EEG Biofeedback for Attention Deficit Hyperactivity Disorder

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Attention Deficit Disorder and Specific Learning Disorders

Attention Deficit Hyperactivity Disorder, (ADHD) is characterized by impulsivity, hyperactivity, and distractibility. These symptoms may be present in varying degrees. For example, hyperactivity may not necessarily be obtrusive in order to diagnose the condition. ADHD is not a disease. There is no single diagnostic test. It is diagnosed by assessment of its severity with rating scales. ADHD is generally an inherited disorder which can be exacerbated by minor traumatic brain injury, including birth injury, and also by emotional trauma, dietary factors, and sleep deprivation. Specific learning disabilities (LD) are correlated with ADHD, but are distinguishable from it. They are discernible deficits in sensory perception, in certain mental processing tasks, and in output functions such as speech. Whereas medical management of ADHD is now standard, and very helpful, such intervention has not been shown to help specific learning disabilities or academic skills disorders.

EEG Biofeedback Training for Symptoms of Disorder

EEG (electroencephalogram, or brain wave) biofeedback has been shown to be helpful with both ADHD and with specific learning disabilities. Often the same training protocol is appropriate for both conditions. The training may, therefore, address an element which is common to all of the above conditions. One common element in all of them is disorder. When we look at the affected population collectively, we see an immense variety in symptoms and in behavior. That is, the condition is intrinsically disorderly! For example, ADHD children frequently have sleep problems. They may be late bed-wetters. They may have sleep onset anxiety, so that they are unable to fall asleep in their own rooms. They may have night terrors. They may be sleep walkers or sleep talkers. Or they may grind their teeth loudly at night. Additionally, they may have problems with frequent headaches. Also, they may have immune system problems: many have frequent childhood illnesses, and continual ear infections, indicating an immature immune system. Others have numerous allergies, indicating an immune response which has become inappropriately sensitized. There may be also be associated mood disorders such as anxiety or depression, or more severe behavioral disorders such as oppositional-defiant disorder or conduct disorder. Also, these children may exhibit obsessive-compulsive behaviors, or motor and vocal tics. They may have unusual dietary sensitivities. When they get older, they are more likely than others to be attracted to illicit drugs, and to fall afoul of the criminal justice system, or to commit suicide.

Finally, as already stated, ADHD children are more likely than others to have specific learning disabilities as well. If looked at in this overarching way, the predominant characteristic is of disorder! There are other disorderly aspects: The symptoms may vary from day to day, and month to month and year to year. School work that children are able to handle on one occasion bowls them over on another. School performance may be maddeningly inconsistent, and behavior highly variable. Performance can fluctuate significantly even over the course of a 22-minute continuous performance test! Our success in dealing with many of the above symptoms with EEG training compels us to see the issues as interrelated. If one training protocol can be helpful to conditions as distinct as sleep disorders, headaches, attention problems, reading difficulties, and temper tantrums in a particular child, then perhaps these problems have something in common. We believe that the EEG in these children points to the answer.

EEG Characteristics of ADHD and LD Children

The EEG in ADHD children tends to be of larger amplitude than that of other children. In particular, the EEG is higher at the lower frequencies. This condition is more appropriate to a sleep or day-dreaming state than an alert and focused state. In these children, the EEG shows that cortical electrical activity is disregulated. The greatest point of difference between a typical ADHD EEG and a normal adult EEG is in the low-frequency component. The low frequency activity gradually diminishes as the child ages, and as the brain learns to stabilize and regulate the cortex. Hence, the EEG of an ADHD child looks like that of a younger child. Unfortunately, it may not mature in the normal fashion by itself. The symptoms may arise, then, from a condition of a disregulated EEG, in combination with whatever the child's particular weaknesses are, given his genetic makeup and any trauma he may have suffered. The disregulated EEG shows up over a broad area of the cortex. The specific weaknesses relate to localized areas of the cortex. An analogy which may be helpful here is to a typhoon in Bangladesh. In order to give help to the people there, we have to know where the typhoon is (where the EEG is large), and we have to know which islands are the most likely to be flooded (which functions are most susceptible to disruption in a particular child). That is, we have to know both the weather and the geography. The EEG tells us the weather in the child's brain, and the symptoms tell us the geography. A particular child with an unruly EEG may have speech or handwriting problems, another may have uncontrolled temper tantrums. Apparently totally unrelated problems have in common a disorderly EEG. Learning to control this "storm in his brain" could then lead to remediation of such diverse problems. This is what we observe.

EEG Training

In EEG training for ADHD, we present information to the child about what is happening at that moment in his cortex. He is seeing his own brain waves misbehave, and he tries to get them under control. Gradually, he is able to do so. When that happens, his sleep may improve. His bedwetting may stop. His headaches, if any, may disappear. He may no longer explode in temper tantrums. He may start reading better, and listening better, and his school behavior may become less disruptive. His math grades may improve significantly. His handwriting may improve. Speech may improve. Sometimes, of course, other specific factors are responsible for the deficit, and we cannot help. But if the particular symptom is exacerbated by the disregulated cortex, then we may very well be able to help. Once the child's brain has learned to regulate itself better, it continues to use that skill, just as other children's brains do naturally. In general, only further trauma to the brain (physical or emotional) counteracts the effects of the training.

Symptomatic Change with EEG Training

Among the symptoms responding to the training, it is easiest to document progress with tests of cognitive function and of intelligence. The results of testing with the Wechsler Intelligence Scale-Revised are shown in Figure 1 for a group of fifteen children who underwent the training. Testing was done by an independent clinical psychologist. The lowest-scoring categories in the pre-test are those having to do with attention and with sequential processing: Arithmetic, Coding, Information, and Digit Span. All of these categories show major gains. The equivalent increase in measured IQ is 23 points. We assume that we are not making children smarter. We are simply making their intrinsic mental capability more accessible and useable to them.

Figure 1. Results of intelligence tests with the Wechsler (WISC-R) for 15 children who underwent EEG training in a clinical study. The testing was done independently. Average results are shown. The pre-training IQ score was 114; the post-training average was 137.

With regard to specific learning disabilities, we have shown improvement in visual retention by means of the Benton Visual Retention Test. The results are shown in Figure 2. Only fourteen of the group were tested. Of these, six who started out testing average or below scored in the superior range after EEG training. Six others showed significant improvement. Two others were rated superior both before and after the training. So twelve out of twelve children for whom visual retention was a problem made progress with the training. The fact that auditory retention also improves was demonstrated by the Digit Span subtest of the WISC-R. The training also seems to have broken bottlenecks in reading and arithmetic ability for a number of children, some of whom jumped several grade levels in reading and arithmetic, as determined with the Wide Range

Achievement Test (WRAT).

Figure 2. Results of Benton Visual Retention Test before and after EEG training. Striking improvement is shown in 9 of the 12 children.

We have also demonstrated improvement in fine motor skills with the tapping subtest of the Harris Tests of Lateral Dominance. This test is particularly useful when minor neurological damage is suspected. And, indeed, three of the fifteen children made more than 100% improvement in this test with the training. Others improved only modestly, where presumably this was not a problem. The median improvement in tapping score was 40%. Significantly, there was also a change in the ratio of right-hand to left-hand performance. This is shown in Figure 3. Before training, the ratio of right to left hand tapping skills ranged widely. After training, there was a narrow peak for the right-handers, and a narrow peak for the left-handers, with fewer cases of mixed dominance. These data are perhaps the most surprising, and the most direct evidence that neurological function is being altered with the training. After all, one does not expect handedness to change with children sitting in front of a video game for several hours, particularly one where they don't even use their hands but only their brain!

Figure 3.Right-left ratio in tapping performance before and after EEG training. Ratio varies widely before training. After training, there is a depletion of mixed dominance, and peaks emerge for right-handers and left-handers. The change in laterality is taken as evidence for the remediation of minor neurological deficits.

Long-term Changes with EEG Training

Some months after the completion of EEG training, we did followup with the parents of the children in the study group. We assigned a "+" for every category where they said significant progress was still being observed. We assigned a -for every category where there was a residual problem. And we assigned "++" for those categories where the change was of striking and major proportions. Then we added up all the pluses and minuses. The results are shown in Figure 4. The most significant improvement was seen in self-esteem. That wasn't even a category which we asked parents about. It is something that they brought up themselves. And it was the most common finding. The children are now prouder of who they are. They recognize that they are in better charge of themselves. They feel better about themselves because they have reason to, and because they did this for themselves!

Figure 4.Followup evaluation by parents six to nine months after completion of EEG training. Positive scores indicate improvement; negative scores residual problem areas.

The data also show that sleep problems improved, and headache syndromes were remediated. We arbitrarily divided the categories into two groups in Figure 4. Group B shows categories where there were significant residual problems. These include academic skills deficits and behavior problems. Even though EEG training has brought these children to a new level in terms of ability and self-control, several still can benefit from educational therapy or tutoring to deal with academic lags. With regard to behavior, it is clear that more is needed than simply EEG training. Many of the children are in difficult family situations, and they may benefit from complementary family therapy. Nevertheless, EEG training appears to deal with the neurological dimension of many learning and behavior problems, which lays the basis for success of conventional therapeutic modalities. The parental assessments were also confirmed as children showed improvements in their grades.

Summary

If we take a bird's eye view of all that we have said, a coherent picture emerges: Many problems of young children - of learning, of behavior, of attention - may be due to immaturity or inadequacy of the brain in controlling or regulating itself. The deficits are functional in nature, although they clearly have their basis in some (usually elusive) organic flaw. In particular, the problems do not generally lie in a failure of the child's will! If we now train the brain to order its own function, a large variety of symptoms may be expected to resolve themselves. This finding is profoundly hopeful and humane, because the more deviant the child's behavior, the more likely it is that we are dealing with a disordered brain, not with a willfully obstreperous child. Biofeedback empowers him to deal with these problems with his own resources, and with a minimum of frustration. The view presented here differs somewhat from the conventional one. This is because the "real world" requires black and white answers for something that is actually many shades of grey. The pediatrician has to decide whether to medicate: yes or no. The insurance company has to have a diagnosis: yes or no. The school district has to decide on special services to the child: yes or no. So everyone involved has to act as if matters were black and white. Also the impression is given when a diagnosis is made that there is something relentless and immutable about it. It says to the child, "this is who you are." Our success with biofeedback demonstrates that children need not be the perpetual victims of their diagnoses. There is a lot they can do for themselves. By the same token, biofeedback can also be helpful to those who don't meet arbitrary criteria for a diagnosis of ADHD or specific learning disabilities, but are nonetheless struggling with real deficits.

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