An Introduction to Neurotherapy

In the late 1960's and 1970's we learned that it was possible to recondition and retrain brainwave patterns. Some of this work began with the training of alpha brainwave activity for relaxation, while other work originating at UCLA focused on uncontrolled epilepsy. This training is called Neurotherapy or EEG biofeedback or Neurofeedback.

Before discussing this in more detail, let me provide you with some preliminary information about brainwaves. Brainwaves occur at various frequencies. Some are fast and some are quite slow. The classic names of these EEG bands are delta, theta, alpha, and beta. They are measured in cycles per second or hertz (Hz).

Beta brainwaves (above 13 Hz) are small, faster brainwaves associated with a state of mental, intellectual activity and outwardly focused concentration. This is basically a "bright-eyed, bushy-tailed" state of alertness.

Alpha brainwaves (8-12 Hz.) are slower and larger. They are associated with a state of relaxation and basically represent the brain shifting into an idling gear, relaxed and a bit disengaged, waiting to respond when needed. If we merely close our eyes and begin picturing something peaceful, in less than half a minute there begins to be an increase in alpha brainwaves. These brainwaves are especially large in the back third of the head.

Theta brainwaves (4-8 Hz) represent a day dreamy, spacey state of mind that is associated with mental inefficiency. At very slow levels, theta brainwave activity is a very relaxed state, representing the twilight zone between waking and sleep.

Delta brainwaves (0-3.5 Hz) are the slowest, highest amplitude brainwaves, and are what we experience when we are asleep. In general, different levels of awareness are associated with dominant brainwave states.

Each of us, however, always has some degree of each of these brainwave bands present in different parts of our brain. Delta brainwaves will also occur, for instance, when areas of the brain go "off line" to take up nourishment. If we are becoming drowsy, there are more delta and slow theta brainwaves creeping in, and if we are inattentive to external things and our mind is wandering, there is more theta present. If we are exceptionally anxious and

tense, an excessively high frequency of beta brainwaves is often present. Persons with ADD, ADHD, learning disabilities, head injuries, stroke, Tourette's syndrome, epilepsy, and often chronic fatigue syndrome and fibromyalgia tend to have excessive slow waves (usually theta and sometimes excess alpha) present. When an excessive amount of slow waves are present in the executive (frontal) parts of the brain, it becomes difficult to control attention, behavior, and/or emotions. Such persons generally have problems with concentration, memory, controlling their impulses and moods, or with hyperactivity. They can't focus very well and exhibit diminished intellectual efficiency.

WHAT IS NEUROFEEDBACK TRAINING?

Neurofeedback training is brainwave biofeedback. During typical training, a couple of sensors are placed on the scalp and one or two are usually put on the ear lobe. Then, high-tech electronic equipment provides you with real-time, instantaneous audio and visual feedback about your brainwave activity. The electrodes measure the electrical patterns coming from the brain--much like a physician listens to your heart from the surface of your skin. No electrical current is put into your brain. Your brainwave patterns are relayed to the computer and recorded.

Ordinarily, we cannot influence our brainwave patterns because we lack awareness of them. However, when you can see your brainwaves on a computer screen a few thousandths of a second after they occur, it gives you the ability to influence and change them. The mechanism of action is operant conditioning. We are literally reconditioning and retraining the brain. At first, the changes are short-lived, but the changes gradually become more enduring.

With continuing feedback, coaching, and practice, we can usually retrain healthier brainwave patterns in most people. It is a little like exercising or doing physical therapy with the brain, enhancing cognitive flexibility and control. Thus, whether the problem stems from ADD/ADHD, a learning disability, a stroke, head injury, deficits following neurosurgery, uncontrolled epilepsy, cognitive dysfunction associated with aging, depression, anxiety, obsessive-compulsive disorder, or other brain-related conditions, Neurofeedback training offers additional opportunities for rehabilitation through directly retraining the brain. The exciting thing is that even when a problem is biological in nature, we now have another treatment alternative than just medication. Neurofeedback is also being used increasingly to facilitate peak performance in "normal" individuals and athletes.

Frank H. Duffy, M.D., a Professor and Pediatric Neurologist at Harvard Medical School, stated in an editorial in the January 2000 issue of the journal Clinical Electroencephalography that scholarly literature now suggests that Neurofeedback **"should play a major therapeutic role in many difficult areas. In my opinion, if any medication had demonstrated such a wide spectrum of efficacy it would be universally accepted and widely used"** (p. v). **"It is a field to be taken seriously by all"** (p. vii).

Once an assessment is complete and treatment goals have been established, we usually place two sensors on the scalp and one or more on the earlobes during neurotherapy training sessions. The trainee then watches a display on the computer screen and listens to audio tones, sometimes while doing a task such as reading. These training sessions are designed to teach the person to slowly change and retrain their brainwave pattern. With continuing feedback, coaching, and practice, the healthier brainwave patterns are maintained. Some persons may need to learn to increase the speed or size of brainwaves in some parts of the brain. Other individuals need training to decrease the speed of brainwaves in certain areas of the brain. In a sense, it is like exercising or doing physical therapy with the brain, enhancing cognitive flexibility and control. Neurofeedback training usually requires at least 25, and most commonly 40-50 sessions of about 40 minutes in length.

Alcoholism & Drug Abuse. EEG investigations of alcoholics (and the children of alcoholics) have documented that even after prolonged periods of abstinence, they have lower levels of alpha and theta waves and an excess of fast beta brainwaves in their EEG's. This means that alcoholics and the children of alcoholics tend to be hard-wired differently from other people, and in a way that makes it difficult for them to relax. However, following the use of alcohol, the levels of alpha and theta brainwaves increase. Thus, individuals with a biological predisposition to develop alcoholism (and their children) are particularly vulnerable to the effects of alcohol. Without realizing it, alcoholics seem to be trying to self-medicate and treat their own brain pathology. The relaxing mental state that occurs following alcohol use is highly reinforcing to them because of the manner in which their brain is functioning. Several research studies now show that the best predictor of relapse is how excessive the beta brainwave activity is in alcoholics and cocaine addicts (Bauer, 1993, 2001; Prichep et al., 1996; Winterer, 1998).

Recently, EEG biofeedback training to teach alcoholics how to achieve stress reduction and profoundly relaxed states through increasing alpha and theta brainwaves and reducing fast beta brainwaves have demonstrated promising potential as an adjunct to alcoholism treatment. Peniston and Kulkosky (1989) used such training with chronic alcoholics compared to a nonalcoholic control group and a traditional alcoholism treatment control group. Alcoholics

receiving 30 sessions of brainwave training demonstrated significant increases in percentages of their EEG record in alpha and theta rhythms, and increased alpha rhythm amplitudes. The brainwave treatment group also demonstrated sharp reductions in depression compared to controls. Alcoholics in standard (traditional) treatment showed a significant elevation in serum beta-endorphin levels (an index of stress and a stimulant of caloric [e.g., ethanol] intake), while those with brainwave training added to their treatment did not demonstrate an increase in beta-endorphin levels. On four-year follow-ups (Peniston & Kulkosky, 1990), only 20% of the traditionally treated group of alcoholics remained sober, compared with 80% of the experimental group who received Neurofeedback training. Furthermore, the experimental group showed improvement in psychological adjustment on 13 scales of the Millon Clinical Multiaxial Inventory compared to traditionally treated alcoholics who improved on only two scales and became worse on one scale. On 16-PF personality inventory, the Neurofeedback training group demonstrated improvement on 7 scales, compared to only one scale among the traditional treatment group. Thus, Neurofeedback training appears to hold encouraging promise as an adjunctive module in the treatment of alcoholism, and in remediating damage done through drug abuse.

Posttraumatic Stress Disorder. Peniston and Kulkosky (1991) added thirty 30-minute sessions of alpha/theta EEG biofeedback training to the traditional VA hospital treatment provided to a group of PTSD Vietnam combat veterans, and compared them at 30 month follow-up with a contrast group who only received traditional treatment. On follow-up, all 14 traditional treatment patients had relapsed and been rehospitalized, while only 3 of 15 Neurofeedback training patients had relapsed. While all 14 patients treated with Neurofeedback had decreased their medication requirements by follow-up, among traditionally treated patients, only one patient decreased medication needs, two reported no change, and 10 required more psychiatric medications. On the MMPI, Neurofeedback training patients improved significantly on all 10 clinical scales--dramatically on many of them--while there were no significant improvements on any scales in the traditional treatment group.

ADD/ADHD & Learning Disabilities: Since the late 1970's, Neurofeedback has been researched, refined, and tested with ADD/ADHD and learning disabilities. Clinical work with Attention-Deficit/Hyperactivity Disorder and learning disorders by Dr. Lubar and his colleagues at the University of Tennessee and others has demonstrated that it is possible to retrain the brain. This Neurofeedback research is quite strong in demonstrating its effectiveness in treating ADD/ADHD. Whereas the average stimulation medication study follow-up is only three weeks long and the longest medication study is only 14 months long with ADD/ADHD, Dr. Lubar (1995)

has published 10 year follow-ups on cases and found that in about 80% of patients Neurofeedback can substantially improve the symptoms of ADD and ADHD, and these changes are maintained.

Rossiter and LaVaque (1995) found that 20 sessions of Neurofeedback produced comparable improvements in attention and concentration to taking Ritalin, and Fuchs et al. (2003) likewise demonstrated that Neurofeedback produced comparable improvements to ritalin. In a one year follow-up, control group study, Monastra et al. (2002) found that Neurofeedback produced superior improvements to ritalin, without needing to remain on drugs. Neurofeedback training for ADD/ADHD is commonly found to be associated with decreased impulsiveness/hyperactivity, increased mood stability, improved sleep patterns, increased attention span and concentration, improved academic performance, increased retention and memory, and increased IQ scores (often averaging 10 IQ points in published studies).

Other Clinical Applications of Neurofeedback Training. Neurofeedback has good research support for its effectiveness in treating anxiety (Moore, 2000). It is also being used to work with other clinical problems such as depression (Baehr, Rosenfeld & Baehr, 2001; Hammond, 2001), chronic fatigue syndrome (Hammond, 2001), fibromyalgia (Donaldson et al., 1998; Meuller et al., 2001), sleep disorders, Tourette's, obsessive-compulsive disorder (Hammond, 2003), autism (Jarusiuwicz, 2002), Parkinson's tremors (Thompson & Thompson, 2002), and essential tremor. Neurofeedback is being utilized in peak performance training, for instance in enhancing musical (Egner & Gruzelier, 2003), with athletes, business executives, for cognitive enhancement in normal college students (Rasey, Lubar, McIntyre, Zoffuto & Abbott, 1996), for memory enhancement in normal individuals (Vernon et al., 2003), and for "brain brightening" to counter effects of normal aging. However, these areas of application do not yet have strong research validation.