# Resetting the Fear Switch in PTSD: A Novel Treatment Using Acoustical Neuromodulation to Modify Memory Reconsolidation

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Landmark research that began a generation ago has found that veterans from the Vietnam era with serious posttraumatic stress disorder have shown surprisingly little improvement in their condition even when treated. In a recent article from the New York Times, Doctor Charles Marmar, chairman of psychiatry at NYU Langone Medical Center and director of the NYU Veterans Center noted that, "A significant number of veterans are going to have PTSD for a lifetime unless we do something radically different. More than 18% of those with PTSD have died by retirement age, about twice the percentage of those without the disorder." Fortunately, new interventions are being developed that are proving to be both rapid and effective. A unique method of Reconsolidation Enhancement by Stimulation of Emotional Triggers (RESET Therapy) is described here, which combines neuroacoustical stimulation with patient recall of traumatic memories. The therapy goal is to *reset* emotional memory circuits to pre-trauma levels during the reconsolidation experience, thereby resulting in significant reduction of symptoms. We present in this article a PTSD case study that exemplifies RESET in action along with our theory of the mechanism of action for this therapeutic intervention.

## *RESET Therapy in Clinical Practice: A Case Result*

RJL served honorably in the Vietnam War as a gunner who was thrust headfirst into horrific experiences that are difficult for a human being to imagine. He has suffered for nearly 50 years from the after effects of this experience, unable to shake the traumatic memories that have haunted him. He has struggled to cope with a sleep disorder, drug use and overwhelming anxiety further complicated by misdiagnosis, unsuccessful therapy, multiple hospitalizations, and numerous medications that left him numb and devoid of his personality. He is like tens of thousands of other vets who suffer in silence.

In RJL's Diagnostic Intake he revealed that, "Things would flare-up and I would get into fights. I did drugs. I stopped taking my medications because I was still having flashbacks." His wife reported that her husband was quite mean toward her and that she was at her wit's end trying to deal with his endless anger and rage.

From Camp Pendleton he was deployed to Vietnam and a couple of weeks later he was called into combat as a mortar gunman. In one gruesome instance, RJL described how he was directed to help about 20 wounded Marines in the field to board a chopper and then had to collect the bodies of those that died. "We packed all the bodies in a pile as we were fighting and a mortar round came in and hit them. There were body parts everywhere. We had to gather them up. I've had lots of flashbacks of picking up the pieces." Another traumatic event involved firing rounds of white phosphorous on houses after they had tried to evacuate inhabitants. "There were many people that just didn't come out. When we hit the houses, kids and adults started coming out.

Some were killed and some died later. Word was that all of them died. That has haunted me for years and years. After I got back from Vietnam I had flashbacks and nightmares. For 15 to 20 years I was nothing but an alcoholic and a drug addict. I would bolt upright from sleep at night terrified because I thought I was in combat."

RJL was hospitalized over 30 times after being diagnosed by the VA Medical Center as being paranoid schizophrenic and a psychopath. I carefully reviewed DSM-IV criteria for PTSD within the context of the patient's symptomatology in contrast with criteria necessary for a diagnosis of paranoid schizophrenia. It became glaringly apparent that this patient had been misdiagnosed and provided with medications that did not address the symptoms of his primary diagnosis of PTSD.

Given his diagnosis and negative prior experience from traditional psychotherapy, I chose to utilize RESET Therapy as a treatment of choice using the Bio- Acoustical Utilization Device (BAUD) that is a Class II, FDA-cleared instrument that emits 2 frequency-adjustable sound tones which interact to create a third binaural beat. Developed in 2003 by Dr. G. Frank Lawlis, a medical psychologist, it was initially designed to improve symptoms of ADD/ADHD, and later discovered to help reduce emotional symptoms. I have found this device, when used with the RESET protocol described later, to be highly effective in significantly reducing the emotional symptoms of PTSD. RJL was provided with a 15-minute intervention utilizing this neuromodulation treatment 'while lighting up the target'. In other words, the patient needed to re-experience the full impact of his trauma, including: body sensations; thoughts and feelings; and imagery at the time of the incident.

On his return visit one week later, RJL reported that, "I was thinking about the event and everything about it seemed more peaceful. I haven't had any nightmares or flashbacks compared to previously having them 2 to 3 times per week." His wife reported that her husband had done some work on the car rather than just sitting despondently in the house. "Now he talks again and is carrying on conversations. He didn't do that before. He would just lay in bed with a dark look on his face eating and watching TV all the time. His communication is getting better and he is getting back to the way he used to be. He helps with the chores. The very first treatment he had was like a miracle. He went home, slept well, didn't jerk awake, didn't jump up awake slamming, screaming, looking like someone was going to kill him."

RJL perceived that he was doing better with his Vietnam issues and he was encouraged to test his limits by watching war movies focusing on this era. He was seen in follow-up one week later and reported that, "I watched a war story and it didn't bother me at all. When I wake up I feel great! I don't argue over any little things anymore. I was talking with a guy about Vietnam and it didn't bother me." His wife noted that, "He hasn't been having any nightmares and doesn't jerk anymore at night. Overall he is improving but I'm concerned about his gambling problem."

RJL selected his next therapy target, which, at his wife's insistence, was focused on his urge to gamble. On his return the following week he reported that, "I don't want to play anymore. The charge in it for me is gone." His wife added that, "His whole attitude is changed. He seems to be doing marvelously well." A final target was selected which consisted of his resentment at his father for favoring his older sister and brother. "My father met me at the airport when I came

back from Vietnam. That was the first time he actually ever seemed to be glad to see me. I was close to my mom but she died when I was 15. I probably never got over her death." In his final appointment, he relayed that he was feeling better about this matter and was now able to go with things on his own. He has been followed since therapy through telephone contact and his PTSD has remained in remission for well over eight months at the time of the writing of this article.

The above case illustrates the complexity often seen in Vietnam era patients with chronic PTSD and other mental health issues. The patient received three RESET sessions with 3 distinct focuses. His rapid response to this unique therapy is typical for most of my patients who have undergone this treatment for trauma. Amazingly, the majority of them remain in remission from their PTSD symptomatology (Bennet 2014).

## *PTSD and Memory Reconsolidation Theory*

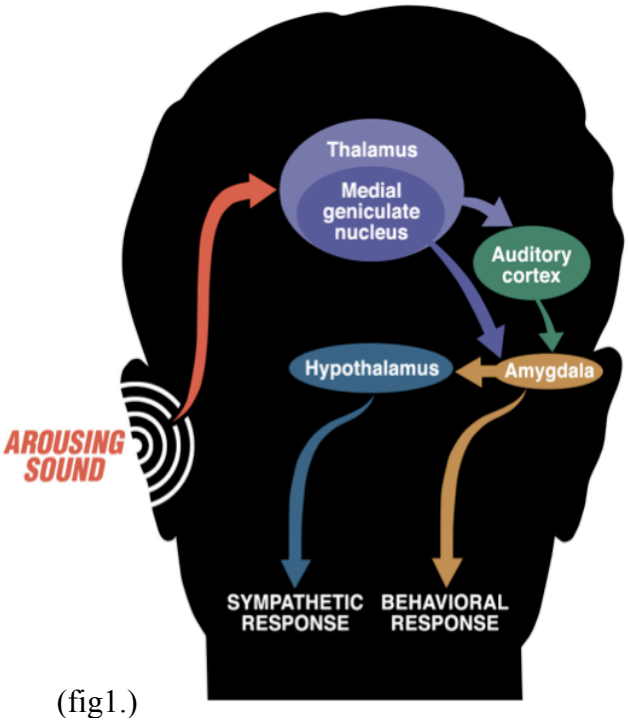
RJL's outcome as well as the success of my other PTSD patients stands out as remarkable and unique in my 44 years of clinical practice. As a neuropsychologist, I naturally had questions about the neural mechanism of action that could cause such profound changes so quickly. I contacted Richard Bruursema who has trained and supported BAUD therapists for the last 9 years, and whose research into memory reconsolidation has served as a foundation upon which we have collaborated to produce this article. Our theoretical framework for RESET Therapy is that we are interrupting memory reconsolidation in the limbic system through a neuromodulation process thereby resulting in rapid and dramatic relief of PTSD symptoms. We offer the above-described clinical results, fMRI imaging, and related memory research in support of this theory.

Recent advances in neuropsychology and brain imaging have opened new doors to our understanding of PTSD and other anxiety-related disorders. We now know that the symptoms associated with this condition closely interweave with memory circuits in the limbic system of the brain. A working premise forthcoming from this body of research is that: *although PTSD is triggered by trauma, it is really a disease of memory. The problem isn't the trauma; it's that the trauma can't be forgotten!* More specifically, the *emotional charge* of the memories remains hair-trigger and consequently intrudes into numerous activities of daily living.

Groundbreaking memory research has been ongoing over the last 15 years by many notable individuals including Joseph Ledoux, a neuroscientist at New York University, and Karim Nadar, his former graduate student and now professor at McGill University. Their work has laid the foundation for new memory-based therapies to treat PTSD such as: utilization of drugs including Propranolol and PKM Zeta; talk therapies such as Coherence Therapy; EMDR, and most recently: what we describe here as RESET Therapy. These interventions are designed to therapeutically interfere with or 'erase' fear/anxiety-based memories.

T. Agren defined fear memories in 2012 as being, "made stable and permanent through a process called consolidation that stretches on for hours after the initial encoding. When a memory is recalled, it is again rendered unstable and becomes the subject of a new stabilization process termed reconsolidation. During both the consolidation and reconsolidation processes, some *memories can be modified by the disruption of these processes*. . .This attenuation of fear memories by means of disrupted reconsolidation has recently been demonstrated in humans and may represent a novel treatment strategy for fear and anxiety. . . "

LeDoux has come to a similar conclusion: "In short, once recalled, a memory is in a fragile state and susceptible to disruption. This has profound implications in PTSD research. If we could bring up traumatic memories associated with certain triggers, and then administer a drug that blocks protein synthesis, thus blocking reconsolidation, we might improve the psychological outcome of thousands of returning veterans. . . . . the research so far suggests *it reduces the zing, takes the emotional valence out of the situation, rather than erases the memory itself."* In my clinical experience, this is precisely the type of outcome experienced by RJL and my other PTSD patients, but much more quickly than I expected.




(fig1.)

We have come to believe that neutralizing the emotional aspects of trauma from PTSD patients' memories will not only provide relief of their symptoms but will also enable them to self-actualize, to re-shape their self-perception that has been previously molded by their trauma. When we can neutralize the trauma *feelings*, we neutralize the *'poison within'* thereby allowing our patients to once again strive to attain their full potential and to fully become themselves.

## *RESET Therapy Detailed*

We propose that the mechanism of action of RESET is to disrupt the reconsolidation of problematic memory circuits within the limbic system of the brain through the use of sound stimulation. Research confirms that trauma creates potentiated or sensitized neural circuits in the limbic system, especially the amygdala, that perpetuate the problematic emotions. (Francati, 2011) When these hyper-aroused/hyper-sensitized circuits are interrupted through an acoustically-driven neuromodulation process, they appear to "reset" back to (or closer to) a homeostatic norm that existed prior to the trauma experience. This neural reset is evidenced by the lasting reduction or elimination of the reported symptoms. The treatment enables the brain to re-establish plasticity that became frozen through the effects of trauma.

We have been able to determine that acoustical neuromodulation affects the limbic system directly: specifically the amygdala and the hippocampal regions of the brain. These sound frequencies are translated into disruptive electrical impulses in the auditory canal, and are then finely tuned in frequency to resonate with the memory circuits of the targeted trauma. These impulses are selectively guided by our patient's particular focus, which consequently activates (lights up) the targeted neural circuits. In other words, the patient's attentional focus becomes a very precise targeting mechanism that can be used to activate specific patient-triggered traumatic memories for disruption by the RESET intervention.

The BAUD produces a full square wave which is typically perceived by the patient as unpleasant or even somewhat irritating. It has been compared to the sound of angry, buzzing bees. We believe that this reaction elicits an amygdala-based emotional arousal. The cortical pathway of the mechanism of action for this treatment is thought to be as follows: research shows that sound has a direct, unfiltered pathway to the amygdala through the auditory thalamus (medial geniculate nucleus) (Spreng 2000). It is well-established that sound, especially aversive sound, has an arousing effect on the amygdala (Kumar, et al., 2012). A common example of this would be the startle response, where a loud sound makes us duck without thinking (fig1.).

We perceive that through this acoustical pathway we are able to directly modulate neural activity in the amygdalo-hippocampal circuit during memory retrieval and reconsolidation. Emotional memories are first consolidated here, marked by synchronized theta activity between the amygdala and hippocampus (Richer-Levin & Akariv, 2000), and are reactivated here during fear memory retrieval (Siedenbacher et. al., 2003). The combination of the patient's multi-faceted attention with the BAUD's acoustical theta stimulation during the reactivation process creates a state of synaptic plasticity that provides a unique opportunity for therapeutic intervention.

## Reconsolidation Enhanced by Stimulation of Emotional Triggers Utilizing the BAUD

RESET Therapy requires patient participation in identifying the sound frequencies that affect their problem symptom. The two sound tones provide both a diagnostic and therapeutic function. The first tone is used to identify the resonant frequency of the problem circuits, and the second tone provides the disruptive pulse. Once the settings have been identified, the patient then continues with an active mental and emotional focus for approximately 15 to 20 minutes to complete the reconsolidation modification of the problem memory.

a. The first tone (frequency dial) creates an activating sound frequency that serves to stimulate and resonate with the target circuit. Frequently, the patient becomes aware of this resonance through some type of physiological reaction such as labored breathing or other bodily reaction associated with the specific stressor. Alternatively, they may experience the target feelings growing slightly stronger. A number of PTSD patients are cutoff from their physiological experiences (disassociated) thereby necessitating other means of setting the appropriate resonance level. In these cases, use of fine motor movement assists in making this determination.

b. The second tone (disruptor dial) creates a binaural pulse which, when properly set, has the effect of weakening, reducing, diluting etc., the targeted stimulus. Our experience has shown that this second tone is almost always set in the 4-8 Hz theta range. Research showing that fear memories are reconsolidated during synchronous theta wave activity (Narayanan, 2007) lends support to our theory of disruption.

c. Active patient participation is critical to the success of this therapy. They must *activate* the problem memory circuits enough to create plasticity. The patient is instructed to recall the traumatic memories as fully as if the event were occurring for the first time and to allow themselves to deeply feel the traumatic affect that arises during the treatment.

The two critical objectives of RESET Therapy are common to all emerging memory-based therapies. The first is to re-stimulate the reactive limbic portion of the targeted neural circuit. The second is to introduce a modifying stimulus: in our case a *disruptive* theta-pulsed sound that interrupts the reconsolidation of the sensitized memory circuit. The result is that the patient experiences relief of the 'symptom,' often within a few minutes.

Ledoux's research supports the protocol outlined above in emphasizing that anytime a neural circuit is activated, it can consequently be modified. "Part of the memory consolidation dogma was that a memory is consolidated only once. - - - But in spite of this strongly held assumption, other research, largely ignored for decades, suggested that memories become labile when retrieved and have to be restored, or re-consolidated, in order to remain available for later retrieval. *If something is done to them during this time when they are labile or before they are reconsolidated they are subject to disruption - - - that is, the memories might be erased, or made permanently inaccessible, during this time."* (Ledoux 2009).

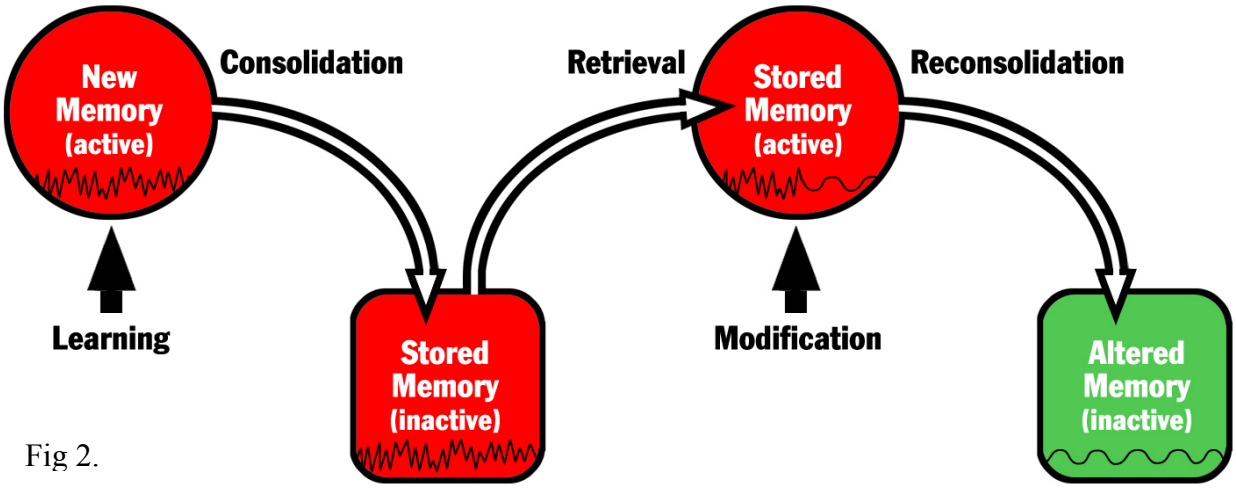



Fig 2.



*Figure 2 illustrates the process of consolidation, retrieval and reconsolidation. The retrieval stage is where acoustical intervention using RESET Therapy is applied. Modification could also be accomplished with drugs, therapy, or even new learning (updating).*

The safety of this acoustical intervention has been well-established in clinical use with more than 300,000 clinical applications in 16 different countries to date. Reports of adverse results through utilization of the BAUD are both rare and mild. Furthermore, because RESET Therapy creates only a *temporary disruption* of a sensitized circuit, we are not imposing a potentially negative

neural state based on external measures or decisions, but on our patient's intrinsic sense of normalcy. We are stimulating a neural 'reset' based on the brain's innate ability to self-regulate.

Perhaps the most direct and confirming evidence we have for this therapy's effect on the brain is a pilot study conducted at the University of Kansas Medical Center's Hoglund Brain Imaging Center. This study examined the effects of RESET Therapy on a spider-phobic subject (Bruursema & Martin 2013). The intervention device used was the BAUD, chosen because an international study had shown this device to produce significant (~50%) reduction in fear and anxiety in clinical use (Lawlis, 2010). While not specifically focused on PTSD, we believe this study is relevant since anxiety is a shared symptom of both disorders. Additionally, we can see direct evidence of acoustical stimulation's neurological effect on four brain structures also known to be involved in PTSD. In this study, scans were obtained while control and spider images were shown to the subject both pre and post BAUD intervention. Computer analysis conducted on Blood Oxygen Level Dependent (BOLD) contrast imaging revealed significant changes primarily to the limbic system and related structures, including:

1) The parahippocampal gyrus (fig. 3), associated with fear memory encoding. (Hayes et al. 2012) PTSD has shown symptom severity that is positively associated with blood flow in the hippocampus and parahippocampal gyrus. (Shin, et al. 2004)

2) The left posterior cingulate. (fig. 4). PTSD patients have been shown to exhibit decreased functional connectivity in the left lingual/posterior cingulate cortex. (Qin et al. 1012)

3) The insular cortex (fig. 5), whose anterior portion is often grouped as part of the limbic system. Reactivity in the anterior insula has been shown to correlate with PTSD symptom severity. (Linnman et al. 2011)

4) The inferior frontal gyrus, (fig. 5) which has shown co-activation with the amygdala and hippocampus during memory retrieval. (Greenburg, at al. 2005).

*Note: Activity shown in the rear portion of the brain reflects general activation of the visual cortex from viewing the images. The lack of expected activity in the amygdala was noted by the study author and commented on: "This lack of effect may be a result of fast habituation. Previous fMRI studies with phobic individuals have shown that the amygdala response is strong but brief (Larson et. al. 2006). Our design with a sustained picture presentation (blocks of 60s) might not be optimal for the detection of such fast activation changes."*

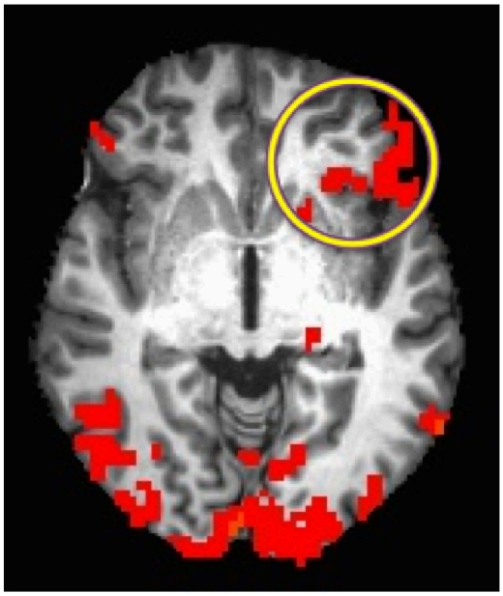


fig 5. Insula & Inferior Frontal Gyrus

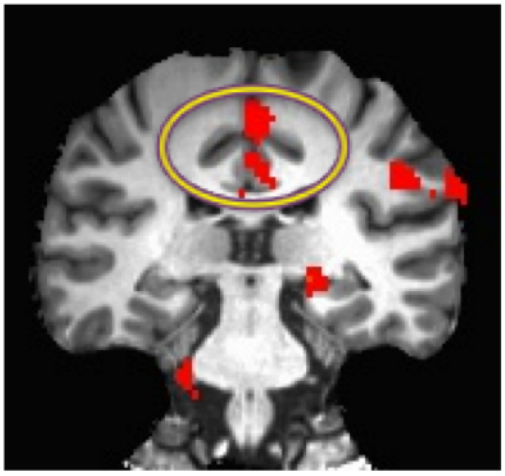


fig 4. Left Posterior Cingulate

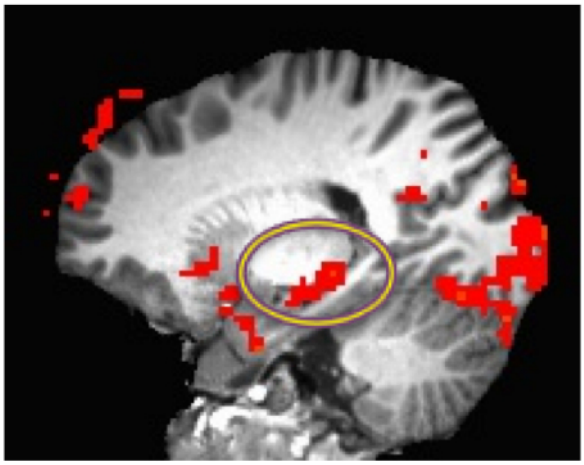


fig 3. Parahippocampal Gyrus

Through relating brain function and symptomatology, it becomes easier to understand some of the complex manifestations of PTSD. The relationship between various structures of the brain and some PTSD symptoms is finally becoming clearer. For example, the hippocampus is involved in the encoding of context during fear conditioning. When it fails to function properly, it negatively impacts the way a person remembers and recalls memories, especially memories that contain fearful or traumatic components. With PTSD, this presents as dissociative flashbacks; recurrent memories regarding the event and distorted negative beliefs. Changes to the right inferior frontal gyrus helps to explain why PTSD patients suddenly engage in high-risk activities. The over-activity of the amygdala presents as symptoms of hypervigilance and the exaggerated startle response (Shin, et al. 2012). The post-intervention fMRI images identify brain areas clearly associated with trauma, memory encoding and recall, thereby adding support to our theory of RESET as a uniquely effective memory reconsolidation therapy.

## *Comments and Discussion*

Every single day in America, twenty-two veterans will choose to commit suicide rather than continue their endless struggle with overwhelming feelings of fear, anger and mind-numbing depression. On top of that, their PTSD can also bring debilitating flashbacks, sleep disorders, hyperarousal and physical illness that rob them of any chance for happiness. According to the *Military Times* (Oct. 2013), in 2012 *more active duty US soldiers died from suicide than in battle, for the second year in a row.*

Many of these wounded warriors have found their symptoms stubbornly resistant to antidepressants, so doctors have turned to antipsychotics. However, recent research is showing these to also be ineffective (Krystal, et al., 2011). Dr. Lawlis adds that, "Pharmaceuticals have been unsuccessful in many PTSD cases and even made problems worse in others. Psychotherapy has its limitations with recovery time, inconsistency, chronicity and its need for specialized professionals."

Research is confirming the understanding of PTSD as a disease of memory rather than a psychiatric illness or a weakness of personality. When we treat the traumatic memories, multiple related symptoms also disappear, as reported in RJL's case. This is a therapy that can be readily learned and integrated by professionals into their specific theoretical orientation.

There are profound implications if further research confirms our proposed neural mechanism of action for RESET Therapy. It opens the door to treating many chronic, stubborn disorders that research is now linking to memory and the limbic system, including addiction, pain, and obesity (McGill University, Barak, et al. 2013, Martin, et al. 2014). RESET Therapy has shown efficacy for all of these. Surprisingly, it has been found to produce significant benefit with Parkinson's tremors, seizures, and tics that are also tied to limbic function. Based on clinical results and preliminary research, we believe that this therapy is a quantum leap forward in PTSD treatment. It represents a paradigm shift toward circuit-specific intervention and lasting symptom relief. We believe it will prove to be one of the most rapid and effective change agents available to remediate not only PTSD, but numerous other chronic and resistant disorders.

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