Email:marina@addtherapy.co.za
Web:www.addtherapy.co.za
Direct:0733031375

Marina Grobler
ADD / ADHD Therapeutic Approach

**EEG BIOFEEDBACK**

EEG Biofeedback is a learning strategy that enables persons to alter their brain waves. When information about a person's own brain wave characteristics is made available to him, he can learn to change them. You can think of it as exercise for the brain

**WHAT IS EEG BIOFEEDBACK USED FOR**

EEG Biofeedback is used for many conditions and disabilities in which the brain is not working as well as it might. These include Attention Deficit Hyperactivity Disorder and more severe conduct problems, specific learning disabilities, and related issues such as sleep problems in children, teeth grinding, and chronic pain such as frequent headaches or stomach pain, or pediatric migraines. The training is also helpful with the control of mood disorders such as anxiety and depression, as well as for more severe conditions such as medically uncontrolled seizures, minor traumatic brain injury, or cerebral palsy.

**HOW IS EEG BIOFEEDBACK PERFORMED**

An initial interview is done to obtain a description of symptoms, and to get a picture of the health history and family history. Some testing may be done as well. And the person does the first EEG training session, at which time we get a look at the EEG. This all may take about two hours. (The details may differ among the various affiliate offices. In some offices a full brain map, or quantitative EEG, is routinely obtained, which may require a separate office visit. Or more extensive testing may be done.) Subsequent training sessions last about 40 minutes to an hour, and are conducted from one to five times per week. Some improvement is generally seen within ten sessions. Once learning is consolidated, the benefit appears to be permanent in most cases.

The EEG biofeedback training is a painless, non-invasive procedure. One or more sensors are placed on the scalp, and one to each ear. The brain waves are monitored by means of an amplifier and a computer-based instrument that processes the signal and provides the proper feedback. This is displayed to the trainee by means of a video game or other video display, along with audio signals. The trainee is asked to make the video game go with his brain. As activity in a desirable frequency band increases, the video game moves faster, or some other reward is given. As activity in an adverse band increases, the video game is inhibited. Gradually, the brain responds to the cues that it is being given, and a "learning" of new brain wave patterns takes place. The new pattern is one which is closer to what is normally observed in individuals without such disabilities.

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**WHAT THERAPEUTIC APPLICATIONS HAVE CLINICAL EVIDENCE**

There are clinical reports or case histories concerning the effectiveness of neurofeedback for the following therapeutic applications.

- Addiction
- Anxiety
- Attachment Disorder
- Attention Deficit Disorder (ADD)
- Autoimmune Dysfunctions
- Chronic Pain
- Chronic Fatigue Syndrome (CFS)
- Conduct Disorder
- Depression
- Epilepsy
- Sleep Disorders
- Stroke/TBI
- Tourettes Syndrome

**WHAT RESULTS DO WE OBTAIN**

In the case of **ADHD**, impulsivity, distractibility, and hyperactivity may all respond to the training. This may lead to much more successful school performance. Cognitive function may improve as well. In several controlled studies, increases of 10 points in IQ score were found for a representative group of ADHD children. And in two clinical studies, an average increase of 19 and 23 points was demonstrated.

**Behaviour** may improve in other ways as well: If the child has a lot of temper tantrums, is belligerent, and even violent or cruel, these aspects of behaviour may come under the child's control.

In the case of **depression**, there can be a gradual recovery of "affect", or emotional responsiveness, and a reduction of effort fatigue. In the case of anxiety and panic attacks, there is gradual improvement in "regulation", with a drop-off in frequency and severity of anxiety episodes and panic attacks until the condition normalizes.

In the case of **epilepsy**, we observe a reduction in severity and incidence (frequency of occurrence) of seizures. The dosage of anticonvulsant medication may ultimately be reduced (if ordered by the referring neurologist), and side effects of such medication may diminish.

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**CAN A MORE SUCCESFULL OUTCOME BE PREDICTED**

It is not possible to predict with certainty that training will be successful for a particular condition. But for the more common conditions we see, a reasonable prediction of outcome is usually possible. More important, however, the effectiveness of the training can usually be assessed early in the course of training. For most conditions, there are no known adverse side effects of the training, provided that it is conducted under professional guidance.

**WHY DOES THIS TRAINING PROCEDURE WORK**

The brain is amazingly adaptable, and capable of learning. It can also learn to improve its own performance, if only it is given cues about what to change. By making information available to the brain about how it is functioning, and asking it to make adjustments, it can do so. When the mature brain is doing a good job of regulating itself, and the person is alert and attentive, the brain waves (EEG) show a particular pattern. We challenge the person to maintain this "high-performance", alert and attentive state. Gradually, the brain learns, just like it learns anything else. And like with other learning, the brain tends to retain the new skill.

We observe that if the EEG is not well-behaved under these circumstances, there may be adverse impacts on learning ability, on moods, on sleep, and on behaviour. With training, these may be gradually brought under control, along with normalization of the EEG.

**WHAT DOES EEG FEEDBACK LOOK LIKE**

The therapist computer is usually positioned behind the patient. This enables the therapist to monitor the patient's EEG at any time during the session without disturbing the biofeedback.

A single electrode is placed on the scalp (above the motor strip, typically) using gel or paste and two other electrodes are attached to the earlobes. Most patient recline during training.

The game computer is placed a few feet away, directly in front of the patient. The patient interacts (only using her EEG) with the game computer for the next 30 minutes.

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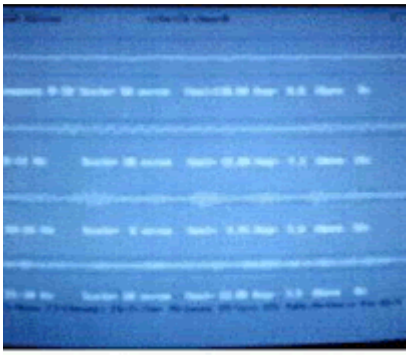
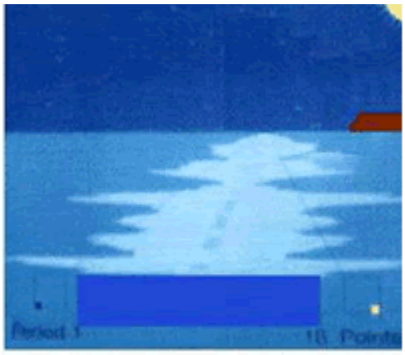


Therapist Computer

Each display contains four EEG data streams (below each stream are text and average data values). The top line, slightly squiggly, is the person's entire EEG recorded from the scalp by the single active electrode. The three wavy lines below show activity in three separate EEG frequency bands or rhythms -- here, theta, SMR, and high beta bands. The patient's goal is to increase certain EEG frequency bands (e.g., SMR) while decreasing others (e.g., theta & high beta).The patient monitors her EEG frequency band activity NOT as wavy lines on the therapist machine, but as elements of a game on the game computer. Each frequency band appears as a colored rectangle which grows larger or smaller in response to her brain wave activity.



Patient (Game) Computer

With her brainwaves she is playing the game called "Islands." Frequency band activity is displayed at the bottom of the screen -- two square "inhibit" boxes on either side on a large "enhance" rectangle. At this instant, she is doing quite well, inhibiting or reducing the activity of the bands represented by purple & yellow (at the moment, mere dots in each corner of the screen). She has increased her SMR activity to a point where it overflows the middle (blue) rectangle. As long as she keeps this up, she is rewarded in the game with visual and auditory stimuli. During the 30 minute session, she will work to keep purple and yellow small and make blue large as long as possible. Hundreds of times she may need to alter her brain activity in order to achieve a brain state which scores the most points. For every half second that her brainwaves stay in

**HOW LONG DOES TRAINING NORMALLY TAKE**

EEG training is a learning process, and therefore results are seen gradually over time. For most conditions, initial progress can be seen within about ten sessions. Initial training goals may be met by twenty sessions, at which time the initial retests are usually performed. In the case of hyperactivity and attention deficit disorder, training is expected to take about forty sessions, or even more in severe cases. Teeth grinding usually responds in twenty sessions. Some symptoms of head injury

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often respond in less than twenty sessions (quality of sleep; fatigue; chronic pain), whereas others may require longer training before they show an initial response (memory function, for example).

**HOW FREQUENT SHOULD THE TRAINING SESSIONS BE**

In the initial stages of learning, the sessions should be regular and frequent, at two, three, or even more sessions per week. After learning begins to consolidate, the pace can be reduced. Daily sessions can be very beneficial as well.

**ACKNOWLEDGEMENTS**


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