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Common Modalities of Biofeedback

These are the major biofeedback modalities. They are explained in isolation, so that as they are mentioned with regard to treatment of disorders, the reader might have a rough sense of the procedure.

Electromyography biofeedback (EMG) uses a surface electrode to measure muscle tension, and by displaying this information on a screen, patients can directly see their muscle tension and learn how to reduce the tension. In most systems, the resolution is one microvolt or better, which is one millionth of a volt. This very small amount of electricity indicates more muscle tension with more microvolts. By learning to relax one’s own musculature, physical tension can be brought under control. This can be especially helpful for those suffering with tension headaches or any disorder in which muscle tension release would be helpful (e.g., arthritis).

Temperature training can be very useful for general relaxation, hypertension, headaches, and tinnitus. The sensor is sometimes called a “thermistor,” and can measure temperature to a very fine degree. This is taped to the skin, usually one of the fingers. A display shows how the temperature changes. A lower temperature usually indicates anxiety, while higher temperature correlates with being relaxed. The patient is trained to increase the temperature by imagining the hand getting warmer, or by various autogenic phrases, such as “My hand is getting warm and heavy,” or by visualizing themselves on a pleasantly warm beach. The patient is asked to practice such exercises at home, sometimes with a small handheld temperature device which can be purchased in an electronics store. The goal might be to get to 95 degrees for 10 minutes in a row, and they may have to practice this every day, twice per day, for a number of weeks before achieving this on a regular basis. Temperature training has been used successfully with hypertension, Raynaud’s disease, migraines, and anxiety. As with many biofeedback techniques, temperature training is often combined with other modalities.

Skin conductance biofeedback measures the electricity emitted from the skin. This is accomplished by putting two sensors on the skin (often two fingers separated by one finger). This is also known as galvanic skin response (GSR) or electro-dermal activity (EDA). This electrical activity is produced by sweat from the skin, and is correlated with relaxation when the measure goes down, and with anxiety when the measure goes up. If a practitioner mentions something stressful, for example, this very sensitive measure of emotion will register, providing a measure of stress or emotional reactivity. By learning to calm one’s skin conductance in the context of some stressful suggestion, relaxation and desensitization can result.

In heart rate variability training, the measure is the variability of the heart rate, which in healthy people varies as much as 10 beats from the lowest (often on the exhale) to the highest (often as one inhales). It is asserted by experts in heart rate variability training (HRV) that by learning to coordinate one’s respiration with the heart rate variability, a physiological coherence is attained which can be very therapeutic (Lehrer, 2007). (A previous conceptualization was termed Respiratory Sinus Arrhythmia, or RSA.) A simple sensor is attached to a finger or an ear lobe, which measures the pulse, and a display shows the heart rate. For young people, a display of an animation is sometimes used. By employing relaxed breathing and coordinating this with the HRV, a calmness can result and produce an autonomic balance of the parasympathetic and sympathetic nervous systems. In many disorders, this kind of training can be helpful, including cardiac conditions, hypertension, anxiety, and any disorder which involves chronic maladjustment of the autonomic nervous system.

Respiration is training the patient to control his/her breathing, which can be very helpful for pulmonary diseases, and is often utilized with heart rate variability training, noted above. This will not be discussed in detail; more information about this can be found in the text, Biofeedback by Schwartz and Andrasik (2003).

EEG biofeedback (aka, neurofeedback or neurotherapy) is when patients are trained to control their own brain waves, or what is called the EEG (electroencephalograph). The patient often obtains a quantitative EEG in order to identify where the brain waves need to be trained, or changed. The electrode is then placed in one or more areas, and the patient is displayed feedback on a screen so that the dysfunctional frequencies are trained down, and the “good” waves are trained up. The display can be the brain waves themselves (good for some patients), or a display generated by the computer. The patient is asked to keep the animation going (for example), and by operant conditioning the patient trains his/her brain waves to be more normal. Neurofeedback is considerably more complex than most other biofeedback modalities, and is the newest modality in the field of biofeedback. Nonetheless, there is a fair amount of research regarding its effectiveness (see Monastra, 2005; Yucha & Montgomery, 2008; Thompson & Thompson, 2003). Neurofeedback has been shown to be effective for attention deficit disorder, chronic pain, traumatic brain injury, and other brain disorders (Yucha & Montgomery, 2008). Frank Duffy, a well-known neurologist, stated in a special issue of the journal Clinical Electroencephalography devoted to neurofeedback that “if any medication had demonstrated such a wide spectrum of efficacy, it would be universally accepted and widely used” (p. v).

Hemoencephalography (HEG) biofeedback trains the patient to control the cerebral blood flow in the frontal lobes. An infrared camera sensor is placed on the forehead which reads the cerebral blood flow (actually a close correlate of the blood flow), and the patient learns to control the blood flow by the display being watched. In the case of the pir HEG, the display is a movie — any DVD the patient wishes to see. If the frontal lobe blood flow remains high, the patient can continue to watch the movie. When the temperature drops (believed to be in the anterior cingulate gyrus), then the movie stops, and by focusing on a bar graph display, the cortical activity increases such that the movie starts again.

Other methods of biofeedback include capnometer, which measures the CO2 from the breath, and pelvic floor EMG rehabilitation, an effective treatment for pelvic floor training for female urinary incontinence and vulvodynia (Glazer & Laine, 2006; Glazer, 2000). This latter method of biofeedback has proven so successful that Medicare pays for this treatment.