



# ***THE SCIENCE OF BIOFEEDBACK***

## ***for INNERACTIVE AURA VIDEO BIOFEEDBACK IMAGING SYSTEMS***

The following articles and scientific papers will give you a good basic overview of the Science of Biofeedback, which forms the scientific basic of all Inneractive AURA VIDEO SYSTEMS. The **unique combination of Biofeedback, Color Psychology, Energy Medicine Knowledge, Aura & Chakra Information with a colorful, intuitive Multimedia Interface and Technology** transforms Inneractive's AURA VIDEO SYSTEMS into a new dimension of way beyond regular biofeedback technology.

### ***An Overview of Biofeedback***

*"Know thyself." - Socrates*

The human nervous system is the most complex communication system known to exist in the universe. It has more interconnections (synapses) than there are stars in the sky. The nervous system regulates, controls, and coordinates the moment-by-moment flux of thousands of chemical constituents in the body, organ function, all our movements, our perceptions of the world, our thoughts, emotions, learning, and interpersonal communication, and links us spiritually to the unity of the cosmos. Most of this activity happens unconsciously and automatically, without our knowledge or effort.

In the human nervous system, patterns of nerve transmission that are repeated often become ingrained and habituated—even if they are not adaptive or healthy. When we are confronted with different stressful situations—anything from a sudden stop in traffic to being interviewed for a job—our bodies respond in much the same way, with the "fight or flight response." We automatically prepare to either fight the stressor or run from it: our heart rate increases, muscles tense, breathing becomes more shallow, we start to sweat, our minds race, etc. But this ancient unconscious pattern, which once provided human beings with the responses necessary for self-protection in a challenging physical environment, is today the root cause of many stress-related illnesses and a reduced quality of life.

Throughout our lives, as we confront the various stressors that occur every day, we respond by constantly tensing and relaxing. Eventually, after each instance of tensing, we cease to return to our original level of physiological relaxation. Thus, through the years we establish a stair-step pattern: we adapt to increasing levels of physiological activity. In so doing, we lose familiarity with deeper levels of relaxation and get used to greater levels of tension as the norm. This habituation to unnecessary physiological activity has a wearing effect and can cause such conditions as high blood pressure, headaches, digestive problems, and other illnesses.

Physiologically, this habituation occurs on the level of the autonomic nervous system, a major division of the nervous system that includes two principal subdivisions: the sympathetic and parasympathetic. The system is called "autonomic" because many of the functions under its

control are self-regulating or autonomous; the individual is not usually aware of or able to control its function. Examples of autonomic functioning include dilation of pupils of the eye and acceleration of the heart rate in response to stress.

Although we are often not aware that these responses are occurring, they can have a cumulative negative effect on our health. If we can change these responses, we can eliminate much discomfort and illness and enhance our general quality of life.

Within the last 25 years, we have learned how to recognize this kind of habituation and re-train ourselves to achieve lower levels of physiological activity through biofeedback. In doing so, we learn to control ourselves in a way that was once thought to be impossible, and achieve a deeper understanding of ourselves and our relation to the world around us.

### **What Is Biofeedback?**

Simply put, biofeedback 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. Using a thermometer to take our temperature is a common kind of biofeedback. Clinical biofeedback follows the same principle, using specialized instruments to monitor various physiological processes as they occur. 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 training familiarizes us with the activity in our various body systems so we may learn to control this activity to relieve stress and improve health. Trying to change physiological activity without biofeedback is like playing darts while blindfolded--we can't see whether we are hitting the mark or not. Biofeedback lets us know when we are changing our physiologies in the desired direction.

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 learn to control them rather than having them control us.

In his book, Biofeedback: A Practitioner's Guide, *Mark Schwartz* defines biofeedback as

"(1) a group of therapeutic procedures that (2) utilizes electronic or electromechanical instruments (3) to accurately measure, process, and 'feed back' to persons (4) information with reinforcing properties (5) about their neuromuscular and autonomic activity, both normal and abnormal, (6) in the form of analog or binary, auditory and/or visual feedback signals. (7) Best achieved with a competent biofeedback professional, (8) the objectives are to help persons develop greater awareness and voluntary control over their physiological processes that are otherwise outside awareness and/or under less voluntary control, (9) by first controlling the external signal, (10) and then by the use of internal psychophysiological cues."

In a typical biofeedback session, the client is seated in a comfortable chair and hooked up to the biofeedback instrument with sensors attached to the surface of the skin at various locations on the body (usually the shoulders, fingers, back, and head). Electrical impulses from these locations are

recorded and reflected on a computer monitor in the form of graphs or other visual displays such as mandalas. Additionally, the client may receive auditory feedback reflecting increases and decreases in body system activity in the form of higher and lower musical tones.

Before beginning training, the client's baseline measures in the various modalities are recorded without feedback, to give the clinician a picture of his or her overall psychophysiological state. At BRI, this comprehensive evaluation takes 32 minutes, during which readings are taken for 5 minutes with eyes closed, 5 minutes with eyes open, 15 minutes of discussion, and 7 minutes of eyes closed self-soothing. The clinician then chooses to begin training by focusing on the most appropriate physiological system, as indicated in the initial evaluation. At BRI, the client may be directed to pay particular attention to one physiology, while information on the other body systems is monitored by the clinician. While the client is observing the activity of a particular system onscreen, audio feedback in the form of musical tones is also being presented, reflecting activity in the same system or a different one.

Every individual exhibits a unique set of characteristic psychophysiological patterns that reflect the various accommodations to stress that he or she has made over the years. The goal of biofeedback training is to gain self-regulatory skills with which to adjust the activity in various systems to optimal levels for the task at hand. At the Bio Research Institute (BRI), we have found that clients have greater success when they train toward a specific range of activity in each modality that our research has found to be both possible and desirable, rather than simply training to reduce activity. We call these ranges the goal zones.

### **Biofeedback Modalities**

Many physiological processes can be monitored for biofeedback applications. Some of the more common ones are:

#### **Temperature**

Temperature is measured by sensors placed on the ring fingers. The temperature modality indicates the contraction or relaxation of the smooth muscles surrounding the blood vessels, which determine how much blood reaches the fingertips. When these muscles are contracted (tense), the temperature is cooler because less blood reaches the fingers. We experience this coldness in our hands when we are stressed--for example, when going to a job interview and shaking hands with a prospective boss.

It is not uncommon for people's temperature readings to be as low as 70 to 80 degrees Fahrenheit, nor is it uncommon to see a difference of five or ten degrees between right and left hand measures. The brain is organized so that right hemisphere is associated with activity in the left side of the body, and the left hemisphere is associated with activity in the right side of the body. Some clinicians believe that when one hand is significantly colder than the other, this represents an imbalance in the activity of the right and left hemispheres of the brain.

At BRI, the goal of training is to achieve a balance between right and left hand temperatures in the range between 94 and 98 degrees Fahrenheit.

## **EMG**

Muscle activity is measured by the EMG (electromyograph), which detects the electrical activity occurring within certain muscles, typically the trapezius (shoulder) and anterior temporalis (jaw and scalp) muscles. Muscle tension indicates stress; for example, it is common for people to react to the stress of anger by clenching their teeth and generally tensing up.

To measure EMG, the skin is cleaned and adhesive sensors with a conductive gel are attached to the shoulder muscles. At BRI, the jaw and scalp sensors placed on the outer forehead are small silver discs held in place by an elastic headband. Muscle activity is measured in microvolts, and it is not uncommon for levels to range from 5 to 40 microvolts.

At BRI, the goal of training is to quiet muscle activity to a range between .5 and 2.5 microvolts.

## **EDA**

Electrodermal activity (EDA) is measured at BRI in two ways: BSR (basal skin response) is a measure of the average activity of the eccrine (sweat) glands, and GSR (galvanic skin response) is a measure of the phasic activity (the high and low points) of eccrine gland activity. Most people are familiar with having cold, clammy hands under stressful circumstances, such as meeting new people or having to perform before an audience. The coldness comes from constriction of the smooth muscles surrounding the blood vessels (measured by Temp), while the dampness is caused by eccrine gland activity. The eccrine glands secrete a salty solution in response to emotional and stress stimuli, and this salty solution conducts electricity.

BSR sensors are attached with elastic bands to the first and second fingers of the right hand. It is not unusual for people to measure between 150 and 500 kilohms without training.

The goal of training at BRI is to reduce eccrine gland activity to the range between 800 and 1200 kilohms.

## **Heart Rate**

Heart rate is measured in beats per minute. Faster heart rates are often caused by stress; for example, our hearts may race and pound when we are afraid. Other kinds of stress, such as depression, may result in lower heart rates.

To measure heart rate, the inside wrists are cleaned and three silver sensors with conductive gel are slipped under elastic wrist bands. Heart rate can also be measured at the fingertips. The goal of training at BRI is to achieve a heart rate between 56 and 66 beats per minute.

## **Respiration**

Respiration is measured in breaths per minute, typically by a strain gauge worn around the chest. At BRI, it is measured by the same sensors that are used to measure shoulder muscle activity. Our respiration becomes faster, shallower and uneven when we are stressed, for example, when we gasp in surprise or feel short of breath when frightened. It is not unusual for people to have a breath rate of between 16 and 30 per minute prior to training.

The goal of training at BRI is to reduce breath rate to 6 to 12 breaths per minute.

## EEG

Brain waves are measured by the electroencephalograph (EEG). EEG is comprised of several bandwidths: Theta (4-7 Hertz), Alpha (8-12 Hz), Beta (13-20 Hz), Gamma (21-Up). The overall purpose of EEG training is to develop range of motion among bandwidths, so that the client knows what each bandwidth feels like and how to use each state for its characteristic benefits. Speaking very generally, beta and gamma are useful for directed activity and getting things done; alpha is useful in situations where relaxed vigilance is called for (such as meditation); and theta is useful for creative, day-dreamy generation of imagery (theta is sometimes called the gateway to the unconscious).

At BRI, brain wave measurements are typically recorded through silver discs placed in a bipolar montage at three locations: FPZ, the base of the scalp to the right of center (occipital 1), and the base of the scalp to the left of center (occipital 2).

Unlike some of the body measures, EEG is a very complex phenomenon. BRI has dedicated years of research exploring and interpreting EEG data to establish a unique training protocol called BioIntegration, which complements and enhances body measure training.

Amplitude density is an exciting measure that reflects the activity of the brain as it occurs, revealing both how much activity is occurring and how often it occurs in each bandwidth. Amplitude density is measured in microvolts per second.

Standard EEG measurement at BRI includes measurement of right and left brain activity.

Brain waves respond to subtle psychophysiological conditions, such as whether the eyes are open or closed, whether or not we are speaking, and the content of our thoughts. At BRI, EEG training generally aims first at reducing activity in the 13-35 Hz bandwidth (beta-gamma). This bandwidth typically characterizes our waking state and often accompanies unnecessary tension we habitually carry in our bodies. When a client becomes familiar with how this bandwidth feels, he or she can recognize it and move out of it to accomplish certain goals, for example, to relax.

When the client has learned to reduce activity in the beta and gamma bandwidths (13-35 Hz), training is continued to enhance the production of alpha activity. When the client has learned how to generate increased alpha activity, training moves on to encourage the client's ability to generate theta waves.

Other biofeedback modalities include electrogastrography (EGG) to measure stomach functions; strain gauges to monitor penile erections; and moisture sensors to indicate bladder incontinence.

It is advantageous for clients to receive feedback in many modalities at once, even if the practitioner chooses to address a specific condition by working primarily with one modality (e.g., using Temperature training as a means of reducing migraine headaches). Multimodal training recognizes that the human being is a complex whole, whose various systems are constantly interacting in an effort to achieve a point of homeostasis (balance). When a client receives information about several psychophysiological systems during training, he or she can develop an understanding of the interrelationships that support his or her usual psychophysiological state and has more choices in terms of self-regulation skills.

## **Indications for Training**

Clinical biofeedback is used successfully in the following applications:

- Anxiety disorders
- Mild depression
- Epilepsy
- Headaches
- Concentration improvement for education and meditation
- Control of brain waves for spiritual development and inner
- Tranquillity
- Musculoskeletal disorders involving chronic muscle tension
- Relaxation therapies
- Stress management techniques
- Neuromuscular re-education of gait mechanics
- Chronic pain syndromes
- High blood pressure
- Asthma
- Circulatory problems such as Raynaud's disease
- Temporomandibular joint syndrome (TMJ), jaw pain and dysfunction
- Bruxism (teeth grinding, often at night)
- Urinary incontinence (bedwetting, nocturnal enuresis, leaky bladder)
- Fecal incontinence
- Attention Deficit Disorder

Although biofeedback training may focus specifically on one psychophysiological system as a means of addressing a particular presenting complaint, clients are soon reminded of the holistic

nature of the human organism as they observe that changes made within one system create changes in all other systems, to greater or lesser degrees.

It is a mistake to think of biofeedback training in any one modality as the hammer that pounds the nail of a certain problem, leaving the rest of the structure unaffected. At BRI, as clients discover the interrelationships that exist between psychophysiological systems, they learn to create a "mix" that addresses their presenting complaints and shows them a path out of habitual patterns of consciousness and behavior, facilitating personal and evolutionary development. We call this "BioIntegration"--the process by which an individual, through multi-modality training, links internal and external life events such that he or she is able to make more real-time choices instead of being unconsciously dominated by habitual patterns.

Thus, biofeedback training has long-range implications that go beyond the notion of "fixing what ails you." While the training is certainly beneficial for a wide range of complaints and provides relief from and mastery over many conditions in a gentle and completely noninvasive way without the use of drugs, it inevitably does more than that. It awakens the realization that we have the power to make lasting changes in our bodies and minds, and the accompanying opportunity to direct these changes for life-enhancing benefits.

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## *Biofeedback Basics*

### **Introduction to Biofeedback for a Person beginning to Receive Personal Training**

Biofeedback is a coaching and training process which helps people learn how to change patterns of behavior-- physiological response patterns-- to take greater self responsibility for their health and for their mental, physical, emotional and spiritual functioning.

In all biofeedback, some form of technology is used to provide extra information beyond the ability of normal senses about some bodily (physiological) function. The person first uses the information as feedback to increase awareness or consciousness of the changes in the body/mind function. Then, the feedback is used to learn to develop new levels of voluntary self control over the function.

Biofeedback training usually involves the following body measures:

- EMG (electromyograph= muscle) for relaxation, muscle pattern optimization, sports performance,
- EEG (electroencephalograph= brain waves,) Attention, mental clarity, relaxation, meditation
- Thermal (blood flow in fingers and toes,) relaxation
- Respiratory (breathing,) relaxation
- SCL (Skin Conductance Level= related to sweat gland activity,) relaxation

Studies have shown that after adequate training, including training to transfer the self control skills to real life, people automatically and effortlessly use the skills they've learned in biofeedback.

Usually people use the skills to bring aspects of their life into better balance and to function at a higher, more optimal level. If they have anxiety, stress, attention, or performance problems, these will often respond very well to biofeedback training, usually either disappearing altogether or decreasing in frequency, severity, intensity and duration.

Once you learn to voluntarily control what were previously involuntarily, subconsciously, or habitually controlled behaviors, you then go on to develop new, positive automatic self-responsible habits. It's like riding a bike. Once you learn it, you can do it. You don't have to re-learn it, though you may be a bit wobbly if you don't ride for ten years.

With biofeedback you learn skills which you will use and practice on a regular basis. It is not a treatment that is done to you. It is a learning process which you integrate into your repertoire of inner strengths and skills. A good trainer will combine biofeedback with the activities which challenge you, such as reading, studying, problem solving, concentrating. You learn to recognize how it feels when you are focusing more effectively and when you are spacing out, allowing yourself to become distracted.

If you exercise in a gym, lifting weights and using muscle building machines, after 30 or forty sessions your muscles will be bigger. If you keep at the exercise, they will stay that way. If you just stop exercising altogether, the new muscle tissue will go away. It is believed that with brainwave biofeedback, a similar process occurs. Over the course of thirty or forty sessions, more blood flows to the areas of the brain being trained and eventually, more blood vessels grow there, increasing the vascularization of that part of the brain. PET scan studies seem to support this theory.

If you continue to use your brain-- i.e., keep exercising it-- at the new level, then the improvements are retained-- even without the continued use of biofeedback for most people.

When it comes to ADD, the results are sometimes good enough so people can stop or reduce meds. Sometimes the results are only improvements in aspects meds don't help.

The same is true for other forms of biofeedback. Sometimes hypertensives get off all meds, sometimes they cut back, sometimes the blood pressure just becomes more stable. Headache sufferers whose headaches have been occurring because of less than optimal physiological balance and susceptibility to stress often rid their lives of headaches.

One variable in all this is responsibility . Biofeedback requires that the client work at it, do homework and take self responsibility for practice. It is not something one passively has done to oneself. This is often the reason for failures. The biofeedback process is not going to work if you don't . Of course other valuable things, like freedom, intelligence, opportunity are like that too.

On the other hand, some people do not respond to biofeedback through no fault of their own, for various reasons. But it's worth a try.

The biofeedback approach offered at the Center for Optimal Living is oriented toward helping the individual learn skills which empower him or her to take greater self responsibility for health and all the other dimensions of functioning life. It is not a treatment or therapy. It is a coaching and training process.

Some of the areas in which biofeedback has proven helpful by teaching people to optimize their mind/body functioning:

- \* Headache-- Tension, Migraine, Mixed, etc.
- \* Stress / Panic Disorders,
- \* Anxiety
- \* Chronic Pain, Fibromyalgia
- \* Creativity, Personal Growth
- \* Consciousness Exploration
- \* High Blood Pressure
- \* irritable bowel, colitis
- \* incontinence
- \* immune system functioning: HIV, cancer,
- \* arthritis pain and related mobility
- \* diabetic neuropathy, wound healing & claudication
- \* Traumatic Brain Injury TBI or MTBI
- \* Post Traumatic Stress Disorder (PTSD)
- \* premenstrual Syndrome (PMS)
- \* Sleep Disorders
- \* Stroke
- \* Alcoholism/Addiction
- \* Bruxism (teeth grinding)
- \* Depression, Poor Self Esteem,
- \* Smiling, laughter & deeper Emotional expression

Neurobehavioral Continuum:

- \* "Attention Deficit Disorder" (ADD/ADHD)
- \* ODD Oppositional Defiance Disorder
- \* OCD Obsessive Compulsive Disorder
- \* Tourette's Syndrome
- \* Autistic disorders
- \* Conduct and Rage Disorders
- \* Chronic Fatigue Syndrome
- \* Learning Disabilities
- \* Epilepsy

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