

Biofeedback – The Ultimate Self-Help Discipline

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What is Biofeedback?

Biofeedback opens a new channel of communication between you and your own body. Becoming aware of your own body can help it to become more functional. There are two basic ways of achieving this. One is to quiet and calm the mind, so that it can become more aware of body states. An example of this is paying attention to your own breathing. The other way is to bring up the "signal level" to where it is recognizable and obvious.

That's where all the biofeedback instrumentation comes in. We can measure hand temperature, perspiration, or blood pressure, as indicators of our state of "excitation," if you will. By bringing awareness to these aspects of our function, we can learn to control them.

The body, after all, has the burden of regulating its own function in all its particulars - heart rate, body temperature, pain threshold and even how we pay attention. Normally this happens without much conscious awareness. Thus the body manages heart rate and blood pressure to meet the demands of the moment, all the way from the strenuous exercise to deep sleep, without our keeping track. Since what we call the body/mind normally manages this well, the process doesn't attract much attention. It is intended to be entirely "self-regulating." However, much of what chronically ails the human species can be seen as a breakdown in such self-regulation (chronic pain, generalized anxiety, chronic sleep disorders, chronic stress reactions, migraines).

Biofeedback is the attempt to train the body/mind to recover its natural self-regulatory capacity through a learning, or re-learning, process. Also, by bringing awareness to the task of regulation, we can directly influence our own regulatory function. This can hold true for conditions ranging from incontinence to hypertension, from panic attacks to irritable bowel.

Biofeedback Provides Information

The biofeedback process simply provides information - usually on a meter or computer - about various bodily functions, in order to achieve improved regulation. The person responds to this information in an attempt to move toward better-controlled function. As an example, as you learn to relax your hands warm up. A thermometer measuring your finger temperature reflects this, allowing you to know when you are succeeding. Success then leads to more success. This is a

very natural process, which gets things working the way they are supposed to. After all, the brain-body system has internal pathways to keep itself informed about the various body states. In biofeedback, we simply support these internal pathways with external sources of information. It is these external feedback paths on your internal biological functions that make it “biofeedback.” The process gives you information on how to re-normalize regulatory function, after which the body “owns” better regulatory control.

Commonly, information provided in biofeedback may relate to muscle tension, for example, or to skin temperature. The primary application here is to what is called relaxation training, which is used for generalized anxiety and stress reactions. Other key variables include perspiration, respiration, heart rate, blood pressure, or even the electrical brainwave activity. Information about these physiological variables is usually provided by dedicated biofeedback instruments—many now computerized—in the form of moving graphs or even of video game-like displays. Information can also be provided by sound, or even with tactile feedback (vibration).

Biofeedback: a mirror to ourselves

Biofeedback is like a mirror to us, telling us how we look at a given instant in terms of how well our bodies are working. However, in this case the mirror has an opinion. It rewards us for moving the “bodystate” in the direction of better control, and withholds reward whenever our system moves in the wrong direction. In the ordinary course of events, there are moment-to-moment fluctuations in the measures of interest, and in biofeedback every time our body happens to move in the “right” direction, the mirror is set up to reward us for doing so. The repetition of such rewards leads to the gradual learning, or relearning, of a new state. Whereas allopathic medicine attempts to restore efficient regulation by drug intervention, biofeedback does so through the twin processes of learning through practice and of increasing awareness of the state of self-regulation.

Biofeedback: the self-help discipline

Biofeedback can therefore be seen as the ultimate self-help discipline. All the benefits are entirely attributable to one’s own efforts—even though it is tempting sometimes to give credit to the instrumentation when the observed changes are dramatic. Generally, biofeedback is done with the help of a biofeedback therapist who selects the appropriate therapeutic modality, establishes a training regimen, sets up the instrumentation, teaches awareness skills, and follows up with the client. However, much of what is learned in session can be continued on a home use basis, and

home training is often an essential part of the therapy. Moreover, the skill of increased awareness can be usefully applied at any time in one's life to regain a measure of control over one's nervous system, whenever things threaten to get out of hand.

Use of information from electrical brainwave activity (the electroencephalogram, or EEG) has developed into a distinct discipline called EEG biofeedback, neurofeedback, or neurotherapy. It will be discussed separately below, but the main ideas about biofeedback as a means of enhancing self-regulation are applicable to neurofeedback as well. One point of difference is that we don't ordinarily have any way of knowing what the electrical activity is in our brains at any time. We require instrumentation to inform us. Hence, there is a more limited ability to continue the work on a home-training basis.

Who can benefit from biofeedback?

Biofeedback can be helpful in the management of a large variety of disorders. Foremost among these are the disorders on the anxiety-depression spectrum. Secondly, biofeedback can be helpful in various chronic pain syndromes, as well as minor sleep disorders. Additionally, help can be provided in cases of hypertension, cardiac arrhythmias, hyperventilation, panic disorders, irritable bowel disorders, TMJ (temporomandibular joint) dysfunction, and Raynaud's Syndrome (problem in temperature regulation). Biofeedback can be helpful in many muscle-related problems such as pelvic muscle disorders, incontinence, spasticity, paralysis and hemiparesis, tremor, and visual accommodation. EEG biofeedback can be particularly helpful in attentional and behavioral disorders, specific learning disabilities and cognitive deficits, traumatic brain injury and stroke, the epilepsies, PMS, and migraines.

History of Biofeedback

In the early part of the century, in Germany, J.H. Schultz developed a technique called *Autogenic Training*. In this method, verbal instructions are used to guide a person to a different, more relaxed and controlled, physiological state. The method flourished, and the results were reported upon by Wolfgang Luthe in 1969 in the United States.

The technique is still used to this day, but it is so thoroughly marbled in to what biofeedback clinicians do that it may no longer be distinguished as Autogenic Training.

Edmund Jacobson developed the technique of *Progressive Relaxation* training in the 1930's in the

United States. This was a series of muscle activities to teach people awareness of tension and relaxation. The effect was to reduce muscle tension and certain causes and effects of stress and other symptoms.

In the 1960's and 1970's there began to be an awareness in the Western world of the Eastern yogic traditions and the ability of some yogis and other masters to alter their physiology volitionally. Most dramatically, a yogi could survive in a sealed box by voluntarily reducing his metabolic rate to the point where he would not exhaust the supply of oxygen over a period of hours—a hazard that would have killed any other man. After a designated period of time, he would raise his metabolic rate again and ask to be released from the enclosure. The altered states that were being achieved by meditative means attracted the attention of a few key researchers.

The gurus taught that in this state of relaxation and control they could change a number of variables that were thought to be autonomously regulated: blood pressure, heart rate, finger or hand temperature. These functions are managed by the autonomic nervous system, so named precisely because it was thought that such functions could not be altered voluntarily.

The autonomic nervous system has two divisions—the sympathetic and the parasympathetic. The sympathetic nervous system gets you up, gets you ready and gets you going, and regulates the flight/fight response. It gets you on the freeway, keeps you thinking about going to the doctor's office, or what kind of presentation you are going to make. The parasympathetic nervous system calms and relaxes you (when you lie down, take your break, go to sleep etc.), and manages body functions like digestion. The two work in tandem with each other in a reciprocal relationship. It was Canon and Selye, researchers in the body response to stress, who increased general awareness of the role of stress in physical diseases and mental disorders. Many of these manifested in disregulations of autonomic response.

Hatha yoga, and other yogic traditions, became established in the United States as techniques for physical relaxation and enhancement of conscious control over our physiology. Additionally, meditation techniques such as Transcendental Meditation and Zen Buddhism stimulated the elaboration of the *Relaxation Response* by George Benson in 1975, the notion of *Behavioral Stillness* by Mulholland, the *Quieting Reflex* by Chuck Stroebel in 1982, and the attention training

technique of *Open Focus*® by Les Fehmi in 1980. The idea of influencing and controlling the body with the conscious mind was finally getting a toehold in the West.

There are many other methods used to promote relaxation and manage pain and stress. A few of these include *Silva Mind Control*, Norman Shealy's *Biogenics*, *Interactive Guided Imagery* (SM) (developed by Bresler and Rossman) and hypnosis. A number of these techniques have been combined with biofeedback instrumentation to enhance learning physiological self-regulation (or mind-body control).

History of Thermal or Temperature Biofeedback

Temperature biofeedback is the easiest to conceptualize and also to instrument.

Straightforwardly, it is the body's tendency to "conserve" resources when stressed, so circulation is withdrawn from both the periphery and the gut, and delivered instead to the large muscles, the heart, and the brain, which would be needed for fight/flight. When we are threatened by a disgruntled rhinoceros, digestion can wait, and we don't need warm hands and feet. This stress response mechanism is meant to be used sparingly, only when needed. When stress is chronic, e.g. when the disagreeable supervisor is always on your back, it takes a toll on the body.

Temperature biofeedback can then teach the body how to return to a better resting state and "unlearn" its acquired bad habits.

Typical thermal biofeedback devices present a resistance to current flow that varies strongly with temperature. This resistance is measured and can be converted into degrees of temperature, and displayed in terms of a graph or an image for feedback to the person, and for display to the therapist. The person simply has to know when he is getting better or changing for the worse, and learning takes place. The measurements are non-invasive, requiring only the taping of a sensor on the skin (typically on the fingertip), and the probes involved do not deliver any current to the body.

History of Galvanic Skin Response Biofeedback

Galvanic Skin Response biofeedback has its basis in early medical research. In the latter half of the nineteenth century, investigators became aware that skin resistance varied all over the body. Although this was originally dismissed as artifact, eventually it was established that galvanic skin

response varied systematically with the state of physiological arousal and even with mental processing. These changes were identified with sweat gland activity. Later the famous psychologist Carl Jung established GSR as an objective way to track physiological arousal, and laid the basis for the further development of the field.

In the general case, the stress response is accompanied by increased sweat gland activity. Hence, cold and clammy hands. Biofeedback training may be undertaken to train the body toward relaxation, as well as back to a more normal response pattern (warm and dry hands). Galvanic Skin Response (GSR) biofeedback is also known by other terms, including Electrodermal Response (EDR) or Skin Conductance Response (SCR) or Skin Conductance Level (SCL). GSR is measured by passing a miniscule current between two sensors mounted on the skin. The dominant current path will be via the layer of moisture on the skin, allowing its resistance (or, equivalently, conductance) to be measured and displayed. Two measures are of interest: 1) the steady-state skin conductance, and 2) the response to a sudden challenge, such as a handclap. Both are useful indicators.

The combination of temperature and GSR is a favorite way among biofeedback therapists to measure the effects of stress management. Initially, it is a matter of finding out where a person "carries his stress," and then addressing that variable. Additionally, these measures are often used to give clues to states of arousal and distress in psychotherapy. In cases of migraine headaches or Raynaud's disease or other peripheral vascular diseases the patient is encouraged to learn temperature training (often using Autogenic Training as well).

History of Electromyographic Biofeedback

Electromyographic (EMG) Biofeedback has its origin in the work of Galvani, who discovered electrical responses in nerve and muscle action in the early 1800's. EMG biofeedback utilizes the electrical activity generated by muscles as an indicator of muscle tension, and rewards a decrease in muscle tension toward more normal values. The EMG signal is picked up by electrodes placed on the muscle group of interest, and is expressed in microvolts.

Research in this field began in 1969. By 1974, EMG biofeedback was used for muscle spasm in such conditions as spastic torticollis. In 1977, Wolf and Basmajian set up a measurement scale for

grading stroke patients as they made progress in neuromuscular re-education. Basmajian showed that humans could learn to exercise control over the firing of single motor units. (In a charming but undignified detail that did not make it into the published literature, the control was so complete that a subject could get his wired-up motor unit beating out the rhythm of *Yankee Doodle Dandy*.) By repeatedly exercising the muscle with EMG feedback, function could be gradually restored in many instances where it has been completely lost. In recent years the practical application of this technique of retraining individual muscle groups for spinal cord injury and other cases of paralysis has been pioneered by Bernard Brucker. Unfortunately, this spectacular breakthrough in the treatment of various kinds of paralysis and paresis is not yet widely known, and remains available only to the fortunate few. Jeff Cram, Stu Donaldson and others have refined the more standard EMG feedback techniques in recent years to include very specific muscle exercises and movement. The potential benefit of these techniques unfortunately also remains under-exploited.

Currently, EMG biofeedback is standardly used for muscle tension and muscle spasms, in pain management where muscle tension is involved, and in certain physical therapy applications such as neuromuscular re-education. This work is relevant to stroke victims, accident victims, and to those suffering from spasticity. EMG biofeedback is also a standard component of any program of general relaxation training.

History of Muscle Strength Training

A close relative of the EMG technique is muscle strength training. Whereas in EMG training we monitor electrical activity in neurons that control individual muscle groups, in muscle strength training we measure the output of muscle activity directly. This has its most prominent application to incontinence. The use of biofeedback as a treatment for urinary incontinence started with Kegel in 1948. First, Kegel used a structured exercise program for lax pelvic floor muscles. After exercising, the improved pelvic floor muscle tone enhanced the support to the pelvic structures (bladder neck and urethra) and therefore reduced incontinence. Subsequently, Kegel introduced the pressure perineometer to give direct feedback on the effectiveness of the muscle-strengthening exercise. The unit is placed in the vagina and the pressure of the muscle contraction is displayed on a pressure gauge or a computer screen. This work may have been the very first use of biofeedback instrumentation of any kind. The exercises have been taught to women post-pregnancy for many years to strengthen perineal structures stretched in childbirth. It

turns out to be important that these exercises—when used for incontinence training—be taught with the periometer. Otherwise, other muscles can enter into the exercises and failure of the treatment, or even adverse consequences, can ensue. Since the time of Kegel there have been many studies and many methods used. The periometer still appears to be the instrument of choice for urinary incontinence. There can be more than 80% success with long-term follow-up showing retention of benefit.

Muscle strength training is also the method of choice for fecal (stool) incontinence. In 1973, Kohlenberg successfully used a water balloon attached to a tube and a clear cylinder to encourage the strengthening of the external anal sphincter muscle, which began the current treatment for fecal incontinence. In 1974, Engel used a three-balloon device to reinforce three of the responses that encourage continence. Another version of the periometer is also used with success for stool incontinence. Since then, the techniques have improved and the success rate for biofeedback training for those who are good candidates is at least 70% for continence or 75% for decrease in frequency of incontinent episodes

History of Breath Training

Many symptoms that are experienced as caused by stress may in fact be due to breathing incorrectly. These symptoms include panic, functional chest pain, asthma, irritable bowel syndrome, migraine headaches and hypertension and many others. The influence of breathing on regulation of state is just coming to be understood. One of the things that distinguishes us as human beings is the exquisite control of breath that makes speech possible. For us, therefore, control of the breath is not quite as "automatic" as other autonomic functions. There is more of a voluntary component, and that may enlarge the opportunities for things to go wrong on the one hand, and the possibilities of re-regulation by explicit training on the other.

In 1975, Hirai suggested that the regularity of the lung action which moves the diaphragm caused the abdominal contents to stimulate the vagus nerve. This stimulates the parasympathetic nervous system, bringing about relaxation. More recently, the important role of blood carbon dioxide level in autonomic nervous system regulation was recognized (Naifeh, Kamiya, and Sweet). The stress response has the characteristic of driving one toward hyperventilation. Chronic hyperventilation, accompanied by excessively low carbon dioxide levels, can then create its own

set of problems.

Various techniques for teaching breathing skills have been developed, utilizing both biofeedback measures and/or behavioral techniques. Eric Peper has pioneered in this field, developing programs for patients as well as training professionals. Since we can be aware of our own breathing without instrumentation, much of this can be rehearsed on an individual basis.

However, these techniques can be aided as well by instrumentation that ranges from the simplest augmentation device that allows one to hear one's own breath all the way to capnometers that measure carbon dioxide content in the exhaled breath. In the middle lie other instruments such as inspirometers that measure air inhalation/exhalation volume, or pneumographs (strain gauges) that measure expansion of the chest or abdominal area with breathing. Such instruments can encourage a shift from thoracic breathing to the more healthful diaphragmatic or abdominal breathing. Yet other instruments guide a trainee in maintaining a suitably low breathing rate during the training session by giving him or her a signal to track. Most recently, measurements have extended to what is called Respiratory Sinus Arrhythmia (RSA), a subtle pattern of variation in heart rate that tracks the breathing process.

History of General Relaxation Training

The verbal techniques of promoting relaxation and control remain a very important part of the biofeedback discipline, whether or not instrumentation is employed to aid the process. Relaxation with guided imagery, that is, suggestion of a beautiful place, a healing story, or a reframing of an old problem have become very popular. Many practitioners have become experts in this area. Emmett Miller, for example, has developed numerous videotapes for support in addressing various problems such as smoking, chronic headaches, or immune system insufficiency. In the 1970's, Carl Simonton showed that imagery could augment the treatment of cancer patients. David Bresler and Martin Rossman developed "*Interactive Guided Imagery*" (SM), in which a guide encourages the client to develop his own imagery and dialogue with his/her own inner wisdom (called "Inner Advisor" or "Inner Healer") and thus encourages self-management for one's own health. An important way in which our body can communicate to us is through visual imagery. Conversely, by invoking imagery, we can direct the response of the body. Religious and spiritual imagery can be very significant here as well, since much stress that is experienced may in fact

emerge out of a fundamental spiritual yearning.

Another tool, Conditioned Relaxation, was developed by David Bresler ("Free Yourself From Pain") in the 1970's to encourage busy people to realize that with very little effort they could accomplish stress management. It is based on Pavlov's theory of Classical Conditioning in which he trained dogs to salivate to a bell by pairing the bell with meat powder, and after some time he found that the dogs would salivate upon hearing the bell alone. The relaxation exercise is preceded by (paired with) a signal, in this case, a breath (hence his term "signal breath"). The exercise proceeds with certain key phrases built into it (called anchors). The body learns to relax. After some dedicated practice the body is able to relax just with the signal or the breath.

Les Fehmi developed the "Open Focus"® self-guided program of learning attentional skills. The techniques have been refined over many years of clinical research. The work emanates out of the realization that our state of arousal and activation are closely coupled to our state of attention. If we "pay attention to how we pay attention" we can also re-normalize arousal. The larger objective, then, remains the "control of state," but in this case the task can be accomplished without instrumentation on a personal training basis.

Training ourselves to enlarge our attentional focus calms the body. A repeated exercise of this opening up of our attentional focus can be a useful corrective for the tendency in the industrialized world to become narrowly focused, fragmented in mental processing, and distractible as a result of the daily challenges we face. It is found that we perform best when we work out of the most relaxed state consistent with the challenges we face. Relaxed in this sense does not mean belly-up at the beach, but rather a state of de-stressed control. And when a particular task can be rehearsed, it is best overlearned, so that it can be accomplished without conscious micro-management. Giving our bodies regularly the experience of learned "open focus" allows us to maximize resilience in the face of challenge.

Summary

The above has covered briefly some of the dominant themes that have emerged in the field of biofeedback. The over-arching message of all of these developments is that the body-mind is profoundly responsive to interventions that simply support the way the body is supposed to work

in the first place. Biofeedback is a gentle but persistent nudge to get the "system" back toward a better, more functional place. Self-regulation is the way the system works. Training in self-regulation simply takes advantage of that. In our enthusiasm for the latest findings of allopathic medicine, we lose sight of the fact that ultimately nearly all healing is self-healing. We now turn to the emerging field of EEG biofeedback, which is extending the reach of self-regulation techniques to yet other conditions.

History of EEG Biofeedback

EEG biofeedback had a curious beginning. After all, no one in the Western scientific tradition would think it likely that one might actually be able to train people's brain waves! The early findings were therefore somewhat serendipitous, and even accidental. There were actually two independent beginnings, for the two divisions in the field which exist to this day. EEG biofeedback got its start with the study of the famous "alpha" rhythm, the rhythmic signal at about 10 cycles per second (called Hertz) which appears in our visual cortex when our eyes are closed and the visual system isn't very busy. This rhythm can be seen as the idling rhythm of the visual system. On a separate research track, the idling rhythm of the motor system (called the Sensorimotor Rhythm, or SMR) was investigated in cats. These two lines of research led to very different approaches to EEG feedback, addressing different conditions and employed by different disciplines. It is interesting to review the history briefly.

The History of Alpha Training

The so-called alpha rhythm was the first feature identified by Hans Berger in the late twenties. Berger was interested in consciousness, and in how it might be measured. The work was immediately controversial, and controversy seems to have dogged this field ever since. Decades later, Joe Kamiya, then at the University of Chicago, was also interested in studying consciousness with the help of the alpha rhythm. He asked the question, can a person be aware of his or her own alpha rhythm, and if so, what is that awareness? He successfully trained a subject—by simple reward—to discern when an alpha rhythm, or rhythmic spindle, was present in his visual cortex. Over a period of time, the person became 100% accurate. The serendipitous aspect of this work is that Kamiya never found another subject who was nearly that good in all his subsequent work. Later in his research, Kamiya succeeded in training people to increase their alpha activity. This was the first case in the Western world of EEG biofeedback training.

Subjects found the training to be very relaxing and comforting. In some instances, the experience even opened the door to spiritual transformation. The sciences were not prepared to deal with such unruly and subjective phenomena, so it was not long before this line of investigation fell into disrepute. The fact that all this was happening in the psychedelic age of the sixties did not help. EEG feedback quickly captured the public fancy, aided by enthusiastic public lectures by people like Barbara Brown. Sober left-brained scientists were aghast. The hard scientific data were meager at this point, and the whole matter became unsuitable for serious scientific discourse at the universities, with work only continuing among certain independent research groups. The most famous of these was the one at the Menninger Foundation, which included Elmer Green, Alyce Green, Dale Walters, Steve Fahrion and Pat Norris. Other researchers and clinicians who persisted in this line of work included Jim Hardt, Tom Mulholland, Les Fehmi, Adam Crane, and the late Chuck Stroebel.

It was recognized that what became known as alpha training was really a way of quieting the mind. By virtue of the connection between a quiet mind and a quiet body, this was also a way of achieving what came to be called "behavioral stillness." In a larger sense, the training was a way of achieving and extending voluntary control over one's own mental and body states. With an increasing propensity toward revved, left-brained mental activity in the Western world, the respite afforded by the alpha training was a treasured antidote. The few remaining stalwart practitioners learned that the alpha training could be extremely helpful to those who were undone by the demands of Western life and manifesting anxiety disorders, pain syndromes, sleep disorders, and various other reactions to chronic stress.

In 1989, Peniston and Kulkosky reported a stunning research result in which stage 4 alcoholism (with a long-term history of treatment failure) was essentially fully remediated in some Viet Nam veterans by a treatment program which included alpha training as a primary component. This result was so incredible that initially it was given essentially no credence by the scientific community. What is most striking is the fact that these early results have held up in follow-up over the subsequent ten years, which takes us up to the present. The work has also been replicated in a number of other studies, and has been extended to other drugs of choice. Together, these results are giving rise to a reappraisal of alpha training, now called alpha-theta training because of the inclusion of even lower frequencies in the reward, namely the theta region of frequencies (4-8 Hertz).

It has become clear that this work is best seen as a treatment for post-traumatic stress disorder (PTSD), which was sustaining the addiction in these particular Viet Nam veterans. But the word treatment is inappropriate. The person undergoing the feedback is the only active agent in everything that happens in biofeedback! There really is no treatment here. Rather, what is accomplished is that the person is guided to a comfortable, comforting state of his body-mind in which true healing—the healing of psychic wounds—can take place. The biofeedback training simply aids in movement toward that healing opportunity.

The History of Sensorimotor Rhythm Training

In the mid-sixties Barry Sterman of UCLA was also studying brain-behavior relationships. He observed the EEG of cats that were trained to withhold a response under certain conditions. What he found was a brain rhythm of somewhat higher frequency than the alpha rhythm, one that was associated with motor stillness. He called it the sensorimotor rhythm (SMR), and it turned out to be the idling rhythm of the motor system. After training the cats toward motor stillness and observing SMR spindles, he turned matters around and decided to reward the cats for making more SMR spindles, and observed the resulting behavior. Not surprisingly, the cats became motorically still. What was surprising is that it turned out to be easier to train the cats to change their EEG (and thus their behavior) than it was to train them to change their behavior directly. Here was the second instance of EEG biofeedback training. It was also a case of training the brain toward behavioral stillness, or, in a larger sense, control in general.

Fortuitously, Sterman was given the task by NASA to study the effects of a toxic substance called monomethylhydrazine (MMH), a rocket fuel that was used in the Apollo program and was believed to be causing astronauts to suffer cognitive deficits in space when exposed to small amounts of the substance. At higher dosages, the stuff was known to cause seizures and even death. Sterman studied the effects of MMH on his cats, and found to his amazement that some cats showed a much higher threshold for seizures. These fortunate cats turned out to be the ones that had been previously trained to make more of the SMR rhythm! Thus a new field was born.

Sterman subsequently demonstrated seizure reduction in human epileptics with the EEG training, and a new therapeutic approach was launched. Lubar, Tansey and others successfully employed the same technique with hyperactive and learning-disabled children. Others extended these

findings to minor traumatic brain injury and a host of other conditions. Results were variously reported for anxiety and depression, PMS and migraines, sleep disorders and chronic pain syndromes, even autism and cerebral palsy! What could possibly account for such a broad reach of such a simple technique?

How does EEG biofeedback work?

The best way to look at EEG biofeedback is in terms of an exercise model. In this case, it is the brain that is being exercised directly. It appears to us now that the brain rhythms we observe in the EEG are the means by which the brain organizes its own activity—a built-in metronome, so to speak, or a "virtual conductor."

By training these rhythms, we are exercising the brain in its fundamental role of controlling and regulating various functions. Such exercise appears to make the mechanism function more stably, and more appropriately. We may be doing little more than putting the brain on a stair stepper, if you will, challenging it to work better. Once we do so, however, the brain acquires a new skill that it will continue to employ. Hence, the skill should be retained over the long term. EEG biofeedback may be the ultimate self-help program for the brain.

The biofeedback challenge moves the brain out of the state that it is in, and guides it gently to a more appropriate state. What is this brain state that we are talking about? It is our state of alertness, of awakeness, of attentiveness, and also the state of our emotions. If we improve regulation of these states, we affect the whole being. We have found it helpful to see the problems that biofeedback addresses in terms of disregulation—shortcomings in the brain's regulatory activity. And when recovery occurs, it has been by virtue of improved capacity for "self-regulation" by the brain. Self-regulation is the brain's modus operandi. We are only challenging the brain to do better. Thus, when we succeed, it may not look like anything has actually happened. EEG Biofeedback is nothing beyond getting the brain to do its job!

Biofeedback has the reputation of "fixing" a lot of problems. For that reason, it is difficult to get one's arms around it and understand what is really going on. Perhaps it is best seen as not a single tool but an overall strategy—one of improved "self-regulation." And what it addresses are the problems of "disregulation," whatever they may be. Thus the problem of insomnia can be

looked at as "disregulated sleep;" the problem of chronic pain can be seen as a "disregulated pain threshold;" the problem of ADHD can be seen as "disregulated attention;" and anxiety and depression can be seen in terms of "disregulated mood." If we guide the brain to do better in terms of regulating these functions, it may in fact succeed. How do we guide it? The biofeedback training rewards it repeatedly for doing the right thing, which in EEG terms means functioning at the right frequencies! And symptoms may subside.

What is the difference between biofeedback and neurofeedback?

Biofeedback generally refers to using measures derived from peripheral physiology rather than the EEG, measures such as skin temperature, muscle tension, skin conductance, heart rate, and the breath. All of these are subject, of course, to the management of the central nervous system. Hence, all of biofeedback can be seen as referring back to the brain. However, it is much easier to understand why we train an anxious person with cold and clammy hands to warm their hands than it is to tell them why we are training certain frequencies in their EEG, the province of neurofeedback. Both are in the interest of improved self-regulation, and it is all biofeedback. However, each specialty area in biofeedback has its unique strengths.

Why go to the Biofeedback Therapist?

A biofeedback therapist is required when the problems that are experienced become greater than one can handle. Perhaps, medical help has been sought and the symptoms still exist; perhaps the idea appeals of participating in one's health utilizing the resources of the body. Biofeedback becomes an education or a journey toward inner awareness and self-management using the tools of feedback.

These may include instrumentation, dialogue with self and a therapist, and practice in various life situations, as well as in the biofeedback therapist's office. It requires dedication and time, and often a change in philosophy. It takes time to understand the physiology of the body and how to break a habit that may have existed for years before the symptoms appeared.

Despite a strong self-help component, it is prudent to do biofeedback under the care of a trained mental health professional, and only after medical evaluation has determined that a more serious condition isn't being "masked" by the training. Seeing a biofeedback practitioner is like going to

see a trainer at the gym. The practitioner is there to guide the trainee by designing an individualized program for improved health, encouraging regular practice, monitoring results, and supporting the training process in various ways, including advice regarding complementary interventions.

What to expect when you go to Biofeedback

Initially, the biofeedback therapist will do a history of past health and of the current symptoms. Then a psychophysiological profile is done on the biofeedback equipment, which may include: 2 EMG sensors, one on the muscles of each shoulder, a temperature sensor to one fingertip and a sensor to measure hand sweat (called GSR, EDG or SCR). Occasionally, a measure of breathing skills will be done with strain gauges. Then, the client may be asked to do a variety of things during which the monitor will display the physiological responses. These may include reclining, sitting in a straight chair, standing, walking, talking of pleasurable things, relating stressful events, discussing symptoms, and relaxing during a guided meditation.

Some examples of the instrument readings follow:

EMG (Electromyograph) – In the event of a stiff neck and sore shoulders, the readings on the biofeedback computer may be elevated or variable, depending on body position or posture; alternatively one shoulder muscle may be more tense than the other, which will be revealed by a higher reading. That would have implications for the training.

Fingertip Temperature - Stress will cause cold hands. The biofeedback office is a new situation, so fingertip temperature may be low for that reason alone. As one is guided to relax with eyes closed, the temperature may rise. However, if it does not, this may simply be an indication to the therapist to continue monitoring. This is because efforting may be counter-productive, and change temperature in the wrong direction initially.

GSR (or EDG or SCR) - The levels of arousal can also be measured with the sweat gland activity of the hand. Loud noises such as sudden clapping, or relaxation with imagery can produce changes that are of interest to the biofeedback clinician. Baselines are taken in the first session under various conditions, against which future progress can be compared. Usually a more relaxed state yields lower readings.

RSA (Respiratory Sinus Arrhythmia) - This is a particularly sophisticated way of looking at arousal levels. The technique measures thoracic and abdominal breathing along with heart rate and skin

temperature.

These findings are discussed with the patient in relationship to the presenting symptom. A discussion of the role of stress will be included. A plan for the future biofeedback sessions will be presented and, often, a relaxation tape will be sent home with instructions to begin "ownwork".

How to find a Biofeedback Therapist

Medical referral may be useful for purposes of insurance coverage. However you may find a listing in the phonebook, or call the state biofeedback association, or the national biofeedback professional organization, the AAPB (see references below).

Is Biofeedback covered by insurance?

Some insurance companies cover biofeedback services but often only for certain diagnoses. Such insurance corporation policies are subject to frequent change based on new input as well as customer demand. Some biofeedback therapists are able to bill the insurance companies, but many cannot due to certain restrictions set up by the insurance companies. In these cases, payment at the time of the visit may be required, but most likely a superbill (receipt) with treatment codes will be provided for submission to insurance. Reimbursement may take up to 6 weeks. Check with the insurance company using the following list so there will not be any surprises.

Some questions to ask the insurance company.

1. Do you cover Biofeedback?
2. If yes, is it under the Medical or Psychological or Physical Therapy part of the policy?
3. Will you pay for Biofeedback for (the particular symptom)?
4. At what rate do you reimburse?

i.e.: 80% of the usual and customary fee (Insurance companies often assign a fee they feel is appropriate); or, 80% of billed amount (Often the biofeedback therapist uses a fee that includes more time or other services)

5. What is my deductible?

Do I have any deductible left?

What is my co-payment?

6. For how many sessions of biofeedback will you pay?

a. Per year?

b. Before I see the doctor again?

7. Is there a limit of total amount paid out?

i.e.: the company may pay for biofeedback only up to \$1500 in one year or six months.

8. If it is covered under medical, must I get a letter from MD to say it is medically necessary?

9. Do I need to send the letter to you before I see the Biofeedback Therapist, or can it go in with the first bill?

10. If I do not need a letter, do I need a prescription?

11. Is my doctor on the insurance provider list? If not, do you have provisions for unlisted providers?

12. What qualifications does the biofeedback therapist need to have? R.N., Ph.D., M.D., M.F.T. etc.?

Specific Biofeedback Applications

There are numerous conditions for which biofeedback can be useful. In the following section, several key application areas are treated in depth. One of the largest areas of application has been to management of pain and stress, whereas for neurofeedback the primary areas of application are to **ADHD, seizures, head trauma, and addictions**.

Biofeedback for Stress Management

There are many ways to accomplish stress management. There are courses offered in every community, either privately or in community colleges and churches. There are meditation tapes with music, verbal phrases, subliminal phrases, binaural beats available in every store and library. Recently, the health insurance companies have begun to add alternative classes to their clients. These can vary from exercises, yoga, organization techniques, relaxation skills, imagery tools, self-hypnosis, etc. These are usually very excellent ways to learn how to make lifestyle changes appropriate to mild or moderate levels of stress. The goal is prevention of more stress-related diseases or to learn management of problems such as headaches, gastric distress, irritable bowel,

chronic muscle spasm, hypertension, etc.

Biofeedback for Anxiety and Panic

Traditional and neurofeedback techniques can be extremely helpful with anxiety. The anxiety response is another way in which a stressed nervous system can overreact. Of course there is also a normal anxiety response. The difficulty comes when the anxiety becomes chronic and habitual. A related phenomenon is panic reaction, in which there is a strong nervous system overreaction to a particular event or situation, and this overreaction becomes learned, possibly even becoming uncoupled from particular triggers. Often, anxiety and panic can be caused or accelerated by poor breathing. The calming effects of conventional biofeedback techniques can be quite helpful in mastering anxiety conditions, whereas neurofeedback can often be quickly helpful in stabilizing a nervous system so that it no longer makes excursions into panic. Anxiety disorders are among the most common referrals for biofeedback.

Biofeedback for Pain Management

Biofeedback has become well known for its role in pain management. The degree to which it is effective depends on the severity of the symptom, in combination with the dedication of the individual and the body's receptivity to the learning process. The measurement of the arousal or relaxation of the body through feedback gives a guide to the individual as to his progress. All kinds of biofeedback are helpful here, with different techniques being particularly appropriate for various kinds of pain. For example, using EMG to measure the state of tension in muscles can guide the person as he works with a chronic muscle condition such as back or neck problems. The additional measures of temperature and GSR give an indication of the effectiveness of the relaxation. For instance, "relaxing" on the couch watching TV may still leave your hands cold, which indicates that the body has not reached a deep enough state of relaxation or homeostasis..

One's psychological state influences the pain sensitivity directly. Fear and anxiety can heighten one's pain sensitivity. One of the manifestations of the anxiety response is shallow breathing. For example, if one has rapid or shallow breathing, has long pauses in breathing or hyperventilates, the oxygen-carbon dioxide ratios in the blood are affected and thereby cause increases in pain or at least cause a decrease in personal pain management. Therefore another part of good biofeedback training is through breath training.

Brainwave biofeedback appears to be effective in addressing the mechanism of pain originating within the nervous system itself. This includes chronic pain attributable to errors in pain threshold, to nerve pain, and to migraines. In this regard, it should be recognized that pain is not an absolute quantity like blood oxygen level. Rather, pain is what the central nervous system calls pain. Pain relief may be little more than getting the pain system regulated again. Such regulation may require us to focus on other systems that are dysregulated, beyond the pain system itself.

There are many kinds of pain, ranging from minor to conditions so severe that the person considers suicide. They all can be helped with self-regulation techniques. Headaches are an example of how pain can be helped by biofeedback. Below is a multi-faceted program that has been used successfully.

Vulvar Pain (Vulvodynia)

This particular pain is singled out by the authors because so few people recognize that there can be relief.

Vulvodynia is part of a multi-dimensional connective tissue disorder. Usually women with this condition have generalized vulvar skin pain and discomfort, including pain and/or itching, stinging, parchedness, drying, swelling, and drawing sensations all over the vulvar skin, or only certain parts of it, as well as in the rectal, or anal skin. It is characteristically a burning pain that usually occurs primarily in response to pressure or stretching. There may be urological symptoms, deep boring or piercing pain, or shooting pain across the buttocks. *Vestibulitis* is one particular type of vulvar pain referring to pain in the entrance to the vagina.

What to do?

Currently, there is a regimen of treatment that provides relief. This can include specific medications (i.e., Guaifenesin), estrogen cream, calcium citrate, dietary changes (low oxalate diet), relaxation, and biofeedback.

The Pain Project - a research and treatment project headed by Dr. Clive Solomons, in Denver, Colorado - has since 1986 treated over 2000 women. The key to this care has been the testing of urine for the individual's abnormal oxalate excretion pattern within the 24 hours. Of those who have abnormal levels, the women who take calcium citrate in advance of their daily surges of oxalate excretion experience pain reduction. The low oxalate diet, combined with timed calcium citrate, usually produces significant relief in symptoms (burning, itching, swelling, hypersensitivity, and urinary urgency and frequency). It usually is the most effective when used in conjunction with other treatments as recommended by a Vulvar Pain specialist. A Low Oxalate Cookbook is now available (see Vulvar Pain Foundation listed below).

The obstetrics and gynecology clinic at Scripps in La Jolla, California endorses this program and refers all patients for biofeedback evaluation of the pelvic floor muscles. There is always bracing in reaction to the pain. Rehabilitating the muscles is critical in resolving pain when muscle spasms are present. Kegel exercises done with biofeedback instrumentation (described below under incontinence), is one major part of this treatment plan. The exercises are prescribed incrementally to teach relaxation of the spasmed or bracing muscles, and must be continued at home. *Relaxation exercises* are also an important piece of the treatment and *healing imagery* is included and should be specifically designed for each patient. These exercises must be done regularly to be effective.

Vulvar Pain Foundation - As with many other kinds of pain, there is a very well organized group who provides support nationally to sufferers of vulvar pain. There are support groups, networking organizations, lectures, and monthly newsletters (see resources below).

Biofeedback for Incontinence

It is not possible to discuss every condition successfully treated with biofeedback. However, incontinence represents one of the prominent applications, and also one of the most successful. It therefore deserves special mention. As well, it is one of the diagnoses using biofeedback that is usually covered by insurance.

Incontinence is the involuntary loss of **bladder** or **bowel** control. It is a major clinical problem and a significant cause of disability and dependence. Urinary incontinence, for example, affects all age groups and is particularly common in the elderly. More than 75% of urinary incontinence

sufferers are women. The most recent survey indicates that at least 10 million Americans suffer from urinary incontinence and the average incontinent person spends \$900 for adult diapers and other products with a total national treatment expenditure of some \$10 billion. These include medical costs for care of persons in the community and in nursing homes. Indirect costs such as loss of income from inability to work, or cost of home care, were difficult to estimate.

There are four types of urinary incontinence. They include stress incontinence, urge incontinence, overflow incontinence, and reflex incontinence. In addition, there is fecal (stool) incontinence, for which no subtypes have yet been identified. Incontinence is a symptom of some other disorder and is not a disease itself. It can occur for many reasons such as loss of muscle control due to aging, childbirth, bladder infection, side effects of medication, spinal cord injury, prostate and/or other surgery, overweight conditions,, nervous system disorders (such as Multiple Sclerosis) and diabetes.

Despite its prevalence and implications people often do not report urinary incontinence and often physicians do not treat it comprehensively. Most forms can be cured or significantly improved. Biofeedback is used very successfully and should be considered before surgery.

What to do!

The first thing to do is acknowledge the problem and have it checked out by a professional. There is help available. One way of helping the problem is through biofeedback-assisted muscle re-education. This has no side effects and no contra-indications. However it is important to have a thorough medical examination before biofeedback when incontinence is at issue.

What to expect with biofeedback

You are initially evaluated for pelvic floor muscle activity and strength with a sensor (perimeter). You are shown how your pelvic floor muscles work and how to do a series of "Kegel exercises." These muscle strengthening exercises, which help control the leakage of urine and stool, are

initially practiced with the sensor in place, which gives feedback on a monitor as to your muscle activity and strength. You will be sent home with pelvic muscle exercises that will increase in difficulty weekly. Probably, you will rent a portable biofeedback device to assist you in the initial weeks. As well, it will be necessary to keep a diary of bladder and bowel activity and it will include dietary intake.

How much you improve depends on how much time you devote to the exercises, how well you learn to do them properly, and your own unique physical situation. The training will require, at a minimum, three to six office visits and eight weeks of home training.

Self-help for urinary incontinence

If you have a mild problem and you have checked with your doctor, then you can often help the problem by practicing Kegels yourself. Many women have been taught these before and after childbirth. The motion consists of contracting your pelvic floor muscles as if you were going to stop the flow of urine. You must be careful not to use any other muscles such as your abdomen, buttocks or thigh muscles.

Key Applications of Neurofeedback

Essentially all of biofeedback is ultimately an appeal to the brain, and most conditions responsive to biofeedback are also found to be responsive to neurofeedback. On the other hand, there are some applications for which neurofeedback plays a unique role. The most prominent application is to Attention Deficit Hyperactivity Disorder.

Attention Deficit Hyperactivity Disorder (ADHD/ADD)

Attention Deficit Hyperactivity Disorder is the most prevalent disorder currently diagnosed among elementary school children. It is characterized by distractibility, impulsivity, hyperactivity and inattention. The condition is thought to be partly genetic, but also has a significant environmental component. The good news is that these characteristics yield to neurofeedback training, typically to the point at which the child may no longer meet diagnostic criteria for the condition.

It could be said that the business of the brain is paying attention—not only to the outside world, but also to internal processes, in which the brain monitors its own activities and those of the body. When we train certain brain rhythms we find that hyperactivity, impulsivity, and vigilance improves. Usually children can normalize their behavior with this training so that it is no longer out of line. Some twenty to forty training sessions may typically be required.

Beyond the attentional benefits, other benefits are observed as well, particularly with those aspects of behavior that are often seen together with ADHD. Fewer errors are made on cognitive challenge tests, response time usually improves (if it is slow to begin with), and response time is more consistent. Bedwetting may subside, and nocturnal teeth grinding. Sugar craving may disappear, as well as motor and vocal tics. Obsessiveness can also calm down. Even IQ scores are typically found to improve, and handwriting may suddenly get better. The effect of the training is therefore far-reaching, or to put it another way, the nervous system may simply be under better control, and its tone better modulated.

Significantly, the more severe disruptive behavior patterns that are often seen together with ADHD can also respond. This includes oppositionality, temper tantrums, rages, excessive anger, defiance of authority, patterns of lying, and even the more severe issues of overt aggressiveness, cruelty to animals, starting fights, and fire setting. Some of these children show no remorse, and can be described as cold-blooded. The benefit of training in these latter areas indicates that the neurofeedback can also help with children who are dysregulated in the realm of moods and emotions. It can be helpful with the depressed child, with the anxious child, with the socially insecure and withdrawn. It can be helpful with the emotionally disturbed child. These are all recent findings that have not yet appeared prominently in the pediatric literature.

It is now customary to address ADHD with a variety of medications, including stimulants, anti-depressants, and anti-convulsants. Each of these categories of medication response is addressed differently with neurofeedback. Most children will be able to reduce or even eliminate the need for medication when this training is accomplished.

It is found that when the training is taken to completion, the benefits are observed to hold for the long term. However, ADHD children got to be who they are for a reason. Somehow their nervous systems are more vulnerable than those of other children, whether for genetic, nutritional,

developmental, or family context reasons. These nervous systems are also more vulnerable to subsequent insults, in which case refresher sessions may have to be undertaken.

Neurofeedback for seizures

The field of neurofeedback started around seizures, and that is still a prominent area of application. The training generally makes the brain more stable, and that is of particular relevance for those brain that have a seizure focus or other source of instability. The training may have to be long-term, but some improvement is usually possible, which is observable in improved level of function, reduced number of medications, reduced medication dose and side effects, and perhaps avoidance of brain surgery for intractable seizures. Most people with medically intractable seizures have not had to undergo surgery after doing the neurofeedback training.

Neurofeedback for minor traumatic head trauma and stroke

The consequences of minor traumatic brain injury, whiplash, or post-concussion syndrome, include headaches, body pain, dizziness, nausea, disorientation, depression, effort fatigue, visual disturbances, auditory processing deficits, sleep problems, tinnitus (ringing in the ears), irritability and anxiety, and even personality changes or instability. There is no conventional medical treatment for such head injury symptoms; however, all of them usually respond to neurofeedback training. Such symptoms resolve to an average level of 80% (by self-report) within an average of 35 training sessions. Recoveries tend to hold for the long term, as the brain continues to employ its recovered capacities. The training may be fruitfully conducted at any time after the injury—even years later. Some natural ("spontaneous") recovery is expected early after head injury, but the EEG training can speed the process.

Significant recovery can be achieved for stroke as well. Many of the consequences of stroke are not localized to the site of injury, and are similar to those listed above for minor head injury: sleep problems, irritability, mood variability, depression. These typically respond to the training rather early. The specific deficits attributed to the stroke—gait, speech, one-side weakness or neglect, take more time for recovery, and also the recovery may not be complete. There may be benefit to continued long-term training on an episodic basis, as the brain gradually builds on its recovered capacities.

Neurofeedback for depression

Neurofeedback can be used to retrain the brain out of depression. It is now increasingly recognized that depression is on a continuum with anxiety. Whereas anxiety responds more readily to peripheral biofeedback intervention, depression seems to respond more readily to neurofeedback. The training also addresses the sleep dysregulations that are typically seen in the context of anxiety and depression. Much of ADHD may also be affected by a depressive or anxiety component. Regulation of mood states may turn out to be one of the most prominent applications of neurofeedback.

Neurofeedback for addictions

The latest breakthrough in the field of neurofeedback is with respect to addictions, where conventional treatment has a notoriously bad record. Over the last ten years, neurofeedback has been found effective in keeping people in treatment successfully, and ultimately in maintaining sobriety after discharge from the treatment program. Secondly, neurofeedback can be helpful with some craving issues, because brain function can be normalized so that there may no longer be the physiological dependency on the substance. Thirdly, it has helped in terms of personality measures (which were thought to be stable!). This is particularly important because much of addiction is sustained by issues of early trauma, and the training helps to resolve those issues.

The success in relapse prevention has been most solidly demonstrated for alcoholism, with follow-up data now available for ten years post-treatment. More recently, these findings have been reproduced also for cocaine, methamphetamine, and heroin addictions. The training involves both the high-frequency SMR-beta training and the low frequency Alpha-Theta training, and must be conducted by a suitably trained mental health professional. In all of the above research studies, the training was combined with conventional treatment which involved individual and group therapy, as well as continuing involvement with 12-step programs to aid in the maintenance of sobriety.

Resources for Biofeedback and Neurofeedback

For information or for therapists in your area:

National Organizations:

Biofeedback Certification Inst. of America (BCIA)

Offers listing of certified biofeedback and neurofeedback practitioners nationwide

10200 W. 44th Ave, #304

Wheat Ridge, CO 80033-2840

(303) 420-2902; FAX (303) 422-8894

Assoc. for Applied Psychophysiology & Biofeedback (AAPB)

The international organization for biofeedback professionals

10200 W. 44th Ave, #304

Wheat Ridge, CO 80033-2840

(800) 477-8892, (303) 422-8436 FAX (303) 422-8894

Society for Neuronal Regulation (Neurofeedback)

State chapters:

Biofeedback Society of California (BSC)

P.O. Box 4384

Huntington Beach, CA 92605-4384

(800) BSC-6966

Biofeedback Society of Texas

P.O. Box 160097

Austin, Texas 78716-0097

(512) 328-9639

Specific Applications:

Pain Management

Vulvar Pain Foundation

Newsletter; Cookbook; Regional Meetings;

Networking; Referral list for biofeedback

P.O. Box 177

Graham, NC 27253

(910) 226-0704 FAX (910) 226-8518

www.vulvarpainfoundation.org

Incontinence

Resource for biofeedback information for incontinence

www.incontinet.com

Imagery and Relaxation

Academy for Guided Imagery (AGI)

Professional training; practitioner referral list; tapes and literature.

P.O. Box 2070 Mill Valley, CA 94942

(800) 726-2070 FAX (415) 389-9342

www.healthy.net/agi

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Donald W. Novey M.D.

Published by Mosby, a Harcourt Health Science Company.

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