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## **The Efficacy of Neurofeedback Training for ADD/ADHD**

Attention Deficit/Hyperactivity Disorder (AD/HD) is defined in *Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV)* as "a disorder that afflicts either a person's inattentiveness, hyperactivity/impulsivity, or a combination of inattention and hyperactivity/impulsivity." Children and adolescents with this disorder demonstrate short attention spans, frequent distractibility, poor retention of details, frequent boredom, sudden outbursts of physical and verbal aggression, and limited skills in problem solving and verbal memory. According to *DSM-IV* criteria, 2-8% of school-age children in the United States have ADHD (the average generally used is 3-5%). Research shows that, without effective treatment, ADHD symptoms have a 50% chance of persisting into adolescence and may continue into adulthood.

The most common treatment for ADHD is psychostimulant medication -- drugs such as Ritalin and Adderal. A large number of studies have clearly demonstrated that stimulant medication is an effective treatment for most children with ADHD, and that most experience few, if any, side effects. Even so, it is important to recognize that stimulant medication has its limitations:

- Not all children with ADHD benefit from stimulant medication. Among those that do, many continue to have residual difficulties that must be addressed via other means.
- Although the sustained benefits of well-conducted medication treatment have been demonstrated for periods of more than a year, the long-term outcomes of medication treatment are yet to be conclusively documented.
- A small percentage of children experience adverse side effects that preclude them from taking stimulant medications.
- Although stimulant medication can be very effective in managing a child's ADHD symptoms, it is only helpful for those times when the child is on medication, and does not provide any type of permanent remedy for the underlying disorder.
- Although no adverse consequences of long-term medication treatment are currently apparent, data clearly demonstrating the safety of long-term medication use is currently lacking.

Therefore, despite the substantial benefits that medication treatment provides to many children with ADHD, it is important to develop effective alternative treatments as well. For the past 25 years, researchers in the fields of neurology, pediatrics, neuroscience, psychology, and education have compiled quantitative neurological evidence suggesting

biofeedback as a natural and effective option in handling ADHD. In 1971, researchers first recognized that people with ADHD have slower EEG activity in the area of the brain that controls attention and concentration. Subsequently, researchers and clinicians found that, through biofeedback monitoring, people could learn to improve brainwave activity in the portion of the brain that corresponds to ADHD symptoms. Some of these studies are highlighted below; for a comprehensive listing of studies, refer to the Summary of Neurofeedback Efficacy Studies Timeline at the bottom of the prior page.

#### **Trials and Studies**

In 1976, Joel F. Lubar and Margaret N. Shouse applied EEG biofeedback as a treatment tool on an 11-year-old boy who was taking Ritalin for his ADHD. Their mission was to correct his symptomatic hyperkinesis, enhance his sensorimotor rhythm (SMR), and lower his theta waves (passive brainwaves that are disproportionately high in children with ADHD). The treatment was successful and resulted in increased attention, increased self-motivation, decreased oppositional disorder, and the discontinued use of Ritalin. A follow-up report, conducted a few years after this study, identified long-term benefits of biofeedback treatment for this subject.

In 1979, Lubar and Shouse applied the same premise, methodology, and treatment to a sample of 24 hyperkinetic boys. Results yielded the same positive conclusion for both the short- and long-term efficacy of biofeedback. These early studies of biofeedback treatment did not include control subjects, but all of the long-term follow-up reports showed significant, sustained improvements in the social and academic performance of each child tested.

In 1983, Michael Tansey and Richard Bruner treated a hyperactive ten-year-old boy with EEG biofeedback. The boy was diagnosed with a reading disorder, ocular instability, and ADHD. After three sessions of this specific training, the boy showed no remnants of reading or visual disorders. He subsequently was placed in regular education classes, and was known to produce academic work above grade level. By the fourth of 20 biofeedback sessions, his behavioral problems were resolved. The boy's 24-month post-evaluation tests revealed continued above-grade-level reading performance, strong academic progress, and exceptional attention-related behavior. In a 10-year follow-up report on this boy's progress, Tansey found sustained social and academic success and consistently "active" EEG brainwave patterns. This is the first long-term efficacy report that confirms the stability of the biofeedback regimen. Though only a single-case study, it offered hope and encouragement to those seeking long-term benefits from treatment for attention related academic and social problems.

In 1984, Lubar applied his biofeedback protocols to learning disabled (LD) children. He treated six ADHD and LD children in his private clinic. For pre-test evaluation, Lubar administered three academic achievement tests and recorded the subjects' EEG levels. For almost 27 months, Lubar treated each child twice per week, hoping to improve SMR and beta activity. None of the subjects was medicated. Each subject showed significant

improvement in academic and behavioral standing upon post-testing. Lubar obtained his objective of using biofeedback as a treatment for learning disabilities. Follow-up studies produced positive behavior results, as well.

In 1995, Thomas Rossiter and Theodore La Vaque compared 23 ADHD patients who received EEG biofeedback to 23 ADHD patients who received psychostimulants. The groups were well matched for age, intelligence, and gender. The researchers conducted 20 sessions of EEG training in conjunction with regular medication treatments, respectively, for each of the subjects in both groups. All post-test scores indicated highly significant improvements for both forms of treatment. Given the similarities of the scores, the researchers concluded that EEG biofeedback could be an effective tool in dealing with ADHD.

Lubar et al. conducted a similar study to Rossiter's, comparing biofeedback to stimulant treatment in terms of efficacy. The results indicated that 75% of biofeedback subjects showed a significant increase in beta waves, and 43% of the subjects increased their posttest IQ scores. This represented the second successful study comparing psychostimulant treatment to EEG biofeedback treatment in working with ADHD. In the summer of 1995, Lubar conducted an intensive biofeedback-training program with 19 children. The experimental group received one-hour training sessions each day for 8-10 weeks. Of the 19 children, 12 showed significantly lower theta readings. These same 12 subjects also improved on the TOVA scales of behavior. Post-test evaluations of attention and hyperactivity also showed significant improvement among the subjects. To avoid speculation on such positive results, an independent neuropsychologist administered follow-up tests of IQ. These tests confirmed a 43% improvement and furthered the efficacy of neurofeedback.

In 1996, Linden and Habib applied a more complex protocol to a multi-classified population. They tested 18 subjects—12 diagnosed with attention problems and six classified as learning disabled. None of the subjects received medication or psychotherapy during this study. The experiment group underwent 40 bi-weekly biofeedback sessions over six months. A video game format provided the auditory feedback. Children received reinforcement when they were able to decrease theta activity and increase beta. Following treatment, the group showed significant improvement on the K-BIT IQ test. Post-test measures of attention levels showed significant improvement in the experimental group. However, aggressive behaviors did not show significant improvement.

The 1996-1997 and 1997-1998 annual reports of the New Vision School show the efficacy of EEG biofeedback treatment in the classroom setting. The New Vision School is a public-charter school in the Minneapolis school system that treats students with ADHD and other anxiety disorders using biofeedback protocols. Biofeedback is included in the curriculum portfolio of the students, and all classroom and extra-curricular activities are scheduled around students' treatment plans. The students generally receive

two half-hour biofeedback sessions per week. The time and frequency vary with the severity of the disorder. In the 1996-1997 school year, 65 students received biofeedback treatment; 75 students received the training the following year. Of these students, the treatment administrators noticed that children receiving more than 40 sessions during the school year yielded the greatest improvements. The most noted improvement related to impulsivity, where 63% of the population improved upon post-test evaluation. The school accepts EEG biofeedback as a standard treatment for behavior disorders. Its success demonstrates that biofeedback can be administered outside of a clinical setting and placed in each child's natural environment.

In 1998, Thomas Rossiter conducted a patient-directed biofeedback test, moving the biofeedback treatment setting from the clinic to the home. He chose six of his patients, ranging in age from 7 to 45, and trained them (or their parents, depending on the age) on the Lexicor POD-2 biofeedback equipment. Rossiter conducted the first 10 treatment sessions in the clinic, and the patients conducted the last 50 sessions at home. Conclusions on post-test efficacy showed significant normalization for all six patients. Rossiter concluded that biofeedback is the most effective treatment for ADHD, and patient-directed biofeedback is a significant, cost-effective alternative to therapist directed treatment.

#### **Efficacy**

Over the past 25 years, biofeedback studies consistently have yielded positive results. These studies cover a variety of demographics and varied degrees of attention-related disorders, and demonstrate that biofeedback is effective in reducing inattention, hyperactivity, and the symptoms of learning disabilities. Researchers acknowledge that the sample sizes varied greatly among the experimental groups and some studies lacked a control group, but they also point to an overwhelmingly positive record of long-term, beneficial results. Every researcher stressed the need for extensive application and acceptance of biofeedback in helping children overcome attention-related academic and behavioral problems.

The pre- and post-test evaluations used (TOVA, WISC III, parent and teacher behavior rating scales) are well respected in the clinical, medical, and educational communities. Their results offer credence and sound conclusions for the evaluation of biofeedback. As best stated by Dr. Frank H. Duffy, a neurologist at Boston Children's Hospital, an affiliate of Harvard Medical School, "If any medication had demonstrated such a wide spectrum of efficacy [as biofeedback], it would be universally accepted and widely used."