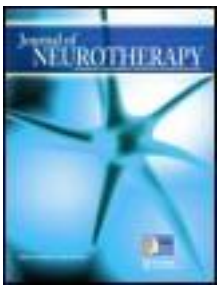

Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience

Patient-Directed Neurofeedback for AD/HD

Thomas R. Rossiter Ph.D. [a]
[a] USA
Published online: 20 Oct 2008.

To cite this article: Thomas R. Rossiter Ph.D. (1998) Patient-Directed Neurofeedback for AD/HD, Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience, 2:4, 54-64

To link to this article: http://dx.doi.org/10.1300/J184v02n04_04

Patient-Directed Neurofeedback For AD/HD

Thomas R. Rossiter, Ph.D.

The study reports on Patient-Directed neurofeedback for Attention Deficit/Hyperactivity Disorder (AD/HD). Therapist involvement was limited to 10 treatment sessions used to train the patient or parents of younger children to use the equipment, to monitor treatment, and to make changes in the treatment protocol as necessary. The remaining 50 sessions were conducted at home using inexpensive, easy to operate, 1 or 2 channel Lexicor PODs. Results from the initial 6 patients, ages 7 to 45, are reported. Thirteen of 24 Test of Variables of Attention (TOVA) measures (attention, impulsivity, reaction time and variability) were below average (SS < 90) at baseline. After 30 neurofeedback sessions, only 5 TOVA variables remained below average. It is concluded that Patient-Directed neurofeedback may be an effective alternative to Therapist-Directed treatment for many AD/HD patients and can be delivered at substantially less cost.

Address all correspondence to Thomas Rossiter, Ph.D. The Biofeedback Center, 424 S. Monroe St., Greenbay, WI 543001 or e-mail crossiter@dct.com.

Barkley (1992) asserted that "there is not enough evidence from well controlled scientific studies to support the effectiveness of EEG biofeedback for AD/HD children." While this conclusion may have been justified at the time, it is no longer valid. Studies using a variety of control groups (e.g., waiting list, pseudo-treatment, psychostimulants, cognitive-control therapy) have demonstrated that neurofeedback reduces the inattention, impulsivity, and hyperactivity that are the hallmarks of AD/HD (e.g., Cartozzo, Jacobs & Gevirtz, 1995; Scheinbaum, Zecker, Newton & Rosenfeld, 1995; Linden, Habib & Radojevic; 1996) and is as effective as stimulant drugs in controlling AD/HD symptoms (Rossiter & La Vaque, 1995; Rossiter, 1998). In addition, outcome studies with samples as large as 530 (e.g., Kaiser & Othmer, 1997; Kaiser, 1997; Lubar et al, 1995) have reported significant reduction in AD/HD symptoms with children, adolescents, and adults treated with neurofeedback. All of the studies noted used objective test data (e.g., Test of Variables of Attention, Wechsler Scales) and/or physiological data (QEEG) as well as behavioral ratings to assess treatment effects. Although these studies employed somewhat different neurofeedback protocols with AD/HD patients of varying ages, they obtained remarkably similar results. Taken together, these studies offer persuasive evidence that neurofeedback is an effective treatment for AD/HD. There are also indications that neurofeedback is beginning to gain acceptance in the medical community (Tan & Schneider, 1997).

Follow-up studies of successfully treated AD/HD patients by Lubar (1995) and Othmer, Othmer & Marks (1991) suggest that the gains made during treatment are likely to be permanent. This is not particularly surprising since neurofeedback is a learning process that involves the acquisition of self regulatory skills through operant conditioning. The advantages of neurofeedback are clear when compared to stimulant drugs which can have serious side effects and only temporarily suppress symptoms (Barkley, 1990). In addition, since as few as 30% to 40% of children with AD/HD "outgrow" the disorder (Weiss & Hechtman, 1993), the

majority can look forward to a lifetime of drug treatment or continued AD/HD symptoms that disrupt their lives. Over a lifetime of treatment, psychostimulants are an expensive method for suppressing AD/HD symptoms. A survey of pharmacies indicated that the yearly cost of Ritalin, 10 mg, tid averaged $538 (range $464 to $617). This did not include the cost of physician office visits to monitor for side effects or physician charges for monthly prescriptions. The yearly cost of treatment is even greater for AD/HD patients needing psychotherapeutic, educational, and/or other interventions.

In spite of the advantages over traditional drug treatment, neurofeedback is utilized by a relatively small segment of the AD/HD population. This is due, in part, to the large number of treatment sessions needed to complete treatment and the resulting inconvenience and expense. Neurofeedback has required 40-60 office treatment sessions, scheduled two, three, or more times a week. Nevertheless, many parents have willingly paid $4000 or more to have their children treated. In this era of managed care, some insurance companies have become increasingly unwilling to authorize treatment other than stimulant drugs for AD/HD. For this reason, neurofeedback has been too expensive for many people to consider. Even parents who have strong misgivings about the use of powerful drugs to temporarily control their children's behavior, have felt that they had no viable alternatives.

Neurofeedback for AD/HD has traditionally utilized a Therapist-Directed model with the therapist, often a psychologist, actively involved each treatment session. This model, while effective, is also quite expensive because of the professional time involved. However during the past several years, the availability of inexpensive, easy to operate one and two channel EEG biofeedback equipment has facilitated the development of alternative delivery systems for neurofeedback. Compared to the Therapist-Directed model, a Patient-Directed treatment model can potentially utilize the professional in a more efficient and cost effective manner. In the Patient-Directed model, the therapist conducts the initial assessment; develops a treatment protocol for each patient; teaches the patient or family members of younger children to implement the protocol using a computerized EEG biofeedback instrument; monitors progress; modifies the treatment protocol as needed during the course of treatment; and conducts assessments midway through and at the end of treatment.

Treatment Options

With the Patient-Directed model, direct therapist involvement is limited to ten treatment sessions with the balance conducted by the patient and/or a family member, usually in the home. Treatment is completed in three months or less. Three Patient-Directed treatment options were offered to patients with costs ranging from $1250 to $1850 for the three month program. The significant cost reduction compared to Therapist-Directed treatment potentially brings neurofeedback within the financial resources of most AD/HD patients and their families, regardless of their insurance coverage. However, for Patient-Directed treatment to be an acceptable alternative to Therapist-Directed treatment, it must first be demonstrated to be effective in alleviating the symptoms of AD/HD.

Option 1. Combination of Therapist-Directed office and Patient-Directed home treatment: 5-7 sessions per week ($1850); EEG biofeedback with therapist (10 sessions);

use of Lexicor Medical Technology POD-1 or 2 EEG biofeedback equipment and computer system in the home for 3 months; re-evaluation after 30 and 60 treatment sessions with Test of Variables of Attention, Behavior Assessment System For Children and/or Brown ADD Scales. Option 1 is well suited to individuals living outside the metropolitan area or those whose work or school schedules make it difficult to obtain the minimum of five treatment sessions per week in the office . It also allows the greatest frequency of treatment and, therefore, the shortest completion time.

Option 2. Combination of Therapist-Directed office & Patient-Directed home treatment: 5-7 sessions per week ($1550). Option 2 is the same as Option 1 except that it does not include rental of the computer system needed to operate the EEG biofeedback equipment. For individuals who already own or have access to a compatible computer system, Option 2 further reduces the cost of treatment.

Option 3. Combination of Therapist-Directed office and Patient-Directed office Treatment: 5 sessions per week ($1250). All treatment sessions, both Therapist and Patient-Directed take place in the office. Option 3 may be preferable for those who live in the immediate area, can schedule 5 treatment sessions per week during clinic hours, and wish to minimize their treatment costs.

Method

Participants

The participants in the pilot program were six patients seen at a private mental health clinic in Green Bay, Wisconsin on a fee for service basis. They were evaluated by the author prior to treatment and received a primary DSM-IV (American Psychiatric Association, 1995) diagnosis of Attention Deficit/ Hyperactivity Disorder, Combined Type (2), and Predominantly Inattentive Type (4). One patient had a secondary diagnosis of Oppositional Defiant Disorder (DSM-IV, 313.81). None of the other patients had emotional, behavioral, or learning difficulties sufficient to warrant an additional diagnosis. The participants ranged from 7 to 45 years of age (Mean = 17.2 , SD = 14.2) and included 3 males and 3 females with IQ's ranging from 85 to 132 (Mean = 109.5, SD = 11.5).

Evaluation Instruments

Intelligence data were obtained using the Kaufman Brief Intelligence Test (KBIT) or the age appropriate Wechsler Scale (WISC-III or WAIS-R). The IQ data were needed to interpret the data from the Test Of Variables of Attention (TOVA). The TOVA (Dupuy & Greenberg, 1993) was the primary instrument used to make the initial diagnosis of AD/HD and was also used to assess response to neurofeedback midway through and at the end of treatment. The patient's TOVA performance was compared to expectations based on age, sex, and intelligence. In general for individuals of average intelligence, discrepancies of one standard deviation (Mean = 100, SD = 15) or more between intelligence and TOVA scores were considered to be clinically significant. Behavior ratings were obtained using the Behavior Assessment System for Children (BASC) completed by the patient's mother for patients through 18 years of age. Adolescents and adults completed the Brown ADD Scales, a self report symptom checklist with versions for adolescents (13-18 years) and adults (19 years and over). Details of the evaluation process can be found in Rossiter & La Vaque, 1995.

Biofeedback Equipment

Patient-Directed treatment sessions were conducted using a one or two channel POD manufactured by Lexicor Medical Technology (Boulder, CO). The PODs are compact, inexpensive ($695 one channel, $995 two channel) units that plug into the parallel printer port on an IBM compatible computer. They use Lexicor's Mental Conditioning (peak performance) software, which is a modified version of the Biolex (clinical) software used with Lexicor's clinical EEG units. The most important difference between the Biolex and Mental Conditioning software is that the latter does not allow modification of the existing training protocols or the addition of new protocols. The clinical units can only be purchased by licensed/certified health care professionals while the PODs are available for sale to the general public. Treatment protocols for AD/HD and other disorders can be added to the Mental Conditioning software using the Biolex software provided with the clinical units. The clinician can write a treatment protocol for each AD/HD patient using the Biolex software and then copy the Biolex file to the Mental Conditioning software. The Mental Conditioning software allows thresholds, inhibit levels, displays, etc., to be customized to meet the needs/preferences of the user, but the treatment protocols themselves can not be altered by the patient/trainee in a way that might be harmful. Thus, the PODs can be used independently and safely by the patient at home or in the office. The patient options can be further reduced by deleting the peak performance protocols and providing the patient with only his or her treatment protocol.

The computer systems provided to the patients were IBM compatible 486 DX 4-133 systems configured with 8 megabytes of Random Access Memory, a Sound Blaster compatible sound card, Windows 3.1 and MS DOS 6.2. They were purchased from a local dealer for $600 each. The computers were assembled using used 212 megabyte hard drives and used 14 inch VGA color monitors. The remaining components in the computers were new. At the time, used computer systems compatible with the Lexicor PODs could be purchased for as little as $300-$350. The computers were built to meet the specifications required for the Lexicor PODs and guaranteed to be compatible. This eliminated problems that were encountered with patients using their own computers. Some of the problems included incompatible sound cards, software that conflicted with the Lexicor software, and insufficient conventional memory (minimum of 598 Kb required) to run the Mental Conditioning software. Windows 95 also proved to be more problematic to use than did DOS 6.2. In the future, I am considering eliminating option 2 which allows the patient to use their own computer system. In the three instances where the patients used their own computers, there were difficulties that made the biofeedback equipment unavailable for patient use for periods of several days to two weeks. The delays were frustrating to the patients and wasted valuable time and enthusiasm.

Treatment

During the three month treatment program, none of the patients received any treatment (e.g.., medication, counseling, home or school based behavior modification, cognitive training, tutoring, etc.) other than neurofeedback All six participants chose one of the two home-based treatment options. During the first week of treatment, four sessions were conducted by the author to teach the patient and parents of the younger children to use the biofeedback equipment and to interpret the information that the equipment was providing. The

patients were then provided with a one or two channel Lexicor POD and an IBM compatible computer system, if needed, to be used at home five times per week.

Neurofeedback protocols were patterned after Othmer and Othmer (1992) and involved enhancement of Beta (15-18 Hz) or SMR (12-15 Hz) amplitude while inhibiting Theta (4-7 Hz), Delta (0.5-4 Hz) and High Beta (22-30 Hz) amplitude. Training for all 6 patients used a single referential electrode at Cz (International 10-20 System), a reference electrode on the left ear, and a ground electrode on the right ear. Skin preparation was conducted according to recommendations by the equipment manufacturer. Skin impedance's during training sessions were less than 10K ohms.

Daily treatment consisted of two-15 minute or three-10 minute (younger children) neurofeedback sessions. It typically required 40 minutes to complete and included a brief period at the end of each session to review the summary data and a graph of the session data. Patients were given a brief instruction manual containing step-by-step instructions for using the equipment and software, a description of how to interpret the feedback from the equipment, direction in defining session goals, and detailed instructions for using their treatment protocols and saving session files for later review. The manual was produced by a word processing program (Microsoft Works, Version 3.0) that allowed it to be easily modified and individualized for each patient.

Defining specific goals for each treatment session (e.g., reducing the theta/beta or theta/SMR ratio, reducing theta amplitude and/or variability, etc.) provides a focus for the session and allows the patient to objectively determine whether or not they have been successful. It is also very helpful in alleviating the monotony of 60 treatment sessions and maintaining high levels of motivation. Patients were encouraged to set their own goals for each treatment session and were free to change them from session to session. For example, over the course of treatment, one adult initially focused on reducing his theta/beta ratio, then on reducing theta amplitude and variability, and finally on increasing beta amplitude.

After the first week, patients were seen weekly for three weeks, and then every two to three weeks throughout the remainder of treatment. Prior to each office visit, the patient copied saved session files since their last office visit to a 3.5 in IBM floppy disk. The sessions were loaded on the office computer and reviewed with the patient. The key elements that were evaluated as pertinent to progress were decreases in the theta/beta or theta/SMR ratios over the course of treatment, reduced variability in theta amplitude within sessions, and most importantly, the ability to reduce theta/beta or theta/SMR ratios within the 10 or 15 minute neurofeedback sessions. The latter is interpreted as demonstrating the ability to deliberately shift from a lower to a higher level of brain activation. Changes in the average theta/beta or theta/SMR ratios over the three month course of treatment do not always accurately reflect changes in the patient's status. The obtained ratios vary with a number of factors including the time of day, fatigue, health status, drug effects, etc. For example one patient experienced a significant increase in theta/beta ratios during a 7 to 10 day period when he was suffering from a cold. Nevertheless, he was able to reduce the ratios from the beginning to the end of the 15 minute treatment sessions confirming that he was still capable of shifting to a higher level of brain activation although his overall efficiency was clearly reduced. One of the EEG

characteristics that frequently changes over the course of treatment is the variability in the theta amplitude. As patients improve, theta variability decreases. This appears to be related to the consistency with which the patient pays attention. Large swings in theta amplitude are hypothesized to be characteristic of a fluctuating attention span. In many real life situations, the consistency with which an individual pays attention may be as important as the intensity with which they pay attention.

The treatment program provided a minimum of 60 treatment sessions by training five times per week. It was believed that this would provide time for the patients to learn to make the shift from a lower to a higher level of cerebral activation, but more importantly, would provide sufficient training for the skill to become "over learned." Unless the skill becomes a habit, the patient's ability to produce the shift may diminish over time. With Therapist-Directed neurofeedback, 40 sessions had generally been sufficient to produces lasting results. An additional 20 sessions were added to the Patient-Directed program to counter any loss in efficiency during the initial stages of treatment and to provide additional opportunity for "over learning."

Previous experience with younger AD/HD children suggested that sustaining the level of motivation needed to successfully complete treatment was a crucial issue. Frequently, younger AD/HD children do not really understand the nature of the disorder, how it effects their lives at home and a school, and the potential benefits of neurofeedback. Lacking that understanding, it can be difficult for them to sustain the level of motivation needed to benefit from what is a difficult and not particularly entertaining task. Although neurofeedback involves operant conditioning, little learning is likely to take place simply by exposing the patient to the feedback. Unless the desired changes in EEG activity result in feedback/rewards that are meaningful and seen as positive by the patient, little learning will occur. Sterman and his colleagues (e.g., Wyrwicka & Sterman, 1968) trained cats to increase SMR amplitude and duration by following the desired response with a food reward. Adolescents and adults in the program seemed to find positive feedback about their performance intrinsically reinforcing because it indicated movement toward their goal of symptom reduction and control. This is not always the case with younger children who may require extrinsic rewards for improved performance.

To deal with motivational problems with younger children, a daily behavior modification program aimed at improving the quality and consistency of the patient's neurofeedback sessions was initiated for the children (ages 7, 8 and 11), but only after it became clear that their motivation was diminishing. The behavioral criteria included obtaining theta/beta or theta/SMR ratios below a certain level and keeping Movement (0.5-4.0 Hz) and EMG (23-32 Hz) artifacts at acceptable levels. Privileges were earned in three steps rather than on an all-or-none basis and included varying the patient's bedtime, TV watching, access to preferred games or activities, etc. Privileges were earned on a daily basis except for a once a week "Special Event" that was based on level of performance over the previous five daily sessions. The "Special Event" might be having a friend sleep over, going to a movie with a friend, etc. Different privileges were used for each child. In order to earn the highest level of privileges, the patient would initially have to equal or slightly improve upon his/her baseline theta/beta ratio, while maintaining Movement artifact at less than 5.0 % and EMG artifact at less than 10.0 %.

Beta or SMR threshold levels were set in conjunction with the theta inhibit levels to provide reinforcement 60% to 85% of the time. This was done to insure that there was sufficient reinforcement to maintain motivation and effort. The performance standards were increased in small increments over time as needed. However for the most part, daily adjustments in threshold and inhibit levels were seldom necessary after the 8th to 10th treatment session if treatment sessions were conducted at about the same time each day. The parents of one child devised a system that provided more immediate rewards for meeting or exceeding the performance targets. They set up a "grab bag" system that seemed to work well. After each successful 10 minute training session, the parent reached into the bag and pull out one of a variety of small, concrete rewards (e.g., gum, candy, etc.) for the patient. I anticipate that the "grab bag" will prove to be a more effective technique for sustaining motivation than the daily reward system. It provides the opportunity for small, but immediate and frequent rewards. The only aspect of the daily privilege system that I plan to continue to use is the weekly "Special Event." This seemed to be an attractive and meaningful incentive for the children.

The role of the parents in working with younger children with the neurofeedback is different from that of the usual parent-child relationship. It is not primarily to direct the treatment sessions or to control their child's behavior. Their role is to act as a coach by drawing attention to relevant information being provided by the equipment, helping set goals, and providing encouragement and verbal reinforcement. This can be a difficult role for parents to assume but it is vital. Parents may be able to make their child sit in front of a computer monitor for a biofeedback session, but they cannot force him or her to learn. Too much "direction" and parental attempts to control behavior during sessions can elicit an oppositional response. Often, the willingness of young children to do the training is a function of the time of day and the presence of more attractive competing activities. The best time to do the training is when the child is not fatigued and there are few attractive alternatives. For some families, early morning is a good time. For others, after school works well. Later in the evening is almost never a good time for younger children. Very often, one parent works better with the child than the other parent. Early in treatment, there is considerable trial and error in determining the best times, coach, etc. Ordinarily, I recommend that training be done alone with the patient and the coach. However, a seven-year-old enjoyed performing for peers, grandparents, etc. and had some of her most productive sessions in front of an audience. Both the therapist and parents need to be open to considering a variety of training arrangements and to modifying them as needed. The ultimate goal is to facilitate the patient's learning by maintaining high levels of motivation from the beginning to the end of treatment. However, it is not always possible whether it is a therapist or a parent working with the younger patient. There are bound to be some non-productive training sessions. As long as they occur relatively infrequently and the parents avoid power struggles with their children, the effect on the outcome should be negligible.

It is my impression that most of the treatment neurofeedback "failures" in my practice over the past six years have been caused by failure to maintain motivation rather than unresponsiveness to the treatment. In some cases they have involved children and adolescents whose oppositional tendencies were not fully recognized prior to starting treatment or whose motivation and level of effort

diminished after the first 20 to 30 days of treatment. This is not to suggest that treatment failures are the "fault" of the patient. It is the therapist's responsibility to help motivate patients and to identify those patients who because of age, oppositional tendencies, etc., are not good candidates for neurofeedback. In cases where I consider the child to be too young or unlikely to be cooperative, I may suggest using behavior modification techniques and/or psychostimulants to manage the symptoms until the likelihood of success with neurofeedback is greater.

Motivation has not been a problem to date with the adolescents and adults involved in the Patient-Directed program. This appears to be due to a combination of factors. All patients are given a demonstration of a training session before making a commitment to the program. They are told explicitly that they have veto power over the treatment. If they are "not sure" about beginning treatment, it is suggested that they should wait until they are sure. Thus, adolescents and adults don't start treatment unless they have made a firm commitment to do so. The other factor that seems to help maintain motivation is the fact that they, and they alone, are responsible for the outcome of treatment. If they don't carry out five training sessions per week or don't make a consistent effort, it is because they have chosen not to do so. Generally, I ask parents of adolescents to take a "hands off" position with respect to treatment. It is the therapists responsibility to monitor progress, provide encouragement, deal with flagging motivation, etc. One of the best motivators is simply to "remind" the patient why they have chosen to undertake treatment and how they stand to benefit when it is successful. The parents of adolescents become directly involved only if and when they are asked to do so.

Results

The small sample size and the range of the pre-treatment TOVA scores (Table 1) suggest that statistical analysis of the data would not yield meaningful results. However, inspection of the changes in TOVA scores (attention, impulsivity, reaction time, variability) does confirm that treatment was effective. Fifteen of 24 TOVA scores improved (increased > 7.5 points), nine scores were unchanged , and none of the scores worsened (decreased > 7.5 points) as a result of 30 sessions of neurofeedback (Table 2). In addition, the improvement occurred most frequently in what were initially the areas of greatest deficit (attention, processing speed, and variability in attention). None of the baseline impulsivity scores were below average. Thirteen of 24 TOVA scores were below average (SS < 90) at baseline. After the 30th neurofeedback session, only 5 scores were still below average (Table 3). Neurofeedback resulted in significant changes in the direction of normalizing TOVA scores. Rossiter & La Vaque (1995) found that the improvement in TOVA scores was associated with a corresponding reduction in associated AD/HD symptoms as measured by behavioral questionnaires completed by patient's mothers.

Conclusions

Initial results obtained from the Patient-Directed neurofeedback program indicate that it may be an effective alternative to Therapist-Directed treatment for many AD/HD patients. Of equal importance, it can be delivered at substantially less cost. The Therapist-Directed model is still appropriate for individuals who are unable to conduct Patient-Directed treatment on their own or who do not have friends or family available to assist them. For the majority of patients, however, it may have

Table 1
Pre & Post Treatment TOVA Standard Score Means (Standard Deviations)

TOVA Variables	Pre-Treatment	Post Treatment
Attention	62.0 (49.8)	105.3 (4.4)
Impulse Control	107.3 (6.6)	111.3 (10.0)
Processing Speed	62.5 (31.5)	81.8 (13.8)
Variability	68.8 (36.0)	90.8 (18.7)

Table 2
Pre & Post Treatment Changes in TOVA Standard Scores

TOVA Variables	Improved Gain >7.5 points	Unchanged Gain or Loss <7.5	Worse Loss>7.5
Attention	4	2	0
Impulse Control	2	4	0
Processing Speed	5	1	0
Variability	4	2	0
Total	15	9	0

Table 3
Pre & Post Treatment TOVA Standard Score Ranges

TOVA Variables	Pre-Treatment			Post-Treatment		
	<90	90-109	>109	<90	90-109	>109
Attention	3	3	0	0	5	1
Impulse Control	0	2	4	0	3	3
Processing Speed	6	0	0	4	2	0
Variability	4	2	0	1	5	0
Total	13	7	4	5	15	4

<90 = below average
90-109 = average
>109 = Above Average

no advantage over the Patient-Directed model in terms of the treatment outcome.

If neurofeedback is to become the accepted treatment of choice for AD/HD, clinicians must not only demonstrate that it is effective, but must also find more cost effective methods of delivering their services. An effective treatment that is prohibitively expensive, is of little value to most patients. Patient-Directed treatment is only one alternative. Group

treatment (Toomin, personal communication, 1996) may be preferable for patients who are not suitable for Patient-Directed treatment because of age, the severity of symptoms, etc.,. In addition, tailoring neurofeedback protocols to the individual rather than using "standard" protocols, could increase the efficiency of treatment, reduce the number of sessions needed, and decrease the cost to the patient. For example, the Othmers (EEG Spectrum, 1997) use baseline test results and the pattern of the patient's presenting symptoms, AD/HD related and otherwise, to determine the appropriate neurofeedback protocol or combination of protocols. However, even with more efficient treatment protocols, treatment will continue to be a lengthy process. While it is possible to obtain good symptom control with 20 sessions of neurofeedback (Rossiter & La Vaque, 1995), additional training is necessary to insure that the changes will be permanent and not erode with time.

Patient-Directed treatment appears to be a viable alternative to Therapist-Directed treatment for most adolescents and adults. For younger children, however, the situation may not be as clear-cut. Whether working with a therapist or parent, sustaining motivation and a good working relationship with a younger child over the course of treatment can be difficult. Even children who do not present significant behavior problems may work better with a relative stranger than with a parent. In this case, small group office treatment conducted by the therapist might be an option. Another method of alleviating the potential motivation problem might be to employ feedback displays that are engaging in addition to being informative. However, displays which "hold" the patient's attention may be less effective training tools than less interesting displays that simply provide information and require the patient to generate the attention. It is typical of many AD/HD children and adolescents that they have little or no difficulty focusing and maintaining attention on activities that are of interest to them. It is with tasks that are of limited interest and/or are repetitive, that fluctuating attention becomes a problem.

In order to bring neurofeedback into the mainstream of AD/HD treatment, clinicians may have to offer a variety of delivery methods that can be tailored to meet the specific treatment needs and financial realities of individual patients. The results of the present study suggest that Patient-Directed treatment is one of the neurofeedback delivery methods that should be considered.

References

Barkley, R. A. (1992). Is EEG biofeedback treatment effective for ADHD children? Ch.A.D.D.er Box, 5-11.

Barkley, R. A. (1990). Attention deficit hyperactivity disorder: A handbook for diagnosis and treatment. New York: Guilford Press.

Cartozzo, H. A., Jacobs, D., & Gevirtz, R. N. (1995). EEG biofeedback and the remediation of ADHD symptomatology: A controlled treatment outcome study. Proceedings of the 26th AnnualMeeting of the Association for Applied Psychophysiology and Biofeedback, USA, 21-25.

Dupuy, T. R., & Greenberg, L. M. (1993). T.O.V.A. manual Test Of Variables of Attention computer program version 6.x. (Available from Universal Attention Disorders, 4281 Katella Avenue, #215, Los Alamitos, CA 90720)

EEG Spectrum Training Syllabus, Volume 1, (July 1997). (Available from EEG Spectrum, Inc., 16100 Ventura Blvd, Suite 10, Encino, CA 91436)

Kaiser, D., (1997). Efficacy of neurofeedback on adults with attentional deficit and related disorders. (Available from EEG Spectrum, Inc., 16100 Ventura Blvd, Suite 10, Encino, CA 91436)

Kaiser, D. & Othmer, S., (1997). Efficacy of smr-beta neurofeedback on attentional processes. (Available from EEG Spectrum, Inc., 16100 Ventura Blvd, Suite 10, Encino, CA 91436)

Linden, M., Habib, T., & Radojevic, V. (1996). A controlled study of the effects of EEG biofeedback on cognition and behavior of children with attention deficit disorder and learning disabilities. Biofeedback and Self- Regulation, 21, 35-49.

Lubar, J. F. (1995). Neurofeedback for the management of attention-deficit/hyperactivity disorder. In Schwartz, M. S. & Associates (Eds.), Biofeedback: A Practitioneers Guide (2nd ed.), (pp. 493-522). New York: Guilford Press.

Lubar, J. F., Swartwood, M. O., & O'Donnell, P. H. (1995). Evaluation of the effectiveness of EEG neurofeedback training for ADHD in a clinical setting as measured by changes in T.O.V.A. scores, behavioral ratings, and WISC-R performance. Biofeedback and Self-Regulation, 20, 83-99.

Othmer, S., Othmer, S. F., & Marks, C. S. (1991). EEG biofeedback training for attention deficit disorder, specific learning disabilities, and associated conduct problems. (Available from EEG Spectrum, Inc., 16100 Ventura Blvd., Suite 10, Encino, CA 91436)

Othmer, S. F., & Othmer, S. (1992). Evaluation and remediation of attentional deficits. (Available from EEG Spectrum, Inc., 16100 Ventura Blvd., Encino, CA 91436)

Rossiter, T. R. & La Vaque, T. J. (1995). A comparison of EEG biofeedback and psychostimulants in treating attention-deficit/hyperactivity disorders. Journal of Neurotherapy, 1, 48-59.

Rossiter, T. R. (1998). A comparison of neurofeedback and psychostimulant drugs in treating AD/HD: A replication. Manuscript in preparation.

Scheinbaum, S., Zecker, S., Newton, C. J., & Rosenfeld, P. (1995). A controlled study of EEG biofeedback as a treatment for attention-deficit disorders. Proceedings of the 26th Annual Meeting of the Association for Applied Psychophysiology and Biofeedback, USA, 131-134.

Tan, G. & Schneider, S. C. (1997). Attention-deficit hyperactivity disorder: Pharmacotherapy and beyond. Postgraduate Medicine, 101, 201-204, 213-216, 222.

Weiss, G., & Hechtman, L. T. (1993). Hyperactive children grown up: ADHD in children, adolescents, and adults (2nd edition). New York: Guilford Press.

Wyrwicka, W., & Sterman, M. B. (1968). Instrumental conditioning of sensori-motor cortex EEG spindles in the waking cat. Physiology and Behavior, 3, 703-707.

Dr. Rossiter received his doctorate in Clinical Psychology from Miami University (Ohio) in 19733. He is in private practive at the Biofeedback Center in Green Bay, WI and specialized in neurofeedback and biofeedback, neuropsychological assessment, and child and adolescent behavior and learning problems.