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Biofeedback

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SO WHAT EXACTLY IS BIOFEEDBACK?

Stedman's Medical Dictionary cites biofeedback as "A training technique that enables an individual to gain some element of voluntary control over autonomic body functions; based on the learning principle that a desired response is learned when received information such as a recorded increase in skin temperature (feedback) indicates that a specific thought complex or action has produced the desired physiological response".¹

Instrumented biofeedback was pioneered by O. Hobart Mowrer in 1938, when he used an alarm system triggered by urine to treat bedwetting in children (variations on his system are still used by some practitioners today). But it was not until the late 1960's, when Barbara Brown, Ph.D., at the Veterans Administration Hospital in Sepulveda, California, and Elmer Green, Ph.D., and Alyce Green of the Menninger Foundation in Topeka, Kansas used EEG biofeedback to observe and record the altered states / self-regulation of yogis, that biofeedback began to attract widespread attention).²

The pioneering work of Drs. Elmer and Alyce Greene in the application of biofeedback during the 1970's proved beyond any doubt that we could in fact consciously control aspects of our visceral functioning. Such functions as muscle and arterial tone, stomach acid excretion, brainwave activity and emotions which were previously thought to be controlled exclusively by the unconscious or autonomic nervous system.

This was a blow to the credibility of the dogmatic medical model which presumed that people could not control much bodily functioning and that pharmaceutical agents and surgical interventions were the only panacea for illnesses. Biofeedback was also of paramount importance in not only proving our control over our bodies, but it also proved that we can often be the cause of our illness.

Biofeedback has since expanded to many physiological changes that can be measured, and where those measurements could be "fed back" to the subject.

Biofeedback training is a method for becoming more aware of, and gaining more conscious control of bodily processes in order to increase relaxation, relieve pain, and develop healthier, more comfortable life patterns, enhancing both functioning and performance by using physiological signals from the body.

The word "biofeedback" was coined in late 1969 to describe laboratory procedures (which were developed in the 1940's) that trained research subjects to alter brain activity, blood pressure, muscle tension, heart rate and other bodily functions that are not normally considered to be under voluntary control.

HOW IS IT DONE?

The use of biofeedback provides a person information about themselves by means of external instruments.

Using a thermometer to take our temperature when we are sick is a common kind of biofeedback that everyone is familiar with. Biofeedback lets us know when we are changing our physiology in the desired direction.

Biofeedback training then is not really a 'treatment', but rather, it is an educational process for learning specialised mind / body skills which enable us to exert more control over the body's physiological processes.

Common physiology monitored through the use of biofeedback includes EEG (brainwave activity), skin conductance and temperature, heart rate and heart rate variability, breathing patterns including RSA (respiratory sinus arrhythmia) and sEMG (surface electromyography or electrical muscle activity).

Recording is non-invasive and painless utilising electrodes and specialised sensors placed strategically on the skin with non-allergenic conductive gel or paste.

During biofeedback subjects are "fed back" information with reinforcing properties about their neuromuscular and autonomic activity, both normal and abnormal, in the form of analogue or binary, auditory, kinesthetic and / or visual feedback signals.

The use of biofeedback as an intervention is "holistic" in the sense that it emphasises the wholeness of the human organism.

That is, changes within one body system create changes in all other systems, to greater or lesser degrees.



Diagram: EEG Biofeedback in action

Clinical biofeedback follows the principle of using specialised 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. Some biofeedback systems use games and picture puzzles for training.

Many different physiological processes can be monitored and used in biofeedback applications.

As already mentioned, some of the more common physiological measures used in clinical biofeedback are:

TEMPERATURE

Peripheral temperature is an indirect index of peripheral vasoconstriction. Measured by sensors placed on the finger, temperature is a useful measure and training protocol in such conditions as diabetes mellitus, migraine, Reynaud's disease, and stress reactivity.³

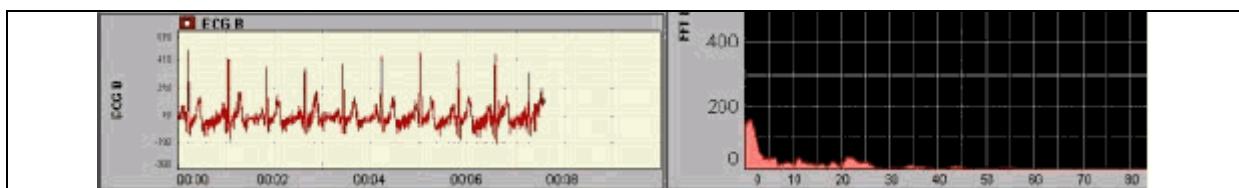
SURFACE EMG (ELECTROMYOGRAPH)

Surface electromyography (sEMG) is the recording of muscle action potentials with skin surface electrodes, and is used as an indicator of muscle recruitment. Both the magnitude and timing pattern of muscle recruitment can be displayed, along with the activity of certain muscles in relation to others.

A typical placement is the frontalis (forehead) or the trapezius (shoulder) muscles, however the technique can be successfully applied to most parts of the body.

The sEMG display is a rich source of motor learning information for patients. Using sEMG, patients gain access to muscle feedback that is far more sensitive than that obtained with the intrinsic senses acting alone.

This feedback helps patients learn to relax overly tense muscles, better activate weak muscles, or change the coordination pattern among agonist, antagonist, and synergist muscles. Applications cover a broad scope of situations including athletic injury, repetitive strain and worker injury, injury due to motor vehicle accident, chronic pain management, asthma, constipation, diabetes mellitus, incontinence, fibromyalgia, headaches, hypertension, neuromuscular re-education and prosthesis control, stress reactivity, temporomandibular disorders, and tinnitus.^{3, 7}



EDA (ELECTRODERMAL ACTIVITY OR SKIN CONDUCTANCE)

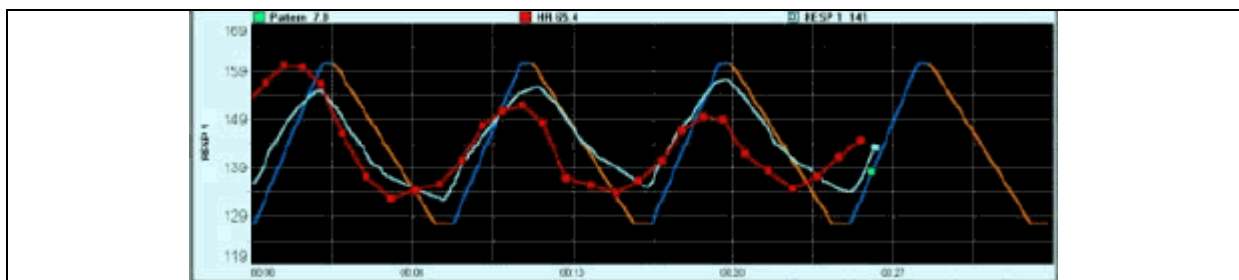
Measured by determining either BSR (basal skin response) or GSR (galvanic skin response) and the percentage rise from basal measure to that after stimulus. SCR, or skin conductance response refers to changes from base line levels. A finger placement of the sensor is generally used. The use of skin conductance is useful in ambulatory monitoring, sweat gland monitoring³ and hyperhidrosis, [anxiety](#) (an anxious thought or feeling which triggers a sympathetic response is usually followed by an electrodermal response. The latency of the response is about two seconds.)⁸ It is generally regarded as a measure of autonomic arousal.³

HEART RATE AND HEART RATE VARIABILITY

Measured in beats per minute, heart rate variability is derived from the electrocardiogram, and is a measurement of the naturally occurring, beat-to-beat changes in heart rate.

It is now recognised that the rhythm of a healthy heart under resting conditions is surprisingly irregular. This irregularity or variability is an indicator of both physiological resiliency and behavioural flexibility, reflecting the person's capacity to adapt to stress and environmental demands. A large degree of instability, or too little variation is detrimental to efficient physiological functioning. Optimal variation is necessary.⁹

The inside wrists of a subject are cleaned and sensors with conductive gel are slipped under elastic wrist bands to measure a person's heart rate (pulse). Faster heart rates are often caused by stress and hence this measure is often used in stress and [anxiety conditions](#). Aspects of heart rate variability have been utilised to effect autonomic homeostasis.⁴ (See the [Heart Rate Variability](#) article for more on HRV).



RESPIRATION

Measured in breaths per minute, typically by strain gauges worn around the chest and abdomen. This dual method is particularly useful in learning how to breath abdominally (diaphragmatically), and therefore in any conditions to do with the respiratory system. Baseline respiratory sinus arrhythmia (RSA, the normal breathing related beat-to-beat fluctuation in heart rate) changes with various factors and disease states including: age, coronary artery disease, hypertension, depression, and asthma.⁵ RSA has been widely investigated as a measurement on autonomic regulation.⁶ The use of breathwork to control anxiety attacks is well documented. Cognitive training is enhanced by breathwork and RSA breathing is utilised in a number of conditions including some cardiac conditions.³

EEG

Brain waves are measured by the electroencephalograph (EEG). The EEG is comprised of several bandwidths including: theta (4-7 Hz.), Alpha (8-12 Hz.), beta (13-20 Hz.), Gamma (21+ Hz.). EEG biofeedback has been used in addictions, attention deficits with and without hyperactivity, mood and behavioural disorders, peak performance training and epilepsy.³ See the [EEG biofeedback article](#) for more information on EEG biofeedback.

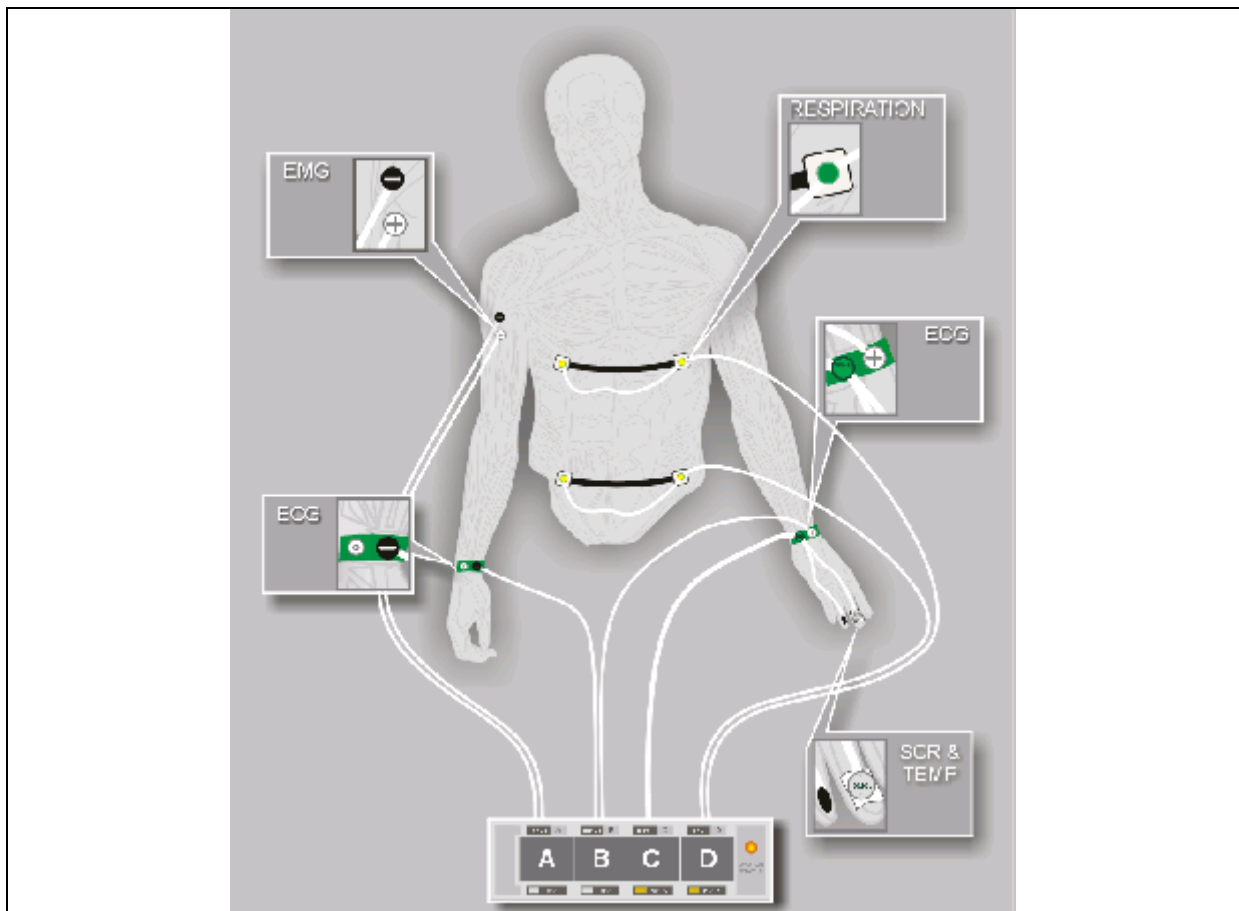


Diagram: Main Screen from J&J Engineering's "USE-3 Physiolab" showing typical placements of sensors and electrodes.

CONCLUSION

Biofeedback machines can detect a person's internal bodily functions with far greater sensitivity and precision than a person can use the intrinsic senses alone. Both participants and therapists use the information gathered from these machines to gauge and direct the progress of treatment.

Although most allopathic physicians initially viewed biofeedback practices with scepticism, researchers have repeatedly shown that it is possible for people to consciously control so called involuntary responses with training by being "fed back" the information either visually, kinesthetically or audibly about what was occurring in their bodies. Through clinical research and application, biofeedback techniques have expanded into widely used procedures that treat an ever-lengthening list of conditions.

Biofeedback research has shown that individuals can learn to consciously control brainwave activity, cardiovascular and respiratory functioning, reduce skin temperature, and voluntarily modify many autonomic processes as the table below illustrates.

1. OSTEOLOGY

- Neck and lower back pains
- Whiplash (up to 75% of all fibromyalgia sufferers had whiplash prior)
- Muscle tension
- Jaw pain and dysfunction

2. JOINTS

- Temporomandibular joint syndrome (TMJ)

3. VASCULAR

- High Blood Pressure

- Cardiac arrhythmias (abnormalities in the rhythm of the heartbeat)

4. NERVOUS SYSTEM

- Bruxism (teeth grinding, often at night)
- Tension headaches
- Attention Deficit Hyperactivity Disorder
- Migraine headaches
- Epilepsy
- Paralysis -Spinal cord injury and musculoskeletal disorders
- Mental disorders
- Phobias
- Panic & Anxiety disorders
- Mood disorder
- Mild depression

5. DIGESTIVE SYSTEM

- Acute and chronic pain of the digestive system
- Faecal incontinence

6. RESPIRATORY SYSTEM

- Asthma

7. URINARY SYSTEM

- Bedwetting - nocturnal enuresis
- Leaky bladder
- Urinary incontinence (a condition affecting up to 30 percent of elderly people living independently)

8. REPRODUCTIVE ORGANS

- Premenstrual Syndrome
- Menorrhagia (excessive menstruation)
- Menstrual Disorders
- Herpes
- Sexual Dysfunction
- PMS

9. IMMUNE SYSTEM

- Tonsillitis

Repeated studies have demonstrated that we have more control over so-called involuntary (autonomic) bodily functions than Western medicine once thought possible. As a result, biofeedback when properly applied, can offer individuals techniques for living a healthier life overall, whether afflicted with a medical condition or not. Biofeedback techniques have been widely utilised in enhancement and peak performance training.

FURTHER READING SUGGESTIONS

- Anxiety
- Heart Rhythms and Heart Rate Variability (HRV)
- Neurofeedback - EEG Biofeedback - a Drug-Free Strategy for ADHD, Learning Disorders and Other Conditions
- See also EEG and QEEG biofeedback references in the:
Comprehensive Neurofeedback Bibliography, By Prof. D Corydon Hammond

LINKS

PLEASE NOTE :

Learning Discoveries offers the links below as a convenience to our clients and the users of this website. However, we do not control third party websites and we are not responsible for the websites content.

- **Biofeedback Society of California (BSC)**

<http://www.biofeedbackcalifornia.org/>

BSC is the oldest guild in biofeedback. BSC is more than an 'organization.' We are a group of professionals joined together by a common bond to promote, advance and protect biofeedback skills. BSC is a friendly place for beginning and established health providers to find out about the latest scientific discoveries in bio-technology. We are most interested in how bio-technology can apply to meaningful self-regulation skills for the advancement of health and well-being.

- **Brain and Mind – Electronic Magazine on Neuroscience**

<http://www.cerebromente.org.br/>

- **International Society for Neurofeedback & Research (iSNR)**

<http://www.isnr.org/>

The premier international organisation for EEG biofeedback and QEEG

- **J & J Engineering**

<http://www.jjengineering.com/>

J&J Engineering has dedicated its resources to providing clinicians and researchers in a wide range of disciplines with the most advanced, reliable, and easy to use physiological monitoring and data acquisition systems. This dedication has resulted in the broad use of its systems in clinics, universities, and research facilities worldwide

- **Pennsylvania Society for Behavioral Medicine & Biofeedback**

<http://www.pabiofeedback.org//index.html>

The Society's main purpose is to bring together professionals who share research, scientific, and clinical interests in biofeedback. We focus on the use of biofeedback to enhance harmony through teaching self-awareness through self-regulation.

- **The Association of Applied Psychophysiology and Biofeedback (AAPB)**

<http://www.aapb.org/>

Has many references and shows a rated scale of effectiveness of the forms of biofeedback in many conditions

- **The Biofeedback Foundation of Europe (BFE)**

<http://www.bfe.org/>

The Biofeedback Foundation of Europe sponsors education, training and research activities in biofeedback.

- **Thought Technology Ltd**

<http://www.thoughttechnology.com/>

The world's leading biofeedback and psychophysiological instrument manufacturer. Their products include clinical grade and portable instrumentation from 1-40 channels, coupled with a wide range of software, educational programs and biofeedback supplies.

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