13-3
10

A COMPARATIVE STUDY: PROGRESSIVE MUSCLE RELAXATION,

AUTOGENIC TRAINING, EMG BIOFEEDBACK, AND

SELF-RELAXATION

A Thesis

by

Neerja Swaroop Bhatnagar

January 1983

APPROVED BY:

H. G. Schneider
Chairperson, Thesis Committee

Susan D. Moss
Member, Thesis Committee

William H. Knight
Member, Thesis Committee

Joyce G. Crouch
Chairperson, Department of Psychology

Joyce V. Lawrence
Dean of the Graduate School

A COMPARATIVE STUDY: PROGRESSIVE MUSCLE RELAXATION,
AUTOGENIC TRAINING, EMG BIOFEEDBACK, AND
SELF-RELAXATION

A Thesis

by

NEERJA SWAROOP BHATNAGAR

Submitted to the Graduate School

Appalachian State University

in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

January 1983

Major Department: Psychology

ABSTRACT

A COMPARATIVE STUDY: PROGRESSIVE MUSCLE RELAXATION, AUTOGENIC TRAINING, EMG BIOFEEDBACK, AND SELF-RELAXATION. (January 1983)

Neerja Swaroop Bhatnagar,

B. S., Appalachian State University

M. A., Appalachian State University

Thesis Chairperson: H. G. Schneider

The role of biofeedback and relaxation has been given widespread attention in the treatment of stress related disorders. Procedural and individual differences were investigated to determine main effects of treatment and personality and interactions between the two variables. The effects of the following four relaxation instructions, as independent variables, were compared: (a) Electromyography biofeedback (EMGBF), (b) Abbreviated Progressive Muscle Relaxation (PMR), (c) Abbreviated Autogening training (AT), and (d) Self-relaxation control (SR). The other independent variables manipulated in this experiment were Anxiety (High and Low) and Absorption (High and Low). The dependent measures of physiological arousal were (a) frontalis muscle activity, (b) digital skin temperature of the dominant hand, and (c) radial pulse rate. Forty-eight undergraduate females from psychology classes were chosen, based on their appropriate Anxiety-Absorption scores and their willingness to participate in this four session mixed factorial design. Sample included 12 High Anxiety-High Absorption (HH), 12 High Anxiety-Low Absorption (HL), 12 Low Anxiety-Low Absorption (LL), and 12 Low Anxiety-High Absorption (LH) subjects. Instructions of the relaxation techniques were presented in counterbalanced order to each subject. Other dependent measures included ratings of subjective anxiety (SAI), relaxation strategy, treatment preference and change in locus of control. Results indicate that the EMGBF group had a greater reduction in EMG levels. No main effect of treatment in skin temperature was evidenced although there were slight increases. Pulse decreased for all subjects over time. No main effects of anxiety or absorption were observed. A significant main effect of SAI was found; EMGBF was rated the least relaxing procedure. Surprisingly, subjects preferred AT as a relaxation technique. Differences in strategies were found as a function of treatment, but not personality. Interactions between treatments and personality variables demonstrate that during EMGBF and SR, HH subjects maintained lower EMG readings during treatment. Also, as a group, High Absorption subjects did not maintain skin temperature increases, as did the Low Absorption subjects. As hypothesized, response specificity to feedback was evidenced; subjects were unable to demonstrate generalized relaxation, possibly as a result of the lack of mind-body awareness. Contrary to the predictions, SR was not found to be less effective as a relaxation technique in comparison to the other three techniques. Specific suggestions were made for future research in interactional studies and clinical applications of the present findings were discussed.

ACKNOWLEDGEMENTS

There are many people who have helped in making this thesis complete. I would like to sincerely thank Dr. Henry Schneider, my thesis chairperson, for his guidance, persistence and support during the various stages. I would also like to thank Dr. William Knight and Dr. Susan Moss for their help and support as committee members.

Special appreciation is in order for Dr. Deanna Bowman, Director of Computer Services, and her staff for providing invaluable assistance and demonstrating patience and humor.

This project would not have been possible without the constant support and flexibility of Dr. Sally Atkins, Director of Counseling and Psychological Services Center, and the rest of the staff. I am appreciative for the use of the equipment, their generosity of time, and their willingness to listen during times of frustration.

I would also like to express my thanks to my family and friends who gave support and understanding constantly and ungrudgingly. My special thanks goes to Ms. Jane Rawson, a friend and colleague, without whose company and determination, this project would be incomplete.

Finally, there are countless other supporters who I am unable to acknowledge separately, but do express my deepest appreciation for their seemingly unlimited patience and willingness to encourage me in this endeavor.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

Early Developments

Prior to the 1950's, a clear distinction was made between the responses of the skeletal muscles and the glandular and visceral systems, the former being voluntary and the latter involuntary. Bichat, a French Philosopher, in the 19th century, distinguished between the cerebrospinal nervous system of the great brain and spinal cord, controlling emotional and visceral responses, and the dual chain of ganglia ("little brains") controlling emotional and visceral responses. It was a widely held belief that autonomically mediated behavior could be modified by classical, but not instrumental training methods (Miller, 1969).

This theoretical foundation was later challenged with the hypothesis that autonomic or visceral responses could be trained instrumentally (DiCara & Miller, 1968). Earlier experiments found that animals paralyzed with curare could be conditioned to increase or decrease a glandular response and thus refuted the dicotomy. Half of the rats were trained to increase their heart rate and half to decrease their heart rate. The positive findings were maintained even after the curare was removed. In these findings, other properties of instrumental conditioning like shaping, discrimination and retention were also successfully demonstrated. Following these initial experiments, other investigators found that operant conditioning techniques resulted in changes in heart rate, galvanic skin response, blood pressure, vasodilation and urine formation (Blanchard & Epstein, 1978).

An important aspect of these findings is the possibility that humans may be capable of instrumental learning of visceral responses. Since humans could not be subjected to deep paralysis by means of curare, it had been suggested that changes recorded may represent unconscious learning of skeletal responses rather than true instrumental learning of visceral responses (Katkin & Murray, 1968). The significant findings of visceral and glandular learning in animals led to investigation of similar learning in humans. Miller (1969) designated the use of instrumental conditioning of autonomic responses in human subjects. As summarized by Shapiro (1977) and Taub (1977), the application of operant conditioning methods in the control of visceral and vasomotor responses in humans had been shown to demonstrate positive results. Snyder and Noble (1968) were able to increase the frequency of vasoconstriction events by operant methods involving presentation of a light when finger pulse volume amplitude fell below a criterion value (Taub, 1977). These and other studies using human subjects not only demonstrated the success in operantly controlling autonomic responses, but also had wide-spread implications for practical clinical application to psychophysiological disorders.

As early as 1969, Miller addressed the implications of these findings in the treatment of psychosomatic symptoms. Visceral reaction to certain situations are evidenced and maintained or reinforced by a variety of rewards. The specificity of autonomic responses was also demonstrated in a comparison of four studies. It was found that diastolic blood pressure increased more for anger than fear, heart rate increased more in fear than anger, and frontalis muscle tension increased more in fear than anger. Lacey, Bateman, and VanLehn (1953) demonstrated that anxiety, or anticipation of a stressor, can lead to patterns of autonomic responses that are different with each subject and which are reproducible over time (Martin, 1961). In this study, correlations among the autonomic lability scores were used to determine the degree of covariance among physiological measures during presentation of a stressor. While emphasizing the role of learning in visceral responses, Miller (1969) stressed another factor. He states:

> Such learning does not, of course, exclude innate individual differences in the susceptibility of different organs. In fact, given social conditions under which any form of illness will be rewarded, the symptoms of the most susceptible organ will be the most likely ones to be learned. (p. 444)

These findings supported the notion that individuals have learned to respond to stress and anxiety with a unique set of consistent sequence of visceral reactions (DiCara, 1970).

Many aspects of operant conditioning such as response definition, data recording and precise analysis of behavioral changes are responsible for the breakthrough in an area known as biofeedback. A definition for the term "biofeedback" is provided by Stoyva (1976) in the following statement:

> Biofeedback training consists of detecting an electrical signal generated by some bodily tissue. This signal is

> amplified and then used to trigger a visual or auditory display, thus providing the subject with continuous information as to his progress in controlling the signal; the subject is connected in a feedback loop with some physiological response he himself is generating. (p. 12)

Cognitive and sensed information concerning bodily function led individuals to an awareness of the relationship of physiological activity with the subjective experience and corrective adjustments could be initiated to activate the internal feedback system (Brown, 1977). By providing the patient with relatively immediate information or feedback of some bioelectric response, treatment of different psychosomatic disorders has been positive. The learning of self control of a physiological event, provided by a positive feedback loop has led to the integration of behavioral and physiological aspects of health and is termed as the "psychosomatic attitude" (Leigh, 1978).

Clinical Applications

As a result of the development of the theoretical foundations of biofeedback and the sophistication of instrumentation after World War II, a device for precise measurement of muscle action potential was developed. This made possible the widespread use of electromygraphy (Tarler-Benlolo, 1978). Budzynski (1969) reported the use of analogue feedback action potential as an aid to subjects to reach deep states of muscle relaxation.

This initial exploratory work eventually led to a relatively new type of therapeutic interventation called clinical electromyographic (EMG) biofeedback. An area where clinical EMG biofeedback has been successful is in the treatment of muscle contraction or tension headaches. In 1954, Sainsbury and Gibson reported that the resting levels of frontalis electrophic activity was higher in patients with muscle contraction headaches than in normals which thereby supported the position that stress may result in substantial contraction of the frontalis muscle (Turk, Meichenbaum, & Berman, 1978). By providing analogue feedback to the frontalis muscles, five patients experiencing tension headaches learned to reduce tension in frontalis as well as other facial muscles and subsequently developed the ability to control the frequency and intensity of the headaches (Budzynski, Stoyva, & Adler, 1970). Tasto and Hinkle (1973) found that they were able to decrease the frequency and duration of tension headaches in six subjects with only relaxation instructions and self monitoring. While both studies demonstrated significant decreases in the symptoms, they did not allow for the assessment of comparative effectiveness of the therapy components. Haynes, Griffin, Mooney, and Parise (1975) and Cox, Freundlich, and Meyer (1975) found that although both EMG biofeedback and relaxation instructions proved superior to the control procedure in decreasing headache activity, they did not differ significantly from each other in effectiveness. Electromyographic feedback has demonstrated decreased muscle tension and subjective relief during an anxiety provoking situation (Miller, Murphy, & Miller, 1978; Burish & Schwartz, 1980).

As EMG biofeedback gained respect and popularity as a valid treatment technique, another form of biofeedback was being developed simultaneously. In a well known study, DiCara and Miller (Taub, 1977) showed that rats paralyzed with tubocurare could be trained in a single session to differentially constrict the vasculature of one ear while dilating the vasculature of the other ear. In another study (Miller & DiCara, 1968), paralyzed rats were trained to change the blood flow in the vessels of the tail. In a later study, Gruber, School, and Taub (Note 1) used non-paralyzed rats to demonstrate success in thermal biofeedback. Thermal biofeedback has been defined by Taub and Emurian (1976) as a process that "involves operant shaping of small variation in skin temperature by means of change in visual (or auditory) information display" (p. 147). They found that normal subjects clearly evidenced learning within four sessions. Other studies have replicated the findings that contingent feedback does lead to the ability to alter hand temperature (Kappes & Michaud, 1978; Wand, Slattening, Haskell, & Taub, Note 2; Crosson, 1980; Taub & Emurian, 1976). Suggestion or imagery has been used in conjunction with biofeedback or instead of biofeedback as a means to regulate skin temperature. Herzfeld and Taub (1977) found that subjects displayed a significantly larger temperature change in the instructed direction on suggestion rather than on non-suggestion training days. When compared to a control group receiving feedback alone, subjects who received feedback combined with suggestion demonstrated significantly better results than the former group. The same results were found by Keefe (1978) as the feedback plus "thermal" suggestion group performed significantly better than feedback alone. Relaxation exercises, relying on suggestion of warmth and heaviness have demonstrated the capacity to produce change in peripheral skin temperature (Schultz & Luthe, 1969). The response of vasodilation during "warm" imagery and the opposite reaction of vasoconstriction during the "cold" imagery has led to the advent of clinical thermal biofeedback.

One area in which thermal biofeedback has been used is in the treatment of Raynaud's Disease. This syndrome is a painful vasospastic disorder usually affecting the digits in the hands and feet. Subjects suffering from idiopathic Raynaud's Disease have been treated successfully with biofeedback (Taub, Spalding, Gruber, & Kunz, Note 3; Keefe, Surwit, & Pilon, 1980) and also with autogenic instructions alone or in conjunction with biofeedback (Surwit & Fenton, 1980). Migraine headaches have the similar properties of vasoconstriction and vasodilation: Preheadache prodromal symptoms follow vasoconstriction of cerebral arteries, whereas the headache results from vasodilation of the external caratoid arteries (Olton & Noonberg, 1980). As an alternative to drugs, thermal biofeedback has been used in the treatment of migraine headaches. The possibility of using autogenic feedback training was suggested when it was accidently noted that following a spontaneous recovery from a headache, the individual demonstrated a 10^{o}F rise in two minutes. This incident led Sargent (1973) to initiate a study employing 75 subjects in which treatment resulted in improvement for 81% of the subjects.

Review of the Literature

In clinical biofeedback, some form of relaxation is frequently incorporated into the treatment. The importance of relaxation in treatment has been emphasized by early researchers (Budzynski, Stoyva, & Adler, 1970). They reported that subjects who employed relaxation home practice on a regular basis achieved significantly lower levels of EMG. Relaxation has also been shown to aid in the treatment of anxiety neurosis (Canter, Kondo, & Knott, 1975), tension headaches (Tasto & Hinkle, 1973; Haynes et al., 1975) and phobias (Mathews & Gelder, 1969; Wolpe & Lazarus, 1966). The importance of relaxation instructions in the treatment package has also been noted with normal subjects (Burish & Hendrix, 1980). The disorders noted above have the commonality of being stress-related disorders. Different forms of relaxation training have been employed and have been found to be successful in relieving general bodily tension (Brown, 1977).

Electromyographic biofeedback, a procedure to train subjects to produce extremely low tension levels, has been shown to produce a deep state of relaxation. Zero firing or single-motor firing in the large forearm muscle bundles was achieved in less than 20 minutes through the use of a feedback meter which showed the subject his own electromyographic tension level. This precise, continuous and immediate information provided alleviates the problem of lengthy treatment associated with other relaxation techniques (Green, Walters, Green, & Murphy, 1969).

The efficacy of EMG biofeedback assisted relaxation has been investigated and challenged in that the instrumentation may represent a placebo effect and other less expensive relaxation techniques may be equally effective (Alexander, 1975; Deffenbacher & Michaels, 1978). On the contrary, in many comparative studies, biofeedback relaxation has been shown to be superior. In comparison to an instruction only group, the EMG treatment group significantly reduced resting levels of frontal EMG and frontal EMG response to stress, but showed no change on cardiovascular measures (McGowan, Haynes, & Wilson, 1970). Biofeedback was found more effective than instructions and placebo in reducing EMG levels (Cox et al., 1975). Similar studies by Coursey (1975) and Ohno, Tanaka, Takeya, Matsubara, Kuriya, and Komemushi (1978) also demonstrated that the EMG biofeedback condition had significantly lower levels of frontal EMG activity compared with the no feedback condition. Decreased physiological responses were noted by Gatchel, Korman, Weis, Smith, and Clark (1978) when comparing EMG biofeedback with a false EMG feedback control group. EMG biofeedback was also found to be more effective as a relaxation procedure in comparison to group therapy in the treatment of chronic anxiety (Townsend, House, & Addario, 1975). Burish and Schwartz (1980) were able to support efficacy of EMG biofeedback in comparison to a control no feedback condition.

The efficacy of EMG biofeedback assisted relaxation has also been compared with traditional methods of relaxation. Progressive muscle relaxation (PMR) as developed by Jacobson (1938), consists of alternately and systematically tensing and relaxing different muscle groups in order for the subject to attain discriminative control of the skeletal musculature (Edelman, 1970). Reinking and Kohl (1975) used the following design to compare relaxation procedures: the four experimental groups were EMG feedback, EMG feedback plus Jacobson-Wolpe instructions, classic Jacobson instructions, EMG feedback plus a monetary reward, and a no treatment control group. Although all groups subjectively reported increased relaxation, EMG readings showed that speed of learning and depth of relaxation were superior in the EMG feedback group to the Jacobson instruction group. The findings support the premise that although relaxation can be taught to some degree by the traditional techniques, some form of EMG biofeedback seems to be needed for maximum results. A similar study that again compared EMG feedback, PMR and a control group reported that although both EMG feedback and PMR were equally superior to the control group, the EMG group demonstrated greater increases in the subjects' correct estimation of absolute difference in muscle tension between trials (Sime & DeGood, 1977). EMG feedback has shown greater decreases in frontalis muscle tension than PMR or control condition in subjects exhibiting anxiety neurosis (Canter et al., 1975). Delman and Johnson (1976) showed that the biofeedback subjects demonstrated lower EMG readings than the PMR and control subjects. Haynes, Moseley, and McGowan (1975) reported that biofeedback was the most effective procedure in reducing EMG levels, although the difference between biofeedback and PMR was not statistically significant.

The assessment of other studies employing relaxation procedures has led to inconsistent and frequently controversial findings. EMG biofeedback and PMR have been found to be equally superior to the control procedure (Haynes et al., 1975; Miller et al., 1978). Progressive muscle relaxation has demonstrated improvement in stress related disorders like sleep disturbance (Borkovec, Kaloupek, & Slama, 1975) and speech anxiety (Hamberger, Note 4). Bradley and Canne (1981) found PMR superior to Benson's relaxation response in lowering heart rate. In two contradictory studies, significant differences on physiological measures were not noted between the PMR condition and the control groups (Edelman, 1970; Mathews & Gelder, 1969). When the latter researchers employed a greater sample, a clinical population, a within subject design and additional physiological measures, they found that there were significant differences between the two conditions in psychological as well as physiological measures. Counts, Hollandsworth, and Alcorn (1978) reported that no significant differences in anxiety scores were evidenced as a result of EMG or relaxation instructions.

Another relaxation technique frequently used to alter physiological levels related to stress in Autogenic training. Autogenic training is designed to support self-generating or self-regulatory mechanisms for counteracting the effects of stress. The trainee regularly practices psychophysiological exercises leading to musculature relaxation and self-control of breathing, blood flow, and heart rate. The instructions include suggestion of warmth and heaviness in the limbs (Schultz & Luthe, 1969). This technique has also demonstrated the capacity to produce relaxation (Reed & Meyer, 1974; Shapiro & Lehrer, 1980). Subjects decreased their scores on the Mood Adjective Checklist as a result of Autogenic training, although significant changes in physiological measures were not noted (Jessup & Neufeld, 1977). Keefe et al. (1980) found no significant differences in physiological responses during biofeedback, Autogenic training or PMR.

Procedural and Individual Differences

Some important differences need to be mentioned that may account for the variability in the studies reviewed here. Number of sessions ranged from one (Haynes et al., 1975; McGowan et al., 1979) to 25 (Canter et al., 1975). The duration of the sessions ranged usually from 20 minutes to 30 minutes (Budzynski et al., 1970; Miller et al., 1978; & Raskin et al., 1978), while adaption periods varied from no adaption period (Mathews & Gelder, 1969) to 10 minutes (Burish & Hendrix, 1980; Ollendick & Murphy, 1977; & Shapiro, 1977) to 14 minutes (McGowan et al., 1979). The importance of an adequate amount of time for stabilizing in the experimental setting has been noted in the literature (Taub & School, 1978). Kondo, Canter, and Bean (1977) examined the effect of intersession interval length on EMG performance. They found that sessions spaced in a short to medium interval of time resulted in larger decreases in EMG readings. All studies reviewed in this study used frontalis EMG placement with the exception of Mathews and Gelder (1969) who used the forearm extensor placement.

The rationale for using the frontalis muscle as the electrode position is the belief that this muscle reflects the general muscle tension level in subjects who are experiencing anxiety (Burish & Schwartz, 1980; Canter et al., 1975; & Raskin et al., 1973). EMG activity has also been correlated with other physiological and self-reported psychological changes (Budzynski et al., 1970; Canter et al., 1975; Haynes et al., 1975; Hendler, Derogatis, Avella, & Long, 1977; & Shapiro, 1977). The theory of generalized relaxation resulting from frontalis muscle relaxation has been debated and is contradicted in the literature. Ohno et al. (1978) found that although changes in the respiratory rate correlated with changes in EMG activity, the changes in heart rate did not. Measurements from a normal sample demonstrated no significant correlation between EMG levels, skin conductance level, cardiac activity and heart rate. All subjects were instructed to relax their forehead muscle (Siddle & Woods, 1978; Suter, 1979). A similar study (Gatchel, 1978) supported the position that EMG readings are specific to the forehead muscle relaxation by demonstrating that although heart rate decreased with EMG decreases, skin conductance level increased. During stressor session, EMG levels were maintained at a low level and heart rate and skin conductance levels both increased, coninciding with the subjects' self-report of anxiety. Delman and Johnson (1976) reported that their subjects in different relaxation groups exhibited reductions in different areas. Respiration rate decreased most for the PMR group, while EMG levels decreased more for the EMG biofeedback group. A discrepancy between self-report measures of relaxation and measures of EMG activity has also been noted, which may suggest that self-reported measures may often reflect the influence of experimental demand characteristics (Qualls & Sheehan, 1981a). The distinction between the greater frontalis relaxation produced by auditory eyes-closed feedback as opposed to visual feedback is also indicative of the specificity of EMG feedback training (Alexander, French, & Goodman, 1975). Response specificity to a particular feedback location has also been demonstrated in thermal biofeedback (Taub & Emurian, 1976; School & Taub, Note 5; Taub et al., 1981; Wand et al., Note 2). These findings of specificity in biofeedback learning has led to the position that as a result of the lack of generalizability in EMG feedback, these procedures may not be as effective as a general relaxation training technique (Alexander, 1975; Alexander et al., 1976; Burish & Hendrix, 1980; Burish & Schwartz, 1980; Deman & Johnson, 1976).

Specific differences in techniques may account for some of the variability in these studies. However, Hayes et al. (1976) suggest another factor: the response due to individual differences. Increasingly more research and attention have been focused on this factor as the analysis of group data tends to obscure individual differences (Turk et al., 1979). Qualls and Sheehan (1980) and Blanchard, Andrasik, and Silver (1980) stress that this neglect of individual differences parameter avoids the findings that EMG biofeedback is an effective procedure for some, but not all individuals. Individual differences in physiological responses have been noted in the research (Roberts, Kewman, & MacDonald, 1972; Matus, 1974; Page

& Schaub, 1978; Surwit, Bradner, Fenton, & Pilon, 1979; VanEgeren, Headrick, & Hein, 1972).

An individual characteristic quite often manipulated in the biofeedback research is trait anxiety. In a study of autonomic changes during PMR, it was demonstrated that high anxious subjects were not affected by PMR, while the low anxious subjects were (Edelman, 1970). It has been suggested that EMG biofeedback assisted relaxation may be self-defeating for chronically tense subjects who are overusing an active intervening strategy. The amount of time these subjects attended to feedback decreased over time (Coursey, 1975). Subjects with high trait anxiety increased their temperature significantly more than subjects with low trait anxiety (Bass, Mittenberg, Wiley, & Peters, 1973). Differential response in biofeedback as related to anxiety has been reported in other studies as well (Organ, 1976; Valle & DeGood, 1977).

The conflicting results in the efficacy of biofeedback has led Qualls and Sheehan (1979) to suggest that the performance is not simply a motivational factor, but rather a capacity for absorption, defined as the commitment of available perceptual, motoric, imaginative and ideational resources to a unified representation. High absorption individuals are identified by good capacity for absorbed attention, together with a preference for using these capacities toward inner directed activities. The low absorption individuals, on the other hand, display a limited capacity for absorbed attention and show a preference for an external, reality orientation. It has been reported that high absorption subjects experience interference during biofeedback (Qualls & Sheehan, 1981a). Instructional manipulation of imaginal strategies was effective in overcoming the interference effect (Qualls & Sheehan, 1980). It has been suggested that high absorption subjects differ from low absorption subjects in that the former appear more experientially and less instrumentally oriented than the latter (Tellegen, 1981). Qualls and Sheehan (1981c) stress the role of attention in influencing the situation specific response for the high and low absorption individuals. Although some research has related absorption to hypnotic susceptibility (Roberts, Schuler, Bacon, Zimmerman, & Patterson, 1975; Tellegen & Atkinson, 1974), it has also been pointed out that absorption in fact represents a dimension different from hypnotic susceptibility (Hilgard, Sheehan, Monteiro, & MacDonald, 1981) and is describing a relatively new personality dimension (O'Grady, 1980).

Locus of control of reinforcement has been considered as another important area of individual differences. It has been postulated that persons with internal locus of control perceive reinforcement as contingent upon their own behavior, while externals perceive events as a result of change, luck or powerful others (Rotter, 1966). Using heart rate as a dependent variable, it has been shown that internal locus of control subjects were better able to increase their heart rate and the externals were better able to decrease their heart rate (Gatchel, 1975; Ray, 1974; Ray & Lamb, 1974). Hall (1979) demonstrated that internal locus of control subjects were able to reduce their EMG activity to a significantly greater degree than external locus of control subjects. In another study, no significant differences were reported between internals and externals in their ability to decrease heart rate (Blankstein & Egner, 1977). While Reed and Saslow (1980), Logsdon, Bourgeois, and Levenson (1978), and Stern and Berrenberg (1977) all reported a shift in locus of control from less internal to more after the treatment condition, Hurley (1980) reported no significant differences. Ollendick and Murphy (1977) reported interactional results between locus of control and treatment condition. The cognitive relaxation procedures resulted in a greater decrease in heart rate and subjective distress for the internals, while the muscular relaxation produced the greater decrement for the externals. These findings emphasize the utility of the client-treatment interactive model.

Statement of the Problem

These inconsistent findings have added to the confusion regarding the relative efficacy of EMG feedback and other relaxation procedures. Research in the past has shown that the role of relaxation is becoming important in the treatment package (Budzynski et al., 1970; Canter et al., 1975; Haynes et al., 1975; Wolpe & Lazarus, 1966). Differences in procedural variables have been explored (Kondo, Canter, & Bean, 1977; Taub & School, 1978). Another area of investigation is the relationship of personality variables with the treatment technique.

In this study, subjects will be assigned in a partial counterbalanced order to the following relaxation conditions: (a) EMG biofeedback, (b) Progressive Muscle Relaxation, (c) Autogenic training, and (d) Self-relaxation control. Relaxation instructions serve the function of the primary independent variable. The role of individual differences will also be explored in this study. Two personality characteristics, high or low anxiety, and high or low absorption and internal or external locus of control, were investigated, both serving as independent variables. (For more detail on personality variables, see Reference Note 6). Dependent measures of this study will be frontalis electromography readings, digital skin temperature from the dominant hand, pulse rate, change in locus of control, subjective anxiety score, preference of the type of relaxation, and strategies used during treatment.

The following hypotheses were posited regarding the efficacy of the different relaxation techniques: (a) EMG biofeedback, PMR, and Autogenic training will be superior to self-relaxation in all measures of relaxation. (b) Specificity of physiological responses will be observed in that the EMG biofeedback group will demonstrate lower frontalis readings at the end of the treatment in comparison to the other treatment conditions; autogenic training group will exhibit higher skin temperature readings at the end of the treatment than the other treatment conditions. (c) There will be an interactional effect between the treatment conditions and personality variables in regards to the efficacy of the treatment techniques.

METHODOLOGY

Subjects

Forty-eight female subjects were selected as volunteers from undergraduate psychology classes. The classes were asked to take the State-Trait form of the Spielberger's State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, & Luscene, 1970) and the Tellegen Absorption Scale (see Appendix A) (Tellegen, 1981). After scoring each individual test, an appropriate number of High Anxiety-High Absorption (HH), High Anxiety-Low Absorption (HL), Low Anxiety-Low Absorption (LL), and Low Anxiety-High Absorption (LH) oriented individuals were selected so that an equivalent number of each were represented in each group. This resulted in 12 subjects in each personality group. All people with appropriate scores were contacted by telephone. Those interested in participating in an experiment on different types of relaxation were asked to meet at a later scheduled time period. This method of selection resulted in subjects with a mean age of 19.1 years. Subjects in the Low anxiety group had a mean score of 30.9 and subjects in the High anxiety group had a mean score of 51.5. Mean scores for Low and High absorption were 15.3 and 26.8, respectively. Most of the subjects had no previous experience in any form of relaxation and most subjects were not taking any prescribed medication. A written, as well as verbal, contract was made in order to insure their participation for all four sessions (see Appendix B). Since this design required a great amount of subject involvement and time commitment, a certain amount of subject attrition was anticipated. If subjects were unable to finish the sequence of four relaxation sessions, other volunteers from the appropriate Anxiety-Absorption group were asked to participate. Subjects were asked to abstain from alcohol or drug consumption (i.e., caffeine, marijuana, etc.; prescribed medicine was noted), any soft drinks containing caffeine and to refrain from smoking for a period of two hours before the scheduled times. Subjects were treated in accordance with the ethical standards of APA.

Apparatus and Physiological Measures

Electromyography biofeedback equipment, Autogen 1700 Feedback Myography was employed to measure the muscle potential of the subject and Autogen 5100 Digital Integrator was used to record the data. Autogen 2000 Feedback Thermometer was included to measure skin temperature as another dependent variable. Instructions to relax were provided to the subject by a cassette tape player. The four tapes used in this study were based on transcripts of tapes used in past research (see Appendix C). Commercial tapes were researched, but were rejected due to either inappropriateness of content and/or length of instructions. Each relaxation tape was preceded by instructions common to all relaxation exercises (Appendix D). The tapes were recorded by a male graduate student.

Experimental Setting

The biofeedback laboratory in the Appalachian State University Counseling and Psychological Services Center was used for this study.

This room was divided in half by a sound resistant screen. One side contained a reclining lounge chair for the subjects, a stereo speaker for the tapes, an 8 ohm speaker for the auditory feedback tone, and a thermometer to record the room temperature. Biofeedback instruments and all other equipment were placed on the other side of the screen. A thermometer, used to record outside temperature, was visible through a window behind the screen. The experimental room was dimly lit by two table lamps, one on either side of the screen.

Design

A 4 (treatment conditions) X 2 (anxiety) X 2 (absorption) mixed factorial design was employed in this study. The main focus of this study was the four different types of relaxation instructions: (a) EMG biofeedback (EMGBF), (b) Progressive Muscle Relaxation (PMR), (c) Autogenic training (AT), and (d) A control group using self-relaxation (SR). Two individual variables were also investigated: Low or High Trait anxiety measured by Spielberger's State-Trait Inventory and Low or High imaginative absorption measured by the Tellegen Absorption Scale. This study compared and assessed the differences, if any, among the four relaxation techniques. The dependent measures were frontalis EMG muscle action potential, digital skin temperature from the dominant hand, radial pulse rate, subjective anxiety inventory, change in locus of control, and preference of the type of relaxation training.

Procedure

The treatment techniques were partially counterbalanced for the four different sessions and presented on four different days.

Twenty-four possible presentation orders were formed. Since only 12 subjects were placed in each treatment group, every other presentation order was selected. The same 12 presentation orders were used for the four treatment groups and 12 subjects in each group received the 12 presentation orders. The subjects were randomly assigned to the initial experimental condition. Order effect of the treatment sequences was controlled by the above mentioned partial counterbalancing technique. As the subjects arrived for the session, they were asked to sign a consent form regarding the experiment (see Appendix B). Subjects were also asked to complete the Rotter Internal External Locus of Control Scale (Rotter, 1966), the Hopkins Symptom Checklist (see Appendix E) and a short questionnaire requesting demographic information. Upon completion of these inventories, the subject was taken to the relaxation room. The female experimenter attached the EMG electrodes to the forehead and the skin temperature electrodes to the dominant hand, took the pulse, started the tape player behind the screen, and began to record readings from the equipment. Recordings for physiological measures were recorded on a data sheet (see Appendix F). A short induction was used with each subject before the beginning of the tape.

Readings were taken at constant points during the treatment sessions. Sessions were divided into a 10 minute adaption phase, a 25 minute treatment phase, and a 10 minute post treatment phase. The average of one minute readings for EMG and skin temperature was recorded every minute. Pulse was taken once prior to the adaptation phase and again after the post treatment phase. The complete treatment session was approximately one hour, except for the first day when subjects were requested to arrive 15 minutes prior to the scheduled time in order to complete the preliminary forms.

To control for expectancy effect and prevent confounding, no mention was made of the particular techniques' effectiveness. After completion of each session, subjects were asked to describe the strategy employed during the session and their subjective rating of their relaxation. Following the termination of each session they rated the degree of relaxation on a scale from 0 to 100 with 10 point intervals (see Appendix G) (Goldfried & Davison, 1975). At the end of the final session, subjects were also given the Rotter Internal External Locus of Control Scale to assess any change. They were interviewed to assess their preferred type of relaxation and debriefed as to the purpose of the experiment.

RESULTS

In this 4 (EMGBF, PMR, AT, and SR) X 2 (High anxiety and Low anxiety) X 2 (High absorption and Low absorption) mixed factorial design, relaxation was assessed by three physiological measures: reduction of muscle action potential of the frontalis muscle (EMG), increase in surface skin temperature of the dominant hand, and decrease in radial pulse rate. EMG and skin temperature were recorded every minute during the 10 minute adaption phase, 25 minute treatment phase, and the 10 minute posttreatment phase. This resulted in 45 one minute readings. Each five readings were collapsed together and averaged, resulting in two adaption, five treatment, and two posttreatment averages for a total of nine readings. In the future, these nine averages will be referred to as time blocks one through nine for EMG and skin temperature results. Pulse was recorded prior to the adaption phase and taken again immediately following the posttreatment phase. Nonphysiological measures also served as dependent variables: The Subjective Anxiety Inventory score (SAI) taken at the end of each relaxation session; strategy(ies) employed during a relaxation session; change in locus of control, initially taken prior to the first session and again at the end of the last session; and finally, the subjects' preference for the relaxation techniques, recorded at the end of the final session. The independent variables were: (a) treatment (including EMGBF, PMR, AT, and SR), (b) anxiety (including High and Low), and (c) absorption (including High and Low). Grouping the last two variables resulted in the formation of four distinct personality groups: high anxiety-high absorption (HH), high anxiety-low absorption (HL), low anxiety-high absorption (LH), and low anxiety-low absorption (LL). The data for EMG and skin temperature were analyzed employing a 4 X 2 X 2 X 9 repeated measures analysis of variance.

Physiological Measures

EMG. Analysis of the readings during the adaption phase was performed in order to determine if there were starting differences for the subjects on the physiological measure. The analysis proved to be nonsignificant with EMG as a dependent variable, indicating that the initial EMG was approximately the same for all treatment and personality groups. (The ANova summary table and means are presented in Appendix H, Table 1.)

A 4 (treatment) X 2 (anxiety) X 2 (absorption) X 9 (time blocks) repeated measures analysis of variance was conducted using EMG as a dependent variable. This analysis, demonstrated in Figure 1, illustrates a significant time effect, indicating that all subjects were able to decrease their EMG levels during the nine time blocks across all four treatments (F (8,352) = 19.38, p = .0001). In addition, there was a significant main effect of treatment (F (3,132) = 11.64, p = .0001), which demonstrates elevated readings for PMR treatment during time blocks three and four. The elevated readings, as a function of the unique instructions during the treat-session, are responsible for producing the significant difference.

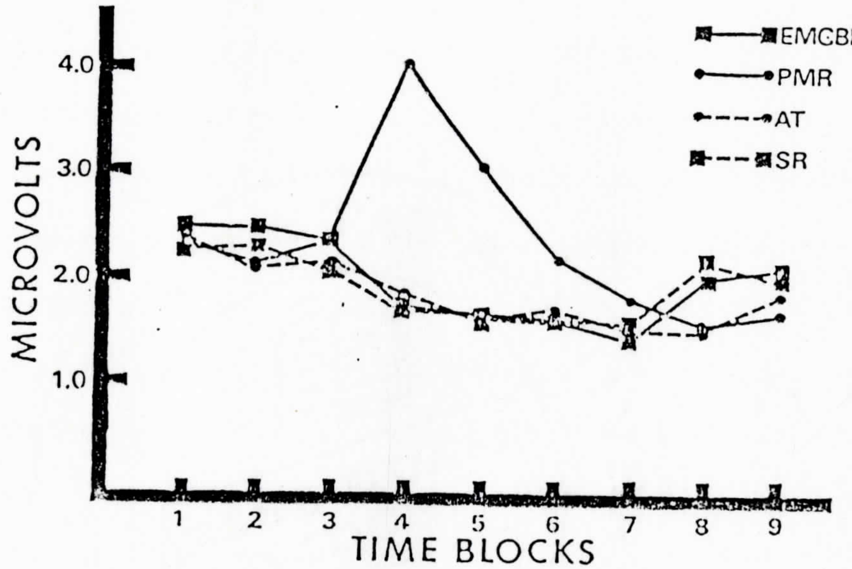

Figure 1. Average EMG readings for all subjects across nine time blocks.

There was also a significant interaction between treatment and time blocks (F (24,1056) = 25.73, p = .0001), which is represented in Figure 2. As indicated by the graph, it is apparent that all groups decreased their EMG levels across the treatment sessions. The readings of time blocks three and four are unusually elevated during the PMR treatment session, which is the primary reason for the significance between treatment and time blocks. Another significant interaction was found between treatment X time blocks X anxiety X absorption (F (24,1056) = 1.67, p = .0226), which is represented by the four graphs in Figure 3. This set of graphs displays the interaction across the nine time blocks for the four treatment groups and the four personality groups. The four personality groups do not differ noticeably among themselves in the PMR and AT relaxation treatments, but differ quite apparently in the EMGBF and SR groups. In the EMGBF and SR groups, the high anxiety-high absorption (HH) subjects reduced their EMG levels noticeably more during time blocks four through seven, which represents most of the treatment phase. However, all personality groups finished their treatment session at approximately the same levels. (The Anova summary table is presented in Appendix H, Table 2.) It appears that the fluctuation of readings, evidenced by the time block significance, may be partially responsible for the interactional effect. In other words, the time block significance may override all other significant results for EMG and may present itself as a confounding factor. This confounding factor may also make interpretations of the results difficult and erroneous.

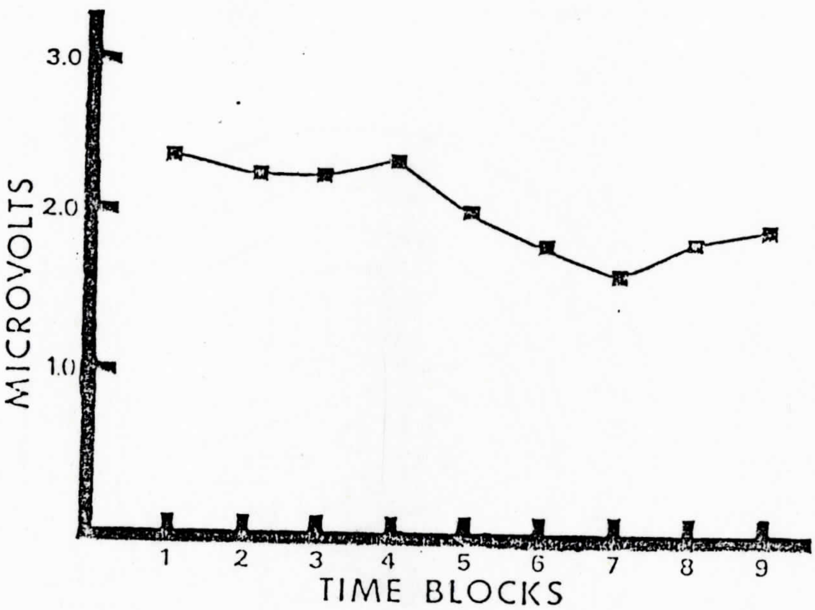

Figure 2. Average EMG readings for all subjects across nine time blocks as a function of treatment.

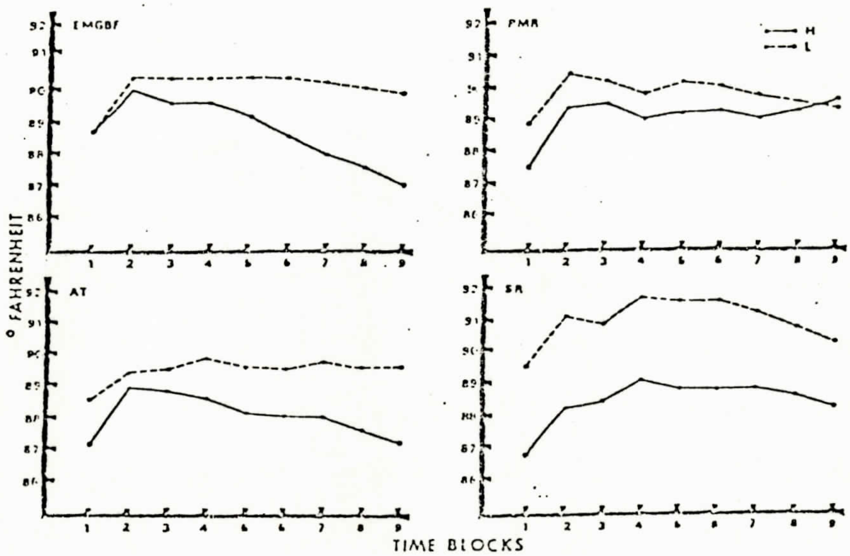

Figure 3. Average EMG readings as a function of treatment, time blocks, anxiety, and absorption.

Since the repeated measures analysis of variance may have contributed to this confounding factor, it was reasoned that the change score from pretreatment adaption phase to the final time blocks of the treatment phase would present a more accurate picture of the data. By ignoring time blocks three through five during treatment, which fluctuate as a function of the nature of instructions, and also time blocks eight and nine during posttreatment, which may have been a cue for subjects to end active relaxation, confounding factors could be eliminated.

A 4 (EMGBF, PMR, AT, and SR) X 2 (High and Low anxiety) X 2 (High and Low absorption) mixed factorial design was employed to analyze the change scores for EMG. With EMG as a dependent variable, time blocks one and two from the adaption phase were averaged and time blocks six and seven from the end of the treatment phase were averaged to form two new data points. The change score from time blocks 1 + 2 / 2 to time blocks 6 + 7 / 2 yielded significance for EMG. (The Anova summary table and means are presented in Appendix H, Table 3.) The graph for the significant treatment effect is pictured in Figure 4. It indicates that although all treatment groups reduced their EMG levels, at least one group differed significantly in the amount of reduction. Newman-Keuls (Bruning & Kintz, 1977) multiple F test was employed to compare the difference in the change scores of the four relaxation techniques. Significance resulted in the following four comparisons: (a) With $\underline{F}$ (132) = .40, $\underline{p}$ = .05, the difference between EMGBF and PMR was found to be significant. The EMGBF group was able to reduce their muscle

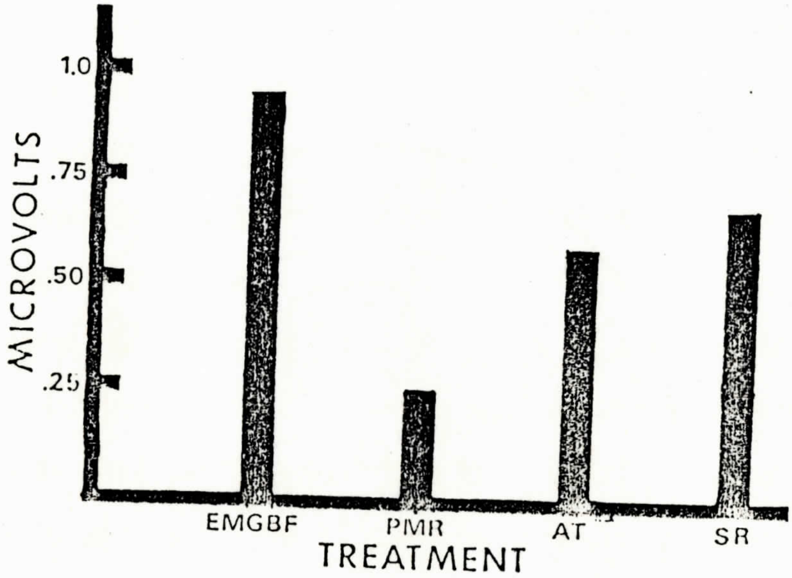

Figure 4. Average EMG reduction as a function of treatment.

activity levels to a greater degree than the PMR group; (b) with $\underline{F}$ (132) = .36, $\underline{p}$ = .05, it was found that the SR group also had a greater muscle activity reduction than the PMR group; (c) with the same critical difference as the criterion, EMGBF was found to demonstrate greater muscle activity reduction than the AT group; and (d) with $\underline{F}$ (132) = .30, $\underline{p}$ = .05, the AT group had more reduction in muscle activity than the PMR group. In summary, the EMGBF group had the most frontalis muscle activity reduction during treatment than the other three relaxation groups, while the PMR group had the least reduction of the four groups. (The multiple F test summary is presented in Appendix H, Table 4.)

Digital Skin Temperature. Analysis of the skin temperature readings during the adaption phase was conducted to determine if there were starting differences. The analysis resulted in nonsignificance, indicating that all subjects began treatment at approximately the same skin temperature regardless of type of relaxation instruction or personality type. (The Anova summary table and means are presented in Appendix H, Table 5.) A 4 (EMGBF, PMR, AT, and SR) X 2 (High and Low anxiety) X 2 (High and Low absorption) X 9 (Time blocks) repeated measures analysis of variance was also employed to analyze change in skin temperature. The analysis yielded a significant time block effect $\underline{F}$ (8,352) = 9.32, $\underline{p}$ = .0001, pictured in Figure 5, which indicates that all treatment groups increased their skin temperature over the nine time blocks. The analysis also resulted in a significant interaction of treatment and time blocks $\underline{F}$ (24,1056) = 1.74, $\underline{p}$ = .0150. This interaction is

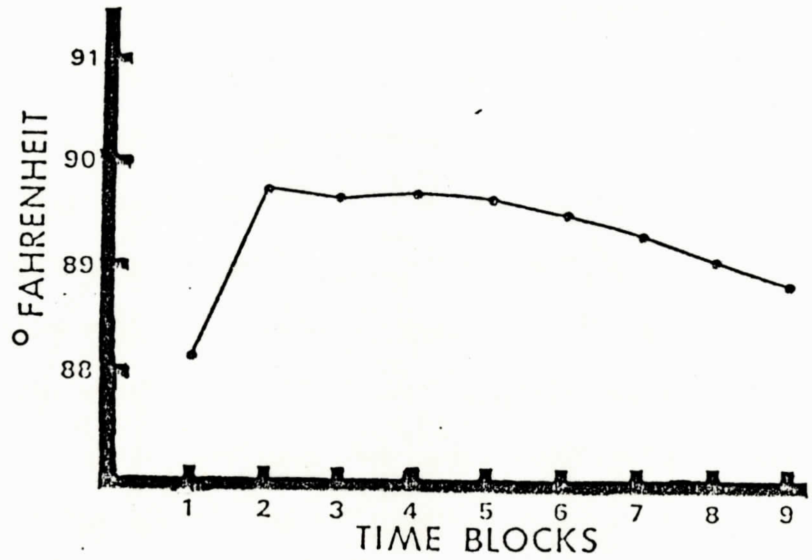

Figure 5. Average skin temperature readings for all subjects across nine time blocks.

illustrated in Figure 6. Subjects in all four groups increased their skin temperature over the nine time blocks, gradually declining after a dramatic increase of at least 1.5°F during the adaptation phase, time blocks one and two. Subjects in the SR group generally maintained a higher skin temperature during the treatment phase in comparison to the AT, PMR and EMGBF groups. The second interaction found for skin temperature was between treatment X time blocks X absorption F (24,1056) = 1.93, p = .0047. The interaction is shown in the graph in Figure 7. It is observed that certainly personality characteristic is a factor during EMGBF and AT. During time blocks one and two, high absorption subjects, as well as low absorption subjects have an increase in skin temperature. However, during the remainder of time blocks, while low absorption subjects maintain their relaxation, high absorption subjects have a decrease in skin temperature. The difficulty for high absorption subjects to maintain relaxation may be resulting from their perception of the treatments as interference. No apparent differences were found during the PMR and SR group as a function of absorption. There was an emerging significant interaction between treatment X time blocks X anxiety X absorption F (24,1056) = 1.47, p = .0671. By using the four anxiety-absorption groups, it was noticed that the treatment X time blocks X absorption interaction masked some important information. Although the findings for the EMGBF and SR are similar when including anxiety as a factor, some interesting trends are seen in the PMR and AT group. During PMR, while high absorption subjects maintained relaxation regardless of the anxiety

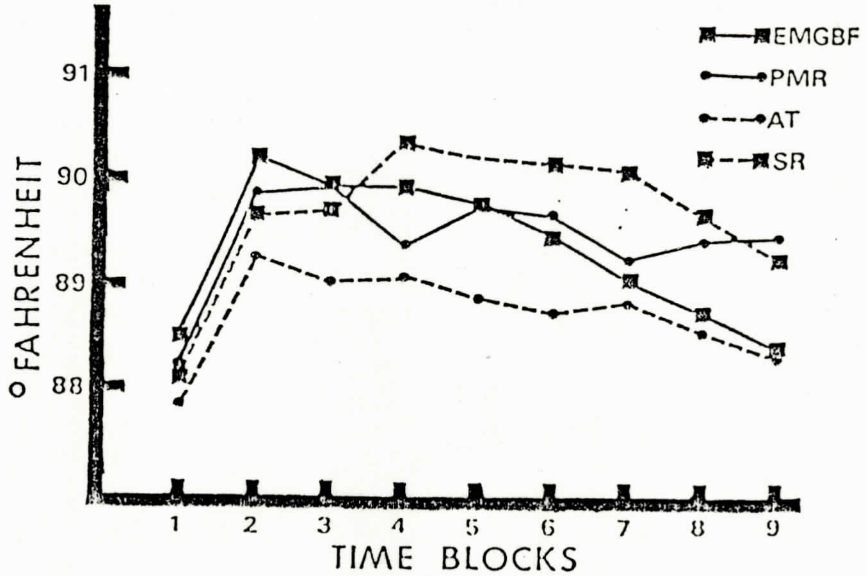

Figure 6. Average skin temperature readings for all subjects across nine time blocks as a function of treatment.

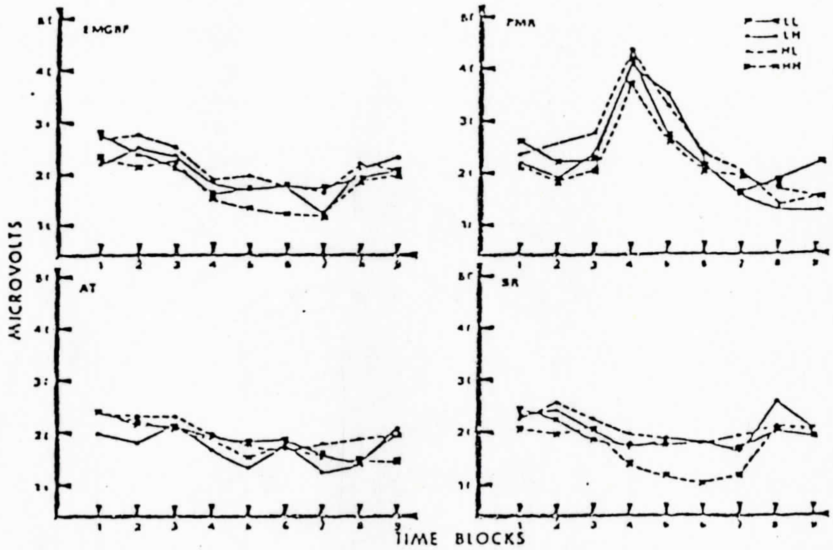

Figure 7. Average skin temperature readings as a function of treatment, time blocks, and absorption.

factor, the low absorption subjects were influenced by the anxiety variable. The LL subjects increased skin temperature during PMR while HL subjects, on the other hand, decreased their skin temperature by the end of the session. (The Anova summary table is presented in Appendix H, Table 6.)

A change score analysis (similar to the one used for EMG) was also conducted with skin temperature as a dependent variable. To eliminate the confounding factor of unusually diverse readings as a function of the instructions, change scores from time blocks 1 + 2 / 2 and time blocks 6 + 7 / 2 were employed. The 4 (EMGBF, PMR, AT, and SR) X 2 (High and Low anxiety) X 2 (High and Low absorption) analysis of variance for change in skin temperature failed to reach significance in both main effects and interactions. After excluding the elevations in the middle time blocks, it appears that beginning and final readings for skin temperature were approximately the same. (The Anova summary table and means are presented in Appendix H, Table 7.)

An order effect of treatment presentation was found for skin temperature, demonstrating that order of presentation of a particular treatment technique was important in the amount of skin temperature change measured. There was more skin temperature change in those subjects who received SR as the first treatment (-4.68). Subjects who were presented with SR in the fourth position had the least reduction (-0.03). In analyzing the order effect for the other three treatment techniques, no significant findings were observed for skin temperature.

Radial Pulse Rate. Pulse was the third physiological measure used as a dependent variable. Analysis of the initial pulse readings prior to the adaption phase resulted in significance for treatment F (3,132) = 3.04, p = .0315, which shows that all subjects did not have similar starting levels. (The Anova summary table and means are presented in Appendix H, Table 8.) The Newman-Keuls multiple F test was employed to determine where significant differences occurred: With F (132) = 4.43, p = .05, it was found that the EMGBF group had significantly higher pulse prior to treatment in comparison to the AT group; with F (132) = 3.38, p = .05, the EMGBF again had higher pulse rate than the SR group. No significant differences were found when the other groups were compared. (The F test summary table is presented in Appendix H, Table 9.)

A 4 (EMGBF, PMR, AT, and SR) X 2 (High and Low anxiety) X 2 (High and Low absorption) X 2 (Time blocks) analysis of variance on pulse rate showed that although there were no main effects of treatment or personality groups, it did result in a significant time block effect F (1,44) = 37.81, p = .0001, indicating that all subjects changed their pulse over the two time blocks. This analysis also resulted in a significant interaction between treatment and time blocks F (3,132) = 3.72, p .0132, which represents a reduction of pulse rate by subjects in all four treatment groups. The decrease in pulse rate as a function of treatment over the two time blocks is demonstrated by the graph in Figure 8. (The Anova summary table and means are presented in Appendix H, Table 10.)

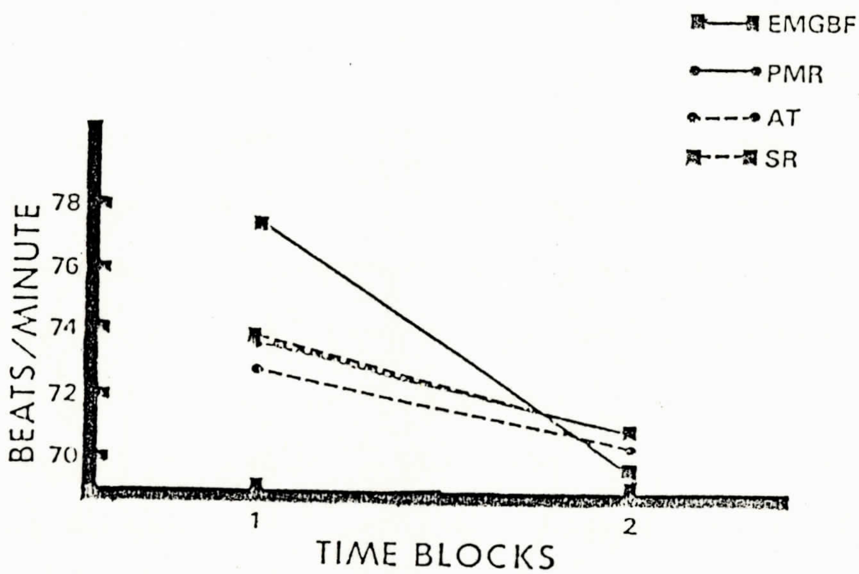

Figure 8. Average pulse readings for all subjects across time blocks as a function of treatment.

The Newman-Keuls multiple F test was employed to determine which groups differed significantly from another in the amount of pulse rate reduction. With $\underline{F}$ (132) = 4.53, $\underline{p}$ = .05, it was found that the EMGBF group had a greater reduction than the PMR group; with $\underline{F}$ (132) = 4.97, $\underline{p}$ = .05, it was found that the EMGBF group had more reduction in pulse rate than the AT group; finally, with $\underline{F}$ (132) = 3.80, $\underline{p}$ = .05, it was shown that the EMGBF group was superior to the SR group in the level of pulse rate reduction. There were no significant differences in the other group comparisons. (The F test summary table is presented in Appendix H, Table 11.) Since there were starting differences for pulse, the significance of pulse rate change may be due to a regression effect and thus the significance must be interpreted with caution.

Nonphysiological Measures

Subjective Anxiety Inventory (SAI). Upon termination of each session, subjects were asked to rate their perception of the level of relaxation achieved, with 0 representing very relaxed and 100 representing very tense; this rating was used as a nonphysiological dependent variable. To determine whether subjects rated their level of tension-relaxation differently for one of the four relaxation groups, a 4 (EMGBF, PMR, AT, and SR) X 2 (High and Low anxiety) X 2 (High and Low absorption) analysis of variance was employed. This analysis yielded a significant treatment effect $\underline{F}$ (3,132) = 5.66, $\underline{p}$ = .0011. The graph for the SAI significant main effect is illustrated in Figure 9. It demonstrates that during at least one relaxation treatment, subjects reported significantly different SAI

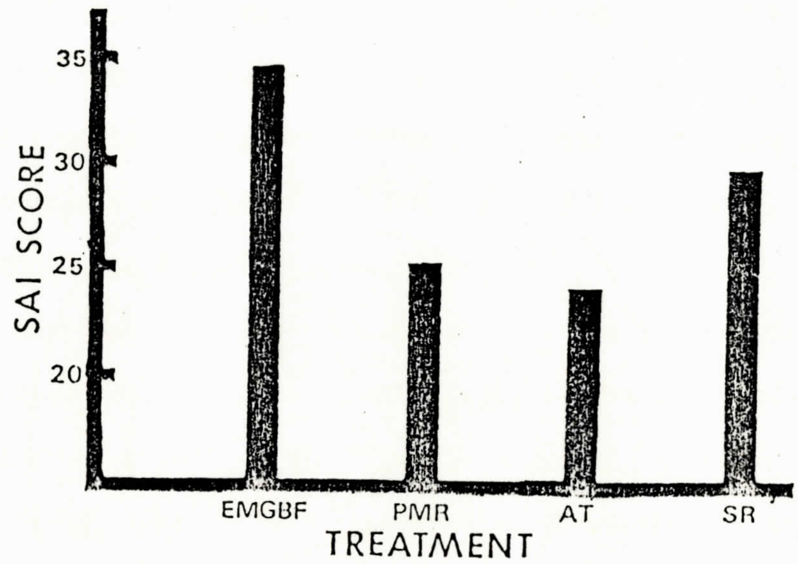

Figure 9. Average subjective anxiety inventory score for all subjects as a function of treatment.

scores. (The Anova summary table and means are presented in Appendix H, Table 12.) The Newman-Keuls multiple F test was conducted to determine differences between any two relaxation groups. This resulted in significance for two comparisons: With F (132) = 7.30, p = .05, it was found that the EMGBF group reported more subjective anxiety than the AT group at the end of the session; with F (132) = 6.65, p = .05, it was also shown that the EMGBF group reported more subjective anxiety than the PMR group. As a group, all subjects reported their anxiety to be highest during the EMGBF session and lowest for the AT session. (The F test summary table is presented in Appendix H, Table 13.)

As expected, the order of presentation of the treatments was a contributing factor in the subjects' SAI score. The individuals who received EMGBF on their first session rated their level of relaxation as 29.33. The ratings increased as the number of treatment presentations increased. When EMGBF was received as the least relaxation treatment, the SAI score increased to 42.00. The reverse trend was found to be true for SR; when SR was presented as the first treatment, subjects rated it 37.5. This SAI rating decreased as more treatments were presented prior to SR; when SR was presented as the fourth relaxation treatment, subjects rated as 24.17. An order effect was not evidenced for PMR or AT.

Strategies. All subjects were asked the following question at the end of each relaxation treatment: "What did you do to make yourself relax?" Subjects varied in the number of responses, some producing only one technique while others listed several techniques.

This resulted in 22 different categories of strategies employed by the subjects. There were a total of 116 responses by the 48 subjects. Since some categories were formed from only one response, strategies with less than 5% representation were eliminated. This elimination process left the following seven categories: (a) Followed instructions, (b) Fell asleep or very tired, (c) Breathing, (d) Imagery, (e) Cleared mind, (f) Day dreaming or let mind wander, and (g) Told body to relax. It was found that "told body to relax" was reported by 32 subjects in the EMGBF treatment. "Fell asleep or very tired" was reported during the EMGBF as the strategy least often used--only by seven subjects. During PMR, all subjects reported that they "followed instructions." This was also the strategy indicated by all the subjects in the AT group. In the SR treatment, however, 32 subjects responded that the strategy employed by them was some form of "imagery." "Clearing mind" and "breathing" were the next most frequently used strategy during SR. Since the analysis of variance for the physiological dependent variables yielded significant interactions of treatment X anxiety X absorption, it was interesting to note the strategies employed by these personality groups. High absorption subjects reported "following directions" most often for PMR and AT, "told body to relax" for EMGBF, and "imagery" for SR. Low absorption did not differ from the high absorption subjects in the type of strategies used. Similar distributions were also found for the low anxiety subjects. There is a slight difference for the high anxiety group: strategies employed for EMGBF, PMR, and AT were the same as for the other personality groups; however, for SR, an equal number of subjects reported "cleared mind" and "imagery." (A complete tally for the strategies is found in Appendix H, Table 14.)

Preference for Relaxation Technique. At the termination of the last relaxation presentation, subjects were asked to list the order of their preference for the techniques. Twenty-five subjects named SR as the most desirable technique, while only 10 subjects rated EMGBF as their preferred method of relaxation. PMR and AT were listed as first preference by seven and six subjects, respectively. AT was named as the least preferred technique by 15 subjects, the largest rating, while EMGBF was least preferred by only seven subjects. (A complete tally chart of the preferences by the subjects is presented in Appendix H, Table 15.)

Locus of Control. Rotter's Locus of Control Inventory (LOC) was employed in this study as an additional nonphysiological dependent variable. Change in locus of control was determined if the scores indicated either a more external or more internal rating as a function of the four treatment sessions. The 4 (EMGBF, PMR, AT, and SR) X 2 (High and Low anxiety) X 2 (High and Low absorption) X 2 (Time blocks) analysis of variance failed to reach significance, implying that the overall change in locus of control from preadaption of the first session to the end of the final session was not significant. There were no significant differences found in change of locus of control among the four personality groups. (The Anova summary table and means are presented in Appendix H, Table 16.)

<u>Correlations</u>. A correlation matrix was created on all the variables used in this study, including change scores for all physiological measures, the subjective anxiety inventory, trait anxiety scores, absorption inventory scores, locus of control inventory scores and the Hopkins Symptom Checklist scores. The matrix yielded four correlations that are of importance to this study. Hopkins correlated positively with trait anxiety (.6164). This implies that subjects who reported greater trait anxiety also reported more physical and emotional symptoms; also, subjects with low anxiety reported less physical and emotional symptoms of stress and anxiety. This correlation supports the use of the Hopkins Symptom Checklist as a valid substitute or alternative to an anxiety inventory. At the same time, self reported trait anxiety is validated by the Checklist, which included items representing physiological and psychological symptoms of stress and anxiety.

Subjects that scored more externally on the initial locus of control inventory recording also scored higher on the Hopkins Symptom Checklist (.4274). The people who felt that fate or others controlled life events also exhibited more physiological and emotional symptoms of anxiety and stress. It is not surprising then, that there would be a positive correlation (.4984) between locus of control and trait anxiety. This correlation demonstrates that subjects who were more "externally" oriented in their view of life would also rate themselves as high in anxiety.

Finally, it is of importance to note that anxiety and absorption were not highly correlated (.1170). This supports the premise that anxiety and absorption are, in fact, representing two different personality traits. As a result, the four personality groups formed, HH, HL, LL, and LH, were four distinct types of individuals with different personality traits.

DISCUSSION

Physiological Measures

This study was conducted as a reaction to the controversy regarding the efficacy of electromyography as a relaxation technique. As the research suggests, electromyography biofeedback has been found to be successful, and frequently superior to other relaxation instructions, in the reduction of muscle activity. Some relevant questions were generated in this study with regards to particular aspects of relaxation techniques and individual traits that contribute to the relaxation response.

The results indicate that with the repeated measures analysis of variance, there was a main effect of treatment for the EMG dependent variable. This resulted from the exaggerated readings during PMR while subjects were tensing forehead muscles under the electrode placement site. Reinking and Kohl (1975) eliminated this confound by not recording EMG while the tape was being played, but rather during the practice session following the tape, at which time the subjects were asked to only concentrate on relaxing. Canter et al. (1975) and Haynes et al. (1975) avoided this problem by using modified PMR instructions which included only attending to relaxing the muscles, not tensing the muscle groups. Coursey (1975) avoided the question of elevated readings due to outside interference, by substituting the lower mean for the higher mean if a subject's EMG total increased threefold over the previous session and was three times the mean for the other seven sessions. In this current study, the elevated PMR readings artifact was eliminated when change scores were used for the EMG dependent variable. This resulted in a significant main effect, showing that subjects who received EMGBF training were able to achieve a greater reduction in their EMG levels. Some reduction in EMG was noted in the other three treatments as well, indicating that all subjects were able to relax to some degree with a one session design. The time blocks 6 + 7 / 2 readings for the four groups demonstrate that although no gross differences in EMG levels were found, slight diversity, ranging from 1.44 mv to 1.78 mv, was evidenced. It has been argued that possibly EMGBF, an expensive and intricate equipment, produces a placebo effect, and is no better than another relaxation technique. This nonspecific response to treatment can be accounted for by the fact that the sample was chosen from a nonclinical population. The individuals who volunteered for this experiment may have been relatively relaxed prior to the treatment presentations and thereby may have exhibited a "ceiling" effect, in that they began treatment at a relatively high level of relaxation and could not increase relaxation further. It was hypothesized that EMGBF, PMR, and AT would be superior to SR as relaxation techniques. Surprisingly, the change score analysis of variance demonstrates a greater reduction in EMG during SR than AT or PMR. This finding supports the validity of self-relaxation technique as a form of relaxation, at least for nonclinical subjects.

Another prediction made for this study stated that there would be an interaction between treatment techniques and the personality variables. The interaction between treatment X time blocks X anxiety X absorption exhibits a somewhat paradoxical finding. The high anxiety-high absorption subjects achieved lower EMG readings during SR as well as during EMGBF, the latter being more structured than the former. The high absorption trait could be helpful during EMGBF by blocking out the feedback tone, an external stimulus. In SR, of course, subjects were allowed to internalize relaxation, as they were not given any specific external instructions and had to depend on internal cues to bring about relaxation. In other words, the subjects exhibiting high absorption as a trait, were able to block out the external interfering stimulus and concentrated on internal cues to aid in reducing EMG muscle activity.

Another physiological dependent measure employed in this study was digital skin temperature. The repeated measures analysis of variance did not produce any main effects of treatment or personality variables. The subjects may have achieved a ceiling effect of temperature by the end of the adaption phase, which ranged from 89.3°F to 90.2°F. The range of 85°F to 95°F is considered to be an acceptable measurement of relaxation. Therefore, these subjects, representing a nonclinical population, may have reached their maximum potential in increasing skin temperature by the time treatment began. There are other explanations for this nonspecific response. All other studies reviewed in the literature measure EMG and other measures besides skin temperature. Also, studies reviewed here either instruct their subjects to simply control skin temperature variation via feedback (Taub, 1968; Taub & Emurian, 1976) or to increase their skin temperature in order to alleviate migraine headaches (Sargent, 1973) or symptoms of Raynauds Disease (Taub, Spalding, Gruber, & Kuntz, 1981). The current research differs because skin temperature was used to only measure relaxation. Another explanation for the lack of treatment effect on skin temperature is that this study employed a nonclinical population, who exhibited an average reading of 89.0°F at baseline. It is expected that patients with Raynauds Disease or migraine headaches will exhibit lower starting temperatures and not surprisingly, increase readings drastically during treatment. An obvious interpretation for this lack of treatment effect is that no feedback was provided for this physiological system. In addition, the instructions used for AT in this study were modified to adapt to the one-session design and the time restrictions. As was done for EMG, change scores for skin temperature showed a slight increase in readings for all treatment groups, a possible indicator of increased relaxation. The drastic elevation during the adaption phase also suggests a ceiling effect for skin temperature in this nonclinical population. Contrary to the first prediction, SR was not found to be less effective in relaxation than EMGBF, PMR, and AT. This again suggests the premise that relaxation techniques might be displaying nonspecific aspects. It also substantiates SR as a valid treatment, as effective in relaxation as EMGBF, PMR, or AT, at least in this design.

Interactions also occurred for skin temperature; absorption, as a personality trait, interacted with at least one treatment. During PMR and SR, high and low absorption subjects had similar readings; whereas during EMGBF and AT, high absorption subjects were not able to maintain their relaxation. These subjects may have been experiencing interference during the two techniques, thereby supporting Qualls and Sheehan (1981b) in their description of high absorption individuals.

The third physiological dependent variable, radial pulse, did not result in a main effect of treatment or personality. The interaction of time blocks and treatment implying greater reduction during EMGBF, may be misleading as there were starting differences. Although this sample was acquired by random sampling, there was an uneven distribution of subjects demonstrated by higher beginning pulse rates during the EMGBF treatment. Therefore, the significant interaction could be attributed to a regression effect. The fact that subjects did not exhibit great differences at posttreatment recording may be due to the lack of feedback to this particular physiological system. It is debatable whether pulse is a good indicator of relaxation since pulse is also affected by change in physical activity; subjects may have had lower readings in pulse by the end of the session resulting from being still, rather than representing relaxation as a function of the treatment techniques.

Specificity

As the results suggest, there are some inconsistencies in these findings in regards to the three physiological variables. An additional prediction made for this design was that greater EMG reduction would be evidenced for EMGBF and greater skin temperature increases would be found for AT. This study is able to support the former, but not the latter. As mentioned previously, the subjects were provided feedback for only one physiological system, specifically frontalis musculature. The fact that increases in skin temperature and reduction in pulse were not striking and parallel to the EMG reduction implies specificity of learning. As early as 1953, Lacey introduced the idea of autonomic lability, suggesting that different physiological reactions (i.e., heart rate, muscle tension or skin conductance) occur with different emotional and stress conditions (i.e., fear, anxiety or anger). In other words, arousal or relaxation in one system does not necessarily bring about the same reaction in other systems. Understandably, no indication of increased relaxation was evidenced by skin temperature and radial pulse readings. Heretofore, an implicit assumption has been found in the literature that relaxation in one system automatically leads to relaxation in other systems. In this current study, relaxation is evidenced in only that area targeted by training. The important factor in producing relaxation may be learning of the response-feedback loop, which is crucial to success in relaxation training. As a function of the response specificity, no one treatment proved to be superior in generalized relaxation.

<u>Nonphysiological Measures</u>

Analysis of variance for subjective anxiety resulted in subjects reporting the least relaxation during EMGBF when in fact, the most EMG reduction was evidenced for this treatment group. An explanation for this inconsistency is that subjective perception of relaxation may reflect total body relaxation rather than specific muscle activity reduction. The inconsistency between mind and body relaxation would be expected to be reduced as the number of presentations of treatment are increased. There is some evidence to suggest that subjective measures correlate more highly with physiological measures like heart rate and skin conductance (Mathews & Gelder, 1969). The possibility of demand characteristics of the experimenters when questioning the subjects needs to be taken into consideration when evaluating the discrepency between EMG readings and SAI ratings. This lack of consistency can also be explained by the response specificity theory.

Since most of the subjects had no prior experience with relaxation techniques, they did not exhibit mind-body awareness. Subjects were unable to associate body states with mental states, possibly because training consisted of only four sessions, only one with feedback. Although no main effects for personality traits were observed, subjects may have found the EMGBF feedback tone to be aversive and performance oriented, thus requiring more alertness and possibly producing more anxiety. The subjective anxiety ratings were also affected by the presentation order of the four treatment techniques. Ratings for the EMGBF group were highest in the fourth position due to the subjects' tendency to compare and evaluate the other three techniques. Ratings, however, for SR were lowest in the fourth position, possibly as a result of subjects using the other three learned techniques, as a result of practice effect, or due to relief with completion in mind.

Strategies that subjects employed during relaxation were also an important contributing factor in regards to their physiological measures and nonphysiological ratings. During the more structured techniques (PMR and AT), all subjects followed instructions, while during EMGBF subjects relaxed by "blocking" out noise and telling their bodies to relax. During SR, subjects used self initiated imagery as a strategy. As anticipated by Qualls and Sheehan (1980) and Tellegen (1981), but not supported by this study, personality groups differed in the type of strategy employed during a particular relaxation technique. These differences were not evidenced in the current study. Since absorption, as well as anxiety groups, resulted from excluding the scores in the middle one-half standard deviation, extreme scores for either absorption or anxiety may not have been acquired and thus may have weakened the distinct personality groupings of these subjects.

The novelty and unusual characteristics of EMGBF also influenced the subjects' preferences for the techniques. It was preferred by significantly fewer subjects than SR. EMGBF not only included a performance component, but also was considered to be an external stimulus. Due to the short induction and lack of understanding for the equipment, subjects may have interpreted the feedback as threatening and an intrusion.

No main effects or interactions were attained with locus of control as a dependent variable. The lack of significant change over the four sessions or failure to demonstrate interactional effects is inconsistent with the findings of Hall (1979), who found that internal LOC subjects were able to reduce their EMG activity and Ollendick and Murphy (1977) who reported that cognitive relaxation (i.e., AT) resulted in greater decrease in heart rate and anxiety for the internals, while PMR produced a greater reduction for the externals. In the current study, subjects were not able to "internalize" control over relaxation in the course of the four sessions. In addition, three of the four treatments required attending to external stimuli and thereby, did not provide the opportunity to internalize.

This study has brought to the foreground some findings with important clinical implications. Although, some degree of relaxation was observed within the four session time span, no striking differences were found, mainly due to the minimal exposure. In order for learning of response and cues of mind-body awareness to be developed, a long program of relaxation should be provided. Self-relaxation is also seen as an effective method of treatment and should be encouraged, especially in the latter stages of a relaxation program. It was reported in this study that EMGBF is experienced as aversive and interfering, especially in the first session. In a clinical setting, a gradual introduction to this technique might prove more conducive to relaxation. In support of this clinical procedure, the order effect when presenting different relaxation techniques is also a valuable factor.

In this study, no one relaxation technique was found to be superior for generalized relaxation, although EMGBF reduced EMG levels to a greater degree. This study supports the notion presented by Canter et al. (1975) that although significant differences may not be attained with minimal sessions, feedback will prove to be superior as the number of sessions increase. Based on this information, a particular form of feedback would be more appropriate for a specific disorder. Lastly, it appears that it is not the personality traits or the treatment techniques, but rather the physiological area of feedback training that determines the success of decreased arousal.

Suggestions for Future Research

The evidence presented in the current study justifies the need for further investigation in the area of response specificity and techniques of generalization of relaxation. A more reliable and accurate method for measuring PMR treatment needs to be investigated and reported in the research. In this study, variance in weather conditions may have influenced skin temperature readings, in spite of the adaption phase. In future research, this factor may need to be controlled.

Some procedural aspects of biofeedback need to be investigated in the future research. In electromyography biofeedback equipment, collaboration in readings has not been established. What is considered to be resting state or baseline on one equipment may differ quite drastically for another set of equipment. While this current study reported average baseline readings of 2.30 mv, Haynes et al.

(1975) reported average baseline readings of 7.38 mv and Ohno et al. (1978) reported 2.01 mv as their mean baseline reading. This lack of calibration would lead to a cautionary note when reporting absolute values of final EMG readings; rather, a report of the percent of change from pre- to posttreatment would be a more accurate indication of a decreased arousal state.

As evidenced in the current study, there was little generalization of change from one physiological system to another, as well as to subjective ratings. In future research, multiple electrode placement sites might be employed to better determine generalized relaxation and to provide a more accurate picture of relaxation. It was found in this study that during the 10 minute posttreatment phase, subjects did not continue to relax or sit quietly as instructed; instead, they began to stretch, flex muscles, or generally became more distracted and ended relaxation. Specific instructions encouraging continued relaxation might yield more accurate posttreatment readings.

Since these female subjects were given instructions by a taped male voice, there may have been a differential effect of sex on relaxation. Finally, in the case of female subjects, the emotional and physiological changes that occur during menstruation need to be investigated in regards to arousal states.

REFERENCE NOTES

REFERENCE NOTES

1. Gruber, B. L., School, P. J., & Taub, E. Thermal and EMG biofeedback training in nonhuman primates. Paper presented at Biofeedback Society Meeting, Nashville, March 1981.

2. Wand, G., Slattening, P., Haskell, J., & Taub, E. Anatomical specificity of thermal self-regulatory effect: Feedback locus on the web dorsum. Paper presented at Biofeedback Society of America, Albuquerque, March 1978.

3. Taub, E., Spalding, T. W., Gruber, B. L., & Kunz, J. Raynaud's disease and thermal biofeedback: Precise anatomical localization of self-regulation effect around feedback loci on the hand. Paper presented at Society for Psychophysiological Research Meeting, Washington, D.C., October 1981.

4. Hamberger, K. L. Effects of relaxation training, therapist presence or absence, and mode of instruction presentation on muscle relaxation. Paper presented at Midwestern Psychological Association, Detroit, April 1981.

5. School, P. J., & Taub, E. Effects on hand temperature of several subject produced behaviors relevant to a thermal biofeedback situation. Paper presented at Biofeedback Society of America, Colorado Springs, March 1979.

6. Rawson, J. C. Biofeedback and relaxation: The role of individual differences. Unpublished manuscript, Appalachian State University, 1983.

REFERENCES

REFERENCES

Alexander, B. A. An experimental test of assumptions relating to the use of electromyographic biofeedback as a general relaxation training technique. Psychophysiology, 1975, 12, 656-662.

Alexander, B. A., French, C. A., & Goodman, N. J. A comparison of auditory and visual feedback in biofeedback assisted musculature relaxation training. Psychophysiology, 1975, 12(3), 119-123.

Bass, A. E., Mittenberg, W., & Peterson, J. State-trait anxiety and biofeedback mediated control of peripheral vasomotor response. Psychological Reports, 1981, 49, 364-366.

Blanchard, E. B., Andrasik, F., & Silver, B. V. Biofeedback and relaxation in the treatment of tension headaches: A reply to Belar. Journal of Behavioral Medicine, 1980, 3(3), 227-232.

Blanchard, E. B., & Epstein, L. A biofeedback primer. Reading, Massachusetts: Addison-Wesely, 1978.

Blankstein, K. R., & Egner, K. Relationship of locus of control construct to the self control of heart rate. Journal of General Psychology, 1977, 97, 291-306.

Borkovec, T. D., Kaloupek, D. G., & Slama, K. The facilitative effect of muscle tension-release in the relaxation treatment of sleep disturbance. Behavior Therapy, 1975, 6(3), 301-309.

Bradley, B. W., & Canne, T. R. The autonomic responses to stress: The effects of PR, the relaxation response, and expectancy of relief. Biofeedback and Self Regulation, 1981, 8, 235-242.

Brown, B. Stress and the art of biofeedback. New York: Bantam Books, 1977.

Bruning, J. L., & Kintz, B. L. Computational handbook of statistics. Tucker, Georgia: Scott, Foresman and Company, 1977.

Budzynski, T. H., & Stoyva, J. M. An instrument for producing deep muscle relaxation by means of analogue information feedback. Journal of Applied Behavior Analysis, 1969, 2(winter), 231-237.

Budzynski, T. H., Stoyva, J. M., & Adler, C. Feedback-induced muscle relaxation: Application to tension headache. Journal of Experimental Psychology, 1970, 1, 205-211.

Burish, T. G., & Hendrix, E. M. Importance of relaxation instructions in the EMG biofeedback training package. Journal of Psychosomatic Research, 1980, 24, 137-145.

Burish, T. G., & Schwartz, D. P. EMG biofeedback training, transfer of training and coping with stress. Journal of Psychosomatic Research, 1980, 24, 85-97.

Canter, A., Kondo, C. Y., & Knott, J. R. A comparison of EMG feedback and progressive muscle relaxation training in anxiety neurosis. British Journal of Psychiatry, 1975, 127, 470-477.

Counts, D. K., Hollandsworth, J. G., & Alcorn, J. D. Use of EMG biofeedback and cue-controlled relaxation in the treatment of anxiety. Journal of Consulting and Clinical Psychology, 1978, 46(5), 990-996.

Coursey, R. D. Electromyograph feedback as a relaxation technique. Journal of Consulting and Clinical Psychology, 1975, 43(6), 826-834.

Cox, D. J., Freundlich, A., & Meyers, R. G. Differential effectiveness of EMG feedback, visual relaxation instruction, and medication placebo with tension headaches. Journal of Consulting and Clinical Psychology, 1975, 43(6), 892-898.

Crosson, B. Control of skin temperature through biofeedback and suggestion with hypnotized college women. International Journal of Clinical and Experimental Hypnosis, 1980, 27(1), 75-87.

Deffenbacher, J. L., & Michaels, A. C. Two self control procedures in the reduction of targeted and nontargeted anxieties--a year later. Journal of Clinical and Clinical Psychology, 1978, 27(1), 9-15.

Delman, R. P., & Johnson, H. J. Biofeedback and progressive muscle relaxation: A comparison of psychophysiological effects. Psychophysiology, 1976, 13(2), 181-187.

DiCara, L. V. Learning in the autonomic nervous system. Scientific American, 1970, 222(1), 30-39.

DiCara, L. V., & Miller, N. E. Instrumental learning of peripheral vasomotor responses by the curarized rat. Communications in Behavioral Biology, 1968, 1, 209-212.

Edelman, R. J. Effects of progressive relaxation on autonomic processes. Journal of Clinical Psychology, 1970, 26, 421-425.

Gatchel, R. J. Change over training sessions of relationship between locus of control and voluntary heart-rate control. Perceptual and Motor Skills, 1975, 40, 424-460.

Gatchel, R. J. Locus of control and voluntary heart rate change. Journal of Personality Assessment, 1975, 39(6), 634-638.

Goldfried, M. R., & Davison, G. C. Clinical behavior therapy. New York: Holt, Rinehart and Winston, 1976.

Green, E. E., Walters, D. E., Green, A. M., & Murphy, G. Feedback technique for deep relaxation. Psychophysiology, 1969, 6(3), 371-377.

Hall, W. E. Locus of control in electromyographic feedback. American Journal of Clinical Biofeedback, 1979, 2(2), 92-93.

Haynes, S. N., Griffin, P., Mooney, D., & Parise, M. Electromyography biofeedback and relaxation instructions in the treatment of muscle contraction headaches. Behavior Therapy, 1975, 6, 672-678.

Haynes, S. N., Moseley, D., & McGowan, W. Relaxation training and biofeedback in the reduction of frontalis muscle tension. Psychophysiology, 1975, 12(5), 647-552.

Hendler, N., Derogatis, L., Avella, J., & Long, D. EMG biofeedback in patients with chronic pain. Diseases of the Nervous System, 1977, 38, 505-509.

Hertzfeld, G. M., & Taub, E. Suggestion as an aid to self-regulation of hand temperature. International Journal of Neuroscience, 1977, 8, 23-26.

Hilgard, E. R., Sheehan, P. W., Monteiro, K. P., & MacDonald, H. Factorial structure of the creative imaginative scale as a measure of hypnotic responsiveness: An international comparative study. International Journal of Clinical and Experimental Hypnosis, 1981, 29(2), 66-75.

Hurley, J. D. Differential effects of hypnosis, biofeedback training and trophotrophic responses on anxiety, ego strength, and locus of control. Journal of Clinical Psychology, 1980, 36(2), 503-507.

Kappes, B., & Michaud, J. Contingent vs. noncontingent EMG feedback and hand temperature in relation to anxiety and locus of control. Biofeedback and Self Regulation, 1978, 3(1), 51-59.

Katkin, E. S., & Murray, E. N. Instrumental conditioning of autonomically mediated behavior: Theoretical and methodological issues. Psychological Bulletin, 1968, 70, 52-68.

Keefe, F. J. Biofeedback vs. instructional control of skin temperature. Journal of Behavior Medicine, 1978, 1(4), 383-390.

Keefe, F. J., Surwit, R., & Pilon, R. Biofeedback, autogenic training and progressive muscle relaxation in the treatment of Raynaud's disease: A comparative study. Journal of Applied Behavior Analysis, 1980, 13, 3-11.

Kondo, C. Y., Canter, A., & Bean, J. A. Intersession interval and reductions in frontalis EMG biofeedback training. Psychophysiology, 1977, 14(1), 15-16.

Jacobson, E. Progressive relaxation (2nd ed.). Chicago: University of Chicago Press, 1938.

Jessup, B., & Neufeld, R. Effects of biofeedback and "autogenic relaxation" techniques on physiological and subjective responses in psychiatric patients: A preliminary analysis. Behavior Therapy, 1977, 8(2), 160-166.

Lacey, J. I., Bateman, D. E., & VanLehn, R. Autonomic response specificity: An experimental study. Psychosomatic Medicine, 1953, 15, 8-21.

Leigh, H. Self control biofeedback and change in "psychosomatic approach." Psychotherapy and Psychosomatic, 1978, 30, 198-204.

Logsdon, S. A., Bourgeois, A., & Levenson, H. Locus of control, learned helplessness and control of heart rate using biofeedback. Journal of Personality Assessment, 1978, 42, 538-544.

Martin, B. The assessment of anxiety by physiological and behavioral measures. Psychological Bulletin, 1961, 58(3), 234-255.

Mathews, A. M., & Gelder, M. G. Psycho-physiological investigations of brief relaxation training. Journal of Psychosomatic Research, 1969, 13, 1-12.

Matus, J. Select personality variables and tension in two muscle groups. Psychophysiology, 1974, 11(1), 91.

McGowan, W. T., Haynes, S. H., & Wilson, C. C. Frontal electromyographic feedback: Stress attenuation and generalization. Biofeedback and Self Regulation, 1979, 4, 323-336.

Miller, M., Murphy, P., & Miller T. Comparison of electromyographic feedback and progressive muscle relaxation training in treating circumscribed anxiety stress reaction. Journal of Consulting and Clinical Psychology, 1978, 40(6), 1291-1298.

Miller, N. E. Learning of visceral and glandular responses. Science, 1969, 163, 434-445.

Miller, N. E., & DiCara, L. V. Instrumental learning of urine formation by rats: Changes in renal blood flow. American Journal of Physiology, 1968, 215, 667-683.

O'Grady, K. E. The absorption scale: A factor analytic assessment. International Journal of Clinical and Experimental Hypnosis, 1980, 28(3), 281-287.

Ohno, Y., Tanaka, Y., Takeya, T., Matsubara, H., Kuriya, N., & Komemush, S. Biofeedback modification of frontal EMG in normal subjects. Biofeedback and Self Regulation, 1978, 3(1), 61-68.

Ollendick, T., & Murphy, M. J. Differential effectiveness of muscular and cognitive relaxation as a function of locus of control. Journal of Behavior Therapy and Experimental Psychiatry, 1977, 8, 223-227.

Olton, D., & Noonberg, A. Biofeedback-clinical applications in behavior medicine. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1980.

Organ, D. W. Locus of control, anxiety and cognitive functioning. Psychological Reports, 1976, 39, 1091-1098.

Page, R. D., & Schaub, L. H. EMG biofeedback applicability for different personality types. Journal of Clinical Psychology, 1978, 34(4), 1014-1020.

Peters, J. E., Lundi, R. M., & Stern, R. M. Peripheral skin temperature responses to hot and cold suggestion. International Journal of Clinical and Experimental Hypnosis, 1973, 21, 205-211.

Qualls, P., & Sheehan, P. Capacity for absorption and relaxation during EMG biofeedback and no feedback conditions. Journal of Abnormal Psychology, 1979, 88(6), 652-662.

Qualls, P., & Sheehan, P. Imagery encouragement, absorption capacity, and relaxation during electromyograph biofeedback. Journal of Personality and Social Psychology, 1980, 41, 370-379.

Qualls, P., & Sheehan, P. EMG biofeedback as a relaxation technique: A critical appraisal and reassessment. Psychological Bulletin, 1981, 90, 21-42. (a)

Qualls, P., & Sheehan, P. Trait-treatment interactions: Reply to Tellegan. Journal of Experimental Psychology General, 1981, 110(2), 227-231. (b)

Qualls, P., & Sheehan, P. Role of feedback signal in electomyograph biofeedback: The relevance of attention. Journal of Experimental Psychology General, 1981, 110(2), 204-216. (c)

Raskin, M., Johnson, G., & Rondestuedt, J. W. Chronic anxiety treated by biofeedback induced muscle relaxation. Archives of General Psychiatry, 1973, 28, 263-267.

Ray, W. J. The relationship of locus of control, self report measures and feedback to the voluntary control of heart rate. Psychophysiology, 1974, 14(5), 527-534.

Ray, W. J., & Lamb, S. B. Locus of control and voluntary control of heart rate. Psychosomatics, 1974, 36(2), 180-182.

Reed, R., & Meyer, R. G. Reduction of test anxiety via autogenic training. Psychological Reports, 1974, 35, 649-655.

Reed, R., & Saslow, C. The effects of relaxation instructions and EMG biofeedback on test anxiety, general anxiety and locus of control. Journal of Clinical Psychology, 1980, 36(3), 683-690.

Reinking, R. H., & Kohl, M. L. Effects of various forms of relaxation training on physiological and self report measures of relaxation. Journal of Consulting and Clinical Psychology, 1975, 43(5), 595-600.

Roberts, A. H., Kewman, D. G., & MacDonald, H. Voluntary control of skin temperature and unilateral changes using hypnosis and feedback. Journal of Abnormal Psychology, 1973, 82, 163-186.

Roberts, A. H., Schuler, J., Bacon, J. C., Zimmerman, R. L., & Patterson, R. P. Individual differences and autonomic control: Absorption, hypnotic susceptibility, and the unilateral control of skin temperature. Journal of Abnormal Psychology, 1975, 84, 272-279.

Rotter, J. B. Generalized expectancies for internal and external control of reinforcement. Psychological Monographs, 1966, 80(1), Whole #1, 1.

Sargent, J. D., Wallace, E. D., & Green, E. E. Psychosomatic self regulation of migraine headaches. Seminar in Psychiatry, 1973, 5(4), 415-428.

Schultz, J. H., & Luthe, W. Autogenic training (Vol. 1). New York: Grune and Stratton, 1969.

Shapiro, D. A monologue on biofeedback and psychophysiology. Psychophysiology, 1977, 14(3), 213-226.

Shapiro, S., & Lehrer, P. M. Psychophysiological effects of autogenic training and progressive training. Biofeedback and Self Regulation, 1980, 5, 249-255.

Siddle, D. A., & Wood, L. Effects of frontalis EMG feedback on frontalis tension level, cardiac activity, and electrodermal activity. Biological Psychology, 1978, 7, 169-173.

Silver, B. V. Temperature biofeedback and relaxation training in the treatment of migraine headaches: One-year follow up. Biofeedback and Self Regulation, 1979, 4, 359-362.

Sime, W., & DeGood, D. Effects of EMG biofeedback and progressive muscle relaxation training on awareness of frontalis muscle tension. Psychophysiology, 1977, 14(6), 522-530.

Snyder, C., & Noble, M. E. Operant conditioning of vasoconstriction. Journal of Experimental Psychology, 1968, 77, 263-268.

Spielberger, C. D., Gorsuch, R. L., & Luscene, R. E. STAI manual for the state-trait anxiety inventory. Palo Alto: Consulting Psychologists Press, 1970.

Stern, G. S., & Berrenberg, J. L. Biofeedback training in frontalis muscle relaxation and enhancement of belief in personal control. Biofeedback and Self Regulation, 1977, 2(2), 173-181.

Stoyva, J. Self regulation and stress related disorders: A perspective on biofeedback. Biofeedback and Self Control, 1976-1977, 3-10.

Surwit, R. S., Bradner, M. N., Fenton, C. H., & Pilon, R. N. Individual differences in response to the behavioral treatment of Raynaud's disease. Journal of Consulting and Clinical Psychology, 1979, 47(6), 363-367.

Surwit, R. S., & Fenton, C. H. Feedback and instructions in the control of digital skin temperature. Psychophysiology, 1980, 50(4), 129-136.

Suter, S. Individual differences in biofeedback performance: EEG alpha, skin resistance and EMG. Perceptual and Motor Skills, 1979, 48, 589-595.

Tarler-Benlolo, L. The role of relaxation in biofeedback training: A critical review of the literature. Psychological Bulletin, 1978, 85(4), 727-755.

Tasto, D. L., & Hinkle, J. E. Case histories and shorter communications: Muscle relaxation treatment for tension headaches. Behavior Research and Therapy, 1973, 11, 347-349.

Taub, E. Self regulation of human tissue temperature. In G. Schwartz & I. Beatty (Eds.), Biofeedback theory and research. New York: Academic Press, 1977.

Taub, E., & Emurian, C. Feedback aided self regulation of skin temperature with a single feedback locus. Biofeedback and Self Regulation, 1976, 1(2), 147-168.

Taub, E., & School, P. J. Some methodological considerations in thermal biofeedback training. Behavior Research Methods and Instrumentations, 1978, 10(5), 617-622.

Tellegan, A. Practicing the two disciplines for relaxation and enlightenment: Comment "role of the feedback signal in EMG biofeedback: The relevance of 'attention' by Qualls and Sheehan." Journal of Experimental Psychology General, 1981, 110(2), 217-226.

Tellegan, A., & Atkinson, G. Openness to absorbing and self-altering experiences ("absorption:): A trait related to hypnotic susceptibility. Journal of Abnormal Psychology, 1974, 83(3), 268-277.

Townsend, R. E., House, J. E., & Addario, D. A comparison of biofeedback mediated relaxation and group therapy in the treatment of chronic anxiety. American Journal of Psychiatry, 1975, 132:6, 598-601.

Turk, D. C., Meichenbaum, D. H., & Berman, W. H. Application of biofeedback for the regulation of pain: A critical review. Psychological Bulletin, 1978, 86(6), 1322-1338.

Valle, R. S., & DeGood, D. E. Effects of state-trait anxiety on the ability to enhance and suppress EEG alpha. Psychophysiology, 1977, 14(1), 1-7.

VanEgeren, L. F., Headrick, M. W., & Hein, P. L. Individual differences in autonomic responses: Illustrations of a possible solution. *Psychophysiology*, 1972, *9*(6), 626-633.

Wolpe, J., & Lazarus, A. A. *Behavior therapy technique*. New York: Pergamon Press, 1966.

APPENDIX A

Tellegen Absorption Scale

TELLEGEN ABSORPTION SCALE

1. I keep close track of where my money goes. (a) True (b) False
2. Sometimes I feel and experience things as I did when I was a child. (a) True (b) False
3. I often stop in the middle of one activity to start something else. (a) True (b) False
4. I can be greatly moved by eloquent or poetic language. (a) True (b) False
5. I could be happy living all alone in a cabin in the woods or mountains. (a) True (b) False
6. While watching a movie, a T.V. show, or a play, I may become so involved that I forget about myself and my surroundings and experience the story as if it were real and as if I were taking part in it. (a) True (b) False
7. I frequently find myself worrying about something. (a) True (b) False
8. If I stare at a picture and then look away from it, I can sometimes "see" an image of the picture, almost as if I were still looking at it. (a) True (b) False
9. Sometimes I feel as if my mind could envelop the whole world. (a) True (b) False
10. I like to watch cloud shapes change in the sky. (a) True (b) False

11. When I have to stand in line, I never try to get ahead of other people. (a) True (b) False

12. If I wish, I can imagine (or daydream) some things so vividly that they hold my attention as a good movie or story does. (a) True (b) False

13. I often monopolize a conversation. (a) True (b) False

14. I think I really know what some people mean when they talk about mystical experiences. (a) True (b) False

15. I sometimes "step outside" my usual self and experience an entirely different state of being. (a) True (b) False

16. Textures--such as wool, sand, wood--sometimes remind me of colors or music. (a) True (b) False

17. I am very level-headed and always like to keep my feet on the ground. (a) True (b) False

18. Sometimes I experience things as if they were doubly real. (a) True (b) False

19. When I listen to music, I can get so caught up in it that I don't notice anything else. (a) True (b) False

20. If I wish, I can imagine that my body is so heavy that I could not move if I wanted to. (a) True (b) False

21. I can often somehow sense the presence of another person before I actually see or hear her/him. (a) True (b) False

22. It is very important to me that some people are concerned about me. (a) True (b) False

23. The crackle and flames of a wood fire stimulate my imagination. (a) True (b) False

24. It is sometimes possible for me to be completely immersed in nature or in art and to feel as if my whole state of consciousness has somehow been temporarily altered. (a) True (b) False

25. Different colors have distinctive and special meanings for me. (a) True (b) False

26. My parents' ideas of right and wrong have always proved to be best. (a) True (b) False

27. I am able to wander off into my own thoughts while doing a routine task and actually forget that I am doing the task, and then find a few minutes later that I have completed it. (a) True (b) False

28. I can sometimes recollect certain past experiences in my life with such clarity and vividness that it is like living them again or almost so. (a) True (b) False

29. Things that might seem meaningless to others often make sense to me. (a) True (b) False

30. While acting in a play, I think I could really feel the emotions of the character and "become" her/him for the time being, forgetting both myself and the audience. (a) True (b) False

31. Many people try to push me around. (a) True (b) False

32. My thoughts often don't occur as words but as visual images. (a) True (b) False

33. I am a better talker than a listener. (a) True (b) False

34. I often take delight in small things (like the five-pointed star shape that appears when you cut an apple across the core or the colors in soap bubbles). (a) True (b) False

35. When listening to organ music or other powerful music, I sometimes feel as if I am being lifted into the air.
(a) True (b) False

36. Sometimes I can change noise into music by the way I listen to it. (a) True (b) False

37. Some of my most vivid memories are called up by scents and smells. (a) True (b) False

38. I see no point in sticking with a problem if there is little chance of success. (a) True (b) False

39. Certain pieces of music remind me of pictures or moving patterns of color. (a) True (b) False

40. I often know what someone is going to say before he or she says it. (a) True (b) False

41. I often have "physical memories"; for example, after I've been swimming I may still feel as if I'm in the water.
(a) True (b) False

42. Whenever I go out to have fun, I like to have a pretty good idea of what I'm going to do. (a) True (b) False

43. The sound of a voice can be so fascinating to me that I can just go on listening to it. (a) True (b) False

44. People consider me a rather freewheeling and spontaneous person. (a) True (b) False

45. At times I somehow feel the presence of someone who is not physically there. (a) True (b) False

46. People seem naturally to turn to me when decisions have to be made. (a) True (b) False

47. Sometimes thoughts and images come to me without the slightest effort on my part. (a) True (b) False

48. I find that different odors have different colors. (a) True (b) False

49. I usually prefer to let someone else take the lead on social occasions. (a) True (b) False

50. I can be deeply moved by a sunset. (a) True (b) False

APPENDIX B

Demographic Information

I, ________________________, agree to participate in four sessions of the Relaxation Experiment. I understand that there is no risk involved in this procedure and that I may withdraw at any time.

Subject ___________________________

Experimenter ______________________

DEMOGRAPHIC INFORMATION

Age ______________

Handedness ______________

Medication ______________

Have you had any experience previously with any type of relaxation or meditation techniques?

_________ None

_________ Brief Exposure (1-3 sessions)

_________ Repeated Exposure (more than 3 sessions)

Note preference for techniques, rated from 1 to 4, when 1 represents best liked and 4 represents least liked:

_________ EMG

_________ PMR

_________ AT

_________ SR

APPENDIX C

Transcripts of Relaxation Tapes

EMG BIOFEEDBACK

Please sit quietly for the next ten minutes and wait for further instructions. (10 minutes)...For the next 25 minutes, I would like for you to practice relaxation. Close your eyes, find a comfortable position in the chair, and listen carefully to the following instructions. For the next few minutes I would like for you to practice relaxation by listening to the tone...(tone begins)...As you become more relaxed, the tone will decrease in pitch and in volume. For example, wrinkle your forehead...Notice how the tone increases its pitch and becomes louder. Now smooth your forehead and relax...Notice the difference in the tone. Now continue to relax and make the tone go away. (25 minutes)...Now continue to sit quietly for the next ten minutes. (10 minutes)...Now I will count from one to four. On the count of one, move your hands and feet, two, stretch your hands and feet, three, move your head around, and four, open your eyes. One. Move your hands and feet. Two. Stretch your hands and feet. Three. Move your head around. Four. Open your eyes. Please remain seated until someone comes in and unhooks the sensors. Thank you for your participation.

PROGRESSIVE MUSCLE RELAXATION

Please sit quietly for the next ten minutes and wait for further instructions. (10 min.)...For the next 25 minutes, I would like for you to practice relaxation. Close your eyes, find a comfortable position in the chair, and listen carefully to the following instructions. Now settle back as comfortably as you can, close your eyes, and listen to what I'm going to tell you. I'm going to make you aware of certain sensations in your body and then show you how you can reduce these sensations. First, direct your attention to your left arm, your left hand in particular. Clench your left fist. Clench it tightly and study the tension in the hand and in the forearm. Study those sensations of tension...Now let go. Relax the left hand and let it rest on the arm of the chair. Note the difference between the tension and the relaxation...Once again now, clench your left hand into a fist tightly, noticing the tensions in the hand and in the forearm. Study those tensions, and now, let go. Let your fingers spread out relaxed and note the difference, once again, between muscular tension and muscular relaxation...Now let's do the same with the right hand. Clench the right fist. Study those tensions...And now relax. Relax the right fist. Note the difference once again between the tension and the relaxation, and enjoy the contrast...Once again now, clench the right fist. Clench it tight. Study the tensions. Study them. And now, relax the right fist. Let the fingers spread out comfortably. See if you can keep letting go a little bit more. Even though it seems as if you have let go as much as you possibly can, there always seems to be that extra bit of relaxation. Note the difference once again between the tension and the relaxation. Note the looseness beginning to develop in the left and right hands. Both your left and right arms and hands are a little bit more relaxed...Now bend both hands back at the wrist so that you tense the muscles in the back of the hand and in the forearm, fingers pointing towards the ceiling. And now relax. Let your hands return to their resting positions, and note the difference between tension and relaxation...Do that once again, fingers pointing to the ceiling, feeling that tension in the backs of the hands and in the forearms. And now relax...Let go further...Now clench both your hands into fists and bring them towards your shoulders so as to tighten your biceps muscles, the large muscles in the upper part of the arm. Feel the tension in the biceps muscles. And now relax. Let your arms drop down again to your sides, and note the difference between the tension that was in your biceps and the relative relaxation you feel now...Let's do that once again now. Clench both biceps muscles, bringing both arms up, trying to touch with your fists the respective shoulders. Study the tension. Hold it. Study it. And now relax. Once again, let the arms drop, and study the feelings of relaxation, the contrast between tension and relaxation. Just keep letting go of those muscles further and further...Now we can direct our attention to the shoulder area. Shrug your shoulders, bringing both shoulders up towards your ears as if you wanted to touch your ears with your shoulders, and note the tension in your shoulders and up in your neck. Study that tension. Hold it. And now relax. Let both shoulders return to a resting position. Just keep letting go further and further. Once again, note the contrast between the tension and the relaxation that is now spreading into your shoulder area...Do that once again. Bring both shoulders up as if to touch the ears. Feel the tension in the shoulders, in the upper back, and the neck. Study the tension in these muscles. And now relax. Loosen those muscles. Let your shoulders come down to a resting position, and study the contrast once again between the tension and the relaxation...You can also learn to relax more completely the various muscles of the face. So, what I want you to do now is to wrinkle up your forehead and brow. Wrinkle it until you feel all your forehead very much wrinkled, the muscles tense and the skin furrowed. And now relax. Smooth out the forehead. Let those muscles become loose...Do that once again. Wrinkle up the forehead. Study those tensions in the muscles above the eyes in the forehead region. And now smooth out your forehead. Relax those muscles. And once again, note the contrast between the tension and the relaxation...Now close your eyes very tightly. Close them tightly so that you can feel tension all around your eyes and the many muscles that control the movement of the eyes...And now, relax those muscles. Let them relax, noting the difference between the tension and the relaxation...Do that once again now, eyes tightly closed, and study the tension. Hold it. And relax. Let go, and let your eyes remain comfortably closed...

Now purse your lips. Press your lips together. That's right, press them together very tightly and feel the tension all around the mouth. Now relax. Relax those muscles around the mouth and just let your chin rest comfortably...Once again now, press your lips together, and study the tension around the mouth. Hold it. And now relax. Let go of those muscles more and more, further and further. Note how much more loose the various muscles perhaps have become in those parts of the body that we have successfully tensed and relaxed-your hands, forearms, upper arms, your shoulders, the various facial muscles. And now, we'll turn our attention to the neck. Press your head back against the surface on which it's resting. Press it back so that you can feel the tension primarily in the back of the neck and in the upper back. Hold it. Study it. Now let go. Let your head rest comfortably now. Enjoy the contrast between the tension you created before and the greater relaxation you feel now. Just keep letting go, further and further, more and more, to the best of your ability. Do that once again, head pressed back. Study the tension. Hold it. And now, let go. Just relax. Let go further and further...Now, I'd like you to bring your head forward and try to bury your chin into your chest. Feel the tension especially in the front of your neck. And now relax. Let go further and further. Do that once again now, chin buried in the chest. Hold it. And now relax. Just relax further and further...Now we can direct our attention to the muscles of the upper back. Arch your back, arch it, sticking out your chest and stomach so that you can feel tension in your back primarily in your upper back. Study that tension.

And now relax...Let the body once again rest against the back of the chair or the bed, and note the difference between the tension and the relaxation, letting those muscles get more and more loose... Once again, arch the back way up. Study the tensions. Hold it. Now relax. Relax the back once again, letting go of all the tensions in these muscles...And now, take a deep breath, filling your lungs, and hold it. Hold it and study the tension all through your chest and down into your stomach area. Study that tension, and now relax. Let go. Exhale and continue breathing as you were. Note once again the difference between the tension and the relaxation... Let's do that once again. Take a deep breath and hold it. Hold it. Study those tensions. Study them. Note the muscles tensing. Note the sensations. And now exhale and continue breathing as you were, very comfortably breathing, letting those muscles of the chest and some of the stomach muscles relax, getting more and more relaxed each time you exhale...And now, tighten up the muscles in your stomach. Tense those stomach muscles. Hold it. Make the stomach very hard. And now relax. Let those muscles become loose. Just let go and relax...Do that once again. Tighten those stomach muscles. Study the tension. And now relax. Let go further and further, more and more. Loosen the tensions. Get rid of the tensions, and note the contrast between tension and relaxation...I'd like you now to stretch both legs. Stretch them so that you can feel tension in the thighs. Stretch them way out. And now relax. Let them relax and note the differences once again between tension in the thigh muscles and the relative relaxation you can feel now...Do that once again, locking your knees, stretch out both legs so that you can feel the muscles. Let them get loose. Get rid of all tensions in the muscles of your thighs...Now tense both calf muscles by pointing your toes towards your head. If you point your toes upwards towards your head, you can feel the pulling, the tension, the contraction in your calf muscles and in your shins as well. Study that tension. And now relax. Let the legs relax and note once again the difference between tension and relaxation...Once again now, bend the feet back at the ankles, toes pointing towards your head, and study the tension. Hold it. Study it. And now let go. Relax those muscles further and further, more and more deeply relaxed...Just as you have been directing your muscles to tense you have also been directing them to relax or to loosen. You've noted the difference between tension and muscular relaxation. You can notice whether there is any tension in your muscles, and if there is, you can try to concentrate on that part, send messages to that muscle to loosen, to relax. If you think of loosening that muscle, you will, in fact, be able to do so, even if only a little. Now as you sit there in the chair, I'm going to review the various muscle groups that we've covered. As I name each group, try to notice if there is any tension in those muscles. If there is any, try to concentrate on those muscles and send messages to them to relax, to loosen...Relax the muscles in your feet, ankles, and calves...shins, knees, and thighs... buttocks and hips...loosen the muscles of your lower body...Relax your stomach, waist, lower back...upper back, chest, and shoulders... Relax your upper arms, forearms, and hands right to the tips of your fingers...Let the muscles of your throat and neck loosen...Relax your jaw and facial muscles...Let all the muscles of your body become loose...Now sit quietly with your eyes closed...Do nothing more than that. Just sit quietly with your eyes closed for a few minutes. (1 min). Now continue to sit quietly for the next ten minutes. (10 min.) Now I will count from one to four. On the count of one, move your hands and feet, two, stretch your hands and feet, three, move your head around, and four, open your eyes. One. Move your hands and feet. Two. Stretch your hands and feet. Three. Move your head around. Four. Open your eyes. Please remain seated until someone comes in and unhooks the sensors. Thank you for your participation.

AUTOGENIC TRAINING

Please sit quietly for the next few minutes and wait for further instructions. (10 minutes)...For the next 25 minutes, I would like for you to practice relaxation. Close your eyes, find a comfortable position in the chair, and listen carefully to the following instructions. You will be asked to repeat some phrases that will help in your achieving relaxation. Continue to repeat the phrases to yourself until a new phrase is presented. Now let's begin. I feel quite quiet...I am beginning to feel quite relaxed... My feet feel heavy and relaxed...My ankles, my knees and my hips feel heavy, relaxed and comfortable...My solar plexis and the whole central portion of my body feel relaxed and quiet...My hands, my arms and my shoulders feel heavy, relaxed and comfortable...My neck, my jaws and my forehead feel relaxed; they feel comfortable and smooth...My whole body feels quite heavy, comfortable, and relaxed...I am quite relaxed...My arms and hands are heavy and warm... I feel quite quiet...My whole body is relaxed and my hands are warm, relaxed, and heavy...My hands are warm...Warmth is flowing into my hands...They are warm, warm...I can feel the warmth flowing down my arms, into my hands...My hands are warm, relaxed and warm...My whole body feels quiet, comfortable, and relaxed...My mind is quiet...I withdraw my thoughts from the surroundings and I feel serene and still...My thoughts are turned inward and I am at ease...Deep within my mind, I can visualize and experience myself as relaxed, comfortable, and still...I am alert, but in an easy, quiet inward turned way...My mind is calm and quiet...I feel an inward quietness... Now continue to sit quietly for the next ten minutes. (10 minutes). Now I will count from one to four. On the count of one, move your hands and feet, two, stretch your hands and feet, three, move your head around, and four, open your eyes. One. Move your hands and feet. Two. Stretch your hands and feet. Three. Move your head around. Four. Open your eyes. Please remain seated until someone comes in and unhooks the sensors. Thank you for your participation.

SELF-RELAXATION

Please sit quietly for the next few minutes and wait for further instructions. (10 minutes)...For the next 25 minutes, I would like for you to practice relaxation. Close your eyes, find a comfortable position in the chair, and listen carefully to the following instructions. I would like for you to practice relaxation by any means that you wish. (25 minutes)...Now continue to sit quietly for the next ten minutes. (10 minutes)...Now I will count from one to four. On the count of one, move your hands and feet, two, stretch your hands and feet, three, move your head around, and four, open your eyes. One. Move your hands and feet. Two. Stretch your hands and feet. Three. Move your head around. Four. Open your eyes. Please remain seated until someone comes in and unhooks the sensors. Thank you for your participation.

APPENDIX D

Induction to Treatment Sessions

INDUCTION TO TREATMENT SESSIONS

First, I am going to take your pulse. Now I will wipe your forehead with alcohol, and I'm going to attach three sensors to your forehead. They're connected to some devices that monitor your muscle activity; no current passes through these, so you can't receive a shock. The sensors attached to your fingers will monitor your skin temperature. Lean back in the chair and sit quietly. In a few minutes, a tape will come on to give you further instructions.

APPENDIX E

Hopkins Symptom Checklist

HOPKINS SYMPTOM CHECKLIST

Below is a list of 58 symptoms most commonly experienced. Across from each symptom is a four point scale representing various degrees of distress:

1 Not at all
2 A little bit
3 Quite a bit
4 Severe

In each of the following examples, circle the number that best approximates your level of distress.

1. Headaches 1 2 3 4
2. Nervousness or shakiness inside 1 2 3 4
3. Being unable to get rid of bad thoughts or ideas 1 2 3 4
4. Faintness or dizziness 1 2 3 4
5. Loss of sexual interest or pleasure 1 2 3 4
6. Feeling critical of others 1 2 3 4
7. Bad dreams 1 2 3 4
8. Difficulty in speaking when you are excited 1 2 3 4
9. Trouble remembering things 1 2 3 4
10. Worried about sloppiness or carelessness 1 2 3 4
11. Feeling easily annoyed or irritated 1 2 3 4
12. Pains in the heart or chest 1 2 3 4
13. Itching 1 2 3 4
14. Feeling low in energy or slowed down 1 2 3 4
15. Thoughts of ending your live 1 2 3 4

16. Sweating 1 2 3 4

17. Trembling 1 2 3 4

18. Feeling confused 1 2 3 4

19. Poor appetite 1 2 3 4

20. Crying easily 1 2 3 4

21. Feeling shy or uneasy with the opposite sex 1 2 3 4

22. A feeling of being trapped or caught 1 2 3 4

23. Suddenly scared for no reason 1 2 3 4

24. Temper outbursts you could not control 1 2 3 4

25. Constipation 1 2 3 4

26. Blaming yourself for things 1 2 3 4

27. Pains in the lower part of your back 1 2 3 4

28. Feeling blocked or stymied in getting things done 1 2 3 4

19. Feeling lonely 1 2 3 4

30. Feeling blue 1 2 3 4

31. Worried or stewing about things 1 2 3 4

32. Feeling no interest in things 1 2 3 4

33. Feeling fearful 1 2 3 4

34. Your feelings easily hurt 1 2 3 4

35. Having to ask others what you should do 1 2 3 4

36. Feeling others do not understand you or are unsympathetic 1 2 3 4

37. Feeling that people are unfriendly or dislike you 1 2 3 4

38. Having to do things very slowly in order to be sure you are doing them right 1 2 3 4

39. Heart pounding or racing 1 2 3 4

40. Nausea or upset stomach 1 2 3 4

41. Feeling inferior to others 1 2 3 4

42. Soreness of your muscles 1 2 3 4

43. Difficulty in falling asleep or staying asleep 1 2 3 4

44. Having to check and double check what you do 1 2 3 4

45. Difficulty making decisions 1 2 3 4

46. Wanting to be alone 1 2 3 4

47. Trouble getting your breath 1 2 3 4

48. Hot or cold spells 1 2 3 4

49. Having to avoid certain places or activities because they frighten you 1 2 3 4

50. Your mind going blank 1 2 3 4

51. Numbness or tingling in parts of your body 1 2 3 4

52. A lump in your throat 1 2 3 4

53. Feeling hopeless about the future 1 2 3 4

54. Trouble concentrating 1 2 3 4

55. Weakness in parts of your body 1 2 3 4

56. Feeling tense or keyed up 1 2 3 4

57. Heavy feelings in your arms or legs 1 2 3 4

58. Please comment on any special concern:

APPENDIX F

Data Sheet

DATA SHEET

Subject ____________________ Experimenter ____________________

Date ____________________ Treatment ____________________

Anx/Abs Group ____________________ Order ____________________

Adaption Phase, 10 minutes

EMG

1.____ 4.____ 7.____ 10.____
2.____ 5.____ 8.____
3.____ 6.____ 9.____

TEMP

1.____ 4.____ 7.____ 10.____
2.____ 5.____ 8.____
3.____ 6.____ 9.____

Treatment Phase, 25 minutes

EMG

1.____ 8.____ 15.____ 22.____
2.____ 9.____ 16.____ 23.____
3.____ 10.____ 17.____ 24.____
4.____ 11.____ 18.____ 25.____
5.____ 12.____ 19.____
6.____ 13.____ 20.____
7.____ 14.____ 21.____

TEMP

1.____ 8.____ 15.____ 22.____
2.____ 9.____ 16.____ 23.____
3.____ 10.____ 17.____ 24.____
4.____ 11.____ 18.____ 25.____
5.____ 12.____ 19.____
6.____ 13.____ 20.____
7.____ 14.____ 21.____

Posttreatment Phase, 10 minutes

EMG

1.____ 4.____ 7.____ 10.____
2.____ 5.____ 8.____
3.____ 6.____ 9.____

TEMP

1.____ 4.____ 7.____ 10.____
2.____ 5.____ 8.____
3.____ 6.____ 9.____

Strategy Employed:

APPENDIX G

Subjective Anxiety Inventory (SAI)

SUBJECTIVE ANXIETY INVENTORY (SAI)

0	50	100
Very relaxed No tension	Somewhat relaxed	Very tense No relaxation

APPENDIX H

Statistical Tables

TABLE 1

ANOVA SUMMARY TABLE FOR EMG

ADAPTATION PHASE

Source	Df	Mean Square	F	Significance
Anxiety	1	0.04	0.02	.8862
Absorption (B)	1	4.43	2.14	.1510
A X B	1	0.20	0.09	.7600
Error	4	2.07		
Treatment (T)	3	0.72	1.91	.1305
T X A	3	0.27	0.73	.5376
T X B	3	0.15	0.41	.7487
T X A X B	3	0.31	0.82	.4873
Error	132	0.38		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMG-BF	2.48	1.02
2 - PMR	2.23	0.80
3 - AT	2.21	0.82
4 - SR	2.28	0.77

TABLE 2

ANOVA SUMMARY TABLE FOR EMG CHANGE

ACROSS NINE TIME BLOCKS

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	0.15	0.01	.9404
Absorption (B)	1	19.76	0.75	.3899
A X B	1	8.37	0.32	.5747
Error	44	26.20		
Treatment (T)	3	20.00	11.64	.0000
T X A	3	0.75	0.44	.7273
T X B	3	0.19	0.11	.9533
T X A X B	3	1.54	0.89	.4458
Error	132	1.72		
Time Blocks (S)	8	14.31	19.38	.0000
S X A	8	0.72	0.97	.4570
S X B	8	0.46	0.62	.7591
S X A X B	8	0.88	1.19	.3034
Error	132	0.74		
T X S	24	10.16	25.73	.0000
T X S X A	24	0.27	0.68	.8708
T X S X B	24	0.36	0.91	.5914
T X S X A X B	24	0.66	1.67	.0226
Error	1056	0.39		

TABLE 3

ANOVA SUMMARY TABLE FOR AVERAGE EMG CHANGE

(TIME BLOCKS 1+2-TIME BLOCKS 6+7)/2

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	0.23	0.15	.6991
Absorption (B)	1	0.05	0.03	.8591
A X B	1	0.29	0.19	.6649
Error	44	1.51		
Treatment (T)	3	4.02	7.29	.0001
T X A	3	0.42	0.76	.5163
T X B	3	0.49	0.89	.4481
T X A X B	3	0.06	0.10	.9585
Error	132	0.55		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMGBF	0.95	0.96
2 - PMR	0.25	0.63
3 - AT	0.58	1.06
4 - SR	0.68	0.76

TABLE 4

NEWMAN-KEULS MULTIPLE F-TEST FOR

EMG CHANGE SCORE

Group	EMGBF	PMR	AT	SR
1 - EMGBF 4	-	.70*	.37*	.27
2 - PMR 1		-	.33*	.43*
3 - AT 2			-	.10
4 - SR 3				-

Critical Differences (< .05):
Steps 2 - .30
Steps 3 - .36
Steps 4 - .40

TABLE 5

ANOVA SUMMARY TABLE FOR TEMPERATURE

ADAPTATION PHASE

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	131.18	2.09	.1554
Absorption (B)	1	92.55	1.47	.2312
A X B	1	0.43	0.01	.9343
Error	44	62.78		
Treatment (T)	3	5.19	0.39	.7517
T X A	3	13.16	0.99	.3975
T X B	3	13.65	1.03	.3810
T X A X B	3	4.40	0.33	.7947
Error	132	13.29		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMG-BF	89.39	4.78
2 - PMR	89.09	5.04
3 - AT	88.60	4.87
4 - SR	88.91	4.86

TABLE 6

ANOVA SUMMARY TABLE FOR TEMPERATURE CHANGE

ACROSS NINE TIME BLOCKS

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	830.00	1.87	.1786
Absorption (B)	1	1005.89	2.26	.1396
A X B	1	109.81	0.25	.6216
Error	44	444.50		
Treatment (T)	3	67.33	0.64	.5896
T X A	3	178.26	1.70	.1705
T X B	3	69.57	0.66	.5763
T X A X B	3	96.12	0.92	.4352
Error	132	104.95		
Time Blocks (S)	8	52.37	9.32	.0000
S X A	8	1.44	0.26	.9791
S X B	8	2.29	0.41	.9162
S X A X B	8	3.58	0.64	.7466
Error	352	5.62		
T X S	24	4.87	1.74	.0150
T X S X A	24	2.05	0.73	.8196
T X S X B	24	5.39	1.93	.0047
T X S X A X B	24	4.11	1.47	.0671
Error	1056	2.79		

TABLE 7

ANOVA SUMMARY TABLE FOR AVERAGE TEMPERATURE CHANGE

(TIME BLOCKS 1+2-TIME BLOCKS 6+7)/2

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	6.98	0.37	.5435
Absorption (B)	1	7.92	0.43	.5175
A X B	1	16.28	0.87	.3548
Error	44	18.61		
Treatment (T)	3	14.68	1.99	.1180
T X A	3	6.51	0.88	.4442
T X B	3	14.37	1.95	.1300
T X A X B	3	16.15	2.19	.0976
Error	132	7.36		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMGBF	0.03	3.38
2 - PMR	-0.43	2.96
3 - AT	-0.21	2.22
4 - SR	-1.24	3.52

TABLE 8

ANOVA SUMMARY TABLE FOR PRETREATMENT PULSE

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	178.26	0.72	.4020
Absorption (B)	1	985.55	3.96	.0528
A X B	1	109.51	.44	.5106
Error	44	248.90		
Treatment (T)	3	215.41	3.04	.0315
T X A	3	127.56	1.80	.1506
T X B	3	52.21	0.74	.5323
T X A X B	3	27.56	0.39	.7614
Error	132	70.93		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMG-BF	77.50	13.40
2 - PMR	73.65	10.03
3 - AT	72.71	12.87
4 - SR	73.75	10.90

TABLE 9

NEWMAN-KEULS MULTIPLE F-TEST FOR

PRETREATMENT PULSE

Group	EMGBF	PMR	AT	SR
1 - EMGBF 4	-	3.85	4.79*	3.75*
2 - PMR 2		-	.94	.10
3 - AT 1			-	1.04
4 - SR 3				-

Critical Differences (< .05):
Steps 2 - 3.38
Steps 3 - 4.04
Steps 4 - 4.43

TABLE 10

ANOVA SUMMARY TABLE FOR PULSE CHANGE

PRE- AND POSTTREATMENT

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	137.76	0.33	.5712
Absorption (B)	1	1066.67	2.52	.1196
A X B	1	126.04	0.30	.5880
Error	44	423.26		
Treatment (T)	3	67.45	0.81	.4895
T X A	3	96.27	1.16	.3281
T X B	3	55.38	0.67	.5740
T X A X B	3	56.77	0.68	.5637
Error	132	83.08		
Time Blocks (S)	1	1504.17	37.81	.0000
S X A	1	51.04	1.28	.2635
S X B	1	137.76	3.46	.0695
S X A X B	1	12.76	0.32	.5740
Error	44	39.78		
T X S	3	167.88	3.72	.0132
T X S X A	3	38.02	0.84	.4732
T X S X B	3	41.75	0.92	.4308
T X S X A X B	3	13.63	0.30	.8240
Error	132	45.15		

Table 10 (continued)

MEANS AND STANDARD DEVIATIONS

Treatment	Mean		Standard Deviation	
Treatment	pre	post	pre	post
1 - EMGBF	77.50	69.58	12.16	9.03
2 - PMR	73.65	70.94	9.05	10.78
3 - AT	72.71	70.31	11.24	9.22
4 - SR	73.75	70.94	9.75	9.67

TABLE 11

NEWMAN-KEULS MULTIPLE F-TEST FOR

PULSE CHANGE

Group	EMGBF	PMR	AT	SR
1 - EMGBF 4	-	5.21*	5.52*	5.11*
2 - PMR 2		-	.31	.10
3 - AT 1			-	.41
4 - SR 3				-

Critical Differences (< .05):
Steps 2 - 3.79
Steps 3 - 4.53
Steps 4 - 4.97

TABLE 12

ANOVA SUMMARY TABLE FOR SUBJECTIVE

ANXIETY INVENTORY (SAI) SCORE

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	96.33	0.16	.6877
Absorption (B)	1	1250.52	2.13	.1520
A X B	1	1160.33	1.97	.1673
Error	44	588.46		
Treatment (T)	3	1095.78	5.66	.0011
T X A	3	87.76	0.45	.7154
T X B	3	95.20	0.49	.6887
T X A X B	3	205.79	1.06	.3673
Error	132	193.64		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMGBF	34.60	18.83
2 - PMR	25.27	15.50
3 - AT	24.12	15.94
4 - SR	29.79	16.32

TABLE 13

NEWMAN-KEULS MULTIPLE F-TEST FOR

SUBJECTIVE ANXIETY INVENTORY (SAI)

Group	EMGBF	PMR	AT	SR
1 - EMGBF 4	-	9.33*	10.48*	4.81
2 - PMR 2		-	1.15	4.52
3 - AT 1			-	5.67
4 - SR 3				-

Critical Differences (< .05):
Steps 2 - 5.57
Steps 3 - 6.65
Steps 4 - 7.30

TABLE 14

FREQUENCY OF STRATEGY USE AS A FUNCTION OF

ANXIETY, ABSORPTION, AND TREATMENT

Treatment	EMGBF				PMR				AT				SR			
	Anxiety: H	Anxiety: L	Absorption: H	Absorption: L	Anxiety: H	Anxiety: L	Absorption: H	Absorption: L	Anxiety: H	Anxiety: L	Absorption: H	Absorption: L	Anxiety: H	Anxiety: L	Absorption: H	Absorption: L
Strategy																
Followed Instructions	2	5	4	3	13	17	13	17	18	17	16	19	0	1	0	1
Fell Asleep	0	3	2	1	3	2	4	2	3	3	3	3	4	2	3	3
Breathing	4	2	2	4	0	2	1	1	0	2	1	1	1	7	4	4
Imagery	6	2	6	2	4	1	4	1	3	3	3	3	6	10	10	6
Cleared Mind	2	1	3	1	0	2	1	0	4	0	4	2	6	2	2	4
Daydreamed/ Mind Wandered	2	4	2	2	1	0	1	1	3	3	3	3	2	3	4	2
Told Body to Relax	10	6	10	6	2	4	4	2	0	1	0	0	4	4	6	3

TABLE 15

FREQUENCY COUNT OF PREFERENCE FOR

TREATMENT TECHNIQUES

	Preference			
	1	2	3	4
Treatment				
EMGBF	10	14	17	7
PMR	7	16	11	14
AT	6	13	14	15
SR	25	5	6	12

TABLE 16

ANOVA SUMMARY TABLE FOR LOCUS OF CONTROL

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	3.62	0.88	.3527
Absorption (B)	1	1.69	0.42	.5189
A X B	1	2.52	0.63	.4310
Error	44	3.99		

MEANS AND STANDARD DEVIATIONS

Personality Group	Mean	Standard Deviation
1 - Low A/Low B	0.42	2.23
2 - Low A/High B	0.50	2.19
3 - High A/Low B	0.33	1.67
4 - High A/High B	-0.50	1.83

VITA

Neerja Swaroop Bhatnagar was born on January 1, 1958 in Lucknow, India. At the age of nine, she immigrated to the United States and settled with her family in Charlotte, North Carolina. She completed her primary and high school education in Charlotte at Myers Park High School. Neerja entered Warren Wilson College in Swannanoa, North Carolina as a freshman and eventually transferred to Appalachian State University, where she was awarded a Bachelor of Science degree in August, 1980, in the field of psychology. Neerja has returned to India for periodic visits.

Neerja began her graduate program in Clinical Psychology in August, 1980 at Appalachian State University and plans to graduate in May, 1983. She is currently residing in Hickory, North Carolina in the process of completing internship requirements.

Neerja is a member of the American Psychological Association, North Carolina Psychological Association, and the National Psi Chi Association for Psychologists. Her permanent address is:

239 Scofield Road
Charlotte, NC 28209