THE POSSIBLE FUTURE OF EDUCATIONAL BIOFEEDBACK

Chapter Five

BRIEF COMMENTS
ON PAST AND FUTURE OF EDUCATIONAL BIOFEEDBACK

By R. Timothy Scully, Ph.D.

Tim Scully, Ph.D., was founder of Aquarius Electronics, Inc. and was president of the company from 1970 until 1976. Aquarius Electronics was one of the first manufacturers of brainwave biofeedback instruments for educational use. Scully designed many custom biofeedback systems for educators and researchers including several biofeedback toys -- a Pong game controlled by EMG and a Thermister; a toy train, which could be controlled by EEG, EMG or skin temperature and a toy monkey that jumped in response to the GSR. Later he designed and manufactured equipment under the name of Mendocino Microcomputers. Scully earned a Ph.D. in Psychology from the Humanistic Psychology Institute in 1979 with his dissertation research on physiological patterns and events in consciousness. He has contributed advice and counsel for this paper, for which I am very grateful.

The educational uses of biofeedback have been pushed to a minor role because of the commercial success of medical biofeedback and insurance reimbursements for medical applications. This is unfortunate. Some of the most interesting applications of biofeedback are non-medical.

In an educational setting, simple biofeedback training can be used for teaching internal locus of control, to demonstrate the diversity of individual styles of cognition and response, to learn valuable relaxation skills and to learn to improve focus of attention. It can be helpful to combine biofeedback training with self-charting, to help each student learn how to take more responsibility for how he or she feels and thinks.

More sophisticated pattern biofeedback (involving several physiological measures) still holds promise as a possible tool for identifying and encouraging "high learning" states when a student is unusually receptive to learning. It is also possible that biofeedback systems may someday be developed which can help students and teachers to recognize which sensory and learning modalities are likely to be most effective at a given moment.

Most research has involved a sharp distinction between the researcher and the subjects. Brainwave biofeedback, however, reveals the inherent paradoxes posed by the standard methods of research. The observer and the observed both respond to the electrical dance that accompanies their individual shifts in focus of attention. Newer forms must evolve from the integration of the experience of the subjects, the data measured, and the perspectives of all participants.

We feel that in time there will be less distinction between the roles of researcher--observer and subject—experiencer. With the aid of any forms of feedback or mirroring, there will be a more intimate interplay between experience and concept in our attempts to develop a consensual view of reality.

------ R. Timothy Scully, Ph.D.
Quoted from his Aquarius Electronics Instruction Manual, **1972**

BIOFEEDBACK AND CHILDREN IN THE 21ST CENTURY

By Stephen Wall, Ph.D.

STEPHEN WALL, Ph.D., Director of the Bio Research Institute, became involved with biofeedback in 1979. Dr. Wall established BRI in 1983 to advance understanding of the relationships between mind and body in order to promote healing and increase our knowledge of specialized states of consciousness. In 1992, the knowledge acquired during many years of clinical practice, research, university teaching, and instrument design culminated in the birth of the Bio Integrator.™ *(This article was originally published in the* AHP Perspective magazine October/November - 2001*. It is re-printed with permission from the Association for Humanistic Psychology -- including updated comments added here.)* *Stephen Wall's e-mail is bri@7hz.com.*

Humanity has a history of wanting to use external strategies to augment human function, rather than developing our innate inner capabilities. Today, competing technologies may be applied to the human race in order to improve or enhance function. They include molecular biology, pharmacological interventions, and even neurocybernetics (the implanting of computer chips into the brain). The use of any of these assumes that we have gone as far as we can on our own and are in need of augmentation.

However, I suggest that restricting ourselves to these approaches to "improve ourselves" runs the risk of denying us the opportunity to enhance ourselves in more holistic, organic, and systems-oriented ways. I have been involved in the field of psychophysiology and biofeedback for more than 20 years, and in that time, I have seen children and adults go from a place of dysfunction or substantial underutilization of their abilities to truly exciting higher function in a reliable, noninvasive, and completely self-directed manner through biofeedback training. In this article, I hope to illustrate how psychophysiology and biofeedback can be used with children to dramatically enhance function.

What Biofeedback Is

Simply put, biofeedback as it is traditionally used is a means for gaining control of our body processes to increase relaxation, relieve pain, and develop healthier, more comfortable life patterns. Biofeedback gives us information about ourselves by means of external instruments, e.g., using a scale to measure our weight. Clinical biofeedback follows the same principle, using specialized instruments to monitor various physiological processes as they occur in real time.

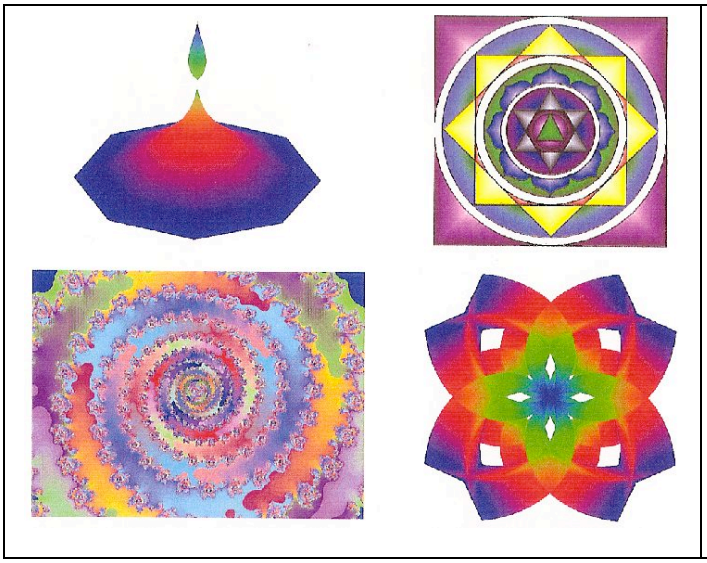
The psychophysiological systems traditionally monitored and fed back in feedback include brain wave activity, muscle activity, temperature, sweat gland activity, heart rate, and respiration. Moving graphs on a computer screen and audio tones that go up and down "reflect" changes as they occur in the body system being measured.

Biofeedback is one of the few areas in which the use of advanced computer technology has a directly empowering impact on the individual who is using it. For example, the Bio Integrator, which I designed at the Bio Research Institute to provide

highly engaging and easily understood feedback, has dramatically improved the learner's ability to see and understand intricate internal functioning and develop strategies for influencing psycho-physiological processes. Through its use, the individual is able to see, hear, and optimize mind-body functioning.

We are at a critical juncture, where children and adults need to be empowered to be their own heroes and healers as much as possible. To do so, one must have access to one's inner resources and be able to depend on them in an accurate and reliable way.

Biofeedback is not a treatment. Rather, biofeedback training is an educational process for learning specialized mind-body skills. Learning to recognize physiological responses and alter them is not unlike learning how to play the piano or tennis-it requires practice. Through practice, we become familiar with our own unique psychophysiological patterns and responses to stress and success, and learn to control them rather than them controlling us.



Bio Integrator Mandala Art

By Stephen Wall © 1994-2007

*These artistic images are just a sample of those that are available with **The Bio Integrator Plus.** They can animate in a variety of ways, can be used to feed back body measures and EEG activity. The image library includes mandalas, nature scenes, animal scenes, and games.*

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Overcoming Response Patterns

Throughout our lives, we develop patterns of responding to the environment that serve us in the immediate moment, but may hang around long beyond their usefulness. For example, the child whose parent engages in binge drinking every Friday night and becomes subsequently abusive develops a psychophysiological strategy for survival to cope with this phenomenon. This strategy involves a noncognitive development of specialized physiological activity that provides protection and soothing, utilized every Friday night. Even though the child may leave this situation, or the parent may work his or her way out of alcoholism, the child may well carry this psychophysiological strategy for survival into adulthood.

My observation of long-term biofeedback training is that outmoded patterns of response can be interrupted and new ones become possible. People who have undergone extended mind/body training tend to make "good choices" without particular guidance from the trainer/therapist, as their consciousness is freed from the effects of chronic activation and sustained dysfunctional patterns. Children, who learn so much more easily than adults, could avoid dysfunctional patterns and develop useful ones.

As we develop, we learn through the harshness of our environment to desensitize ourselves to many experiences in order to avoid painful stimulation. For example, children are simultaneously vulnerable and sensitive, and throughout childhood they have repeated exposure to people who treat them harshly or do not respond positively to their overtures. Such experiences lead them to develop "psychological calluses" that interfere with interpersonal experiences. These withdrawal strategies, practiced and reinforced over time, form a rigid "armor" that reduces the capacity to experience life fully and impedes the self-actualization process, including the learning process.

Sometimes, in an attempt to get back in touch with old feelings they have stifled, or to block current painful feelings, people self-medicate. In the case of one popular drug, alcohol, people say they drink to relax, to reduce stress, or to regain the unselfconscious and spontaneous "good feelings" often left behind in childhood.

In addition, people sometimes engage in high-risk behaviors in order to "feel alive," because they have lost their ability to feel alive in ordinary life.

With current concerns regarding children and substance abuse, as well as high-risk behavior, it makes sense to offer practical, concrete ways for them to understand and make good choices regarding their own feelings. At BRI, we work with children with a wide variety of presenting complaints, including learning disabilities, ADD/ADHD, anxiety, depression, headaches, obsessive/compulsive disorder, oppositional defiance disorder, and conduct disorder. We know that biofeedback offers them concrete tools that empower them to take more effective responsibility for their own well-being, and helps them cope positively with the stresses that confront them. Their parents report that these children also function better in school after biofeedback training.

Biofeedback in the Schools

I suggest that if it were good for children to have a physical education class, then it surely would be good for them to have a mind/body class featuring biofeedback. Here they would learn to make contact with themselves and modulate and influence their own mind/body functions. With the world increasing in complexity at an alarming rate, we've done very little to give people the skills necessary to be aware of and manage their own mental, spiritual, and physical states. The net result of this is a disturbing increase in personal and societal disarray. If our internal states are in chaos and disorder, then it is likely that our external behaviors and interactions will be the same. I submit that not only could biofeedback serve our children as a means of approaching behavioral problems that consistently plague our schools today, it could prevent the development of these problems and in fact free up energy and creativity for significant gains.

More than 50 years of research has shown that chronic stress degrades the human condition, and has been shown to have significant personal, familial, educational, and cultural implications. Currently, we face this in the schools on a daily basis, administering drugs to children with attention problems, depression, anxiety, and other psychophysiological difficulties. Violence is also a major problem in the schools, and is directly related to the inability of children to cope with their own emotions and understand cause and effect.

Special education classes attempt to address these problems listed above, but they are unable to provide enough practical ways for children to learn how to reorganize their

own psychophysiological systems to cope better. Biofeedback is one of the few proven means of giving people practical skills for identifying and coping with stress. Starting psycho-physiological training early can prevent the development of many stress related acute and chronic illnesses. Given the escalating costs of health care, this is no small consideration.

Nationally, there has been an increase in the use of biofeedback for children with behavioral and physical problems. Within the health care field, biofeedback is increasingly recognized as a cost-effective means of both addressing and preventing psychophysio-logical disorders, and it has the bonus of providing clients with a strong sense of having power over their own lives.

So when I'm asked to imagine what the next few years could hold for our children and humanity in general, I am excited to report that a wide variety of enhanced functions could become available immediately through the wider application of biofeedback training. These functions take the form of superior personal insight, better mental and physical health, enhanced intuitive function, greater capacity for learning, enhanced emotional intelligence, greater creativity, and more rewarding and long-lasting personal relationships.

If biofeedback were incorporated into educational systems, mind-body training would be directed toward facilitating appropriate levels of arousal during the learning process, thereby preventing the association between learning and unpleasant, uncomfortably focused effort—in short, preventing the development of inappropriate psychophysio-logical strategies for learning.

The potential applications of biofeedback training within traditional educational systems include the utilization of psychophysiological labs within primary and secondary schools, which children would attend as regularly as other classes. Mind-body training would be incorporated as part of the regular curriculum. From an early age students would become familiar with their own physiologies and responses to various stimuli. Stress education would prevent stress-related accidents and the development of stress-related disease, and set the stage for psychophysio-philosophic development throughout life. The goal would be to increase each child's self-knowledge, and empower him or her to take responsibility for self-development and self-regulation.

Mind-Body Lab: Bio 101

In the bio lab, children would learn progressively more sophisticated psychophysio-logical skills as they went from grade to grade. For example, in the first grade, classes would focus on exploring how internal processes are reflected through the instrumentation. Today's bio devices provide entertaining and beautiful animated graphs and images that catch children's attention and promote awareness and concentration. Becoming familiar with the mechanics of biofeedback would set the stage for later refinement of psycho-physiological skills, such as relaxation and recruitment of appropriate levels of arousal for a given task (differentiating between "spacing out" and being "over-amped"). Further, the bio curriculum would include interaction skills, where children would see how their actions affected others, and how others affected them, on a psycho-physiological level. For example, children would be able to see the psychophysiological effects of angry, hurtful, kind, and supportive words as well as

experiencing these effects emotionally. In addition, children could participate in other curriculum tasks while refining their bio skills, and develop a broader sense of how they actually felt about what they were learning.

Enhancing the Student

Study skills would be enhanced when students learned which levels of mind-body activity were most appropriate for them personally in relation to individual subjects; they would develop an economy of use for various physiological systems when studying particular curricula. If students had an awareness of their psychophysiological states while studying, they would be able to avoid both over- and under-arousal; they would be able to catch themselves when their attention was fading, or when they were "trying" so hard that they defeated their purpose (as in the case of test anxiety).

The inclusion of mind-body information with various areas of study would also aid in the student's overall integration of knowledge. Psychophysiological states would be reflected numerically, mathematics would have an immediate analytic application, and simultaneous displays of the same information in graphs and other images would stimulate spatial development. Personally relevant information presented in spatial and numeric ways, as well as through audio feedback, would facilitate the development of children's capacity to approach and process information of all kinds in a more comfortable and effective way.

With practice in matching appropriate levels of mind-body activity to specific subjects for optimal learning, children would develop the capacity to shift between specialized states of attention with grace and ease, enhancing the individual's ability to respond optimally in other life situations.

Helping the Teacher

The fundamental need for psychophysiological training within the schools offers benefits that far outweigh the cost and effort that would be required for teachers to become adept at providing this aspect of education. In addition, teachers would derive a much greater understanding of each student's learning capabilities and style, and be more able to make timely and appropriate modifications of subject material and thus promote learning.

Teachers would be able to extend classroom discipline beyond the maintenance of order in the classroom. It would be possible to promote genuine cooperation and interdependence between students. When children became disruptive, instead of being sent to the principal's office or the "time out" room, the teacher could send them to the biofeedback lab, where they could simultaneously participate in a feedback game that promoted cooperation, with both parties driving the feedback and simultaneously lowering their arousal levels.

I believe that an educational system with such a psychophysiological component would significantly change our concepts of child development and maturity. It is exciting to imagine what children who had experienced refined self-awareness from a young age might be like by the time they left school and entered the work force.

These children would have a ready ability to adjust their psychophysiological responses to life events. This ability to meet the environment with optimal states of consciousness for the tasks at hand would foster increased use of the subtler human capacities, such as intuition and creativity, which are currently most often overwhelmed by cruder and more immediate characteristics-such as fight~or-f1ight or competitive pack-animal behavior, etc.

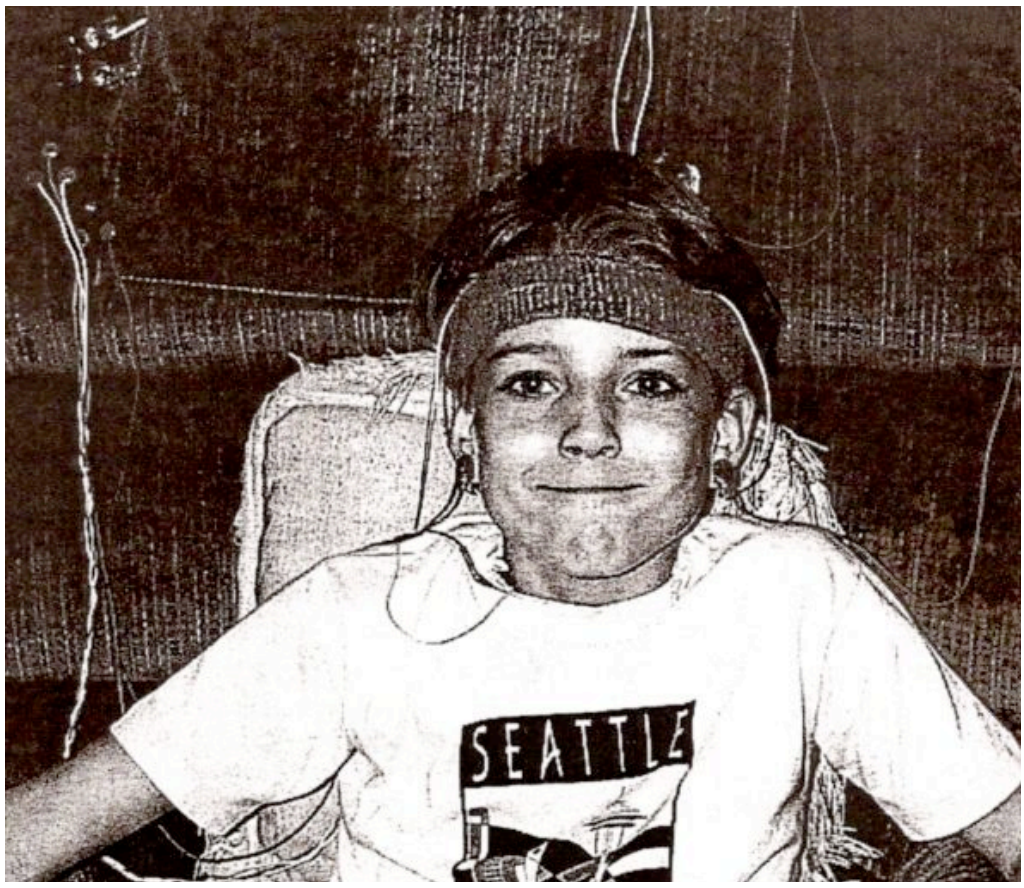
The Evolving Human

The stages of human development that traditionally elicit particular social concern, such as adolescence, would be made more comfortable for everyone involved if children were trained from an early age to identify and cope with psychophysiological change. Mood swings, outbursts, and misbehavior that are usually attributed to genetically programmed hormonal changes would be more manageable if the young individual were accustomed to being aware of mind-body phenomena and adjusting psychophysiological arousal to meet the needs of the situation. This would empower these young individuals and reduce their alienation from the rest of society by giving them body-centered tools to cope with their physiological changes.

In western culture, it is becoming increasingly difficult for adults to provide the kind of guidance that can help children navigate the ever-more complex world in which we live. It is hard for an adult to serve as a "guiding light" in a world where he or she has had no experience comparable to that which the child is facing. If children were encouraged to develop their decision-making abilities through enjoyable mind-body education and training, they would be better able to cope with the multitude of complex stimuli and decisions that confront them. Abilities to make better choices would also support them in dysfunctional family situations, creating the possibility that they would be able to break the cycle instead of repeating with their own children what their parents had done with them.

As part of evolution of humanity, we need to help our children learn to transcend some of the negative animal responses that we inherited over the millennia. At one point in our development, these primitive responses served a useful purpose; however, many of them today serve as a hindrance to the evolution of humanity and the achievement of personal satisfaction with life. Biofeedback is a powerful means of learning about oneself, managing oneself, finding one's inner direction, and exploring optimal levels of functioning and states of consciousness.

Further, it is a strategy that is available now, one that could be included in the curricula of schools today to assist our children in facing the challenges of tomorrow. I understand that this would involve a significant commitment of resources, but the investment would be well worthwhile, and we would reap the benefits of such a long-term vision within a generation. By providing our children with practical, hands-on strategies for learning about their unique makeup and functioning during their developmental years, we could have a dramatic impact in a variety of areas, including health, learning, professional development, spiritual growth, psychological well-being, and emotional and social functioning. We have the capacity to give our children tools that will allow them to be more, and it is my greatest hope that, as time goes by, the wisdom of these ideas will be implemented across school districts, cultures, nations, and continents.



Danny MacDonald is all hooked up to practice biofeedback with the Bio Integrator developed by Stephen Wall at the Bio Research Institute

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---- Stephen Wall, Ph.D. -- 2001

BEYOND THE CLASSROOM –
WHEN PROFESSIONAL THERAPY IS NEEDED FOR ADD

THE USE OF EEG BIOFEEDBACK (NEUROFEEDBACK) IN ATTENTION DEFICIT / HYPERACTIVITY DISORDER

By George H. Green, Ph.D., F.A.B.M.P.

George H. Green, Ph.D., spent 18 years in classroom teaching, and has been in clinical practice at the Biofeedback Center in Reno since 1976. He is a psychopysiologist and holds several national board certifications: EEG Biofeedback, Neurofeedback, Medical Psychotherapy, and Hypnotherapy. The following is quoted from Chapter Twenty-two in Dr. Green's book, "The A.D.D. Quest for Identity: Inside the Mind of Attention Deficit Disorder" *(4th edition). It is a technical article written about the application of biofeedback technology to A.D.D. This discusses the first effective direct methodology for both identification and treatment.*

For more information, contact: www.stresslesslife.com

1. Understanding the Disorder

Both Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD) are characterized by the inability to focus as well as a variety of behavioral problems including excessive impulsiveness, defiance, inattentiveness and risk-taking behaviors. In the early twentieth century, this collection of symptoms has been treated as a grouping of behavioral issues called Minimal Brain Dysfunction, which was assumed to be untreatable. Later it was referred to as Learning Disorder and was treated from a purely behavioral perspective. (Lubar, 1991). A large number of children with ADD or ADHD, *and subsequently adults,* mostly male, have fallen into the unfortunate category of "underachievers" with the mistaken belief that they have been refusing to use their intellect to best advantage.

The strict behavioral model has never provided adequate answers for therapeutic interventions. Prior to 1970 both sedatives and stimulants were utilized with varying results. Eventually, the use of methylphenidate HCl (Ritalin) came to be recognized as the standard treatment for ADHD. The fact that such a stimulant was producing a calming effect as well as a stabilizing response in children gave weight to the theory that the children were suffering from something with more than a behavioral etiology. As the area of Learning Disorders was explored more fully, the diagnoses of ADD and ADHD were designated for this specific symptom group.

2. Theory Behind the Technique

Combining the facts that Ritalin had a stabilizing influence with the growing awareness of familial trends especially along the male lines caused researchers to speculate about possible organic causes. It was theorized that some region of the brain needed internal stimulation as in a feedback loop and was receiving this from

the stimulant effect of the Ritalin. It was assumed that without this internal stimulation, the individual would seek stimulation elsewhere and consequently be unable to hold a focus on any single event. The stimulation of a constantly changing environment appeared to be required.

The creators of the television show, Sesame Street, discovered that rapidly changing informational systems resulted in greater retention and increased interest in the subject matter with concomitant decreases in distractibility. If the specific brain activity responsible for these problems and the improved responses could be identified, then it might be possible to more accurately diagnose and treat these children. Furthermore, it was theorized that it might be possible to train them to modify the functioning of those areas of the brain in which the problems showed up.

3. Scientific Evidence

Research has recently shown a strong biological basis for ADD and ADHD. Both PET Scan (Positron Emission Tomography) and SPECT (Single Photon Emission Computed Tomography) have already demonstrated both cortical as well as subcortical abnormalities in the brains of children and adults with ADD and ADHD.

In 1992, Mann *et al.* published findings showing excessive slow activity in the EEG of individuals with ADD. The presence of this slow activity follows the distribution reported by Zametkin *et al.* (I990) using PET Scan. In addition, children with ADD and ADHD show even more EEG slowing and lack of fast beta wave activation during various academic tasks such as reading, drawing, listening, mathematical computations, puzzle completion and others. One way of looking at the degree of slowing in the EEG is to examine the ratio of slow theta activity to beta activity over different cortical locations. The highest concentration of excessive theta activity relative to beta is usually found along the midline between the sensory motor cortices near the Rolandic Fissure.

Tansey (1990) showed that training individuals to normalize brainwave signatures in these regions showed improved WISC-R (intelligence) profiles as well as “significant remediation of the learning disorders.”

4. How a Biofeedback Program Works and What To Expect

Following an extensive evaluation to identify both the behavioral and EEG pattern dysfunctions as well as the probability of effective response to the EEG biofeedback systems, the individual starts the first phase of the training program. This encompasses about 10 sessions of working with computer-driven biofeedback of their brainwaves. During the biofeedback sessions when a more normal brain wave response occurs, a recognition signal is produced thus teaching the individual when the stronger patterns are happening in their brain. During the first 10 sessions, appropriate training responses are identified which will indicate the probability of success in the long run.

The second phase is the bulk of the training period and can take an additional 30 to 45 sessions. As the training proceeds, behavioral changes generally start to be seen by both family and teachers. Appointments are commonly scheduled twice

weekly during this period and support discussions with the family and patient are strongly advised.

The final phase sets the pattern as permanently as possible by gradually working with the individual less often. The tapering process covers about 15 to 20 appointments spread out decreasingly over several months.

Each session includes both EEG biofeedback and behavioral suggestions designed to enhance the effect of the training. Family members of both children and adults receiving EEG biofeedback are strongly encouraged to be as involved in the process as possible since their interactions can provide a powerful reinforcement for the developing behaviors as they occur.

5. Explanations For Typical Behaviors

The two most obvious symptoms affecting people with ADD and ADHD are poor focusing and distractibility. With poor focusing the mind seems to wander aimlessly in a dreamy, nonspecific manner. On the other hand distractibility is characterized by several thoughts struggling for top priority simultaneously.

Clinically, there seem to be two general types of patterns in both ADD and ADHD. One pattern is manifested by increased theta wave production whenever a task requiring focusing is attempted. This produces an increase in the theta/beta ratio with a concomitant decrease in clear focusing capability. In one clinical case, a young man actually fell asleep in a wide range of circumstances, which precluded simple boredom as an explanation. This was often misinterpreted as oppositional behavior and caused him to get in trouble on a regular basis. What was occurring was a dramatic increase in theta activity when he attempted to focus which subverted conscious activity driving him into a sleep pattern.

The other pattern typically displays reduced beta activity either at all times or specifically when challenged with a focusing task. In these situations the reduction of beta in the 16 - 20 Hz range also carries into the SMR (sensorimotor rhythm) range of 1 2 - 16 Hz. Reductions in SMR are generally accompanied by increased activity levels as the individual seeks stimulation. Under these circumstances a highly distractible state is produced and studying or learning is dramatically compromised.

In both types of patterns there is a reduction of self-esteem that creates numerous secondary and tertiary problems as the normal struggle for identity becomes greatly exaggerated with continuous evidence that failure is imminent. Frustration becomes a way of life with rage and temper outbursts occurring with surprising force.

6. Conclusions

EEG biofeedback has been scientifically and clinically proven to be an effective aid in the treatment of attention deficit disorder and attention deficit hyperactivity disorder when used to train reduced theta wave activity and enhanced beta wave activity in the regions over the Rolandic Fissure. A full evaluation is required as well as cooperation of family members to maximize the potential of a program.

Additionally, EEG biofeedback can be an alternative when medication is contra-indicated or a conjunctive aid when medication is being used.

An important consideration when working with ADD and ADHD is the method by which the signals for focusing are processed in the brain. It appears that the early cortical messages indicating increased focusing on visual and/or auditory input are translated into poor focusing or distractibility based on whether theta is enhanced or beta suppressed. Neurofeedback (EEG Biofeedback) entails reversing these trends.

Reports from hundreds of clinics around the country indicate virtually uniformly positive successes. At The Biofeedback Center in Reno improvements in all age ranges have been seen from 8 to over 60 years.

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KNOW THYSELF

---- SOCRATES

(469ó399 B.C.E.)