture, acupuncture therapy, traditional Chinese medicine, TCM, neurobiology, amygdala, pre-frontal cortex, PFC, hippocampus, default mode network, DMN, scalp acupuncture, auricular acupuncture, Chong.
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Introduction

In 1980, the American Psychiatric Association created the diagnosis of Post-Traumatic Stress Disorder (PTSD) in response to requests from a group of Vietnam veterans along with New York psychoanalysts, Chaim Shatan and Robert J. Lifton (Van der Kolk, 2015). The diagnosis identified a cluster of symptoms that were most commonly seen in Vietnam veterans and grouped them together into a disorder. This diagnosis created the opportunity for treatment. In subsequent years, it became clear that this diagnosis was not only applicable to veterans but to a larger group of people who had experienced trauma in other forms, such as abuse, molestation, accidents, natural disasters and war (Van der Kolk, 2015).

The diagnosis of Acute Stress Disorder (ASD) was introduced to the DSM-IV in 1994. ASD was also identified by a group of common symptoms seen in patients who had fresh exposure to a traumatic event. The diagnosis requires all of the following symptoms within three days and up to one month after trauma exposure: intrusion symptoms, negative mood, dissociative symptoms, avoidance symptoms, and arousal symptoms (American Psychiatric Association & American Psychiatric Association, 2013). “ASD was introduced into the DSM in an effort to prospectively characterize the subpopulation of traumatically exposed persons with early symptoms and identify those at risk for the development of PTSD” (First & Tasman, 2005, p.4). It is suspected by the psychiatric community that early intervention after a traumatic event may prevent the subsequent development of PTSD and great efforts are being made to create early intervention programs and protocols (First & Tasman, 2005).

Current studies show that within one month of trauma, 6 - 33% of survivors show symptoms of ASD. Research and clinical experience show that those with high levels of symptoms early on, including those with ASD, are at risk of developing PTSD. Eighty percent of
those diagnosed with ASD show signs of PTSD six months later (U.S. Department of Veterans Affairs, n.d.). “Approximately, 60% of those who develop PTSD do so without ever meeting diagnostic criteria for ASD” (Friedman & Friedman, 2012, p.93). Because of the difficulty in conducting proper research during the first month after a traumatic event, researchers have had difficulty categorically identifying patient or trauma-specific factors that predict the development of ASD. This has made it difficult to develop scientifically tested interventions that will prevent the evolution of ASD into PTSD (American Psychiatric Association, 2006).

During the 1990s, advancements in brain imaging created opportunities to more thoroughly understand the mechanisms of trauma, for example, researchers discovered that trauma “results in a fundamental reorganization of the way mind and brain manage perception” (Van der Kolk, 2015, p. 21). Dr. Bessel Van Der Kolk, a Boston psychiatrist, lauded for his research on trauma, concludes that trauma-related behaviors are caused by actual changes in the brain. He surmises that the growing development of knowledge about the basic processes underlying trauma opens up new possibilities to reverse its damage. In *The Body Keeps the Score* (Van der Kolk, 2015) he states:

For real change to take place, the body needs to learn that the danger has passed and to live in the reality of the present. The search to understand trauma has led to different thinking not only about the structure of the mind but also about the processes by which it heals. (p. 21)

His findings suggest that most patients respond best to a combination of three avenues for healing, which “allow the body to have experiences that deeply and viscerally contradict the helplessness, rage, or collapse that result from trauma.” (Van der Kolk, 2015, p. 3) The three avenues of healing are:
1. Top-down talking

2. Taking medications to shut down inappropriate reactions or using technology to change the way the brain organizes information; and

3. The Bottom-up approach.

The second and third avenues listed above indicate where there is a valuable opportunity through the use of acupuncture to bring a traumatized individual back to the present moment and to impact the healing of the mind. Historically, acupuncture has been used to mitigate inappropriate reactions and to help change the way the brain organizes information. It has also been used to create somatic changes to the internal environment by calming the fight or flight response and creating balance in the body. This is currently being substantiated in articles such as “The application of polyvagel theory to auricular acupuncture,” by Terry Oleson. His review of a research study he conducted at UCLA shows how historically-used auricular acupuncture points access the vagus nerve to calm the body systems (Oleson, 2018).

Current dialogue about trauma in the Chinese medicine community focuses primarily on PTSD. With the development of the Acute Stress Disorder diagnosis, there is an opportunity to think critically about how acupuncture is being used to most effectively treat the various stages of trauma. This literature review will compare Chinese medicine and western medicine understandings of the trauma response. It will review current western literature on ASD and attempt to identify areas of the brain that are most impacted immediately after a traumatic event. By identifying these areas, we can focus on how acupuncture can be used to facilitate their resilience. It will compare classic Chinese medicine descriptions of the related experience of “shock” to ASD in DSM V. Current protocols for treating trauma within the acupuncture profession will also be examined, and an exploration of whether those treatments adequately met
the needs of individuals in the acute stress phase of the trauma response. A review of what is known about the mechanism of acupuncture on the neuroanatomy involved in processing traumatic events will also be included, as well as suggestions regarding appropriate treatment strategies for treating individuals during the first month after a traumatic event. This literature review will attempt to answer the question: Does the acupuncture literature and western medical research literature illuminate the mechanism by which resilience can be achieved through acupuncture to potentially ameliorate the symptoms of Acute Stress Disorder? The hypothesis is that acupuncture and Chinese medical theory provide a theoretical and practical basis for using acupuncture to manage the symptoms of Acute Stress Disorder.

**Methodology**

A literature review was conducted to further explore how ASD affects the body and to synthesize potential treatment strategies to answer the above questions. This review was broken down into three phases. The first of the multi-staged phases consisted of reviewing current western medicine texts to better understand the intricacies of ASD. Once that was established, a PubMed search focused on what happens in the brain immediately after a traumatic experience was conducted. Once this preliminary search was completed, it was possible to narrow down the areas of the brain most impacted by the early affects of trauma.

The second phase of this literature review focused on synthesizing Chinese medicine literature. A PubMed search was conducted for research about how acupuncture affects the brain after a traumatic event. This yielded minimal and, therefore, unhelpful results, so an additional PubMed search was done on how acupuncture affects the specific areas of the brain most impacted by ASD, in the hope that efficacious acupuncture points and protocols for treating these specific areas would emerge.
The third phase of this literature review began with reviewing Chinese medicine texts to better understand the Chinese medicine concept and treatment of “shock,” the diagnosis most closely aligned with the symptomology of ASD. Chinese medicine theory and source texts were consulted to develop suggestions for further research studies and potentially effective treatment protocols based on the findings of this literature review.

When conducting preliminary searches on PubMed, it became clear that the diagnosis term of Acute Stress Disorder is too recent and not widely-enough adopted to yield significant results. It also yielded insignificant—and unintended—results, as the letters ASD most commonly refer to Autism Spectrum Disorder. Most of what is now defined as Acute Stress Disorder is more commonly seen on PubMed as Acute PTSD. As can be seen in the search results in Table 1 below, the phrase Acute PTSD resulted in the most “hits.”

Table 1. Initial PubMed Search Results

<table>
<thead>
<tr>
<th>Search Terms</th>
<th>Neuroanatomy of Trauma</th>
<th>Neuroanatomy of Acute Stress Disorder</th>
<th>Neuroanatomy of PTSD</th>
<th>Acute PTSD</th>
<th>Acute AND Stress AND Disorder AND Memory</th>
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<td>4</td>
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<td>87</td>
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Because there are a limited number of acupuncture studies on Acute Stress Disorder and Acute PTSD, a more investigative search into the neuroanatomy of trauma was therefore conducted. During that search, it became clear that current brain studies on acute trauma response have identified the hippocampus, amygdala, prefrontal cortex (PFC), gray matter and default mode network (DMN) as areas that need to function optimally for the brain to be resilient.
With this additional information, PubMed searches were conducted to see how acupuncture affected each one of these areas.

For this preliminary step in the literature search, articles containing the search terms, or a variation thereof, were included and screened by title and abstract. Exclusions were made for articles that seemed unrelated to the search terms or were more than fifteen years old. While reviewing the above-referenced articles, it became clear that knowledge from the field of neurobiology is extremely dynamic, constantly growing and changing. For example, research from more than seven years ago could be used to set the stage for current perspectives, but was outdated by the findings of more recent studies. Of the 242 research articles listed in the above chart, five were found to be the most current and advanced in terms of their efficacy. These five neurobiology studies provide the clearest backdrop for exploring the areas of the brain and newly-discovered brain network systems most affected by trauma. One of these studies is a literature review, conducted in 2018, encompassing 45 previous studies that demonstrated correlates of resilience in reducing or negating the onset of PTSD. Its conclusions are corroborated by the other four neurobiology studies highlighted in this literature review below.

Once the data from these five research papers, which altogether incorporate 49 studies in western medicine, was synthesized, search terms were developed for the acupuncture portion of the literature review. Articles containing the phrases in the search terms, or a variation thereof, were included. Articles were screened by title and abstract. Exclusions were made for articles that seemed unrelated to the search terms, or were more than eight years old. Synthesizing the categories in Table 2 below led to some surprising discoveries, which will be laid out in the Chinese medicine section of this paper.
Because of the impossibility of eliminating traumatic events from human experience, the medical community focuses on promoting resilience among those with the greatest risk of being affected. This has been the strategy adopted by organizations, such as the military, police departments and emergency service agencies. They attempt to create resilience by “enhancing the capacity of individuals to cope with traumatic stress through adaptive strategies, such as protective behaviors, control of physiological responses, or actively seeking social support” (Friedman & Friedman, 2012, p.5). This term, resilience, has significance as it appears frequently in research studies on ASD and PTSD, in which brain regions are assessed for their ability to be resilient when trauma occurs. “The public health problem lies in distinguishing vulnerable from resilient individuals during the immediate aftermath of a terrorist attack, mass casualty, or natural disaster” (Friedman & Friedman, 2012, p.93).

The many risk factors for developing ASD are similar to those of PTSD. They include ongoing life stress, lack of social support, preexisting psychiatric disorders, substance abuse, being female, low education, low intelligence, childhood abuse, adverse experiences in childhood, family history of psychiatric disorders, stress severity, depression and avoidant

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coping styles. The current allopathic standard of care for ASD is four-five sessions of Cognitive-Behavioral Therapy (Friedman & Friedman, 2012).

The conventional treatment strategy for PTSD is the deployment of a range of psychosocial and pharmacological treatments. Psychosocial treatments include cognitive behavioral therapy (CBT), eye movement desensitization reprocessing (EMDR), psychodynamic psychotherapy, group therapy, which promotes a therapeutic connection among members through shared experiences, or psycho-education to help patients understand the nature of PTSD. Pharmacological treatments focus on modifying neurotransmission in serotonergic and adrenergic neurons. These include selective serotonin reuptake inhibitors (SSRIs), tricyclic antidepressants (TCAs), Venlafaxine, and monoamine oxidase inhibitors (MAOIs). Because they have a broad-spectrum effect against symptom clusters and comorbid disorders (Friedman & Friedman, 2012), SSRI’s and Venlafaxine are the first-line treatments for PTSD.

Until 2012, researchers thought the most important areas of the brain to be involved in the stress response included the amygdala, which processes emotional input, especially fear; the hippocampus, which is involved in converting short-term to long-term memory; and the medial prefrontal cortex (mPFC), which regulates emotion and arousal, as well as having a regulating function on the amygdala (Friedman & Friedman, 2012).

Since then, through advances in imaging and an increased understanding of neurobiology, the scientific community has come to understand that additional structures and neurobiological processes are also at play. These structures are referred to as networks, and include the default mode network (DMN), the attention network (AN) (also known as the executive network) and the salience network (SN). These networks, first named in 2000, are coordinated responses by
multiple areas of the brain as related to specific types of stimuli. Dr. Marcus Raichle, a neurologist at Washington University in Saint Louis explains:

To summarize the function of the three networks: the attention network makes it possible for us to relate directly to the world around us, i.e., here and now, and the default mode network makes it possible to relate to ourselves and our memories and previous experiences, i.e., the past and future. The salience network makes us switch between the two others according to our needs. (Kunish, 2015, para. 18)

It is important to consider these networks in the study of ASD and PTSD as western researchers are starting to broaden their understanding of the trauma response by including them in the dialogue. Since 2007, the number of papers referencing the networks has increased exponentially (Andrews-Hanna, 2012). An example of this is demonstrated by the Boslinger, Seifritz, Kleim & Manoliu (2018) study presented later in this paper in Table 6.

Advances in brain imaging have made it possible to gain new understanding of how the brain functions. One significant advance has been the discovery of resting state functional connectivity (rsFC). Lee, Smyser & Shimony (2013) relate that up until 1995, researchers tried to understand the complexities of the brain by having subjects perform tasks while receiving magnetic resonance imaging (MRI). This allowed researchers the opportunity to see which areas of the brain lit up in response to the specific types of activities. In 1995, the researcher Biswal conducted a study in which he asked participants not to do any cognitive, language or motor tasks while he performed a functional MRI (fMRI). Through this process, Biswal discovered the connections that occur between a collection of regions with synchronous spontaneous fluctuations when the brain is at rest (Lee et al., 2013). The subsequent observation of rsFC through fMRIs led to the discovery of the above mentioned networks: the salience network,
default mode network, and attention network (Andrews-Hanna, 2012). Due to the discovery of rsFC, researchers have been able to make significant progress in understanding what happens in a brain affected by trauma (Lee et al., 2013).

**Neurobiology**

The comprehension of research into ASD and PTSD comes hand-in-hand with an understanding of the brain systems and structures involved in these diagnoses. These systems and structures include the following:

**Amygdala.** The amygdala is one of the most prominent regions of the brain associated with PTSD, and the understanding of its role in PTSD is evolving as the science changes (see Figure 1). The amygdala, which is considered part of the Salience Network (SN), plays a primary role in modulating the fear response. “In humans, functional magnetic resonance imaging shows that the amygdala responds preferentially to emotionally charged stimuli” (Rasia-Filho, Londero, & Achaval, 2000, p.14).

The research presented below demonstrates that the emotional distress found in PTSD arises from hyperactivity in the amygdala, which is caused by the defective inhibition from a hypoactive medial prefrontal cortex (mPFC) (Zhou et al., 2012). It also presents evidence that decreased functional amygdala connectivity within the SN, as well as decreased amygdala connectivity with DMN structures, seem to be associated with
increased resilience (Bolsinger et al., 2018). Thus, it appears that a hyperactive amygdala is associated with PTSD and that a healthy mPFC can keep the amygdala response under control. Furthermore, the evidence suggests that increased resilience comes from decreased activity in the amygdala overall (Bolsinger et al., 2018).

**Medial Prefrontal Cortex (mPFC).** The medial prefrontal cortex, considered part of the DMN, is a complex area of the brain associated with a variety of functions. It has been associated with emotion and arousal (Friedman & Friedman, 2012) as well as the mediation of decision-making and retrieval of remote, long-term memory. Several researchers have suggested that it supports memory and consolidation on time-scales ranging from seconds to days. It’s been proposed by researchers that the function of the mPFC is to determine associations between context, locations, events, and corresponding adaptive, particularly emotional, responses (Euston et. al, 2012).

Thus, the ubiquitous involvement of mPFC in both memory and decision-making may be due to the fact that almost all such tasks entail the ability to recall the best action or emotional response to specific events in a particular place and time. An interaction between multiple memory systems may explain the changing importance of mPFC to different types of memories over time. In particular, mPFC likely relies on the hippocampus to support rapid learning and memory consolidation. (Euston et al., 2012, p.1057)

In addition to the above-stated research that amygdala hyperactivity is caused by defective inhibition from a hypoactive mPFC (Zhou et al., 2012), a later study found that, “From two days to one month after trauma, activation to trauma-related stimuli is greater in the PFC and right IC (insular cortex), but less in the amygdala and hippocampus of trauma survivors
compared to non-trauma exposed controls” (Xin Wang et al., 2016, p.2). Additionally, alterations in frontal cortical activity and structure during the early post-trauma period appear to be associated with the development of PTSD symptoms (Xin Wang et al., 2016). Interestingly, Bolsinger et al. (2018) discovered that increased gray matter volumes in ventromedial PFC was associated with increased resilience (Bolsinger et al., 2018).

In summary, the PFC is one of the first areas of the brain impacted by trauma, a healthy PFC with larger gray matter volumes may prevent PTSD, a healthy mPFC is needed to keep the amygdala in balance, and an altered mPFC during early trauma is associated with the development of PTSD.

**Hippocampus.** The hippocampus, part of the default mode network (DMN), plays an important role in converting short-term to long-term memory and in navigation. New research emerging from the University of Hong Kong suggests that the hippocampus may be the heart of the brain. They discovered that low-frequency activity in the hippocampus, “contributes to interhemispheric cortical connectivity and mediates sensory functions” (Chan et al., 2017, p.E6980). The researchers interpreted this to mean that the hippocampus can drive the integration between different regions of the cerebral cortex and enhance the response of vision, hearing and touch.

Moreover Zhou et al. (2012) found that “Early altered rsFC of the posterior cingulate cortex (PCC) with the left superior temporal gyrus, right hippocampus and amygdala may be a major risk factor that predisposes patients to develop PTSD”. In 2017, research based on rsFC revealed the difference between anterior and posterior hippocampal connectivity with the posterior cingulate cortex (PCC) and precuneus of patients with PTSD and those who were trauma-exposed but did not develop PTSD. The trauma-exposed group showed healthier function
between the anterior and posterior hippocampus and the PCC and precuneus (Lazarov, Zhu, Suarez-Jimenez, Rutherford & Neria, 2017). In a 2018 study, researchers found that a healthy relationship between the PCC and the posterior hippocampus is a potential marker for resilience in individuals exposed to trauma without PTSD. This relationship was present in trauma-exposed people without PTSD and malfunctioning in those with PTSD (Malivoire, Girard, Patel, & Monson, 2018).

The conclusion drawn from these studies, which are examined in more detail below, is that resilience can be achieved if there is a healthy relationship between the PCC and posterior hippocampus. It also indicates that subjects are less likely to develop PTSD if they have a healthy relationship in structures in the DMN; namely, between the anterior and posterior hippocampus and the PCC and precuneus.

**Posterior Cingulate Cortex (PCC).** The posterior cingulate cortex is a highly active brain region; recent studies suggest it has an important cognitive role.

One influential hypothesis is that the posterior cingulate cortex has a central role in supporting internally-directed cognition. It is a key node in the DMN and shows increased activity when individuals retrieve autobiographical memories or plan for the future . . . Other evidence suggests that the region may play a direct role in regulating the focus of attention. In addition, its activity varies with arousal state and its interactions with other brain networks may be important for conscious awareness (Leech & Sharp, 2014, p.12).

As stated above, an unhealthy relationship between the PCC, left superior temporal gyrus, right hippocampus and amygdala can be a predictor for PTSD (Zhou et al., 2012). Trauma-exposed groups who did not develop PTSD showed healthier function between the anterior and
posterior hippocampus and the PCC and precuneus (Lazarov et al., 2017). It was also found that a healthy relationship between the PCC and the posterior hippocampus is a potential marker for resilience in individuals exposed to trauma who did not get PTSD (Malivoire et al., 2018).

**Precuneus.** The precuneus is a “core node of the DMN. It’s reflective, self-related processed, integration of past and present information, episodic memory retrieval, autobiographical memory retrieval and visual special imagery” (Lazarov et al., 2017, p. 6). As was stated above, we see that trauma exposed groups who did not develop PTSD showed healthier function between the anterior and posterior hippocampus and the PCC and precuneus (Lazarov et al., 2017).

![Photo depicting gray matter in the brain.](https://www.hydroassoc.org/whats-the-matter/) In the public domain.

**Gray Matter.** Gray matter processes information in the brain and is mainly composed of unmyelinated axons and neuronal cell bodies (see Figure 2). Higher intelligence animals have larger amounts of gray matter, specifically the cerebrum, where more complicated brain function occurs. Larger amounts of gray matter in the decision-making and thought-processing parts of the brain indicate a better ability to evaluate rewards and consequences (Bartzokis et al., 2004). Gray matter is important in the understanding of how trauma impacts the brain because:

structural data suggest relatively consistently that increased gray matter volumes in ventromedial PFC, ACC (especially pgACC) and, to a lesser extent, hippocampus are
associated with increased resilience, while amygdala morphology does not appear to play a vital role in this context (Bolsinger et al., 2018, p. 12).

**Default Mode Network (DMN).** As explained above, the DMN is a network of brain areas that work together to accomplish certain functions and was discovered via fMRI while looking at rsFC. The areas of the brain that are a part of the DMN include the hippocampus, PFC, PCC and the precuneus. “The precise function of the DMN remains a matter of debate, but its component brain regions are involved in such processes as self-referential thinking, emotional processing, and recalling memories” (Shen, 2015, p. 14115-14116).

In healthy people, the DMN and SN appear to be tightly coupled. The DMN is most active during “rest” and the SN is more active during goal-directed tasks (Fox, Nijeboer & Solomonova, 2013).

The DMN is involved in episodic memory, integrating memories from our lives in a self-relevant way, daydreaming, planning for the future and recalling memories (Fox et al., 2013) The part of DMN situated in the front of the brain, down almost between the eyes and just above the nose, is at the level of the acupuncture point know as yin tang, translating to Hall of Impression. Dr. Marcus Raichle, who published the first research study about the existence of the default mode network explains that the DMN takes input from our experiences and processes it before passing it on to the

*Figure 3. Example of the three brain networks. From “Dynamic Shifts in Large-Scale Brain Networks as a Function of Arousal.” By C.B. Young and J. Raz, 2017, The Journal of Neuroscience, 37 (2) 281-290. Copyright 2016 by The Journal of Neuroscience.*
amygdala, hypothalamus and brain stem where the emotional responses are produced. (Raichle et al., 2001)

**Salience Network (SN).** The salience network, along with DMN, shows up regularly in PTSD and ASD research. The SN includes the amygdala, anterior insula, dorsal anterior cingulate cortex (dACC), and the pre-supplementary motor area (pre-SMA). The salience networks function is related to the fight-or-flight response. “Intrinsic functional connectivity analyses have demonstrated alterations within the SN in patients with generalized anxiety disorder (GAD) and social anxiety disorder and posttraumatic stress disorder” (Menon, 2015, p.608).

Since 2012, a handful of studies have paved the way for a fresh perspective into ASD and PTSD. A unique feature among these studies is how quickly after the traumatic event participants were engaged in a study, as well as the inclusion of a trauma-exposed control group who did not develop PTSD. This is important because it allows access to the brain immediately after a traumatic event so that the neurobiological mechanisms at work can be observed. It also provides access to how the brain of a trauma-exposed person with PTSD responds in comparison to a trauma-exposed person without PTSD. Of the five studies presented below, the 2012 Zhou, et al. study, summarized in Table 3, and the 2016 Wang, et al. study, summarized in Table 4, both began observing trauma victims two days after the trauma occurred. The 2017 Laserov, et al. study, summarized in Table 5, had 48 PTSD patients and 34 trauma-exposed controls. The 2018 Malivoire, et al. study, summarized in Table 7, included 11 patients with PTSD and 13 trauma-exposed controls. The 2018 Bolsinger, et al. study, summarized in Table 6, was a comprehensive literature review of 45 studies that demonstrated correlates of resilience in reducing or negating the onset of PTSD. It included cross-sectional study designs with two-group designs (trauma-
exposed individuals with and without PTSD), three-group designs (with an additional group of unexposed, healthy controls), twin-studies and longitudinal studies.

As seen below in Table 3, The Zhou et al. (2012) study entitled, “Early altered resting-state functional connectivity predicts the severity of post-traumatic stress disorder symptoms in acutely traumatized subjects,” examined 15 car accident victims randomly recruited in a hospital emergency room (Zhou et al., 2012). The researchers describe that the brain imaging was performed at two days, one month and six months after the trauma. It was reported that all of the participants developed PTSD and the mean time from accident to PTSD diagnosis was 2.33 months, plus or minus 2.28 months (Zhou et al., 2012). Researchers specifically looked at the severity of PTSD within posterior cingulate cortex (PCC) connectivity. They found that:

Early altered resting state functional connectivity of the PCC with the left superior temporal gyrus, right hippocampus and amygdala could predict the severity of the disease and may be a major risk factor that predisposes patients to develop PTSD.” (Zhou et al., 2012, p. 1)

The neurobiological areas mentioned, the PCC, left superior temporal gyrus and hippocampus, are all structures in the DMN. To summarize the combined findings of these studies, the researchers found that altered rsFC between the DMN and amygdala could predict, and be, a risk factor for the development of PTSD. Most importantly, they found that the emotional distress characterizing PTSD arises from hyperactivity in the amygdala, and that the amygdala hyperactivity is caused by defective inhibition from a hypoactive mPFC. (The importance of these two areas of the brain in combating PTSD is highlighted further in the remaining studies discussed in this section.) This prompts the question, can we balance the mPFC/amygdala relationship and DMN/amygdala relationship with acupuncture?
Table 3. Zhou et al. (2012) Study Synopsis

<table>
<thead>
<tr>
<th>Zhou et al. (2012)</th>
<th>Study Results as they pertain to this paper</th>
<th>Affected Brain Area</th>
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<tr>
<td>15 Subjects, all exposed to the same trauma. Brain imaging was done 2 days, 1 month and 6 months after trauma. All patients developed PTSD.</td>
<td>“Early altered rsFC of the PCC with the left superior temporal gyrus, right hippocampus and amygdala could predict the severity of the disease and may be a major risk factor that predisposes patients to develop PTSD” (p.1).</td>
<td>Anterior Hippocampus X</td>
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<td>Emotional distress characterizing PTSD arises from hyperactivity in the amygdala; and that the amygdala hyperactivity is caused by defective inhibition from a hypoactive mPFC.</td>
<td>Posterior Hippocampus X</td>
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<td><strong>Opportunity</strong>: A negative correlation between the amygdala and mPFC was found. The amygdala becoming hyperactive because the mPFC was hypoactive. Can we balance the mPFC/Amygdala relationship with acupuncture?</td>
<td>Posterior Cingulate Cortex (PCC) X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Precuneus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left Superior Temporal Gyrus X</td>
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<tr>
<td></td>
<td></td>
<td>Amygdala X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medial Pre-Frontal Cortex (mPFC) X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anterior Cingulate Gyrus (ACC)</td>
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<td>Right Insular Cortex (IC)</td>
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<td>Left Superior Frontal Gyrus (SFG)</td>
</tr>
</tbody>
</table>

The second important study on this topic was performed in 2016: *Preliminary Study of Acute Changes in Emotion Processing in Trauma Survivors with PTSD Symptoms*, (Xin Wang et al., 2016). This study, summarized in Table 4, examined acute alterations in the brains of 38 subjects who had been involved in a motor vehicle collision. Recruited within 48 hours of the accident, they were asked to evaluate images of emotional faces while their brains were studied with a fMRI: imaging occurred at two weeks and three months post-traumatic incident. It was found that:

from two days to one month after trauma, activation to trauma-related stimuli is greater in PFC and right insular cortex, but less in the amygdala and hippocampus of trauma survivors compared to non-trauma exposed controls (Xin Wang et al., 2016, p.2).
Researchers also discovered that changes over time in the mPFC activation and in PTSD symptom severity were also significantly positively correlated in the probable PTSD group (Xin Wang et al., 2016). They also found additional alterations in frontal cortical activity and structure early after trauma that appeared to be associated with the development of PTSD symptoms. Here again, changes in the PFC indicting the possible development of PTSD can be observed (Xin Wang et al., 2016).

Table 4. Wang et al. (2016) Synopsis

<table>
<thead>
<tr>
<th>Xin Wang et al. (2016)</th>
<th>Study Results as they pertain to this paper</th>
<th>Affected Brain Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects: 38 survivors of a multiple-vehicle collision, recruited within 48 hours of collision to examine acute alterations in emotion circuit activation and structure that may be linked to PTSD symptoms.</td>
<td>“From two days to one month after trauma, activation to trauma-related stimuli is greater in PFC and right IC (insular cortex), but less in amygdala and hippocampus of trauma survivors. compared to non-trauma exposed controls” (p.2). “Changes over time in mPFC activation and in PTSD symptom severity were also significantly positively correlated in the probable PTSD group. A significant time by group interaction was found for volume changes in left superior frontal gyrus (SFG, F = 6.048, p = 0.019) that partially overlapped mPFC active region. Between two weeks and three months, left SFG volume decreased in probable PTSD survivors. These findings identify alterations in frontal cortical activity and structure during the early post-trauma period that appear to be associated with development of PTSD symptoms” (p.1). Opportunity: Observed changes in the PFC indicating the possible development of PTSD begs the question: Can we use acupuncture to access the PFC and prevent the onset of PTSD?</td>
<td>Anterior Hippocampus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posterior Hippocampus</td>
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<tr>
<td></td>
<td></td>
<td>Posterior Cingulate Cortex (PCC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Precuneus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left Superior Temporal Gyrus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amygdala</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medial Pre-Frontal Cortex (mPFC) X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anterior Cingulate Gyrus (ACC)</td>
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<tr>
<td></td>
<td></td>
<td>Right Insular Cortex (IC) X</td>
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<td></td>
<td></td>
<td>Left Superior Frontal Gyrus (SFG) X</td>
</tr>
</tbody>
</table>

Lazarov et al.’s study, “Resting-state functional connectivity of anterior and posterior
hippocampus in posttraumatic stress disorder”, looked at the involvement of the hippocampus in the development of PTSD (Lazarov et al., 2017). Conducted on 48 PTSD patients and 34 trauma exposed controls, this study, summarized in Table 5, was specifically interested in observing the difference between the anterior and posterior hippocampus in trauma victims. The results showed there was a difference in function of anterior and posterior hippocampal connectivity with the posterior cingulate cortex (PCC) and precuneus in those with PTSD versus the trauma-exposed, non-PTSD control. The trauma-exposed control showed healthier function between the anterior and posterior hippocampus and the PCC and precuneus. It is clear from this study that resilience is present when there is a healthy relationship between the hippocampus and the PCC, when there is healthy communication between the anterior and posterior hippocampus, and between the PCC and precuneus (Lazarov et al., 2017).

Table 5. Lazarov et al. (2017) Synopsis

<table>
<thead>
<tr>
<th>Lazarov et al. (2017)</th>
<th>Study Results as they pertain to this paper</th>
<th>Affected Brain Areas</th>
</tr>
</thead>
</table>
| 48 PTSD Patients, 34 Trauma Exposed Controls | This study demonstrates the difference in anterior and posterior hippocampal connectivity with the PCC and precuneus between patients with PTSD and those who were-trauma exposed and did not develop PTSD. The trauma-exposed group showed healthier function between the anterior and posterior hippocampus and the PCC and precuneus. **Opportunity**: Here again, resilience is observed when there is a healthy relationship between the hippocampus and the PCC. The need for healthy communication between the anterior and posterior hippocampus and between the PCC and the precuneus is indicated. Can we facilitate these healthy relationships with acupuncture? | Anterior Hippocampus X  
Posterior Hippocampus X  
Posterior Cingulate Cortex (PCC) X  
Precuneus X  
Left Superior Temporal Gyrus  
Amygdala  
Medial Prefrontal Cortex (mPFC)  
Anterior Cingulate Gyrus (ACC)  
Right Insular Cortex (IC)  
Left Superior Frontal Gyrus (SFG) |
The review of 45 studies demonstrating correlates of resilience in reducing or negating the onset of PTSD done by Bolsinger et al. (2018), “Neuroimaging Correlates of Resilience to Traumatic Events—A Comprehensive Review,” included cross-sectional study designs with two-group designs (trauma exposed individuals with and without PTSD), three-group designs (with an additional group of unexposed, healthy controls), and twin-studies and longitudinal studies. This study, summarized in Table 6, presents a number of important findings. First, an overlap between areas of the brain that increase resilience and deal with emotion and stress regulation were found. Also discovered was that increased gray matter volumes in the PFC, anterior cingulate gyrus and hippocampus are associated with increased resilience, while the amygdala does not appear to play a vital role in this context. Moreover, decreased functional connectivity of the amygdala within the SN and with DMN structures that seems to be associated with increased resilience was indicated. Lastly, “an association of resilience with an increased ability to voluntarily recruit PFC and, to a lesser extent, ACC, suggesting a better ‘top-down’ control due to the inhibitory effects of these brain areas on the amygdala” (Bolsinger et al., 2018, p.12).

In summary, decreased amygdala response is associated with resilience, as is increased gray matter in the PFC, ACC and hippocampus, and a healthy PFC that inhibits the amygdala.

Table 6. Bolsinger et al. (2018) Synopsis

<table>
<thead>
<tr>
<th>Bolsinger et al. (2018)</th>
<th>Study Results as they pertain to this paper</th>
<th>Affected Brain Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is a literature review of 45 studies demonstrating correlates of resilience in reducing or negating the onset of PTSD. These studies</td>
<td>1. “Structural data suggest relatively consistently that increased gray matter volumes in ventromedial PFC, ACC (especially pgACC) and, to a lesser extent, hippocampus are associated with increased resilience, while amygdala morphology does not appear to play a vital role in this context” (p.12).</td>
<td>Anterior Hippocampus</td>
</tr>
<tr>
<td></td>
<td>2. Decreased functional amygdala connectivity</td>
<td>Posterior Hippocampus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posterior Cingulate Cortex (PCC)</td>
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<td></td>
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<td>Precuneus</td>
</tr>
</tbody>
</table>
Bolsinger et al. (2018) included include cross-sectional study designs with two-group designs (trauma exposed individuals with and without PTSD), three-group designs (with an additional group of unexposed, healthy controls), twin-studies and longitudinal studies.

Study Results as they pertain to this paper

within the salience network, as well as decreased amygdala connectivity with default mode network structures, seem to be associated with increased resilience.

3. “More recent studies suggest an association of resilience with an increased ability to voluntarily recruit PFC and, to a lesser extent, ACC, suggesting a better “top-down” control due to the inhibitory effects of these brain areas on the amygdala. The latter findings provide options for future therapeutic interventions. One study demonstrated improved amygdala regulation through increased PFC influence in a neurofeedback-based MRI learning task in healthy individuals. Further research should explore whether such tasks can also prove beneficial in PTSD patients or as a preventive measure to improve resilience” (p.12).

**Opportunity**: Decreased amygdala response is associated with resilience, as is increased gray matter in the PFC, ACC and hippocampus. A healthy PFC and ACC inhibiting the amygdala also creates resilience. With acupuncture, can we reduce the amygdala response and increase the PFC, ACC and hippocampal response?

<table>
<thead>
<tr>
<th>Affected Brain Area</th>
<th>Left Superior Temporal Gyrus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amygdala</td>
<td>X</td>
</tr>
<tr>
<td>Medial Pre-Frontal Cortex (mPFC)</td>
<td>X</td>
</tr>
<tr>
<td>Anterior Cingulate Gyrus (ACC)</td>
<td>X</td>
</tr>
<tr>
<td>Right Insular Cortex (IC)</td>
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<tr>
<td>Left Superior Frontal Gyrus (SFG)</td>
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</table>

The last study, summarized in Table 7, that is examined in this paper is “Functional connectivity of hippocampal sub regions in PTSD: relations with symptoms,” (Malivoire et al., 2018), which investigated 11 patients with PTSD and 13 trauma-exposed controls. It found that the posterior hippocampus plays an important role in memory retrieval and spatial cognition, and that a healthy relationship between the PCC and posterior hippocampus is a potential marker for resilience in individuals exposed to trauma who did not develop PTSD. This healthy relationship was present in trauma-exposed people who did not get PTSD and malfunctioning in those who got PTSD (Malivoire et al., 2018). Here again, we see that the health of the hippocampus
correlates to resilience and the mitigation of the symptoms of PTSD.

Table 7. Malivoire et al. (2018) Synopsis

<table>
<thead>
<tr>
<th>Malivoire et al. (2018)</th>
<th>Study Results as they pertain to this paper</th>
<th>Affected Brain Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Patients with PTSD vs. 13 Trauma-Exposed Controls</td>
<td>Findings were that the anterior hippocampus is preferentially associated with the amygdala, the hypothalamic-pituitary-adrenal (HPA) axis, and the limbic prefrontal circuitry as compared with the posterior hippocampus. The researchers also found that the posterior hippocampus plays a specific and important role in memory retrieval and spatial cognition. A healthy relationship between the PCC and the posterior hippocampus was discovered to be a potential marker for resilience in individuals exposed to trauma who did not get PTSD. This relationship was present in trauma-exposed people who did not get PTSD and malfunctioned in those who developed PTSD. <strong>Opportunity:</strong> If a potential marker for resilience is a healthy relationship between the PCC and posterior hippocampus, can we then use acupuncture to facilitate that relationship?</td>
<td>Anterior Hippocampus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posterior Hippocampus</td>
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<tr>
<td></td>
<td></td>
<td>Posterior Cingulate Cortex (PCC)</td>
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<tr>
<td></td>
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<td>Precuneus</td>
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<td></td>
<td></td>
<td>Left Superior Temporal Gyrus</td>
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<tr>
<td></td>
<td></td>
<td>Amygdala</td>
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<tr>
<td></td>
<td></td>
<td>Medial Pre-Frontal Cortex (mPFC)</td>
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<tr>
<td></td>
<td></td>
<td>Anterior Cingulate Gyrus (ACC)</td>
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<td>Right Insular Cortex (IC)</td>
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<tr>
<td></td>
<td></td>
<td>Left Superior Frontal Gyrus (SFG)</td>
</tr>
</tbody>
</table>

To facilitate resilience in trauma-exposed individuals, the above-mentioned studies clearly demonstrate that several areas of the brain need to be functioning in a homeostatic way. These areas include the amygdala, which has a response that is proportionally related to the health of the PFC. This means that the PFC needs to be supported to keep the amygdala response under control. These studies also make clear that the PFC is engaged immediately after a traumatic event. By focusing early post-traumatic acupuncture treatments on facilitating healthy
PFC function, perhaps acupuncture can assist in fostering PFC health and resilience. The increase in gray matter, particularly in the PFC, as well as a well-functioning hippocampus with a healthy relationship with other structures, such as the PFC, PCC and precuneus, may prevent PTSD. In other words, all structures in these areas of the brain need to be functioning well in order to achieve resilience and prevent PTSD.

**Chinese Medicine Literature**

Investigation into how acupuncture affects the amygdala, PFC, hippocampus, DMN and gray matter of the brain was conducted using the search terms listed in Table 2. Upon synthesizing the data, two sources were determined to be the most valuable in describing how acupuncture affects relevant structures of the brain and for providing relevant references previously vetted for quality and content. Both sources are systematic reviews. The first of these was funded by Carstens Foundation and the Chinese Scholarship Council and published in 2012 under the title “Characterizing Acupuncture Stimuli Using Brain Imaging with fMRI – A Systematic Review and Meta-Analysis of the Literature” (Huang et al., 2012). This paper reviewed research in English, Chinese, Korean, and Japanese databases from the earliest available until September 2009. It found 779 papers and included 149 articles for descriptive analysis and 34 for meta-analysis.

The Huang, et al. (2012) review found that the response of the brain to acupuncture encompasses a wide network of regions:

- Compared with sham acupuncture, verum (true) acupuncture tended to be associated with more activation in the basal ganglia, brain stem, cerebellum, and insula and more deactivation was seen in the DMN and limbic brain areas such as the amygdala and hippocampus. (Huang et al., 2012, p.12)
Several studies included in this review suggest that acupuncture modulates the resting state connectivity within the DMN, SN, and amygdala network.

According to the Huang et al. (2012) review, the most studied acupuncture points were LI-4 (he gu), ST-36 (zu san li), PC-6 (nei guan), LV-3 (tai chong), and GB-34 (yang ling quan). “The brain map of each acupuncture point differ considerably from each other. However, the acupuncture points on the same meridian showed some similarities among the activation/deactivation pattern” (p.5). In the literature reviewed by Huang et al. (2012), and another systematic review analyzed next, the rationale for point selection for each study were not discussed in detail. There were a few exceptions to this, as noted below. Though points on the same meridian were shown to have similarities in activation/deactivation patterns, none of the studies reviewed by Huang et al. (2012) specifically focused on how the points on each meridian affect the brain. Most reviewed studies focused on the effects of one acupuncture point on the brain. In addition, none of the 34 studies included in the meta-analysis focused on treatment protocols. Most of the research in the review focused on how different needling techniques affect the brain differently. The study concluded that electro-acupuncture at low frequencies tend to activate a broader range of brain areas than electro-acupuncture at high frequencies (Huang et al., 2012).

The second systematic review entitled, “Brain functional connectivity network studies of acupuncture: a systematic review on resting-state fMRI” (Cai, Shen, Wang, & Guan, 2018), was published in the Journal of Integrative Medicine. It reviewed English language studies on humans published in PubMed from January 1, 2006 to December 31, 2016. Forty-four resting-state MRIs were included in the paper. The researchers found that “acupuncture at different
acupoints can lead to different changes in brain functional connectivity,” (Cai et al., 2018, p. 31) and that differences:

could be found in the functional connectivity network of different acupuncture manipulations, different needling depths and different stimulation intensities. Compared with sham acupuncture, verum acupuncture could increase DMN connectivity with pain-affective- and memory-related brain areas, as well as SMN connectivity with pain related brain areas. (Cai et al., 2018, p. 31).

Of the 44 trials reviewed in the Cai et al. (2018) study, only 10 used full point protocols. ST-36 (zu san li) and LI-4 (he gu) were the most common points studied.

From the two systematic reviews presented above, it can be seen that acupuncture affects the brain. They share a focus on the study of single points, rather than the effects of protocols or meridians on the brain. From this research, it is clear that needling technique affects which areas of the brain are more active in an MRI.

Detail of the results of the literature review findings on the effect of specific acupuncture points on the brain is provided in Table 8 below. Unfortunately, a clear picture does not emerge from an examination of this data; this will be discussed further in the Discussion section of this paper.

Table 8. Synopsis of studies reviewing acupuncture's effect on the hippocampus, amygdala, prefrontal cortex, default mood network, and gray matter of the brain.

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Points Used</th>
<th>Area of Brain Affected</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhond et al. 2008</td>
<td>PC-6 (nei guan)</td>
<td>DMN Hippocampus Amygdala</td>
<td>This study looked at the effects of a retained acupuncture needle on the brain. Following verum, vs. sham, acupuncture, there was increased DMN connectivity with brain regions related to the limbic system, which includes the amygdala, and the memory region</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Points Used</td>
<td>Area of Brain Affected</td>
<td>Notes</td>
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<tr>
<td>Napadow et al. 2007</td>
<td>LI-4 ( (he \ gu) )</td>
<td>Amygdala</td>
<td>This study looked at the effect of verum vs. sham acupuncture in patients with carpal tunnel syndrome. Patients responded to verum acupuncture with greater activation in the hypothalamus and deactivation in the amygdala than did the sham group (Napadow et al., 2007).</td>
</tr>
<tr>
<td>Lin et al. 2006</td>
<td>LI-4 ( (he \ gu) )</td>
<td>DMN</td>
<td>This study looked at different ways of needling and stimulating a point and how that affected the brain. The results showed that conventional methods to enhance the acupuncture dose induce different DMN modulatory effects. Three-needle acupuncture (one needle in the acupuncture point and two additional needles placed nearby) induces the most extensive DMN modulation, compared with other methods. Conventional methods of enhancing the acupuncture dose could potentially be applied as a means of modulating brain activity (Lin et al., 2016).</td>
</tr>
<tr>
<td>Wang et al. 2014</td>
<td>LI-4 ( (he \ gu) ) LV-3 ( (tai \ chong) )</td>
<td>Hippocampus</td>
<td>Researchers in this study investigated the effect of acupuncture on Alzheimer patients by combing fMRI and traditional acupuncture. Their fMRI study confirmed that acupuncture at LV3 and LI4 can enhance the hippocampal connectivity in Alzheimer patients (Z. Wang et al., 2014).</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Points Used</td>
<td>Area of Brain Affected</td>
<td>Notes</td>
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</tr>
<tr>
<td>Qin et al. 2008</td>
<td>ST-36 (zu san li)</td>
<td>Amygdala</td>
<td>This study looked at the functional connectivity involved in acupuncture on healthy individuals. It found “that there is an amygdala associated resting brain network, which can be further modulated by sham and acupuncture stimulations, and that the specific effects of acupuncture may result from the cooperation of brain regions engaged in the resting functional network” (Qin et al., 2008, p.15).</td>
</tr>
<tr>
<td>Jiang et al. 2013</td>
<td>ST-36 (zu san li)</td>
<td>DMN, Increased functional connectivity in the sensory-motor network</td>
<td>This study explored whether different brain mechanisms might be recruited with different acupuncture modalities in healthy individuals. Its findings suggested that the answer is affirmative. “A more secure and spatially extended connectivity of the default mode network was observed following manual acupuncture and electro-acupuncture, and transcutaneous electro-acupuncture stimulation specifically increased the functional connectivity in the sensorimotor network” (Jiang et al., 2013, p.1)</td>
</tr>
<tr>
<td>Feng et al. 2011</td>
<td>ST-36 (zu san li)</td>
<td>Hippocampus, Amygdala</td>
<td>This study examined the sustained effects of acupuncture on the brain. Following acupuncture, the limbic/paralimbic regions, such as the amygdala, hippocampus and anterior cingulate gyrus, emerged as network hubs.</td>
</tr>
<tr>
<td>Li et al. 2014</td>
<td>UB-23 (shen shu), DU-3 (yao yang guan), UB-40 (wei zhong), KD-3 (tai xi),</td>
<td>DMN, PFC</td>
<td>This study utilized a point prescription for low back pain. It found that less connectivity within the DMN was found in patients with chronic low back pain than in healthy controls, mainly in the dorsolateral prefrontal cortex, medial</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Points Used</td>
<td>Area of Brain Affected</td>
<td>Notes</td>
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<tr>
<td>Ah shi point near UB-23 <em>(shen shu)</em></td>
<td>Prefrontal cortex, anterior cingulate gyrus and precuneus. After acupuncture, patients' connectivities were restored almost to the levels seen in healthy controls. Furthermore, reductions in clinical pain were correlated with increases in DMN connectivity. <em>(Li et al., 2014)</em></td>
<td></td>
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<tr>
<td>Xiaoyun Wang et al. 2016</td>
<td>RN-12 <em>(zhong wan)</em>, RN-10 <em>(xia wan)</em>, RN-6 <em>(qi hai)</em>, RN-4 <em>(guan yuan)</em>, KD-17 <em>(shang qu)</em>, ST-34 <em>(liang qiu)</em>, Qipang</td>
<td>Amygdala, Hippocampus</td>
<td>This study looked at the combined effect of acupuncture and the antidepressant fluoxetine, as well as its underlying mechanism, using resting state functional connectivity (rsFC) in patients with major depressive disorders. Their findings show the additive effect of acupuncture to antidepressant treatments and “suggest that this effect may be achieved through the limbic system, especially the amygdala and the anterior cingulate cortex” <em>(Xiaoyun Wang et al., 2016)</em>.</td>
</tr>
<tr>
<td>Chen et al. 2013</td>
<td>KD-3 <em>(tai xi)</em></td>
<td>Hippocampus, PFC</td>
<td>This study compared the interregional effective connectivity of brain networks by varying needling depths. Results from deep acupuncture at KD3 showed that the dorsolateral prefrontal cortex and hippocampus emerged as central hubs and had significant influences on each other <em>(Chen et al., 2013)</em>.</td>
</tr>
<tr>
<td>Lang et al. 2016</td>
<td>Scalp Acupuncture</td>
<td>Gray matter</td>
<td>This study looked at using unspecified scalp acupuncture points to increase brain gray matter in cerebral infarction patients. They found that scalp acupuncture might inhibit the loss of brain gray matter after a cerebral infarction. <em>(Lang, Cui, Li, Tan, &amp; Zou, 2016)</em></td>
</tr>
</tbody>
</table>
Chinese Medicine Concept of Shock

By looking at the areas of the brain most affected by ASD, Chinese medical theory can be used to develop an educated treatment strategy. Currently, it has been deduced that the amygdala is responsible for the fear response. In Chinese medicine theory, fear is the emotion governed by the Kidneys so any treatment protocol for ASD should, in theory, involve working with either the Kidney meridian, Kidney organ, or Kidney qi in general (Maciocia, 2008). In Chinese medicine theory, the Kidneys also have influence over the brain organ; it is believed that the Kidney produces marrow which makes up the brain and spinal cord (Kim, 2015). This lays the foundation for the compelling argument that Kidneys are a primary player in treating trauma.

Modern research associates the PFC with emotion, arousal and memory consolidation; the memory referred to is implicit memory, which is more episodic, unconscious and unintentional (Giovanni, 2016). This could be related to the Heart system in Chinese medicine theory, as the heart governs emotion and memory. Then there is the hippocampus, which is also involved in converting short-term to long-term memory; namely, explicit memory. This can be a function of the shen of the Heart, but it is more closely associated to the yi of the Spleen and the zhi of the Kidney. The yi of the Spleen is responsible for “applied thinking, studying, memorizing, focusing, concentrating and generating ideas” (Maciocia, 2016), para. 24). The Kidney zhi controls short-term memory (Kim, 2015) and for storing data over the long-term (Maciocia, 2016).
Figure 4. The Kidney’s relationship to brain function.

Figure 5. The Spleen’s relationship to brain function.

Figure 6. The Heart’s relationship to brain function.
The DMN is involved in episodic memory, but it is also active when a person daydreams and is in a relaxed state. As acupuncture treatments work to calm the body’s nervous system and create a relaxed state and a balanced acupuncture treatment naturally creates a homeostatic environment in the body (Goldman, Takano, Kress, & Nedergaard, 2015) it could be argued that patient-appropriate and ASD-appropriate acupuncture protocols facilitate the activation of the DMN of which the PFC, hippocampus, PCC, and precuneus are a part. Activating the DMN deactivates the SN, of which the amygdala is a part. By using protocols that activate the DMN on a regular basis, and therefore balance the PFC, hippocampus, PCC, precueus, and amygdala relationship in favor of reducing the trauma response, we may be able to affect the brain in a way that prevents the cycle of imbalance that leads to PTSD.

If the neurobiology of ASD is viewed through the lens of Chinese medicine, we can see that the Kidneys, Heart and Spleen are most related to the initial trauma response. If we think of the amygdala as primarily related to the Kidney, and the PFC and hippocampus are primarily related to the Heart, we can correlate the delicate balance between these brain systems during the trauma response with the following passage from the Su Wen Chapter 39: “When one is frightened, then the heart has nothing to lean on, the spirit has nowhere to return, and one’s deliberations have nowhere to settle. Hence, the qi is in disorder” (Unschuld, Tessenow, & Zheng, 2011, p.597). When someone experiences trauma, the PFC becomes imbalanced, thus allowing the amygdala to go into excess fear response. The PFC, then, has nothing to lean on, and the spirit, or DMN, has nowhere to return because it needs calm to be present. Thus, deliberations have nowhere to settle.

In Chinese medicine texts, the concept of “shock” most closely matches the stage of
trauma referred to as Acute Stress Disorder. The term first appears in *The Yellow Emperor’s Classic of Internal Medicine-Simple Questions*: “Shock affects the Heart, depriving it of residence; the Mind has no shelter and cannot rest, so the Qi becomes chaotic” (Veith, 1966, p.222). Giovanni Maciocia reviewed this definition of shock from a traditional Chinese medicine perspective in *The Psyche in Chinese Medicine* (Maciocia, 2009). He states that shock causes depletion of the Heart qi by suspending qi. This causes Heart qi deficiency leading to Heart qi stagnation which, in turn, leads to Kidney qi deficiency. This pathway requires the body to draw off of Kidney essence to supplement (Maciocia, 2009).

The points Maciocia recommends for shock are HT-7 (shen-men), DU-20 (bai hui), RN-15 (jui wei), KD-4 (da zhong) (Maciocia, 2009). HT-7 (shen-men) is the yuan source point of the heart; it calms the spirit and pacifies the heart and is used for mental disorders, anxiety, poor memory, palpitations, hysteria, insomnia, stress and anger (Deadman, Al-Khafaji, & Baker, 2016). KD-4 (da zhong) is the luo-connecting point of the Kidney meridian, used for the benefit of the spirit and distended feelings in the chest (Deadman et al., 2016). RN-15 (jui wei) is on the Ren channel, which also known as The Conception Vessel, The Vessel of Closure, The Channel of Bonding (Farrell, 2016) and is used for “letting go of experiences or people in our lives that no longer serve us or support us” (Farrell, 2016, p. 85). Expanding and relaxing the chest and to calm the spirit, RN-15 (jui wei) is the luo-connecting point on the Ren channel and is located just below the xiphosternal synchondrosis, near the medial border of the heart. Lastly, DU-20 (bai hui), which is located at the vertex of the head and located on the DU channel, also known as The Governing Vessel, The Sea of Individuation and The Vessel of Separation (Farrell, 2016). DU-20 (bai hui) is said to enter the brain and is used to clear the senses and calm the spirit by helping with mental disease, loss of memory, and depression. Through this point protocol, the
Kidney, Heart and Brain are balanced to reduce the effects of shock (Maciocia, 2009).

Lonny Jarrett offers a different interpretation of the effects of shock through the lens of Five Element acupuncture. He believes that shock causes a break in communication between the Kidneys and the Heart. In *The Clinical Practice of Chinese Medicine* (Jarrett, 2015), he states:

We must clear shock that separates heart from mind and thus rectify the heart-kidney axis. In this way the primordial influence of original nature and the guiding force in our lives can be restored. Without first creating such a framework of functional harmony, it is unlikely that subsequent treatment will promote...meaningful...healing” (p. XIV).

To clear shock he uses a variety of Five-Element Acupuncture treatment to create balance and harmony in the body.

Jarrett’s view of the impact of trauma on the body is very similar to the views of Dr. Francine Shapiro, creator of EMDR (Eye Movement Desensitization and Reprocessing Therapy). Dr. Shapiro states that:

The memory system is in the brain, and the brain is part of the body. Most of us recognize that if our body is cut it will begin to heal unless there is a block, such as a splinter. Traumatic memories are located in the brain, and since the brain is part of the body, it can and should heal in the same way. (Shapiro & Forrest, 1997, p. 3)

EMDR uses rapid eye movement during talk therapy to reconnect painful memories with the area in the brain that can process and digest them. “Then through the natural healing process, trauma is digested, and the mental wounds can be healed, perhaps as rapidly as those of the body” (Shapiro & Forrest, 1997, p. 41).

The Acupuncturist and teacher Yvonne Farrell, trained by Jeffery Yuan in the Taoist tradition, has a similar view of shock to that of Lonny Jarrett. She teaches that shock scatters qi,
causing a break between the Heart and Kidney. This results in the body having to draw on jing or essence, which will deplete the kidneys and affect the bone. She recommends using either KD-6 (zhao hai) or KD-9 (zhu bin), KD-16 (huang shu) and KD-26 (yu zhong), or KD-27 (shu fu) to reestablish a connection between the HT and KD (Farrell, personal communication, June 7, 2018). These points are not only important because they are on the Kidney channel, but they are also on the Chong Channel and correspond with the upper, middle and lower jiao. KD-6 (zhao hai) and KD-9 (zhu bin) are in the lower jiao and facilitate accessing KD energy; KD-16 (huang shu) is in the middle jiao and facilitates accessing the Spleen energy; and KD-26 (yu zhong) and KD-27 (shu fu) are in the upper jiao, facilitating accessing the Heart energy. This treatment incorporates the three areas associated with the neurobiological functions of the brain discussed earlier in this paper. By utilizing the Chong Channel, this treatment protocol also facilitates a connection with, “pure potential, unity and wholeness” (Farrell, 2016, p. 61). Another interesting feature of Farrell’s treatment for shock is that she manually vibrates the needles in a way similar to light e-stem. As we saw in research presented earlier, light e-stem may be the most effective needling method for affecting particular areas of the brain.

Scalp acupuncture provides another option for regulating the PFC, DMN, Hippocampus, and Amygdala. In Chinese Scalp Acupuncture, Hao and Hao (2011) state that scalp acupuncture can “reduce anxiety, depression, irritability, anger, improve sleep and improve overall sense of well-being” in patients who have experienced trauma (p. 217). He also emphasizes the importance of supporting Heart qi when treating these patients. His treatment protocol uses auricular points called Shen Men and Heart to balance the Heart qi imbalance seen in ASD. He then applies scalp acupuncture bilaterally to the Foot Motor and Sensory Area, Head Area, Thoracic Cavity Area and Reproductive Area and stimulates them by rotating 200 times a minute
for 1-3 minutes; he reduces stimulation if the patient is unable to handle it. The Head, Thoracic Cavity Area and Reproductive Areas are located along the frontal hairline, directly over the PFC. and traditionally have been used to treat mental and emotional disorders, including poor memory, insomnia, poor concentration, anxiety, and depression (Hao and Hao, 2011). There have yet to be any studies on PubMed that solely look at how scalp acupuncture can be used to balance the ASD brain. By targeting the PFC, this could be a very valuable technique in balancing the PFC-Amygdala relationship immediately after a traumatic event.

Auricular acupuncture is commonly used to treat PTSD. The military has adopted it for use on the battlefield and in hospitals (Helms, Walkowski & Elkiss, 2011). Disaster relief organizations, such as Acupuncturists Without Borders, have adopted it for stress and trauma reduction (“Acupuncture for Trauma,” n.d.). The points commonly used vary and can include the National Acupuncture Detoxification Association (NADA) protocol of Shen Men, Sympathetic, Kidney, Liver and Lung. Additional points to consider, based on the research examined in this article, include the following zones in the ear: Amygdala, Hippocampus, Prefrontal Cortex, and Brain (Oleson, 1996). There have not been any studies on how these points affects the brain in ASD.

**Discussion**

Several key pieces of information can be extrapolated from a review of the studies listed above. Acupuncture does, indeed, positively affect the areas of the brain associated with the trauma response. Multiple studies reference acupuncture as having a positive stimulus on the DMN (Dhond et al., 2008; Jiang et al. 2013; Li et al., 2014; Lin et al., 2006), PFC (Chen et al., 2013; Li et al., 2014), amygdala (Dhond et al., 2008; Napadow et al., 2007) (Feng et al., 2011; Qin et al., 2008; Xiaoyun Wang et al., 2016) and hippocampus (Chen et al., 2013; Dhond et al.,
2008; Feng et al., 2011; Xiaoyun Wang et al., 2016; Z. Wang et al., 2014); one study alone referenced the effect of acupuncture on gray matter (Lang et al., 2016). They also point out that needle technique seems to be important when trying to influence brain function; studies that included light e-stem (Jiang et al., 2013) or used multiple needles on the same channel (Lin et al., 2006) elicited greater responses on the fMRI’s in the intended brain regions. What is missing from this group of studies is any cohesive pattern regarding the specific points to needle: PC-6 (nei guan) affects the DMN, hippocampus and amygdala (Dhond et al., 2008); LI-4 (he gu) affects the amygdala (Napadow et al., 2007) and DMN (Lin et al., 2006); LV-3 (tai chong) combined with LI-4 (he gu) affects the hippocampus (Z. Wang et al., 2014); ST-36 (zu san li) affects the amygdala (Feng et al., 2011; Qin et al., 2008), DMN (Feng et al., 2011; Jiang et al., 2013), hippocampus (Feng et al., 2011) and increases functional connectivity in the sensory-motor network (Jiang et al., 2013); KD-3 (tai xi) affects the hippocampus and prefrontal cortex (Chen et al., 2013).

The information presented in the literature points to a need for more research into the brain’s response to acupuncture protocols for trauma. Because the above studies did not clearly identify specific points, or groups of points, that can be grouped together into a coherent protocol, we must turn to acupuncture theory to see how it aligns with ASD brain research. This, hopefully, will allow us to determine the best and most efficacious treatment for ASD.

By aligning current ASD brain research with Chinese medical theory we can see that reconnecting the Heart-Kidney axis during the acute stress phase of trauma recovery may be significant in preventing the onset of PTSD. Related acupuncture protocols, such as those suggested in the section above should be considered when treating these individuals. The addition of light needle stimulation or adding multiple points on one channel should be
considered to enhance the responses in ASD affected brain area.

It is clear that more research needs to be conducted to better understand the role of acupuncture in treating acute stress disorder. This literature review has demonstrated that acupuncture significantly impacts areas of the brain affected by trauma and that there is a real opportunity to positively impact traumatized people’s lives by proving that acupuncture is a viable and valuable resource. The next step will be to conduct controlled research studies on appropriate acupuncture protocols to determine their effectiveness and to legitimize the ability of acupuncture to treat ASD.
References


