Biofeedback Relaxation Training: A Rediscovered Mind-Body Tool in Public Health

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Abstract: More attention is turning to mind-body approaches in public health with the increased realization of the importance of the stress-disease relationship. This paper reintroduces biofeedback relaxation training (BFRT) as a mind-body tool for stress management to address stress-related disease in public health practice. Public health practitioners are provided with a responsible assessment of the integration of relaxation approaches into the treatment of stress-related diseases and conditions in public health as well as theoretical background for such integration. The implementation issues and implications for the use of BFRT among public health professionals as an instructional technology for stress management are discussed.

Before BFRT can be introduced, it is important to discuss stress, its relation to disease, and the importance of gaining awareness of the mind-body connection. Following this discussion, an introduction of BFRT, its relation to health promotion theory, and its application and implementation issues are presented.

STRESS

Cox (1978) defined stress as any influence that disturbs the natural equilibrium of the body, and includes within its reference physical injury, exposure, deprivation, and all kinds of disease and emotional disturbance. In the 1997 Hans Selye Memorial Lecture, Chrousos stated that despite marked advances in stress research there remains to be confusion as to what stress is currently. Selye has been quoted as saying that, "Life exists by maintaining a complex dynamic equilibrium or homeostasis, which is constantly challenged by intrinsic or extrinsic adverse forces or stressors" (Chrousos, 1998). During this lecture, stress was defined as a state of threatened homeostasis, which is reestablished by a complex repertoire of physiologic and behavioral adaptive responses of the organism. In addition, biologic stress was defined as the "nonspecific response of the body to any demand made upon it" according to the latest definition Hans Selye used (Chrousos, 1998).

Most recently, Weiner acknowledged the specificity of stressor responses by describing stressors as selective pressures from the physical and social environment that threaten or challenge an organism and elicit compensatory response patterns (Pacak, 2001). Chrousos and Gold have defined stress as a state of disharmony or of threatened homeostasis, evoking physiologically and behaviorally adaptive responses that can be specific to the stressor or generalized and nonspecific and that usually occur stereotypically, producing a "nonspecific" stress syndrome when the threat to homeostasis exceeds a threshold (Pacak, 2001).

Definitions of stress may vary however, what is important to recognize is that individuals share common physiological responses to stress. Public health professionals need to understand how varying physiological and psychological responses to chronic stress affect long-term health consequences.

STRESS AND DISEASE

Individuals respond to novel and challenging environmental information cognitively and physiologically via activation of the sympathetic nervous system (SNS) and the hypothalamic-pituitary axis. This response can influence health status. The output to effectors of the SNS is diffuse, resulting in widespread effects throughout virtually all of the systems of the body. An example of this output is outlined in Figure 1. In this example, the effects of SNS output on blood pressure (BP) are shown.

As seen in figure 1, exposure to endogenous or exogenous stress stimulates undefined areas of the cen-

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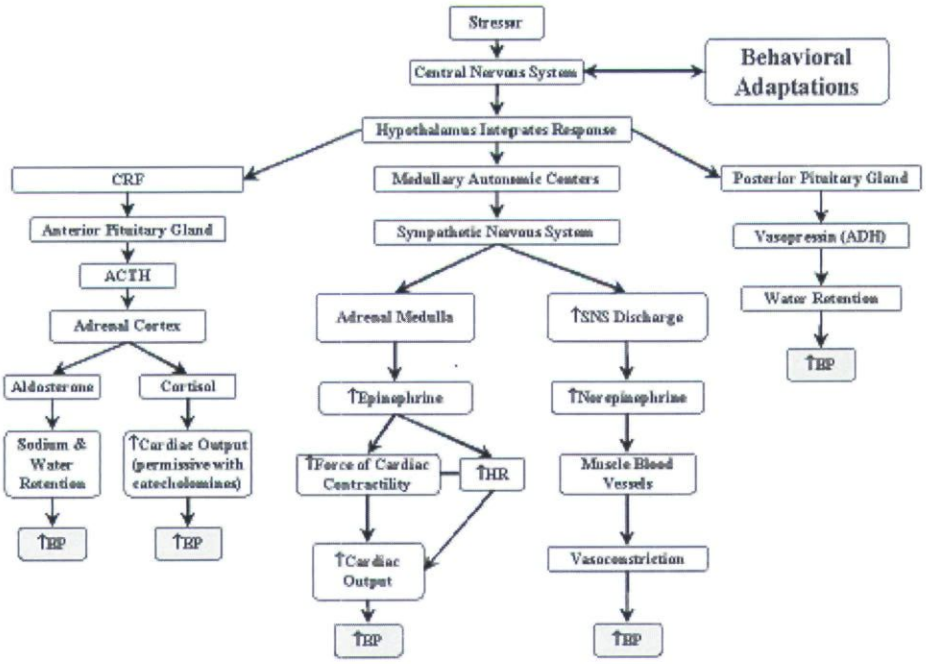
Figure 1. Effect of Stress on Blood Pressure



tral nervous system. The responses of the central nervous system are integrated by the hypothalamus and involve coordinated activities of several neuroendocrine systems to produce metabolic, circulatory, and behavioral effects. Specifically, in response to stress, the hypothalamus (1) stimulates autonomic centers within the medulla activating the sympathetic nervous system, (2) releases corticotropin-releasing factor (CRF) activating the anterior pituitary gland, and (3) stimulates the posterior pituitary gland. Stimulation of the SNS results in sympathetic nerve discharge and subsequent release of norepinephrine from peripheral nerve endings and epinephrine from the adrenal medulla. Norepinephrine produces contraction of arteriole smooth muscle, resulting in a rise in BP. Epinephrine produces an increase in heart rate and the force of cardiac contraction, contributing to a rise in BP. Simultaneously adrenocorticotropic hormone (ACTH) from the anterior pituitary gland stimulates the adrenal cortex to release aldosterone and cortisol. Aldosterone increases sodium and water retention by the kidney. Cortisol, in cooperation with catecholamines, increases cardiac output and BP. Lastly, vasopressin, from the posterior pituitary gland, increases water retention. This increase in water retention, together with contraction of arteriolar smooth muscle and increase in the rate and force of cardiac contraction, results in a rise in blood pressure.

In short, the message that this physiological example provides is that stress has a direct impact on the body's responses. Conceptually, this stress response is intended as a short-term response resulting in an increased capacity to "fight" or "flee" a threat (such as a saber-tooth tiger), but was not designed for a chronic state. When the fight or flight response is prolonged or chronic (i.e. on-going high stress levels), the physiological components of the response produce harmful results, such as increased BP (shown in figure 1) or exacerbating a serious disease state such as coronary heart disease (CHD). It is when stress is extreme and prolonged that it becomes distress.

MIND-BODY HISTORY AND MAKING THE MIND-BODY CONNECTION

As mentioned above, the "fight or flight" response was first described in the early 1900s by Walter Cannon. He described this response as the body's autonomic nervous system pumping blood into muscle tissue and adrenaline throughout the body in reaction to a highly charged emotional situation (Goleman &

Gurin, 1993). A few years later, Hans Selye (1956) identified the connection between environmental stresses and the body's reaction to that stress. Later in the 1960s, Dr. Herbert Benson, found that when people relax their thinking in a particular way, the body also changed, with slower breathing and other metabolic changes. He and his colleagues called this the "relaxation response" (Benson, Beary, & Carol, 1974).

By the 1970s, mind-body techniques began to gain attention in the general public. The Maharishi Mahesh Yogi brought a classic Hindu mantra style meditation to the United States, which became well known as Transcendental Meditation or simply, TM (Goleman, 1977). Also during this time, the field of biofeedback was born, bringing together multiple disciplines into a formalized way of monitoring how the body reacts to stress (Schwartz & Associates, 1995). In 1998, the National Institutes of Health established the National Center for Complementary and Alternative Medicine (NCCAM). This institute expanded the mission of the Office of Alternative Medicine, which was established in 1992. Currently, NIH has several funding mechanisms for mind-body research.

Because stress affects the health and functioning of individuals in many ways, it is important to promote and educate the public about the mind-body relationship. Without addressing this relationship, individuals may not truly be able to understand how to manage stress. More education needs to be done to increase awareness that the mind can truly impact the body's responses. Most individuals are unaware that they have the ability to use their mind, through various relaxation techniques (for example), to gain control over their body's responses.

BIOFEEDBACK RELAXATION TRAINING (BFRT)

WHY BIOFEEDBACK?

Biofeedback is a technique that addresses the mind-body relationship in managing stress. Biofeedback research spanning the past thirty years has shown that humans can be conditioned to control certain autonomic nervous system functions, such as blood pressure, salivation, gastrointestinal contractions, urine formation, sweat gland activity, vasomotor response, and cardiac activity (Schwartz & Olson, 1995). As discussed later, BFRT can be used as a new methodology or implementation tool for public health practitioners in teaching stress management.

WHAT IS BIOFEEDBACK?

Biofeedback is more than thirty years old. Perpetuating its longevity, biofeedback is used today throughout clinics, labs, offices, and other settings for such purposes as general stress management to initiating muscle activity in a paralyzed muscle. Biofeedback has been described and defined across disciplines as a procedure, process, tool, method, technique, and concept. Olson (1995) has synthesized several process, technical, and theoretical definitions to propose a definition of applied biofeedback:

> "As a process, applied biofeedback is a group of therapeutic procedures that utilizes electronic or electromechanical instruments to accurately measure, process, and feedback to person's information with reinforcing properties about their neuromuscular and autonomic activity, both normal and abnormal in the form of analogue or binary, auditory and/or visual feedback signals. Best achieved with a competent biofeedback professional, 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, by first controlling the external signal, and then with internal psychophysiological cues (p. 29)."

With this working definition and throughout this discussion, biofeedback may simply be thought of as a process by which persons learn to control their physiological processes through various feedback signals. Biofeedback is based on operant conditioning whereby, individuals learn from reinforcement (in this case biological feedback) of the performed behavior (in most cases, relaxation or even, increased concentration).

THREE STAGES OF BIOFEEDBACK TRAINING (BFT)

BFT helps individuals bring their physiological activity into a proper range of functioning but it also helps to convince individuals that it is in fact possible to control events that bear on their capacity to cope with stressful circumstances. To further understand the biofeedback process, Lehrer and Woolfolk (1993) have identified three stages of BFT. These are 1) acquiring awareness of the maladaptive response where the individual learns that certain thoughts and bodily events influence a response, 2) learning to control the response and 3) learning to transfer the control into

everyday life.

In the first stage, the individual has to become aware of his or her physiological responses to stress. Examples of responses deserving notice may be 1) muscle bracing while at a computer for lengthy periods of time, 2) increased heart rate and shallow breathing while arguing, and 3) having cold, sweaty palms when speaking in front of a group. These and many others are examples of what individuals may be made more aware during the initial stage of BFT.

In the second stage, individuals want to learn how to control their particular physiological stress responses of which they have been made more aware whether it be muscle tension, increased heart rate, vasoconstriction (resulting in cold fingers and toes), rapid, shallow breathing, sweaty palms, or a combination of responses. At this stage, BFT is combined with some sort of relaxation therapy or techniques to assist the individual in learning to control these physiological responses. The goal is to engage the parasympathetic nervous system (or relaxation responses) and reverse the above described (sympathetic) responses to stress. This is described in detail in the following section. Lastly, in the third stage of BFT, the learned physiological control of the stress response is applied to all situations that elicit the noticed stress responses in the first stage. This is the final stage of BFT that demands more research and intervention efforts to improve efficacy for stress-disease relationships.

RELAXATION TRAINING

As indicated earlier, stress produces changes within the autonomic nervous system, leading to various stress-related disorders which include increased heart rate, blood pressure, respiration, muscle tension, sweat gland activity, and the peripheral vasoconstriction associated with cold hands and feet (Basmajian, 1989; den Boer, 1997; Ellison, 1996; Schwartz & Associates, 1995). Individuals can learn to control these stress responses through biofeedback. Specifically, biofeedback-assisted relaxation therapy (BFRT) can be effective in reducing the stress response by reducing or alleviating unwanted stress-related symptoms. In BFRT, biofeedback is usually augmented with relaxation techniques such as diaphragmatic breathing, progressive muscle relaxation training, autogenic training, guided imagery, and meditation. Each of these commonly used BFRT techniques is briefly described below.

RELAXATION TECHNIQUES

In diaphragmatic breathing (probably the most common technique used by practitioners), individuals are instructed to expand their diaphragm as they inhale and relax the diaphragm as they exhale with the purpose of minimizing or stopping chest and accessory muscle (other than diaphragm) breathing. The standard goal for this breathing is to slow respiration to about 6-8 breaths per minute, which is much less than the 12-15 breaths per minute breathing rate typical for most people (Schwartz & Associates, 1995).

In progressive muscle relaxation (PMR) training (developed by Edmund Jacobson in 1938), individuals learn to recognize tension changes in different muscle groups in the body by first tensing or contracting a given muscle to create tension then, relaxing that muscle. With this basis, muscle groups are systematically tensed and released one by one, using electromyography feedback to monitor changes in tension. The aim of PMR is to elicit muscle – together with mental relaxation – calmness, the removal of disturbing tension and negative emotions.

In 1932, J. H. Schultz developed autogenic training to remove signs of tension and disturbance. The principle of this method is to bring about a condition similar to hypnosis with the help of verbal formulations and images (repeating words and phrases to yourself). The two basic concepts in autogenic training are relaxation and concentration achieved through six basic exercises or groups of autosuggestions dealing with feelings of heaviness, warmth, the awareness of calm breathing, or regular pulse frequency, of warmth in the belly and a cool forehead (Machacova, 1999).

Guided imagery is a technique that simply involves assisting individuals to focus on mental images and scenes that evoke relaxation. The principle behind guided imagery is to provide or assist the mind with a relaxing image in on which to focus thereby interrupting stressful thoughts and images with relaxing ones. This technique can also serve as an escape from stressful thoughts and be used in conjunction with diaphragmatic breathing.

Meditation is the oldest form of systemic relaxation, requiring individuals to direct their attention to repetitive and immobile objects while concentrating on one's pulse rate, or breathing, or the repeating of a word, or syllable or number. Like the other described relaxation techniques, meditation should be practiced every day through mindfulness and concentration, in order to achieve a state where stress has lost all its negative psychophysiological impact (Machacova, 1999). More detailed information regarding specific techniques in implementing these relaxation techniques is beyond the scope of this paper. Having even a brief idea of what these techniques entail and their purposes will be helpful in examining the literature regarding the application of biofeedback and biofeedback-assisted therapies for stress-related diseases.

THE SOCIAL COGNITIVE THEORY AND BFRT

The skills learned in BFRT can be based on the principles of teaching self-control or self-regulation, self-efficacy, coping with stressful stimuli and possessing behavioral capacity. The Social Cognitive Theory provides an excellent grouping of these principles or theoretical constructs. Bandura's Social Cognitive Theory (SCT) (Bandura, 1986) also referred to as Social Learning Theory, is a behavioral prediction theory that represents a clinical approach to health behavior change. This theory has been widely applied to health behavior with respect to prevention, health promotion, and modification of unhealthy lifestyles for many different risk behaviors.

SCT involves numerous key concepts. These concepts include: personal characteristics, emotional arousal/coping, behavioral capacity, self-efficacy, expectations and expectancies, self-regulation, observational/experiential learning, and reinforcement (Perry, Baranowski, & Parcel, 1990; Baranowski, Perry, & Parcel, 1997). Each of these concepts can be directly applied to the basic tenets of BFRT and are outlined in Table 1. This table can be used as a reference for public health professionals that use SCT to be able to frame BFRT activities under an SCT-based model.

BFRT INTERVENTION APPLICATIONS IN PUBLIC HEALTH

Biofeedback practitioners and researchers have come to apply biofeedback to a number of conditions. As can be deduced from the information given thus far, many conditions treated in biofeedback practice have symptoms stemming from heightened arousal or excessive sympathetic nervous system (SNS) activity and have some association to stress or anxiety. Examples include anxiety disorders, recurrent headaches, elevated blood pressure, and irritable bowel syndrome. Some of the basic tools used in biofeedback may include electromyographic (EMG) biofeedback to reduce tension states in targeted muscles, temperature biofeedback to increase peripheral blood flow and skin surface temperature, skin conductance biofeedback to reduce sweat gland activity and heart and respiration rate biofeedback to lower levels. The following sections present some examples of how biofeedback has been successfully applied or may be applied to various health conditions and disease states.

SMOKING CESSATION

Many studies (Hughes, Hatsukami, Mitchell, & Dahlgren, 1986 and Patton, Barnes, & Murray, 1993 for example) have reported that as a group, smokers have more anxiety than nonsmokers. It also seems well documented that persons with high anxiety are more likely to smoke than persons with low anxiety (Smedslund & Gotestam, 2000). These findings are in accordance with the hypothesis that smoking is associated with anxiety.

Stress management techniques and strategies to deal with increased anxiety may be needed for many smokers to stop smoking. BFRT may be a useful tool for stress management training related to smoking cessation and some smoking cessation programs are incorporating stress management into their interventions. For example, the McMaster SmokeStop is a smoking cessation program that uses an individual counseling approach which assists smokers with the use of reflective listening and support as well as, when indicated, acupuncture, nicotine patch, nicotine gum, stress management, and behavior modification (Wilson, Gellatly-Frey, Bauman, 1998). The success of this program is attributed to its multifaceted approach including stress management. Research using BFRT as a stress management tool for smoking cessation should be done to determine improved program efficacy.

ASTHMA

In the U.S., asthma is the most common chronic health condition. More than 20 million Americans, including 6 million children, suffer from asthma (Center for Health and Health Care in Schools (CHHCS), 2003). There is evidence that emotional stress can either precipitate or exacerbate both acute and chronic asthma (Sandberg, et al, 2000). Often, anxiety accompanies asthmatic attacks. Relaxation therapies help patients with asthma to deal with their symptoms associated with anxiety and stress (Huntley, White, & Ernst, 2002). Particularly when used in conjunction with medications and as a component of self-management, relaxation therapy has been accepted as useful in the treatment of asthma. In terms of BFRT however, not all types of biofeedback have had successful effects with asthma control. For instance, Huntley, White, & Ernst (2002) conducted a systematic review of 15 randomized controlled trials using relaxation therapies for asthma and found that the two BFRT studies identified from the 15 (Kotes, 1991; Coen, et al., 1996) using biofeedback induced facial muscle tension had no meaningful effects on asthma.

However, more recent studies using diaphragmatic breathing through a mechanism called respiratory sinus arrythmia biofeedback (RSA BF) has shown quite

promising effects. Lehrer and colleagues have used RSA BF in a series of exploratory studies to determine the effectiveness of respiration manipulation for asthma control. Lehrer et al. (1997) compared RSA BF with EMG and incentive inspirometry biofeedback. Decreases in respiratory impedance occurred only in the RSA biofeedback group however decreases in pulmonary impedance were associated with increases in relaxation across all groups (Lehrer, et al., 1997). Moreover, Lehrer, Smetankin, and Potapova (2000) tested the use of RSA BF combined with a pursed-lip breathing protocol and reported improvements in two spirometry measures among asthmatic children. Not only is the exploration of RSA BF for asthma control

Table 1. SCT and BFRT

SCT Concept	BFRT Skill Application
Personal characteristics - gender, race/ethnicity, education, personality, cognitive factors, motivation, and skills.	Personality factors such as Type A can be addressed by using BFRT skills to deal with stress and self-pressure to overachieve.
Emotional arousal/coping - individual's ability to respond to emotional stimuli with various techniques, strategies, and activities that help one to deal with arousing situations (e.g. anxiety).	BFRT can enhance participants' ability to deal with emotional, anxiety and overall stress responses to emotional stimuli. Participants can practice BFRT skills during stressful/emotional situations such as performances (presentations or tests), arguments with family and friends, etc.
Behavioral capacity - individual's possession of both the knowledge and skills necessary to perform a behavior.	BFRT can increase knowledge of how the body responds physiologically to stress responses. Skills such as taking target heart rates and invoking relaxation responses to stress can be taught.
Self-efficacy - individual's confidence in his or her ability to perform a behavior in various situations.	The unique aspect of receiving immediate feedback of skill acquisition through BFRT can foster self-efficacy. Self-efficacy of physiological self-control and stress reactivity can be measured throughout BFRT sessions.
Expectations - beliefs and values associated with the outcome of a behavior.	Participants can be taught that stress management behaviors can help reduce and prevent future stress-related health problems.
Self-regulation - individual's ability to manage or control behavior.	The self-monitoring and self-reinforcement of the BFRT training can help regulate the performance of the targeted stress reduction behaviors.
Observational/experiential learning - acquisition of a behavior through observation and experience.	This type of learning can occur through the use of personal experience through the BFRT training. Since participants can observe their own ability to relax and reduce stress responses by monitoring and observation as a part of BFRT, experiential learning takes place.
Reinforcement - receipt of support, encouragement for performance of the behavior.	BRFT participants receive constant reinforcement of learned stress reduction behaviors by the monitoring of their own physiological parameters (e.g., heart rate, muscle tension, breathing, etc).

warranted, using basic diaphragmatic breathing for some increased asthma control should be promoted.

BINGE EATING, OBESITY, AND STRESS

With the obesity epidemic, researchers and health professionals are urged to find treatment and prevention interventions for obesity. A particular subgroup of the obese, obese binge eaters, consistently report elevated levels of anxiety and have significantly elevated rates of co-morbid anxiety disorders (Wilcoxon-Craighead & Aibel, 2000). Binge eating disorder (BED), a relatively new defined eating disorder based on long-existing behavior, involves recurrent binge eating without compensatory purging behaviors. Aside from BED, emotional or stress eating can be classified as disordered eating that may occur in a higher percentage of the obese and overweight. Negative affect or emotions such as depression and anxiety could possibly perpetuate binge-eating behavior since the consumption of certain foods may be comforting in coping with these emotions. If this pattern of association is accurate, stress management or anxiety management techniques such as biofeedback may be efficacious for addressing BED and disordered stress eating.

Three proposed hypotheses that address anxiety and eating are: 1) anxiety disinhibits dietary rules meaning, anxiety seems to undo the cognitive and behavioral checks dieters have placed on their eating, leading them to eat more 2) anxiety is misinterpreted by hunger – perceiving anxiety as the need to eat and 3) eating is used in an attempt to alleviate anxiety (i.e. emotional eating) (Wilcoxon-Craighead & Aibel, 2000). A detailed discussion of these hypotheses is beyond the scope of this paper however the central message seems to be the need for stress and anxiety management intervention to address stress and anxiety eating among the growing percentage of obese. Using BFRT may help those that are obese and overweight develop alternate coping strategies to lessen anxiety instead of overeating or binge eating. By employing coping mechanisms that yield decreased anxiety and possible decreases in other negative self-feelings, the obese or overweight individual may reduce the frequency of emotional eating episodes (Wilcoxon-Craighead & Aibel, 2000). Development of stress management interventions using BFRT is needed to address stress-related eating issues among the growing number of overweight and obese individuals.

HYPERTENSION AND CARDIOVASCULAR DISEASE

Hypertension is a significant risk factor for a host of cardiovascular diseases (myocardial infarction, stroke, congestive heart failure). Moreover, hypertension is directly related to stress. The central nervous system, endocrine system and stress hormones are responsible for elevated blood pressure leading to coronary heart disease (Seaward, 2002). Along with lifestyle alterations such as exercise and diet (weight reduction, sodium restriction, moderation of alcohol intake, etc.) stress management techniques should be included in interventions targeted to reduce blood pressure.

Linden and Chambers (1994) analyzed 166 randomized clinical trials, evaluating the effects of various medications, weight reduction, sodium and alcohol restriction, physical exercise, calcium and potassium supplements, standard single-method (progressive relaxation training, autogenic training, meditation, and biofeedback) and standard multi-method relaxation therapy (combinations of aforementioned treatments), and individualized therapies (cognitive behavioral therapy, marital communication training, anger management, etc.) on blood pressure. Individualized therapy was found to be highly effective for systolic blood pressure and diastolic blood pressure, with the magnitude of this effect being similar to that for medication and lifestyle modification. Multi-method relaxation treatment was of moderate effectiveness for lowering systolic blood pressure, but less so for diastolic blood pressure. Single-method relaxation treatment fared slightly less well than multi-method treatment (Linden & Chambers, 1994). These results support the utility of various treatments (including biofeedback and adjunctive relaxation techniques), indicating that tailored treatments are preferable and combined treatments are needed. Moreover, in a recent meta-analysis on the effectiveness of BFRT in treating hypertension, data from 23 studies showed that BF, together with related cognitive therapy and relaxation training, reduced both systolic blood pressure and diastolic blood pressure significantly compared to inactive control treatments (Yucha, Clark, Smith, et al., 2001).

IMPLEMENTATION ISSUES

Just by the few examples presented in this paper, it is apparent that BFRT may be a useful intervention tool when addressing stress or anxiety related conditions or diseases from a public health perspective. When deciding upon how to carry out planned education programs, public health professionals need to decide what are the best instructional equipment, technologies, and methods to use for a given set of objectives. When utilizing and implementing BFRT as an intervention tool, consideration must be taken for all possible methods of delivery, instrumentation options,

training, and cost.

METHODS OF DELIVERY

Probably the most commonly used method of BFRT delivery is through individual sessions. This method is quite effective for personalized stress and anxiety management training and application. The advantages to this delivery method are that individual attention is given to the participant's progress in achieving physiological goals and personalized relaxation training. In addition, the BFRT can be tailored based on baseline stress testing (e.g. concentrating on more muscle relaxation throughout training if displaying high muscle bracing reactivity to stress) and readjusted along the course of intervention (e.g. lessening the concentration of muscle relaxation to include deep breathing). This is most beneficial for practice and BFRT effect.

Another method of BFRT delivery is through group sessions. This method of delivery has been less commonly researched however has some distinct advantages. First, this method of delivery can be conceived as more cost effective than individual sessions since several individuals can attend a session and receive training from a facilitator. Second, an aspect of social support is presented which may be beneficial. Third, because individual differences in relaxation are not easily addressed in a group setting, a more generic form of training is offered thereby making the effects of BFRT more generalizable to other group BFRT interventions using a given protocol for a health condition. This is particularly beneficial in research.

Once again however, the disadvantages of this delivery method are easily deduced. First, the effects of BFRT may be reduced due to offering a more generic and less individualized form of training. Second, in a group setting, the intervention cannot be tailored based on individual baseline assessments. Lastly, the BFRT intervention cannot be easily altered during the implementation duration unless deemed suitable for all group members.

BF INSTRUMENTATION

There are several levels through which BFRT could be implemented. The first level is using no BF equipment. Becoming aware of stress response concepts such as increased heart rate, rapid, shallow breathing and increased skin temperature can be done without the use of BF equipment. For example, participants can be trained to palpate their own pulse to measure heart rate, place their hand on their chest to "feel" breathing rate and depth, and touch their fingers on other parts of their skin to "feel" skin temperature. This level of biological evidence that the participant can see or hear may be challenging particularly in the beginning of BFRT, without the assistance of physiological responses displayed on a monitor or screen display of some kind. However, this intrinsic or internal type of demonstration or physiological response monitoring may assist with long-term BFRT effectiveness particularly, when "weaning off" of reliance on equipment to monitor physiological response control success.

The second level of physiological demonstration using BF equipment is the use of simple BF devices. Examples of these devices may be hand-held thermometers (also know as thermistors) to measure skin temperature; portable sets of electrodes to measure muscle tension in one muscle group, or handheld skin conductance monitors that display conductance for two fingers. These devices are particularly useful for group biofeedback in that they are portable and relatively inexpensive relative to the comprehensive systems described below ($150 - $300). The disadvantages to these devices are that physiological demonstration accuracy is weaker than with advanced BF systems and measurement scope is limited (e.g. only one muscle group as opposed to multiple groups or at least, bilateral assessment).

The third level of physiological demonstration using BF equipment is the use of complete systems. Complete BF systems include software packages for laptop and desktop computers, multi-channel devices for displaying several physiological parameters, and sensor leads. These systems have great advantages in terms of measurement accuracy, ability to measure multiple parameters, and superior visual display. The disadvantages are that these systems are costly ($3000 to $5000) and difficult to use with multiple participants. In addition, a laptop must be transported with to utilize the system hence portability is slightly more cumbersome than transporting simple devices.

BFRT TRAINING FOR PRACTITIONERS

The last aspect to consider when implementing BFRT is receiving the proper training to deliver BFRT and working towards certification. Two training options are training under someone certified and attending a training center. Those working with someone who is certified in BF can receive training from that person and implement BFRT under his or her supervision. Those not working with someone who is certified in BF can attend one of many national BF training centers. These centers will not only offer training in BF various types of BF but also provide education for certification. Obtaining BF certification means that one has met the minimum competencies to deliver BF however, it does not grant an individual to offer BFRT in private practice unless a professional license is held.

Regardless of licensure, if using BFRT as part of a public health intervention for research or service, certification should be obtained to assure at least, minimum competency.

CONCLUSIONS

BFRT can be thought of as a new application to address stress-related issues in public health practice but that is based on old principles. This rediscovering of old principles into a modern application can be brought to personal and professional development, research and practice in public health.

In terms of professional development, pursuing BFRT training may include attending professional biofeedback workshops around the country or even inviting biofeedback speakers to public health conferences. Teaching courses on practice and self-regulation methods that incorporate guided imagery, biofeedback and relaxation in graduate level health promotion and education programs can provide curricular opportunities to develop skill in using these interventions. In addition to professional BFRT training, developing a personal practice with the relaxation techniques can strengthen one's understanding of how it can be used as a method of stress reduction.

For BFRT research, stringent evaluation of biofeedback have been called for using, "the gold standard for clinical research: the randomized controlled clinical trial . . . Because alternative therapies do not possess well-established clinical practice guidelines, wide variations may exist in the treatment provided for a given disorder" (Margolin, Avants & Kleber, 1998, p. 1626). Regardless of evaluation, more research needs to be done to see how BFRT can be incorporated into health promotion interventions in a variety of settings. Although a solid foundation of scientific research exists, more empirical research needs to be done in settings where public health professionals are currently using these stress management techniques.

In practice, those developing and implementing programs need to be more aware of the potential that BFRT techniques can have as a complement to existing health promotion interventions and services. However, little published information exists to guide these efforts. Practice-based research on the use of BFRT interventions in health promotion is virtually non-existent and is needed to contribute to the knowledge base of our profession.

While many public health professionals may employ a holistic approach to health promotion, specialized training and the formal use of mind-body techniques such as biofeedback may need to be expanded in order for broader use. Public health educators must also pay more attention to stress reduction techniques as empirically validated interventions that can enhance health promotion practice.

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