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HOW NEUROFEEDBACK ENHANCES SUBSTANCE ABUSE TREATMENT

By Stephen Sideroff, PhD

Editor's Note: This article is the second in a two-part series on Neurofeedback in the Treatment of Substance Abuse. The first article was published in the December 2009 issue of Counselor.

At the present time there are different, but not mutually exclusive theories as to how neurofeedback has its effect. On the most basic of levels, neurofeedback trains the brain to shift out of its existing pattern. As such, we can conceptualize that this process makes the brain more flexible and more capable of "shifting gears." Based on some models of brain function and conditioned neural patterns, this enhanced ability, in itself, can facilitate the therapy and counseling process and the development of healthier behavior (Sideroff, 2004–2005).

As previously reported studies indicate, neurofeedback enhances the brain's ability to go into specific states necessary for healthy functioning (Sideroff, 2009a). Thus, for example, the Beta/ sensorimotor rhythm (SMR) training protocols appear to improve clients' cognitive functioning and attentional state. At the same time, the alpha/theta protocols assist in going into a more relaxed and calm state.

Other models suggest that neurofeedback exercises neural mechanisms or perturbs these mechanisms, chal-

lenging a higher reorganization based on a complexity model. By giving the brain information about itself it allows for enhanced self-regulation for healthy functioning. Improving the brain's inhibitory functioning would therefore be an aspect of this melioration. This improved self-regulation also includes that of the autonomic nervous system so important in the management of stress and tension.

It is still an open question as to whether or when neurofeedback needs to normalize the electroencephalographic (EEG) patterns in order for it to be effective. Some practitioners begin with an assessment of the EEG, referred to as a Quantitative EEG. This process—in which approximately 19 brain locations are monitored simultaneously, usually under varying conditions, such as eyes open, eyes closed and under task—is compared to normative data. The practitioner then determines training protocols based on those brain locations and frequency ranges and even connectivity between locations that are significantly different from the normal range. Here the goal is to normalize the EEG and by doing this, normalize operational functions of the brain (see Budzynski, et al., 2008).

Other practitioners begin with a more behavioral assessment, and based on the constellation of symptoms, choose a protocol that encourages either a lowered activation or increased activation of the brain. Again, these approaches are not mutually exclusive and many incorporate multiple approaches.

There have been two basic difficulties in distinguishing the effectiveness of these different approaches and thus their relative efficacy. First, most approaches to neurofeedback appear to be successful; and second, there have not been sufficient controlled research studies comparing these models.

Neurofeedback and addictions

Kamiya's early work demonstrating that a subject could learn (through neurofeedback) to produce increases in alpha rhythm, indicated that it might be of use in the treatment of substance abuse. Within the model of drug seeking behavior for self-medication purposes, if an addict was better able to relax and calm themselves as a result of alpha training, this might give them a better or alternative coping mechanism than the drug or alcohol. There have been a few case studies that showed promise (DeGood & Valle, 1978; Jones & Holmes, 1976).

Attention then shifted to combining alpha with theta feedback. This originated partly from observations by one of the pioneers of biofeedback, Elmer Green, who noticed that experienced meditators increased both alpha and theta frequencies when they went into deep meditative states (Green, Green & Walters, 1971). Early studies using this approach appeared promising with addiction (Fahrion, Walters, Coyne & Allen, 1992), as well as with Post-Traumatic Stress Disorder (PTSD) (Peniston & Kulkulsky 1991).

The use of alpha-theta protocols increased theta amplitudes above alpha, referred to as "cross over", thus demonstrating the achievement of deep states of consciousness that were identified with a place of reverie and enhanced imagery (Twemlow, Sizemore & Bowen, 1977). These states appeared to facilitate the process of healing.

Peniston and Kulkosky first reported the results of controlled studies of alcoholics using the alpha-theta protocol (Peniston & Kulkosky,1989, 1990 & 1991; Peniston et al., 1993; Saxby & Peniston, 1995), in which they preceded the neurofeedback with peripheral temperature biofeedback training to enhance the ability to relax, as well as the incorporation of the reading of scripts associated with the rejection of drug taking behavior. They achieved abstinence rates of 80 percent that were monitored up to four years post treatment.

In addition to improvement in abstinence rates, these studies demonstrated improvement in mood and personality factors. In one of the studies the experimental group showed improvement on the clinical scales of the Millon Clinical Multiaxial Inventory (MCMI) (Peniston & Kulkosky, 1989). In their 1991 study, they demonstrated improvement with Vietnam veterans with PTSD. When producing high amplitudes of theta, the subjects showed signs of a hypnagogic state with elevated suggestibility. In a replication of these results in a non-controlled clinical outpatient study similar results were demonstrated (Callaway and Bodenhamer-Davis, 2008). The improvement in mood states was also shown (Raymond, et al., 2005).

Attempts were made to apply these results to other substances of abuse, by employing a controlled and

randomized study of a mixed substance abusing population within an inpatient drug treatment program (Scott, et al., 2002; 2005). In an attempt to maximize the impact of neurofeedback training, as well as to address deficits in cognitive and attentional variables and normalize brain function, our protocol included initial training using a beta and SMR procedure.

In the first article (see *Counselor*, December 2009) I discussed the use of training protocols that addressed Attention Deficit Disorder (ADD). These protocols reinforced increases in either the SMR frequency range (typically either 12–15, or 13–15 Hz) or mid-beta frequencies (typically either 15–18 or 15–20 Hz). We incorporated a protocol that reinforced both these frequency ranges, (SMR on the right side of the brain, and mid-beta on the left side) while down training—signaling when the amplitude dropped below the threshold—frequencies in the theta range (Scott, et al., 2002; 2005). This was intended to improve cognitive functioning, frequently affected by addiction.

The beta/SMR protocol was followed by the alpha-theta protocol. These latter sessions were preceded by customized scripts in which the addict either rejected their preferred substance of abuse, or saw themselves successfully abstinent.

There were four important results from this study. First, subjects in the neurofeedback group remained in treatment significantly longer than the control group subjects. Second, this group achieved one year abstinence rates of 77 percent, compared with 44 percent for the controls. Third, the experimental group demonstrated significant improvement in attention and reduced impulsivity. Fourth, a comparison of before and after MMPI (Minnesota Multiphasic Personality Inventory) scores demonstrated significant improvement (at the $p<.005$ level) on five of the 10 clinical scales: hypochondriasis, depression, hysteria, schizophrenia and social introversion.

The MMPI findings indicated an improvement in psychological health and core ego strength. They also showed a reduced level of general distress or discomfort with an ability to acknowledge problems, along with less alienation and depression.

A recent pilot case study series integrated both neurofeedback and cognitive training into a treatment program (Gunkelman & Cripe, 2008) utilizing an innovative method of assessment based on divergent EEG patterns, referred to as phenotypes, and then determining the neurofeedback protocols based on this selection. Preliminary results showed an average abstinence of 18 months. The study also found significant improvement in IQ, derived from the Woodcock-Johnson III test.

Possible mechanisms of neurofeedback's effectiveness in addiction

The use of neurofeedback with the substance abusing population is not a singular treatment modality; no one suggests that it can be used in isolation of other important aspects of treatment. In all reported studies, it was used in conjunction with other psychotherapeutic modalities as well as the 12-step programs and other adjunctive approaches. At the same time these adjunctive treatments were controlled for and significant results were found in comparison to the control condition (Scott et al., 2005). Furthermore, critics who make the argument that the successful results might be due to non-specific effects; the attention subjects received; or the general relaxation training, have years of treatment experience going against these interpretations of the data, as all these other approaches have proved to be less effective when not paired with the neurofeedback.

Neurofeedback appears to impact a number of factors that coincide with addiction. Studies presented previously (Sideroff, 2009a) noted the findings of abnormal EEG patterns in drug addicts, along with evidence of EEG abnormalities that predispose certain people toward addiction and the process of "self-medication." It is evident that exposure to the addiction process impairs brain functioning. When we recognize how interconnected the brain is—90 percent of neurons connect one area of the brain to another—it is easy to understand how there would be multiple streams of impact due to this impairment.

The EEG patterns found with substance abusers have been associated with cognitive and behavioral problems that leave the addict susceptible to relapse. Impaired cognitive functioning includes poor attention and distractibility; obsessive thinking; poor decision making; and difficulty assessing the consequences of behaviors and other executive functions. Behavioral challenges faced by

abstinent addicts include impulsivity, difficulty relaxing, self-soothing or going to an internal place of calm.

Evidence suggests that neurofeedback is able to address these issues by improving and even normalizing the functioning of the pre-frontal cortex, the executive decision-making area of the brain; and may also be facilitating the communication between limbic system structures and executive areas (Beauregard, M., & Levesque, J. 2006). Results from this same study suggest a restorative effect on the dopamine system, which is very relevant to addiction. Neurofeedback also addresses variables of attention, resulting in a greater ability to focus and remediation of Attention Deficit Disorder and Attention Deficit Hyperactive Disorder including impulsivity, which is common among addicts.

The alpha-theta protocol further helps guide the addict into a place of calm, enhancing their ability to generate alpha. It helps the subject properly modulate autonomic arousal including the ability to lower arousal. The use of the alpha-theta protocol in conjunction with pre-designed scripts may also allow for neuronal reprogramming. In the state achieved with this protocol it appears that the subjects experience a heightened sense of suggestibility leaving them available for the reprogramming of old behavioral patterns. The theta state is "characterized by the unguarded acceptance of incoming information" (Budzynski, 2008). The use of drug related scripting may thus be impacting conditioned aspects of addiction by suggesting behaviors contrary to the conditioned responses.

The power of the alpha-theta protocol lies in its ability to heal and create psychological shifts (White, 2008). Findings from the Peniston and the Scott studies indicated significant improvement in personality patterns that relate to addiction following neurofeedback training, as demonstrated in improvement in standardized psychological inventories. These changes appear to result in reduced vulnerability to the various causes of relapse, while also yielding improved functioning. Improvement in personality patterns is a common goal of the therapeutic and counseling process. This is particularly significant, as most addicts suffer from dual diagnoses.

I have addressed this process recently as I discussed the integration of neurofeedback and psychotherapy (Sideroff, 2009b). The alpha-theta process appears to guide the addict into a vulnerable emotional state that he otherwise has great difficulty achieving. Once there, in the confines of a safe therapeutic relationship, the therapeutic process of letting go (of trauma and other emotional pain, as well as physically letting go) has a greater opportunity to take hold.

At the same time, while in the alpha-theta state, subjects have greater access to images of past

experiences, including painful traumas. However, unlike recalling these memories consciously—where they can trigger autonomic activation and retrigger trauma—when the memories emerge in the deeply calm state, it appears as if the brain is able to more effectively deal with them and integrate them into long term memory. In other words, the process may address the hypersensitivity and reactivity of areas of the brain associated with trauma, such as the amygdala. This might be another mechanism by which neurofeedback impacts conditioned addiction-related responses.

As noted above, the actual process of reinforcing a shift in brain wave patterns suggests the resultant brain has a greater facility shifting gears and self-regulating. This greater brain flexibility may be addressing the addict's inability to stop old behaviors, while enhancing his or her ability to make life changes. In addition, with improved self-regulation and functioning, the brain's enhanced ability to engage its inhibitory functioning might also be instrumental in helping the addict restrain self-destructive behaviors.

Research indicates that stress can be a triggering factor in relapse (Piazza & Le Moal, 1996; Sinha 2008, 2009). Relapse may start with a buildup of stress, including an inability to relax and difficulty tolerating affect, along with deficits in problem solving ability (Washton, 1989). This is exacerbated by dangerous childhood environments placing the future addict in continual survival mode. This developmental pattern results in the sensitization of the brain to stress (Wood, 2007). Neurofeedback appears to be effective in reducing this neurobiological hypersensitivity, while helping addicts develop the ability to calm themselves. By addressing past traumas and improving autonomic self-regulation, the addict is better able to tolerate affect, thus interrupting the viscous cycles that are initiated by stressful events. The ability to better tolerate affect is another factor that can aid the therapy process.

Cautionary notes

Neurofeedback is basically a learning paradigm in which information is fed back to an individual's brain to facilitate self-regulation. For this reason, as well as the historical experience of neurofeedback use over the past 30 years, there does not appear to be a risk of serious side effects. This fact, along with the growing ease of performing neurofeedback, can create a false sense of safety that can encourage those without sufficient training and experience to perform neurofeedback training.

One should be prepared for certain risks involved in doing the training. It is possible for a subject to experience agitation, anxiety, tension and difficulty falling asleep if the brain becomes too activated as a result of treatment. Conversely, a subject might report experiencing lethargy and tiredness through the process of lowering the activation of the brain. Most of the time these symptoms remediate on their own, or can be addressed with a compensating adjustment in treatment protocol during the subsequent session. These conditions, however, can be further complicated when they occur in unstable patients, such as borderline, where a significant shift in bodily sensations can become either too uncomfortable or too frightening. Under these circumstances, the impact of a sudden change in state can result in decompensation or other significant emotional reactions.

As noted, the use of the alpha-theta protocol is designed to take the subject into deeper states of consciousness, which can elicit images of past experiences. It is important that the therapist (trainer) have sufficient experience, or be under appropriate clinical supervision to be able to address the clinical issues arising from these experiences. For these reasons appropriate training and supervision is advised before working with clients.

This, along with my previous article (Sideroff, 2009a), have presented the research, methodology and theory behind the use of neurofeedback in the treatment of substance abusing patients. There are still many research questions that need to be addressed with regard to using neurofeedback with substance abuse. Neurofeedback protocols and procedures incorporate a number of variables, all of which can be optimized through additional research. Furthermore, neurofeedback is typically used as an adjunctive treatment with various other therapeutic approaches. There is still much that can be learned to maximize the synergy of these approaches. However, the results to date demonstrate neurofeedback is a powerful tool as an adjunctive procedure in working with this population. The above discussion demonstrates a number of factors that are important in the

counseling and psychotherapy process that are facilitated by the inclusion of neurofeedback.

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