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NEUROREHABILITATION OF POST-TRAUMATIC STRESS AND DEPRESSIVE BEHAVIORS BY BRAIN STATE CONDITIONING

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Abstract

Brain State Conditioning™ (BSC) is an innovative technology that optimizes brainwaves in real-time to achieve balance and harmony of the human brain. Since the brain function is imbalanced in individuals with psychiatric disorders and neurological diseases, we

explored the possibility of using this technology to help people with post-traumatic stress disorder (PTSD) and depression. We conducted a pilot study of 8 adult subjects who had symptoms of PTSD, depression and anxiety problems. The severity of symptoms was evaluated by Objective survey and Beck's inventory for depression and anxiety. After the initial assessment of brain maps, individuals were administered with highly personalized training sessions, for example 4-5 sessions over 4-5 days. After the administration of BSC, we found a consistent decline in Beck's inventory scores, which implied alleviation of depressive and anxiety tendencies. All subjects in the study responded

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to BSC technology and showed noticeable improvement in the quality of their lives. Thus we suggest that BSC is a viable approach to brainwave optimization to help people overcome health problems due to PTSD and depression.

Key words: *Post-traumatic stress disorder, Depression, Psychiatric disorders, Brain plasticity, Brainwaves, Brain oscillations, Neuronal oscillations, Brain maps, Neural networks.*

Introduction

Psychiatric disorders such as post-traumatic stress disorder (PTSD) and depression, particularly major depressive disorder (MDD), are serious medical illnesses that affect millions of people worldwide, including an estimated 20 to 25 million adults in the United States. The financial burden is huge and many don't seek medical help and yet others simply can't afford to pay for the much needed medication. The

two disorders manifest some overlapping symptoms but they represent two separate disease entities. PTSD is more of an anxiety disorder that people acquire after exposure to traumatic or life-threatening events, such as war, rape, earthquake, hurricane, airplane crash or automobile accident. PTSD can cause problems like flashbacks, or feeling like the event is happening again, trouble sleeping or nightmares, feeling alone, angry outbursts, feeling worried, guilty or sad. Depression or MDD is a medical illness that characteristically demonstrates a significant change in an individual's ability to function on a daily basis. The symptoms of depression include persistently sad or irritable mood, pronounced changes in sleep, appetite, and energy, difficulty thinking, concentrating, and remembering, physical slowing or agitation, lack of interest in or pleasure from activities that were once enjoyed, feelings of guilt, worthlessness, hopelessness, and empti-

ness, recurrent thoughts of death or suicide and persistent physical symptoms that do not respond to treatment, such as headaches, digestive disorders, and chronic pain. Although the mechanism of pathogenesis of PTSD and MDD is not very well understood, both of them have a neurobiological basis (1, 2) and they are manifested as the pathologies of the human brain, most likely because of imbalanced brain function (3). In the present study, we describe that the PTSD and depressive tendencies can be suppressed through brain training using Brain State Conditioning (BSC).

Materials and methods

We studied a total of 8 adult subjects in this pilot study. Four of these cases (all males aged 49 to 59 years) had goals to overcome manifestations of PTSD while the other four cases (2 males aged 35 to 38 years and 2 females aged 41 to 60 years) *had* goals to overcome depression. They all had additional goals such as improving sleep, cognitive performance, social interaction, decision ma-

king, attention and focus, drug addiction and dependency, motivation, mood stabilization, happiness and well-being, weight, pain and anger management, and physical health and balance, etc.

In this pilot study, we used Brain State Conditioning (BSC) as an innovative computer-based technology for brain training. It measures brainwave energy of neuronal oscillations *in* real-time. The method has been outlined in a recently published book (3) and it is also described in detail in the Brain State Technology Manual (Please see www.BrainStateTechnologies.com). BSC utilizes a specific type of electrode, which includes a computer chip that eliminates other electromagnetic energy from producing interference in the brain energy signal being detected. BSC is the process of balancing and harmonizing the brain. Brain function is manifested in the form of electromagnetic energy which can be captured *by* detecting it - or listening to it - without being invasive. Brain energy can be detected from the outer scalp anywhere on the head through the use of electrodes.

We employed multiple methodologies including benchmark and comparative brain maps for each participant, questionnaires, diaries, and socio/economic data. Initial screening of subjects for study eligibility was done by telephone interview, followed by the completion of Objective Survey, PTSD Questionnaire (see below) or standard Beck's Anxiety Inventory (BAI) and Beck's Depression Inventory, 2nd Edition (BDI-II) (Copyright by Aaron T. Beck, 1996, The Psychological Corporation, Harcourt Brace & Company, San Antonio, Texas, USA). The PTSD Questionnaire included the following questions, which were rated on a scale of 0 to 10 (where 0 is no experience of PTSD symptoms and 10 being the worst experience of PTSD symptoms).

1. Recurrent, intrusive thoughts about their experience
 2. Nightmares
 3. Flashbacks - believing as if they are back in the experience
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4. Physical and/or psychological responses to triggers that remind them of the experience (i.e. feeling panicky after smelling a particular cologne)
5. Avoiding thought, feelings, conversations or people associated with the experience
6. Diminished interest in engaging with pleasurable activities or people.
7. Difficulty with memory, focus or cognitive performance
8. Difficulty falling or staying asleep
9. Irritability and/or anger outbursts
10. Depression
11. Anxiety
12. Hypervigilance - a constant watchfulness for safety.

Subjects were scheduled to come for initial assessment (45-60 min) of individualized brain

maps, followed by 4 to 6 consecutive sessions of 90 min each spread over 2-5 days. An illustration is included to show a male subject hooked up to electrodes in the Human Touch™ Perfect Chair™ (Figure 1) manufactured by the company Human Touch in Long Beach,

California, USA. Subjects were asked to complete a PTSD Questionnaire or Beck's Inventory after the final session of brain training. Various observations were stored in a computer database and/or clients files and subsequently analyzed by staff members.



Figure 1. Illustration showing a male subject hooked up to electrodes for BSC

Results and Discussion

The subject characteristics and their response to Brain State Conditioning (BSC) are summarized in Table 1 for PTSD and Table 2 for depression. In the present study, six out of 8 subjects were male while the other two were

females. The age for the PTSD group was between 40 to 59 years whereas the age for the depression group ranged between 35 to 60 years. The objective surveys revealed that although the two groups of subjects had distinctive goals, mainly PTSD or depression, there was considerable overlap of other behavioral manifestations also. For example.

the clients commonly reported lack of sleep and/or poor cognitive performance. Some also reported low level of self-confidence, physical health and balance, and social interactions. Still others reported problems of weight, pain and anger management. All participants were asked to abstain from alcohol one week before the assessment and three weeks after the last session. Before the initial assessment, all subjects completed a PTSD Questionnaire or Beck's Inventory, which represented a baseline or pre-BSC response.

At first, the assessment of each subject revealed specific imbalance in the brain maps of these individuals, i.e. brainwave activity or energy was out of balance. Each individual has a highly personalized assessment, which was done through a sequence of montages using the International 10-20 System. Brain activity is commonly measured by electroencephalo-graphy (EEG), but we modified it to develop Brain State Conditioning (BSC) and we continue to make improvements of this technology. Brain activity is commonly displayed in terms of waveforms or brainwaves: Delta (0.5 -3 Hz), Theta (3.0 -

7.0 Hz), Alpha (7.0 - 12.0 Hz), Low beta (12-16 Hz), High Beta (23-38 Hz) and Gamma (38-48 Hz). Subsequently, depending upon the characteristic brain map and individualized goals, protocols were designed to administer highly personalized brain training sessions. Subjects in the study received 4-6 sessions of about 90 min each spread over a period of 2-5 days. They then completed either the PTSD Questionnaire or Beck's Inventory for depression and anxiety, which represented a post-BSC response.

As summarized in Table 1, all four PTSD subjects showed a considerable reduction in the PTSD score after the administration of BSC (post-BSC). The reduction in PTSD score was approximately 41%, 55%, 64% and 75% for subjects coded P1, P2, P3 and P4, respectively. This finding suggested that all four subjects responded quite favorably to BSC because lower the score means either less or no experience of PTSD behaviors. Alternatively, it can also be said that the administration of BSC suppressed or alleviated the experience of PTSD and thus there was a noticeable improvement of quality of life in these individuals by BSC.

The second group of four subjects with depression also showed positive outcomes, including reduction of Beck's inventory scores (Table 2). The response to BSC was divided into two test scores: (i) BDI-II score for depressive behavior; and (ii) BAI score for anxiety behavior. In spite of the individual differences, all four subjects responded to BSC and showed noticeable reduction in the two test scores. The subject coded D2 showed a 43% drop in BDI-II score whereas the subjects coded D1, D3 and D4 reduced their BDI-II scores dramatically, i.e., 80 to 95% reduction post-BSC. Furthermore, all four subjects also showed considerable reduction (54 to 100%) in the BAI score. The reduction in these scores means that they all responded to BSC and overcame their depressive tendencies. Moreover, the subjects in this study also showed considerably lower level of anxiety, substance abuse and anger management. The improvement of anger management was

directly related to being less irritable after the administration of BSC. Some of the most prominent manifestations of PTSD are depression and anxiety behavior (4, 5), sleep disturbance (6), and alcoholism with or without substance abuse (7, 8). After the administration of BSC, subject in the study showed a noticeable improvement in depressive and anxiety behaviors as reflected by the resolution of stress, calmness, focused attention and reduced hyper-vigilance. Taken together, the improvement of these behaviors also improved the quality of their lives at home and at work, as well as in the society.

Psychiatric and/or psychological disorders such as PTSD, depression, stress, anxiety and anger disorders are manifested as the pathologies of the human brain (1, 2). People affected with these disorders often present overlapping symptoms while the etiology remains poorly understood. Depressive behavior is UK

commonest form of the behavioral problem which is clinically identified as Major Depressive Disorder (MDD). Although MDD has a common clinical presentation the symptoms vary from one patient to another, which implies that the disorder is a very heterogeneous disorder comprising of subsets or subgroups. This also means that no single treatment will be solely effective for MDD but the therapeutic strategy will require modalities for each subset or subgroup of the disorder. It should also be emphasized that the treatment of MDD is of social importance because it is the single most prevalent problem of all psychiatric disorders in the society today.

Neural networks are generally disrupted and the connectivity between neurons is generally lost. Consequently, the neurotransmitter function is impaired *and* nerve-impulse transmission is interrupted. Thus the brain function is modified. In this respect, the scientific evidence suggests that the 'wiring' in the brain influences perso-

nality as well as human behavior (9, 10). Ultimately, this all leads to imbalances in the functional brain or it can also be said that imbalance in the brain could potentially alter brain function. But these changes do not occur throughout the entire brain. Instead, they occur in localized brain regions or lobes or nuclei which are constellations of highly select groups of neurons that utilize specific type of neurotransmitters, for example serotonergic neurons use serotonin as the neurotransmitter and cholinergic neurons use acetylcholine as the neurotransmitter (11). Furthermore, it has recently been shown that the human brain shows plasticity - it has the capacity to re-wire or re-establish neural connections by itself. This property has opened up a narrow window of opportunity to find novel approaches to helping people who suffer from brain diseases and mental illnesses. Stemming from brainwave patterns, the

mapping of the functional-brain is of paramount importance because it permits identification and characterization of neurobehavioral abnormalities that are associated with dysfunctional mental health (12, 13). In this regard, we would like to suggest that BSC is an extremely important technology because it optimizes brain function in real-time balancing. Scientifically speaking, rapidly accumulating evidence suggests that the behavioral disorders, including PTSD and depression, have a neuroanatomical basis and/or neuropathological substrates. Patients with depression show dysfunctional neuronal systems, particularly in the prefrontal cortex, anterior cingulate cortex, temporal cortex and basal ganglia (2, 13, 14). Some MDD patients also show smaller volumes (loss of neurons) in hippocampus, which is a sign of impaired neurogenesis in the hippocampus region of the brain (15, 16). Patients with MDD consistently have low levels serotonin (17) and brain-derived neurotrophic

factor (BDNF) (18), both of which also have neurotrophic effect on hippocampal neurons. Since hippocampus is the primary brain region involved in memory function, the neuronal loss in hippocampus may explain, at least in part, the memory loss or cognitive decline in patients with major depression.

Reduced level of serotonin in MDD patients suggests the involvement of serotonergic neurons of the temporal cortex, basal ganglia and Raphe nucleus in the upper brain stem. Other neurotransmitters such as norepinephrine may also be involved (19). Moreover, patients with major depression consistently show disturbance of the body's "biological clock" often having difficulty in falling sleep. This abnormality is directly related to the neurohormonal imbalance of the hypothalamic-pituitary-adrenal (HPA) axis. The HPA axis through the release of corticotrophin-releasing hormone (CRH) plays a key role in the induction of

stress and anxiety behaviors (20). Childhood trauma has been found to increase HPA axis activity (21), which via CRH could potentially increase the risk of stress and anxiety disorders later on in adult life. CRH axis also plays a physiological role in the modulation of immune response and is a mediator of neuro-immune circuitry (20). Recent experimental finding showed that the immune response, in particular brain autoimmunity, could potentially represent immune trauma perhaps as prelude to developing imbalances in the human brain (22). This line of thinking could also imply that there is a biological need to optimize "neuro-immune balance" by balancing both the nervous system and the immune system (22). In conclusion, the findings of this pilot study clearly demonstrate a positive outcome of BSC in people who suffer from PTSD and depressive behaviors. Brain training through BSC definitely impacted the quality of life of these indi-

viduals, albeit the testimonial and anecdotal nature of the observations. The results are very encouraging and should not be ignored. It is however instructive to conduct clinical studies with scientific rigor in order to demonstrate advantageous and efficacious benefits of BSC for improving health and well-being of people who constantly suffer from PTSD and depression, including those resulting from exposure to combat zones and/or war-related traumatic injuries. The evidence is quite compelling for a neural basis of dysfunctional or imbalanced brain in people with PTSD, depression and related behavioral disorders. We therefore would like to suggest that the intervention through brain state conditioning (BSC) is a novel approach to attain balance and harmony of the brain function, thereby help people suffering from a wide spectrum of behavioral and mental health problems.

Table 1. Characteristics of PTSD subjects and Response to Brain State Conditioning (BrainWave Optimization)

Subject Code	Subject Age	Subject gender	Goals before BSC	Response to BSC (PTSD Score)	
				Pre-BSC	Post-BSC
P1	49 yr	male	<ol style="list-style-type: none"> 1. Pain management 2. Improve sleep 3. Sense of happiness/well-being 4. Improve sexual function 5. Post-traumatic stress 	37	22
P2	59 yr	male	<ol style="list-style-type: none"> 1. Post-traumatic stress 2. Improve physical health/balance 3. Enhance cognitive performance 4. Weight management 5. Increase creativity 	55	25
P3	40 yr	male	<ol style="list-style-type: none"> 1. Sense of calm-manage anxiety 2. Improve sleep 3. Improve social interactions 4. Post-traumatic stress 5. Pain management 	85	31
P4	59 yr	male	<ol style="list-style-type: none"> 1. Post-traumatic stress 2. Depression 3. Improve sleep 4. Decision making 5. Mood Stabilizing 	20	5

Table 2. Characteristics of Depression subjects and (BrainWave Optimization) their response to Brain State Conditioning

Subject Code	Subject Age	Subject gender	Individual goals before BSC	Response to BSC			
				BDI-II Score		BAI Score	
				(Depression)		(Anxiety)	
				Pre-BSC	Post-BSC	Pre-BSC	Post-BSC
D1	35 yr	Male	1. Self-confidence 2. Enhance happiness and well-being 3. Improve sleep 4. Improve spiritual awareness/meditation 5. Increase creativity	22	1	24	11
D2	38 yr	Male	1. duality of mind - failed relationships/war 2. Post-traumatic stress 3. Improve social interaction 4. Overcome addiction and dependency 5. Improve depression and motivation	14	8	21	2
D3	41 yr	Female	1. Weight management 2. Improve physical health and balance 3. Enhance cognitive performance 4. Improve social interaction 5. Enhance happiness and well-being	10	2	2	0
D4	60 yr	Female	1. Self-confidence 2. Post-traumatic stress 3. Increase attention and focus 4. Improve physical health and balance 5. Enhance happiness and well-being	18	2	7	1

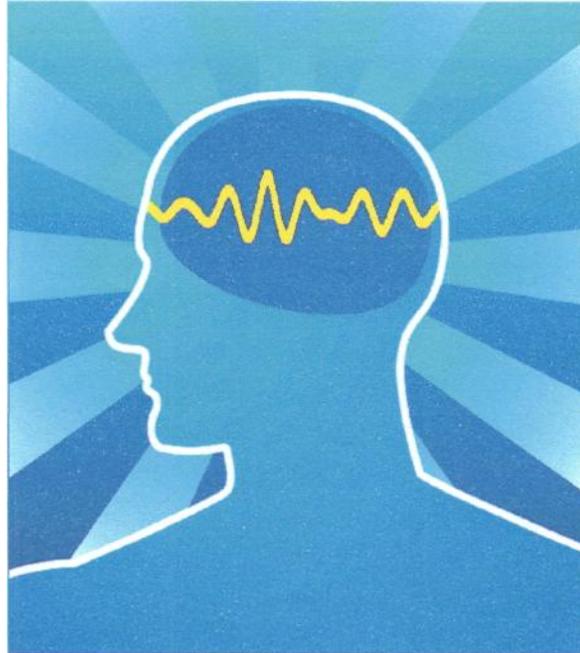
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