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A Comparative Evaluation of Relaxation Training Strategies Utilizing EMG Biofeedback

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A COMPARATIVE EVALUATION OF RELAXATION TRAINING STRATEGIES UTILIZING EMG BIOFEEDBACK

by

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VITA

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CHAPTER I

INTRODUCTION

In recent years there has been an increased experimental and clinical interest in self-regulation strategies. The advent and development of increasingly more sophisticated electronic biofeedback equipment, with the potential for training individuals to monitor and control a wide range of physiological functions, has been a major factor contributing to this interest. Concomitant with these technological advances in the area of biofeedback, current research in psychophysiological processes has led to the generation of more sophisticated models for understanding mind-body relationships.

A particular clinical emphasis associated with these developments has been in the area of relaxation training strategies and their application in the treatment of anxiety and stress related conditions. These relaxation strategies include such established clinical procedures as progressive relaxation and autogenic training, as well as the more recently developed application of various types of meditation techniques and forms of biofeedback training. Although there has been some research suggesting that these procedures can facilitate relaxation, there is a lack of substantive clinical research demonstrating the specific effects of such procedures in the treatment of anxiety and stress related disorders. In spite of many unanswered questions concerning their clinical effectiveness, particularly in regard to the more recently utilized meditation and biofeedback techniques, such procedures continue to grow in popularity as therapeutic self-help strategies.

Previous research in this area suggests several important issues which need further investigation. First, there is a need to clarify the relationship between subjective and physiological effects of such relaxation treatments. Previous research has often found a discrepancy between self-report and physiological measures of treatment effects. In general, this discrepancy has been associated with subject's self-reports of improvement due to treatment in spite of the fact that physiological indicators have failed to show similar improvement. This has been especially the case in comparative studies utilizing placebo control groups, and highlights the importance of evaluating the influence of nonspecific or placebo effects on treatment outcome.

A second critical issue, which follows from the first, is the need to clarify the specific effects produced by different relaxation training procedures. Previous research comparing different relaxation strategies has suggested that different techniques produce different patterns of effects. These findings have been associated with renewed theoretical and empirical efforts to more precisely delineate the components or dimensions associated with the experience of anxiety or relaxation. In general, these efforts have yielded theoretical models and empirical investigations which differentiate response dimensions or subsystems within the general phenomenon of anxiety. An important distinction emerging from these developments is the differentiation of cognitive or psychic vs. somatic or physiological components of the experience of anxiety. This type of conceptualization needs to be utilized in current research on the specific effects of various relaxation training strategies.

A third important issue, especially from a clinical perspective, concerns the role of individual differences in relation to responsivity to relaxation training procedures. A conclusion of previous research evaluating the effectiveness of various relaxation training procedures has been that individual differences may underlie many of the observed differential effects of various treatment procedures. In other words, the overall research question which emerges from this and the previously addressed issues can be stated as follows: What kinds of individuals are likely to benefit from what kinds of treatment and in what ways?

In light of these considerations, the purpose of this investigation was to further clarify, in a clinical setting, the specific treatment effects associated with various relaxation training strategies utilizing electromyograph (EMG) biofeedback. Particular emphasis was placed on evaluating the relationship between self-report vs. physiological measures of anxiety and/or relaxation, between cognitive vs. somatic dimensions of anxiety, and the relationship of individual difference variables to treatment outcome.

CHAPTER II

REVIEW OF RELATED LITERATURE

This review is divided into five major sections. The first section presents an historical overivew of biofeedback and other self-regulation strategies, and their clinical application as relaxation training techniques in the treatment of stress-related disorders. This is followed by three sections which examine the research findings relative to the general and specific effectiveness of these training procedures, and to individual differences associated with ability to benefit from such training. The final section presents the specific purpose of this investigation and puts forth the hypotheses advanced in this study.

Overview of Biofeedback and Relaxation Training Strategies

In recent years there has been an increased experimental and clinical interest in self-regulation strategies. Stoyva (1976) defines self-regulation as "man's attempt to modify voluntarily his own physiological activity, behavior, or processes of consciousness (p. 366)." From an historical perspective, he observes that biofeedback has emerged as the most recent member of a family of self-regulation techniques, including meditation, progressive relaxation, and autogenic training.

A major source of this interest in self-regulation strategies has to do with their potential clinical applications, particularly in the prevention and treatment of stress-related disorders. For example, Jacobson (1938) pioneered a training program in systematic muscle relaxation, progressive relaxation, and utilized it in the treatment of a variety of stress-related disorders, including insomnia, fatigue states, colitis, anxiety disorders and essential hypertension. With similar intent, Schultz (Schultz & Luthe, 1959) developed a series of exercises, autogenic training, which combined both relaxation and auto-suggestion techniques to produce a physiological state of low arousal, characterized by muscular relaxation and increased peripheral blood flow. Like progressive relaxation, autogenic training was designed to facilitate a physiological condition opposite to that produced by stress.

These pioneer relaxation training programs and their clinical application across a wide range of stress-related disorders have been followed more recently by the cultivation and refinement of ancient traditions of meditation training (Benson, Beary, & Carol, 1974; Benson, 1975; Shapiro & Giber, 1978) as a clinical procedure to facilitate relaxed, anti-stress physiological states. Although meditation as a form of self-regulation dates back to antiquity, it is only recently that systematic scientific investigations into its physiological and psychological effects have been undertaken (see Woolfolk, 1975; Davidson, 1976; Smith, 1975). There are many forms of meditation, but those receiving the most scientific inquiry as relaxation techniques are transcendental meditation (TM), Zen meditation, and yoga.

Of particular importance is the work of Benson and his associates (Wallace, 1970; Wallace, Benson, & Wilson, 1971; Wallace & Benson, 1972; Benson et al., 1974; Benson, 1975) which began with an investigation into the physiological effects of TM and culminated in the delineation of a simple technique for inducing a state of relaxation. Wallace and Benson (1972) found that meditation produced an integrated central nervous system response, the "relaxation response," characterized as a "wakeful, hypometabolic state." They found this state to be associated with decreased sympathetic nervous system activity, oxygen consumption, and heart rate; and increased skin resistance, arterial blood flow, and alpha brain waves.

In addition, Benson et al. (1974) suggested that various techniques, ranging from ancient religious-meditative practices to progressive relaxation and autogenic training, can elicit this relaxation response. Culminating his investigations, Benson (1975) presented a simple meditative technique to elicit the relaxation response, composed of the following four elements he has found to be common to most relaxation methods: (a) a quiet environment, (b) a constant stimulus, (c) a passive attitude, and (d) a comfortable position (p. 78-79).

Biofeedback training. The most recent innovation in the field of relaxation training has involved the use of electronic biofeedback equipment to train individuals to regulate their physiological functioning (Budzynski & Stoyva, 1969, 1973; Green, Green, & Walters, 1970). The term biofeedback is derived from biology and cybernetics. In cybernetics, the concept of feedback refers to the process of information going back into an automated mechanical system for self-correction or improvement (Astor, 1977). Analogously, in biofeedback, an electronic device detects the electrical signals generated by some biophysiological function and feeds that information back to the individual, usually in the form of an auditory or visual signal, so that he can ultimately learn to control his physical, mental or emotional processes. Biofeedback instruments have been developed to monitor a variety of physiological functions associated with relaxation. These include: muscle tension (electromyograph, EMG), brain rhythms (electroencephalograph, EEG), electrodermal activity (galvanic skin response, GSR), skin temperature, and blood pressure (Tarler-Benlolo, 1978). For relaxation purposes, EMG biofeedback has been the most widely used procedure.

The three main goals of biofeedback therapy are awareness, control and transfer (Astor, 1977). Through feedback an individual is made "aware" of some aspect of his physiological functioning. He learns to "control" the physiological process by manipulating his mental and internal activities while continuing to receive feedback on any physiological change. The final goal is for the individual to be able to "transfer" the self-control learned in the laboratory or clinic, so as to make functional use of his learning in real-life situations.

Although no one is certain exactly why or how biofeedback works, there have been two major theoretical rationales offered to explain its efficacy--the learning theory model and the relaxation model (Ray, Raczynski, Rogers, & Kimball, 1979). The learning theory model has its roots in the work of Miller and his associates (Miller, 1969, 1978; Miller & Dworkin, 1977) who demonstrated that principles of operant conditioning could be applied to the learning of control over autonomic nervous system or visceral physiological functions. This model suggests that trial-and-error learning shaped by reinforcement explains the process of learning to control or regulate physiological functioning. It not only explains how feedback may serve as a source of information as well as a reward for learning new, more adaptive responses; but it also explains how physiological disorders or symptoms can develop as maladaptive responses to aversive stimulation. A striking feature of Miller's research was the finding that highly specific responses could be learned, which was seen as evidence that a response not ordinarily under voluntary control could be subject to operant conditioning.

Various procedures based on the principles of operant conditioning have become standard in clinical biofeedback. Essentially, these procedures include the following components: (a) continuous measurement of some physiological function, (b) immediate feedback of changes in the physiological measure, (c) integration and transformation of the raw electrical output into a signal that can be detected and interpreted by the subject, and (d) a means to vary the feedback signal in order to shape the response in some desired direction (Tarler-Benlolo, 1978, p. 728).

The relaxation or antistress model has its immediate origins in the work of Budzynski and Stoyva (1969, 1973) and Green and his associates (Green, Walters, Green, & Murphy, 1969; Green et al., 1970); however, its historical roots include the work of Selye (1956), Cannon (1932) and Malmo (1972); (see Stoyva, 1976; and Ray et al., 1979 for an historical overview). This model states that stress exacerbates psychosomatic problems and contributes to the creation of "stress-related disorders," such as hypertension, headaches, and anxiety reactions. The normal physiological reaction to stress is an increase in sympathetic nervous system activation followed by a parasympathetic reaction once the stress has passed. However, some individuals do not readily return to this normal level of physiological relaxation associated with parasympathetic activity, relaxation of skeletal muscles and lessened cortical excitation. Stoyva and Budzynski (1974) suggest that such individuals may even have lost the ability to relax and need systematic training in some procedure that produces relaxation.

In contrast to the emphasis in the learning theory model on control over specific physiological responses through biofeedback training, the assumption in the relaxation model is that a specific response can be an indicator of a generalized response. In this context, the value of specific biofeedback training, e.g., frontalis EMG feedback for muscular relaxation, lies in its ability to facilitate a generalized relaxation response due to complex psychophysiological and biochemical interrelations (Winer, 1977). Stoyva and Budzynski (1974) and Stoyva (1976) have drawn upon neurophysiological theory and research (Hess, 1954; Gellhorn & Kiely, 1972) in developing clinical biofeedback programs; wherein the goal is to train for a "cultivated lower arousal response" or a shift in autonomic nervous system balance from sympathetic to parasympathetic dominance. Stoyva (1976) suggests that this can be accomplished through EMG feedback for muscular relaxation, which produces a "trophotropic" shift toward such a low-arousal, parasympathetic response.

An underlying theoretical issue involved in any conceptualization of biofeedback has to do with the interrelationship of mind and body. Green and his associates (Green et al., 1970) postulated that there exists a "closed-loop" system connecting the mind with the body and the body with the mind. This is defined as the psychophysiological principle:

> Every change in the physiological state is accompanied by an appropriate change in the mental-emotional state, conscious or unconscious, and conversely, every change in the mental-emotional state, conscious or unconscious, is accompanied by an appropriate change in the physiological state (p. 3).

For example, when a person is anxious, his anxiety is likely to be accompanied by muscle tension and mental apprehension. Therefore, the psychophysiological principle suggests that reducing the muscle tension will be associated with relief from feelings of anxiety and mental apprehension.

Girdano and Everly (1979) have summarized the psychophysiological processes involved in biofeedback training in terms of three phases (p. 183):

1. Physical or physiological phase: The release of energy (physical, chemical, thermal, electrical--usually all of these) which can be measured with the appropriate device.

2. Psychophysiological phase: Mind and body controlling the energy-releasing process; coordination of voluntary, involuntary, and endocrine systems.

3. Psychological or learning phase: Voluntary control or conditioning process in which biofeedback becomes an essential link.

The physical release of energy associated with the body's response to stress is gradually brought under conscious, voluntary control, a process associated with increased coordination of mental or cognitive processes and physiological processes.

Biofeedback and self-regulation strategies. Although biofeedback and other self-regulation strategies have been widely utilized as relaxation techniques, several issues related to their effectiveness in the treatment of stress-related disorders remain unresolved.

First, there is the issue of clinical effectiveness of particular relaxation strategies. While there is considerable evidence that progressive relaxation (Davison, 1968; Wolpe & Lazarus, 1966; Paul & Trimble, 1970) and autogenic training (Luthe, 1963; Schultz & Luthe, 1969; Lindemann, 1973) are useful clinical procedures for a variety of stress-related and anxiety-related disorders, the clinical evidence for biofeedback and meditation is less conclusive. For example, regarding the most commonly used biofeedback technique for relaxation, frontalis EMG, several reviewers (Blanchard & Young, 1974; Alexander & Smith, 1979; Ray et al., 1979) have concluded that EMG-assisted relaxation training has not been conclusively shown to be an effective clinical procedure apart from other relaxation techniques.

Similarly, in a review of the research on meditation as therapy, Smith (1975) concluded that there was insufficient evidence for the therapeutic value of meditation in and of itself, since variables such as expectation of relief and the regular practice of sitting had not been controlled for. In a study controlling for the effects of these two variables, Smith (1976) found no difference between TM meditators and controls on measures of trait anxiety and manifest anxiety symptoms.

A second issue concerns the comparative or relative effectiveness of biofeedback assisted relaxation training, either alone or in combination with other relaxation techniques. Several reviewers (Blanchard & Young, 1974; Winer, 1977; Tarler-Benlolo, 1978; Ray et al., 1979) have concluded that there is a need for more clinical evaluation research with better methodological designs to determine the particular contribution of biofeedback training in relation to other more economical relaxation techniques.

Related to this issue is a growing body of research (see Davidson & Schwartz, 1976; Woolfolk, 1975; for reviews) which indicates that different relaxation strategies lead to different patterns of physiological responses. A major contribution to understanding these differences has been made by Davidson and Schwartz (1976) who have developed a psychobiological model to explain the subcomponents involved in the phenomenon of anxiety and in its reduction. Assuming two relatively distinct dimensions of anxiety, cognitive and somatic, they suggest that different relaxation strategies utilized in the reduction of anxiety differ in the degree to which they affect the cognitive vs. somatic subsystems. Furthermore, Schwartz (1975) reviews theory and research which helps clarify the usefulness of specific biofeedback training in relation to generalized physiological response patterns associated with subjective experiences of relaxation.

Beyond the need for further specification of the effects of various relaxation strategies involving biofeedback, a third issue which is critical for any treatment outcome study concerns the role of individual differences and possible interaction effects with type of treatment (Garfield & Bergin, 1978; Beutler, 1979). Indeed, several authors (Benson, 1975; Davidson & Schwartz, 1976; Smith, 1978; Tarler-Benlolo, 1978; Ray et al., 1979) have highlighted this issue in research designed to evaluate the effects of relaxation training procedures. Integrating this concern with individual differences with the above two issues, the overall research question in this area can be stated: <u>What kinds of people are likely to benefit from what kinds of relaxation training and in what ways?</u>

The remaining sections of this review examine research findings related to these critical issues: (1) the effectiveness of EMG biofeedback as a relaxation training strategy, (2) differential effects associated with various relaxation training strategies, and (3) individual differences in responsivity to relaxation training.

EMG Biofeedback as a Relaxation Training Strategy

As indicated above several different forms of biofeedback therapy have been used to assist in producing bodily relaxation, including electromyograph (EMG) feedback, alpha EEG feedback and heart rate feedback. This investigation focused on EMG feedback as a technique for relaxation training for two reasons: (1) EMG feedback is the most widely used type of biofeedback associated with relaxation training, and (2) reviews of the research (Gatchel & Price, 1979; Ray et al., 1979) suggest that alpha EEG feedback and heart rate feedback are not the treatments of choice for relaxation training or anxiety management.

In their pioneer work, Budzynski and Stoyva (1959, 1973) argued that EMG biofeedback may be used to augment the effectiveness of traditional relaxation procedures as well as effectively induce relaxation when used alone. Using paid volunteers in a laboratory setting, they compared an EMG feedback condition to no-feedback or irrelevant feedback control conditions. Their results indicated that the EMG feedback subjects were significantly more successful than control subjects in reducing muscle tension, whether training was done at the site of the frontalis or masseter muscles. Following on their work, most clinical applications have used the frontalis muscles across the forehead as the primary training site, with the assumption that relaxation of these muscles will generalize to other muscles and result in subjective reports of relaxation.

These authors further argued that EMG monitoring and feedback could be used to provide objective evidence regarding the client's relaxation level. This would help overcome the problem of demand characteristics associated with traditional relaxation procedures (e.g., progressive relaxation), which might incline patients to say they are relaxed even when they are not. Thus, EMG feedback was seen as a way to enhance the clinical efficacy of traditional relaxation procedures and their application in such treatments as systematic desensitization. Unfortunately, the research literature has generally not supported the basic assumptions and clinical hopes associated with the development of EMG feedback as a relaxation training procedure (see Blanchard & Young, 1974; Ray et al., 1979; Alexander & Smith, 1979; for reviews).

In an early review of the clinical literature, Blanchard and Young (1974) found evidence for the efficacy of EMG feedback and home practice in relaxation in eliminating tension headaches, but did not find evidence that EMG biofeedback was an effective relaxation-inducing technique apart from other relaxation techniques. One of the studies they reviewed, the one cited as providing the best data on the use of EMG feedback to teach relaxation, is a single group study by Raskin, Johnson, and Rondestvedt (1973), which utilized EMG assisted relaxation training to treat ten chronically anxious psychiatric patients. The results of this study failed to support the efficacy of the biofeedback technique in directly reducing the target symptom of anxiety, but did indicate significant relief from anxiety mediated symptoms, such as tension headaches and insomnia. Other studies reported by Peper (1973), Garrett and Silver (1972), Jacobs and Felton (1969), and Wickramasekera (1972) did not include adequate methodological procedures by which to evaluate the effects of biofeedback. Blanchard and Young (1974) concluded: "There is no clear-cut evidence to support the efficacy of EMG feedback training to teach relaxation either as an intermediary to some other therapeutic endeavor or as the basic training itself" (p. 579).

In a more recent critical review of EMG biofeedback as a relaxation technique, Alexander and Smith (1979) listed four weaknesses associated with research in this area which have hampered a clear scientific evaluation of the value of EMG biofeedback as a clinical procedure. First, most of the positive reports of single-case clinical applications, whether anecdotal case reports or systematic case studies, have incorporated frontalis EMG biofeedback within a treatment package which has included many other therapeutic variables. This does not provide a basis for attributing treatment success to the biofeedback component itself.

Second, the majority of controlled group studies have likewise combined EMG biofeedback with other treatments, especially progressive relaxation or autogenic training as well as nonfeedback home practice. This precludes an experimental isolation of the singular contribution of feedback. Third, many studies include either inadequate or no control for motivation, expectation, or other nonspecific placebo effects. This includes studies where the instructional-situational context of control subjects is not conducive to the level of performance of trained subjects, thereby rendering comparisons biased. Fourth, in many studies EMG reduction at a single site, usually the forehead, is taken as a measure of relaxation when, in fact, general relaxation in a _psychological sense_ is the response of interest. However, the relationship between skeletal muscle tension in general, let alone at a single site, and relaxation in the _psychophysiological_ sense has not been clearly delineated.

Following from these general criticisms of the research, Alexander and Smith (1979) list several basic assumptions involved in the use of EMG biofeedback as a general relaxation training method. These assumptions can be summarized as follows: (1) that contingent feedback will produce a level of performance (EMG tension reduction) unattainable by equivalently goal-directed effort without feedback; (2) that trained reduction of tension in a key muscle (e.g., the frontalis) would produce reduced tension in skeletal muscles throughout the body; (3) that muscle tension reduction is associated with presumed autonomic nervous system indicators of relaxation or low arousal; and

(4) that learned reduction of muscle tension in a key muscle is associated with the subjective experience of being relaxed. Following is a review of the research literature related to these four assumptions.

Effectiveness of contingent EMG feedback. Alexander and Smith (1979) review six studies which address the issue of the specific efficacy of contingent EMG feedback (Alexander, White, & Wallace, 1977; Budzynski & Stoyva, 1969; Coursey, 1975; Haynes, Mosely, & McGowan, 1975; Reinking & Kohl, 1975; White & Alexander, 1976). Budzynski and Stoyva (1969) found that after three sessions of training, contingent feedback subjects had reduced frontalis EMG to lower levels than either a constant tone (irrelevant feedback) or no-feedback group. There were three important features in this study. First, all subjects were told to concentrate on relaxing the forehead. Second, at the end of training, all subjects were paid a nominal sum of money contingent on their performance. Third, the no-feedback group also reduced muscle tension, but no statistical analysis was performed to determine if the decrease for the no-feedback group was statistically significant, nor whether the feedback group was reliably lower than the no-feedback group.

The next study by Coursey (1975) compared a group given contingent feedback with control groups given a constant tone, either with or without specific instructions on how to relax. Unlike the Budzynski and Stoyva (1969) experiment, no special attention was given to motivating performance, nor were subjects told which muscle to relax. These procedures placed the controls at a disadvantage, since the contingent feedback stimulus itself provided sufficient information to the trained subjects to discover the response of interest. Planned comparisons indicated that after six training sessions, the feedback subjects had significantly lower frontalis EMG levels than either of the control groups, who did not differ from each other.

The next two investigations (Haynes et al., 1975; Reinking & Kohl, 1975) also found that subjects given contingent EMG feedback were significantly more successful than controls in reducing EMG levels. However, these studies were also flawed in that control subjects were not told which muscle to relax and were not provided with any performance motivation.

Thus, it appeared that the claims for superior performance _of_ contingent feedback subjects over noncontingent or no-feedback controls in these first four studies may have been due to either of two factors: (1) lesser interest and motivation among control subjects, or (2) unequal and insufficient information provided to control subjects regarding the task of frontalis tension reduction. The latter two studies provided more specific information about the role of these factors in the biofeedback process.

Alexander et al. (1977) conducted a laboratory study designed to explicitly investigate the role of the contingent feedback stimulus while paying special attention to motivational, interest, and instructional factors. They found that highly interested no-feedback control subjects who were impressed with the importance of relaxing a particular area (either forehead or forearm) lowered EMG readings significantly after three sessions and actually did slightly better than feedback subjects. However, this study is limited by the shortness of training. It is possible that even with informed and highly motivated controls the superiority of contingent feedback may have been demonstrated over a longer training period (i.e., six sessions), as was the case in Coursey's (1975) study.

Another criticism of this and the first four studies is that they all were conducted with normal subjects. However, White and Alexander (1976) found similar results in a study with headache patients, in which motivated controls manifested a slight, but non-significant, advantage over feedback subjects as both groups significantly reduced frontalis EMG readings over the course of training. In addition, this study provides further support for the motivational hypothesis investigated in the Alexander study cited above (Alexander et al., 1977), since the study included five rather than three training sessions.

Alexander and Smith (1979) concluded that the results of the above six studies do not provide "any controlled demonstration that the presence of the contingent feedback stimulus provides any unique advantage over what adequately motivated subjects can do without feedback assistance" (p. 118). They further suggest that the main function of the feedback procedure may be to establish and maintain interest and goal-directed performance during tension-reduction sessions, but that the actual tension reduction may be attainable without feedback.

One critical issue not addressed in Alexander and Smith's review has to do with the motivation of the experimenter and potential experimenter bias. For example, it appeared that the intention of Budzynski and his associates (Budzynski & Stoyva, 1969, 1973) was to demonstrate the particular advantages of EMG biofeedback, while the intension of Alexander and his associates (Alexander et al., 1977) clearly seemed to be directed toward finding no unique effects of contingent EMG feedback. Two recent studies have utilized a double-blind methodology to control for potential experimenter bias and experimental demand characteristics as well as placebo or expectational components associated with biofeedback research.

In the first study, Cohen, Graham, Fotopoulos, and Cook (1977) developed a highly sophisticated double-blind methodology to investigate the effects of EEG and EMG biofeedback and successfully employed this procedure with a population of opiate addicts undergoing detoxification. EEG and EMG data from a two-phase study were compared between nonblind and double-blind conditions, and between contingent and noncontingent biofeedback groups within the double-blind condition. No evidence for the learned control of EEG alpha amplitude was found for any subject; performance during feedback sessions and across sessions did not discriminate contingent from noncontingent subjects, nor nonblind from double-blind conditions. While EMG activity did not differ between groups or conditions across sessions, a during-session analysis indicated similar reduction in EMG among nonblind and double-blind contingent biofeedback subjects. Within the noncontingent biofeedback groups, however, double-blind subjects manifested significantly less reduction than nonblind subjects.

The authors interpret their findings as indicating that the introduction of double-blind procedures did not substantially alter the physiological effects of biofeedback training for subjects receiving contingent feedback; the training procedure appeared equally effective for contingent subjects under nonblind and double-blind conditions. In terms of the learning of physiological control, they suggest that noncontingent subjects showed little evidence of acquisition and "that acquisition of physiological control over EMG activity is differentially related to the contingency of the biofeedback training provided" (p. 608). Although they attempted to control for the physiological effects of withdrawal by examining during-session differences as well as differences across sessions (since physiological activity was in the direction of activation due to withdrawal), the authors caution that these findings may not generate to nondrug or previously detoxed populations.

A particularly interesting aspect of their study from a clinical perspective were the findings that double-blind procedures significantly reduced the rate of successful detoxification in comparison to non-blind procedures, but no difference in therapeutic outcome was observed between contingent and noncontingent biofeedback groups. These findings in conjunction with the above results suggest that placebo factors may have played a significant role in treatment outcome.

In a second study utilizing a double-blind design, McSwain (1978) investigated the role of cognitive factors in EMG biofeedback training, with true (contingent) and false (noncontingent) feedback conditions interacting with the presence or lack of relaxation instructions. While the false feedback group demonstrated the least amount of learned EMG reduction, it was not significantly different from the true feedback group. She concluded that there was some evidence that true EMG feedback does work more effectively to lower EMG, but that expectancy might be a mediating factor since all groups improved.

In a study related to the two utilizing a double-blind design, B. Miller (1977) investigated demand characteristic effects in EMG training and found no direct effect on response to the feedback. However, a significant interaction between demand characteristics and direction of feedback was found. When demand (for increased or decreased tension) and actual feedback corresponded, subjects responded more in accord with the feedback than when demand and actual feedback conflicted.

In summary, there is some evidence that true contingent feedback is efficacious. However, this effect may be mediated by experimenter or situational-procedural demand characteristics, or by subject expectations or motivational factors. It appears that further research is needed to clearly demonstrate the unique effect of contingent EMG feedback.

Generalization of tension reduction. Several studies have investigated whether frontalis EMG feedback leads to generalized tension reduction in the skeletal muscles throughout the body. Stoyva (1976) reported findings which suggested that frontalis feedback generalizes to the forearm, but that the reverse relationship does not hold. He concluded that frontalis training was superior to forearm training for producing generalized muscle relaxation, but he cautioned that the research evidence was not clear.

Alexander (1973, 1975) failed to find corresponding reductions in forearm and lower leg muscles despite frontalis EMG reductions resulting from biofeedback training; however, these studies were flawed in that the recording from frontalis and leg muscle sites was not done simultaneously. In an improved study using simultaneous recordings, Shedivy and Kleinman (1977) also failed to find generalization from the frontalis during feedback training to either of two neck muscles (sternomastoid and semispinalis/sipenius).

Overall, the research provides little evidence that frontalis EMG training for muscle relaxation will generalize to other muscles; rather it seems to indicate that it does not. Ray et al. (1979) suggest that it may be important to train other muscles rather than assuming that frontalis EMG biofeedback is a sufficient relaxation training procedure. Moreover, Alexander and Smith (1979) suggest that the generalization hypothesis itself may be naive given the specific (discriminative) nature of basic EMG feedback training and the substantial differentiation of muscular activity within the skeletal muscular system.

Correlation of muscle tension reduction with other indices of low arousal. Several studies provide data relevant to the issue of generalization of muscle tension reduction to other indices of arousal. As with much of the biofeedback research, however, the findings are mixed.

In a pioneer study by Sittenfeld, Budzynski and Stoyva (1972) deep muscle relaxation was found to be associated with an increase in EEG theta, the brain rhythm dominant at sleep-onset. Specifically, they found an inverse relationship between frontalis EMG levels and EEG theta rhythms. In the course of training subjects to increase theta they found that when frontalis EMG was low, theta levels were high; and when frontalis EMG was high, then theta remained minimal or absent. These findings suggested that before high EMG subjects could increase their theta levels, they must first decrease their EMG activity.

Of further interest was the finding that baseline heart rate and frontalis EMG levels showed a correlation of .83 (rank order). Comparing initially high vs. low EMG subjects also indicated a significant decline in baseline heart rate (pre- vs. post-training) for the high EMG subjects, while low EMG subjects showed little or no gain.

In reviewing this research, Stoyva (1976) suggests that these findings support the notion that training in muscular relaxation can be an important first step which facilitates the learning of cortical and autonomic responses associated with low arousal, a process referred to by Stoyva and Budzynski (1976) as the shaping of low arousal. Stoyva (1976) concludes:

> The results also support the concept that muscle, autonomic and cortical systems (at least in the relaxed, pre-sleep condition) are likely to move in the same (low arousal) direction--an observation consistent with the occurrence of generalization (p. 383).

However, more recent research utlizing better controlled designs has not been as optimistic. Yock (1977) investigated the extent of generalization of relaxation effects from EMG frontalis feedback across multiple psychophysiological measures, including EMG forearm, heart rate, respiration rate, blood pressure (diastolic and systolic), and skin conductance level. He found that although EMG level was highly correlated with several other "anxiety indicator" measures, there was no evidence that EMG feedback resulted in superior relaxation when compared to false feedback and self-relaxation control conditions.

Another study by Alexander et al. (1977) produced similar findings. Measures of heart rate, respiration rate, skin conductance and skin temperature were obtained during the course of training. Results indicated strong, nonsignificant trends toward increased skin temperature and decreased heart rate and skin conductance over the training sessions for all treatment groups--frontalis EMG, forearm EMG, or self-relaxation conditions.

In a related study with important clinical implications, Gatchel, Korman, Weis, Smith, and Clarke (1978) examined the relationship of EMG level to multiple physiological measures both during training and under stress-inducing conditions. They found that although an EMG feedback group was able to maintain a low level of frontalis EMG activity under stress conditions, this did not generalize to other physiological responses. Heart rate and skin conductance levels both increased, which also coincided with self-reports of anxiety.

The above studies concerning physiological correlates of muscle tension reduction lead to two observations. First, while EMG induced muscle relaxation may be associated with other physiological measures of relaxation and a general reduction in sympathetic activity (low arousal), this relationship is not unique to EMG biofeedback training since controlled studies show that self-relax or noncontingent feedback groups produce the same pattern. This further highlights the potential impact of placebo factors in biofeedback research.

Second, the Gatchel et al. study (1978) indicated that under stress-inducing conditions, the positive relationship between muscle relaxation and other physiological measures of relaxation may not hold. This casts doubt on the value of using EMG muscle tension reduction training alone as the basis for a clinical intervention designed to cultivate the "low arousal" response.

Correlation of specific muscle tension reduction with subjective relaxation. Several laboratory studies have investigated the issue of subjective correlates of EMG-assisted muscle tension reduction (Alexander, 1975; Coursey, 1975; Reinking & Kohl, 1975; Shedivy & Kleinman, 1977; Sime & DeGood, 1977). Although these studies varied in purpose and design, using either noncontingent feedback or self-relax control groups, or both, the findings are quite consistent. Despite differing amounts of forehead EMG reduction between various experimental and control groups, all subjects reported significant increases in subjective feelings of relaxation during sessions. Moreover, no differences were found between experimental and control groups on reports of subjective relaxation in any of the studies. In reviewing this research, Alexander and Smith (1979) conclude: "Apparently, biofeedback training produces no further subjective experience of relaxation beyond what is afforded by simple unassisted efforts to relax or just sitting quietly" (p. 120).

In the clinical area, several studies have attempted to evaluate EMG biofeedback as a relaxation technique in the treatment of psychiatric patients with acute or chronic anxiety. These studies provide further data relevant to the assumption of a correlation between muscle reduction and subjective relaxation.

The first of these studies (Raskin et al., 1973) failed to demonstrate that EMG-assisted relaxation training led to a significant decrease in self-reported anxiety, although four of the 10 patients did improve. However, as indicated above, the treatment did lead to a significant reduction in anxiety-mediated symptoms--namely, insomnia and tension headaches.

Townsend, House, and Addario (1975) evaluated an EMG-assisted relaxation treatment with a group therapy treatment serving as a control. They found a significant decrease in EMG for the feedback group only, and a significant positive correlation between self-reported anxiety and EMG level (.60). In addition, they found slightly greater improvements on self-reported anxiety for the feedback group and concluded that biofeedback relaxation training was "at least as effective" as group therapy in reducing anxiety. However, since the EMG relaxation treatment included a progressive relaxation component, the efficacy of the biofeedback training itself cannot be determined from this study.

In a more recent, better designed study, Lavallee, Lamontagne, Pinard, Annable, and Tetrault (1977) compared an EMG and drug placebo group to three other groups: (a) anxiety-reducing drug and EMG control (sitting quietly with no feedback), (b) anxiety-reducing drug and EMG feedback, and (c) nonspecific treatment-drug placebo and EMG control. Results indicated equal decrease in EMG for the EMG group and the two medication groups, and a significant correlation between EMG and anxiety measures (.40). In addition the three active treatment groups manifested significantly greater reductions in self-reported anxiety than the nonspecific control group, although they did not differ from each other.

In evaluating the clinical research, Ray et al. (1979) concluded that EMG-assisted relaxation training has not clearly been shown to be an effective clinical procedure. They suggest that future research include nonspecific and relaxation control groups and utilize a design which will allow for an adequate evaluation of the specific contribution of EMG training in treating anxiety.

Two critical issues emerge from the laboratory and clinical studies which investigated subjective correlates of EMG biofeedback training. First, while the subjective experience of relaxation does not appear to be correlated with frontalis EMG muscle tension reduction, self-reported anxiety has shown a significant positive relationship to EMG levels. One explanation for this paradoxical finding may lie in the different populations which typically comprise the laboratory-relaxation vs. the clinical-anxiety studies. Laboratory studies have generally utilized volunteer subjects (sometimes paid) whose EMG levels before training may have been relatively low. This could impose a constraint on the relationship between reductions in EMG level and subjective reports of relaxation. In contrast, clinical studies have typically involved a highly anxious population whose pretreatment EMG levels would tend to be higher, thus allowing for greater change over treatment and higher correlations with self-reported anxiety.

Another explanation for the unclear research findings may lie in a more complex conceptualization of relaxation and anxiety than one which postulates these subjective states as opposite poles on a unidimensional continuum. Several researchers (Davidson & Schwartz, 1976; Lang, 1977; Gatchel, 1979) have pointed to the complex psychobiological interrelationships involved in understanding anxiety and relaxation states. Their conceptualizations will be reviewed in a later section of this paper.

A second critical issue concerns the finding that nonspecific treatment groups tend to improve as much as EMG treatment groups on subjective relaxation, despite differences in EMG reduction. This highlights the importance of considering potential nonspecific treatment factors, such as expectancy, demand characteristics, placebo effects, etc., in evaluating the relationship between self-report and physiological measures in biofeedback research.

Nonspecific treatment factors in biofeedback research. Nonspecific treatment factors have been discussed under a wide variety of headings, including placebo effects (Shapiro, 1971), patient and therapist expectations (Goldstein, 1962), situational demand characteristics (Orne, 1962), persuasion (Frank, 1973), and suggestion (Torrey, 1972). Ray et al. (1979) suggest that all of these variables can be understood under the general rubric of "nonspecific treatment effects," which they define as all those variables which are not explicitly hypothesized as active ingredients of the therapy under investigation.

In their evaluation of research on nonspecific factors, Ray et al. (1979) present three major interacting categories for grouping nonspecific factors: therapist variables, patient variables, and situational-procedural variables. According to the authors, the function of the variables subsumed under each category can be described as follows: patient variables are generally "expectancy for success" of the treatment; therapist variables are generally "confidence in abilities and treatment"; and situational-procedural variables are generally "demand characteristics."

Current research comparing various relaxation training programs incorporating a biofeedback treatment component needs to control for all three potential sources of nonspecific treatment effects. For example, in a comparative treatment evaluation study, Andreychuk and Skriver (1975) found that under positive success expectancy instructions high-suggestibility migraine patients responded more favorably than low-suggestibility patients regardless of the type of treatment they received (hypnosis, temperature feedback, or alpha EEG feedback). This study highlights the importance of assessing and controlling for nonspecific patient variable effects associated with expectancy of success in biofeedback therapy research.

Therapist variables which may exert nonspecific influence on treatment outcome include the therapist's confidence in himself, his belief in and enthusiasm for the treatment, his attitude toward patients, and his persuasiveness. According to Ray et al. (1979) such therapist variables have not been explicitly studied within the context of biofeedback therapy. However, outcome research on other types of treatment (Shaprio, 1971; Goldstein, 1962; Rosenthal, 1963; Frank, 1973) suggests that such variables may interact with patient variables to increase the patient's expectancy of success. Moreover, Lerner and Fiske (1973) suggest that the therapist's belief that he can be of help to the patient is a better predictor of treatment outcome than any of the patient variables. Given the relative newness of biofeedback therapy and the high degree of enthusiasm among its proponents, it seems likely that therapist's positive expectancies may exert a powerful nonspecific influence on treatment outcome. Thus, current biofeedback research must attempt to control for nonspecific effects associated with therapist variables as well as patient variables.

The third category of nonspecific factors, those associated with situational-procedural variables, includes such variables as treatment rationale credibility, suggestibility-enhancing aspects of the therapeutic situation or procedure, and popularity of treatment. As with patient and therapist variables, situational-procedural variables can interact with the other sources of nonspecific influence to affect the patient's expectation of success.

According to Ray et al. (1979), one of the most critical variables in this area, treatment rationale credibility, has not been specifically assessed in biofeedback therapy research. However, several behavior therapy researchers (Kazdin & Wilcoxon, 1976; Borkovec & Nau, 1972; Jacobson & Baucom, 1977) have called attention to differential credibility associated with the rationales of alternative treatment conditions and the potential impact on treatment outcome.

In the area of biofeedback, several authors (Ray et al., 1979; Alexander & Smith, 1979) have suggested, for example, that treatment rationales associated with actual vs. no-feedback conditions are likely to induce different credibility evaluations by subjects. Current research needs to insure equivalence in credibility between alternative treatments or different within-subjects conditions in order to be able to rule out this nonspecific factor as a plausible explanation of treatment effects.

Related to the credibility of treatment rationale are the suggestibility-enhancing aspects of the therapeutic situation and procedures (Coe & Buchner, 1975; Rosenthal & Frank, 1956; Torrey, 1972). Utilizing Torrey's (1972) conceptualization Ray et al. (1979) suggest that biofeedback therapy may incorporate both <u>direct suggestion</u>, such as when the therapist indicates that the treatment is likely to be effective, and <u>symbolic suggestion</u>, such as the culturally reinforced belief in the promise of technological gadgetry, which function as demand characteristics to influence patients' expectancy of benefit and, consequently, treatment effects.

For example, a study by Valle and Levine (1975) on the effect of direct suggestion on EEG alpha training found that subjects who thought they were enhancing alpha exhibited significantly greater control over these brain waves than subjects who thought they were suppressing alpha. However, as Wilkins (1979) in a recent review of various sources of expectancy as nonspecific factors observes, the variable of situational-procedural suggestibility may be necessarily linked to the treatment itself. In the context of this discussion, what seems important in current biofeedback research is to recognize the potential influence of this variable and other "demand characteristics" associated with the treatment procedure and to strive for equivalence across treatment conditions.

Differential Effects of Relaxation Training Strategies

One conclusion which emerged from the above review of the research on EMG biofeedback as a relaxation technique is the need for comparative research to evaluate the effects of EMG biofeedback in relation to other relaxation techniques, such as, progressive relaxation, autogenic training and meditation. Several studies have addressed themselves to this issue. In general, they fall into three categories: (1) studies comparing EMG biofeedback alone to other relaxation techniques, (2) studies comparing EMG biofeedback either alone and/or in combination with various other relaxation techniques, (3) studies comparing relaxation techniques not including EMG biofeedback.

EMG vs. other relaxation techniques.

In a laboratory study, Cleaves (1970) compared a control group and three relaxation treatments: auditory EMG, visual EMG, and combined progressive relaxation and autogenic training. All three relaxation groups reduced EMG levels significantly more than the control group after one 2-hour training session, but there were no significant differences between treatment groups. A major limitation of this study is the single-session treatment.

In a similar study, Staples and Coursey (1975) compared auditory EMG feedback to audiotaped instructions for either progressive relaxation or autogenic training. No significant differences were found between treatment groups in terms of effectiveness in reducing frontalis EMG levels, but the authors did find that the progressive relaxation group responded most positively to their training experience.

In a study previously cited, Coursey (1975) compared an EMG feedback group to a group given simple instructions for relaxing while listening to a constant tone, as well as a group with self-relax instructions and the tone. The feedback group was significantly more effective in lowering frontalis EMG than either of the control groups. However, all three groups reported improvement on subjective measures of relaxation and there were no significant differences between groups. While this is not a true comparative study (since both non-feedback groups were designed as controls), it does provide contrasting data to the previous studies which further supports the efficacy of recognized relaxation techniques, e.g., progressive relaxation, in reducing EMG levels.

In a well designed study, Haynes, Moseley, and McGowan (1975) compared an EMG feedback group, a Jacobsonian progressive relaxation group, a Wolpein passive relaxation group, and two control groups, a contingent feedback group and a no-treatment group instructed to sit quietly. They found that the feedback group was significantly better both in amount and rate of EMG reduction, and that the Wolpein passive form of relaxation training also led to significant EMG reductions. The authors suggest that the tensing exercise component of progressive relaxation may not be optimal or necessary for relaxation training.

Another finding of this study was that subjects whose initial scores on the Taylor (1953) Manifest Anxiety Scale were high demonstrated higher resting EMG levels and were not as successful in attaining low EMG levels as subjects with initially low Taylor scores. Again, however, the results of this study must be considered cautiously since subjects only received one training session.

Sime and De Good (1977) compared EMG feedback, progressive relaxation, and a control group which heard music. Following four sessions of training, the feedback and progressive relaxation groups had significantly decreased EMG levels in comparison to the control group, which failed to change. In addition, the two treatment groups did not differ from each other.

Two recent unpublished dissertations have examined comparative physiological and subjective effects of EMG biofeedback and other relaxation procedures. Crawford (1977) compared EMG feedback, temperature feedback, progressive relaxation and a cognitive task (listening to a tape recorded essay) over four training sessions while monitoring EMG levels and hand temperature. He found that both types of biofeedback were more effective than the other conditions in producing a physiological response pattern associated with relaxation, with the EMG treatment emerging as the most effective. However, he found no clear differentiation of the effects of each type of biofeedback. He concluded that the relaxation training experience as a whole represents a complex set of stimuli which determines the pattern of physiological responses which emerge during training.

Traynham (1977) compared EMG feedback, progressive relaxation, experimental meditation (Benson-type, passive meditation), and a self-relaxation control group on physiological and self-report measures of relaxation. Results indicated that EMG feedback and meditation training led to significantly lower EMG levels than progressive relaxation or the self-relax control condition. In addition, in spite of his hypotheses that biofeedback and meditation would produce equal effects, Traynham found that meditation was significantly more effective than EMG feedback both in reducing EMG levels and on subjective reports of relaxation.

In summarizing the findings of several of the above studies, Tarler-Benlolo (1978) notes that they were generally done with normal subjects who tend to begin with initially low frontalis EMG levels, making it difficult to find significant reductions posttraining.

Since initial EMG levels of patients manifesting various stress-related symptoms are usually higher than those of normals, she maintains that comparisons of the effectiveness of various relaxation techniques must include studies done with clinical populations. Following is a review of clinical studies comparing EMG biofeedback to other relaxation techniques.

Two studies have specifically compared EMG biofeedback to other relaxation procedures in the treatment of tension headaches. Cox, Freundlich, and Meyer (1975) found the EMG biofeedback treatment to be equally effective in reducing headaches as a relaxation procedure consisting of progressive relaxation and cue-controlled breathing. Similarly, Haynes, Griffin, Mooney, and Parise (1975) reported equal success of feedback and a specially designed passive relaxation technique in treating headaches.

Surwit, Shapiro, and Good (1978) compared EMG biofeedback (frontalis and forearm), combined heart rate and blood pressure biofeedback, and a passive meditation relaxation technique (according to Benson) in the treatment of patients with borderline hypertension. Their results indicated no significant reduction in blood pressure over the course of treatment or at follow-up for any group, nor any differences between treatment conditions. However, there were significant reductions during individual training sessions as well as moderate reductions for all groups over the course of training.

In a critical review of the research literature on nonpharmacologic control of essential hypertension, Frumkin, Nathan, Prout, Maurice, and Cohen (1978) evaluated biofeedback in relation to various other relaxation techniques, including, progressive relaxation, Transcendental Meditation (TM), and Zen yoga-like exercises. They concluded that while biofeedback may lower blood pressure during training sessions, there is no evidence that it produces enduring reductions in basal blood pressure levels. In contrast, they maintain that there is some evidence for the efficacy of the non-feedback relaxation techniques in producing long-lasting blood pressure changes.

In a similar review of the hypertension literature, James (1978) suggests that while biofeedback may demonstrate effects in laboratory experiments, it may not be therapeutically effective. He further suggests that meditation-induced relaxation responses may prove to be more clinically effective in controlling blood pressure.

While the above studies have focused on specific stress-related symptoms, e.g., tension headaches and essential hypertension, other studies have compared EMG biofeedback and various relaxation techniques in the treatment of a wide variety of clinical problems. Several of these studies are noteworthy for the present investigation.

Two recent studies compared EMG feedback and progressive relaxation in the treatment of insomnia (Freedman & Papsdorf, 1976; Haynes, Sides, & Lockwood, 1977). In both studies the EMG feedback group and the progressive relaxation group were found to be equally superior to a control group consisting of a placebo set of relaxation instructions. In addition, the Freedman and Papsdorf study found that biofeedback training generalized from the frontalis to the masseter muscle, but not to the forearm extensor.

A recent study by Beiman, Israel, and Johnson (1978) compared EMG biofeedback and various relaxation procedures with tense and anxious clients who responded to an ad for therapy. In a comparison of live (LR) and taped (TR) progressive relaxation, EMG biofeedback (BF), and self-relaxation (SR) on measures of autonomic and somatic arousal and subjective tension, they found that during training LR was superior to TR on reductions in physiological arousal; SR and BF were equivalent except for the superiority of SR on reductions in autonomic arousal. After training, live progressive relaxation was superior to the other procedures on self-control of autonomic arousal. In spite of the differences on physiological measures, all groups showed similar improvements in subjective reports of general tension. The authors concluded that live progressive relaxation is the relaxation treatment of choice for a variety of clinical objectives.

<u>EMG and/or other relaxation techniques</u>. Most of the studies in this category have compared EMG feedback, non-feedback relaxation techniques, and various combinations of these procedures. Although most of these studies have been done with a patient population, there are a few which have used normal subjects. As in the previous section, the results of these studies will be reviewed first followed by the clinical studies.

Duane (1974) compared EMG feedback, progressive relaxation (PR) and EMG plus progressive relaxation and found that the EMG and combined treatments (EMG and PR) were superior to progressive relaxation alone. In a similar study Reinking and Kohl (1975) compared five conditions: (1) progressive relaxation, (2) EMG feedback, (3) feedback plus progressive relaxation, (4) feedback plus monetary reward, and (5) no treatment. After twelve training sessions all groups except the no-treatment control had significantly reduced EMG levels. However, the three EMG treatment groups, who did not differ from each other, were significantly better than the progressive relaxation only group.

Using a slightly different design, Mohr (1976) compared progressive relaxation, autogenic training, a self-relaxation control, and each of the above three conditions in combination with EMG feedback. All experimental treatment groups were more effective than the control group in reducing EMG levels, and there were no significant differences between these treatments.

There have been several clinical studies comparing various relaxation procedures either with or without EMG biofeedback in the treatment of stress-related disorders. Hutchings and Reinking (1976) compared EMG feedback, combined autogenic training and progressive relaxation, and EMG feedback plus the combined relaxation exercises in the treatment of patients with tension headaches. Their results indicated greater EMG reductions for both the feedback groups in comparison to the relaxation only group. In addition, the combined biofeedback and relaxation training group produced the best results in terms of subjects' reports of headache relief.

A similar study by Chesney and Shelton (1976) produced opposite results. They found both relaxation training groups (relaxation exercises and EMG feedback plus relaxation exercises) experienced greater headache relief than the EMG only group. However, this study failed to report changes in EMG level and did not specify the nature of the relaxation exercises.

Several studies have evaluated EMG feedback alone or in combination with relaxation exercises in the treatment of hypertension. In an early study, Moeller (1973) found evidence for the efficacy of EMG feedback plus a combination of progressive relaxation and autogenic training in reducing blood pressure. Although he included a no-treatment control group, no conclusions regarding the relative contribution of the treatment components can be determined from this study. In a similar study with combined biofeedback and relaxation exercises, Orlando (1974) found significant blood pressure reductions in the control group as well as in the treatment groups.

Finally, Weston (1974) compared sequential EMG and BP feedback, EMG and BP feedback plus combined progressive relaxation and autogenic training, alternating sessions of EMG and BP feedback, and BP feedback only. All patients achieved a significant decrease in both systolic and diastolic BP, and there were no differences between groups. Unfortunately, this study did not include a control group.

In general, the above review of research studies comparing EMG biofeedback to other relaxation techniques presents mixed findings. For the most part, EMG biofeedback was found to be as effective as other relaxation techniques, although two studies suggest that it may be more effective (Haynes et al., 1975; Crawford, 1977). Other studies suggest that progressive relaxation may be more effective than EMG feedback in treating various stress-related disorders (Chesney & Shelton, 1976; Beiman et al., 1978). The most consistent finding (Chesney & Shelton, 1976; Hutchings & Reinking, 1976) is that a combination of EMG biofeedback and some form of specific relaxation exercises, usually progressive relaxation, produced the best clinical results. One explanation for these inconsistent findings is the lack of equivalent criteria for evaluating the outcome of various treatments across studies. In particular, a problem in many of the EMG biofeedback evaluation studies is the use of EMG level as the sole or main outcome criterion, which, as was discussed previously, may not be significantly related to overall relaxation.

Relaxation procedures not including EMG biofeedback. There are several studies which have compared various relaxation procedures other than EMG biofeedback and provide data relevant for the present investigation.

Glueck and Stroebel (1975) compared alpha EMG biofeedback, autogenic training, and Transcendental Meditation (TM) in their ability to produce the generalized relaxation response among psychiatric patients. They found TM to be the most effective procedure and attributed its success to the fact that it is easily learned and able to hold patient's interest over time.

Although this investigation did not evaluate EMG biofeedback, the authors' comment that they have successfully utilized that type of treatment in teaching patients to self-regulate specific somatic symptoms, for example, tension headaches. In this context, they suggest that the patient's ability for self-regulation of the somatic symptoms and the prompt symptom reduction may reinforce and encourage regular practice of the specific biofeedback techniques, an inducement that may not occur in the use of biofeedback for general relaxation. They conclude that the various types of biofeedback and relaxation techniques must be tailored to the needs of the individual patient if they are to be effective.

With normal subjects, Weiner (1976) compared the effects of Ananda Marga mantra meditation and progressive relaxation on state and trait anxiety and frontalis EMG levels. He found that both relaxation techniques reduced state anxiety, as compared to no treatment, but found no significant effects on trait anxiety or EMG levels.

In a comprehensive evaluation of the physiological and subjective effects of various types of meditation, relaxation, hypnosis and self-relaxation, Morse, Martin, Furst, and Dubin (1977) found all methods to be effective in producing the "relaxation response" (the deeply relaxed psychophysiological state described by Benson et al., 1974). In addition, they found no differential effects of the various techniques, with the exception of meditation (TM or a variation on Zen meditation), which was significantly more effective than the other methods in reducing EMG recorded muscle activity. Since nine of the ten physiological measures manifested no differences across relaxation techniques, the authors concluded that meditation, relaxation-hypnosis and self-relaxation produce similar physiological responses associated with deep relaxation. However, an analysis of four subjective measures of the quality and depth of the relaxation experience, and the ease with which it was attained, indicated significantly "better" experiences with the meditation and relaxation-hypnosis techniques than with the self-relaxation technique. Thus, while comprehensive physiological measures failed to show significant differences between the three relaxation procedures, subjective evaluation did reveal significant differences.

Two recent studies with alcoholic populations provided data which differentiates specific effects, both physiological and subjective, of meditation and progressive relaxation (Gilbert, Parker, & Claiborn, 1978; Parker, Gilbert, & Thoreson, 1978). In the Parker et al. (1978) study, the effects of meditation training and progressive relaxation on autonomic arousal were compared, with a quiet rest treatment condition serving as a control group. They found that both meditation and progressive relaxation were significantly effective in reducing blood pressure, in contrast to the control condition which did not result in improvement. However, on self-reported anxiety and heart rate all three treatments produced decreases, with no significant decreases between groups. Finally, meditation produced blood pressure decreases earlier in treatment than progressive relaxation and was significantly more effective overall in reducing systolic blood pressure than progressive relaxation.

Noting the positive performance of the quiet rest control group, the authors point to the importance of controlling for expectancy, motivation and attention factors in relaxation training outcome research. They suggest that persons have considerable potential for control over the relaxation process, even without formal relaxation techniques. They attribute the positive performance of the quiet rest group (essentially comparable to self-relaxation conditions in other research) to the substantive rationale for relaxation given to all subjects in their study. Thus, the quiet rest subjects were provided with a set which elicited a strong "desire" to relax, presumably equivalent to that of subjects in the main treatment groups. The authors observe that in much relaxation research expectancy and attention are subtly manipulated by procedures which are not uniform across experimental and control conditions.

A second implication noted by the authors, based on the finding of differential treatment effects across dependent variables, is the need for multiple outcome measures for satisfactorily evaluating the effects of various relaxation procedures. In particular, they suggest that research on relaxation training which relies exclusively on self-report or physiological measures can be misleading.

Finally, the authors point to the greater efficiency and better overall effects of meditation training over progressive relaxation for inducing decreased autonomic arousal as measured by blood pressure. Citing the importance of "cognitive activity" on relaxation, they suggest that the meditation procedure may have been the most effective because of the restricted attention and limitation on cognitive activity associated with this technique.

In the Gilbert et al. study (1978), the effects of the same three conditions (meditation, progressive relaxation, quiet rest) on various mood states were evaluated. Citing the above study (Parker et al., 1978) as well as other research (Glueck & Stroebel, 1975; Ferguson & Gowan, 1973) the authors hypothesized that the above relaxation strategies may produce varying as opposed to homogeneous sets of responses across a range of variables (e.g., mood, reported anxiety, somatic complaint measures, physiological measures) according to the specific technique employed.

In an attempt to further clarify the differentiated effects of various strategies, they evaluated the three treatments with the Profile of Mood States, which consists of six bipolar scales measuring tension, depression, anger, fatigue, vigor and confusion. They found that both meditation and progressive relaxation produced significant decreases in self-reported tension, but progressive relaxation also led to a significant decrease on the depression factor and a trend toward increased vigor. This combination of tension reduction and mood elevation was not observed in the meditation group. Rather the meditating subjects became less tense and slightly less fatigued, a pattern consistent with the "restful alertness" by which Wallace and Benson (1972) characterized the meditative state.

Although these findings are interesting, they must be considered tentatively since the treatment program consisted of only one 15-minute training session. The authors concluded that their findings are consistent with the notion of response-specificity of relaxation strategies and suggest that different relaxation strategies can be expected to produce variation in responding across a wide range of outcome measures. They suggest a need for further research comparing additional techniques (e.g., biofeedback, autogenic training) across multiple outcome measures. This would contribute to further refinement of the homogeneous "relaxation response" (Beary & Benson, 1974) and enable more effective prescribing of specific relaxation strategies for particular disorders.

A recent well-designed study by Zuroff and Schwarz (1978) evaluated several effects of transcendental meditation in relation to a muscle relaxation technique (Paul, 1966, accelerated form of Jacobsonian progressive relaxation) and a no-treatment control group with undergraduate volunteers over a 9-week period. Notable features of this study include its use of separate measures to assess the behavioral, self-report (subjective) and autonomic dimensions of anxiety, the use of locus of control and social desirability inventories as individual difference measures, and procedures and measures to control for the effects of expectation of benefit and frequency and regularity of home practice.

On a behavioral measure of trait anxiety, the Behavioral Anxiety Measure (BAM), the scores of all three groups decreased equally, but on a self-report measure the TM group manifested steady decreases in anxiety, while the other two groups remained unchanged. Although TM subjects held higher expectancies for benefit, and were slightly more regular in practicing their technique, individual differences in social desirability, expectancy and frequency of practice were not correlated with degree of reported anxiety reduction. The authors concluded that TM may reduce trait anxiety but caution that the subjects in their study volunteered hoping to receive training in TM. They offer this as a possible explanation for the discrepancy with Smith's (1976) study, which found TM to be no more effective in reducing anxiety than a nonspecific effects control treatment, which consisted of sitting passively in a chair. In Smith's study, subjects volunteered specifically to receive treatment for anxiety. Thus, the authors suggested that the groups who received what they were seeking --Smith's TM and control groups and their TM group--responded with reports of decreased anxiety.

Two recent studies by Murray and his associates (Goldman, Domitor, & Murray, 1979; Boswell & Murray, 1979) provide further data regarding the specific effects of meditation training and the influence of expectancy or motivation on such effects. In the Boswell and Murray (1979) study with undergraduates, mantra meditation (similar to TM), an antimeditation control, a progressive-relaxation control, and a no-treatment control were compared on self-report measures of state-trait anxiety and autonomic physiological measures, including GSR frequency, skin conductance, and heart rate taken at rest, after practicing, and after a stress manipulation. Subjects were given one training session followed by two weeks of home practice, twice a day for 15 minutes. A postexperimental questionnaire indicated that the three treatments aroused similar expectancies of change and that subjects in all three treatments reported a high degree of compliance with home practice assignments.

The authors found no evidence from any of the self-report or physiological measures that meditation reduced anxiety beyond that shown in the three control conditions. Although an overall trend for all groups to decrease in autonomic arousal was observed, only those subjects initially high in trait anxiety manifested a significant reduction on that measure. The authors suggest that their study confirms other research findings (Smith, 1976; Zuroff & Schwartz, 1978) which argue against the unique effectiveness of meditation as a method of reducing anxiety above and beyond the nonspecific factors involved in many interventions. However, significant limitations of their study include the single session training and only two weeks of home practice.

In the Goldman et al. (1979) study, an effort was made to overcome the difficulty of monitoring home practice and to control for possible non-compliance by having subjects practice daily for one week in the laboratory under direct observation. A similar undergraduate population was used; however, half of the subjects were volunteers recruited through advertisement while the other half were customary subject pool students.

No significant differences on self-report measures of anxiety were found between three treatment groups: Zen meditation, anti-meditation control, and no-treatment control. All groups showed a decrease in state, trait and manifest anxiety following treatment. An interesting finding was that volunteer status interacted with treatment; male volunteers in both active treatments manifested significantly greater decreases on two of the anxiety measures. The authors suggest that personality, motivational or expectancy factors associated with volunteer status may account for many of the reported positive effects of meditation training.

Toward a multi-process model for understanding the effects of relaxation training strategies. A general issue which emerges from the above review of the research comparing various relaxation training programs is the need for theoretical clarification and empirical precision in evaluating treatment outcome. Specifically, there is a need for integration of theory concerning the psychobiology of anxiety and relaxation states with empirical procedures which allow for a valid assessment and evaluation of the specific effects of various treatments.

Previous biofeedback research (see Alexander & Smith, 1979; Gatchel, 1979; Ray et al., 1979) has often yielded results which indicate a discrepancy between physiological measures and self-report (subjective-psychic) measures of anxiety. While this discrepancy may be attributable to the influence of nonspecific factors or to individual differences in response patterns, it nevertheless suggests the need for multiple treatment outcome measures which differentiate and specify the various response components of anxiety.

Several reviewers (Borkovec, 1976; Davidson & Schwartz, 1976; Gatchel, 1979) have presented theoretical models for understanding anxiety as a multi-process phenomenon. In general, these models differentiate between physiological, psychic, and behavioral response components of anxiety.

A particular theoretical framework which holds promise for understanding the specific effects of various relaxation training strategies is Davidson and Schwartz' (1976) conceptualization of relaxation in terms of the cognitive, somatic and attentional processes involved. Essentially their conceptualization proposes a psychobiological model which explains the subcomponents involved in the phenomenon of anxiety and its reduction. Assuming two relatively different dimensions of anxiety, cognitive (psychic) and somatic, they suggest that different relaxation procedures utilized in the reduction of anxiety differ in the degree to which they affect the cognitive vs. somatic subsystems. Furthermore, they propose an activity-passivity dimension, understood as a continuum along which various relaxation techniques can be classified according to the relative degree of active self-generating behavior vs. passive self-regulation of attention involved in the procedure.

Following Davidson and Schwartz, the major relaxation procedures are classified in Table 1 according to the locus of attentional focus (cognitive vs. somatic) and the active (A) vs. passive (P) demands of the technique. An arrow from active to passive indicates that the subject must initially actively self-generate some behavior which soon becomes automatic and therefore more passive. A plus (+) between active and passive indicates that both dimensions are present and form an integral part of the procedure.

Table 1

Classification of Relaxation Techniques Along Cognitive/Somatic and Active (A,a)/Passive (P,p) Dimensions. Lower case a indicates slight attention.

Technique	Cognitive	Somatic
Progressive Relaxation	--	A + P
Hypnotic Suggestion	A	P
Autogenic Training	a→P	P
Zen Meditation	--	P
Transcendental Meditation	a→P	--
Hatha Yoga	--	A

From Davidson and Schwartz (1976, p. 414)

Given this analysis and classification system, Davidson and Schwartz suggest that the frequently observed research finding of differential effects elicited by different forms of relaxation training can be understood in terms of the pattern of processes associated with a particular technique. For example, they hypothesize that progressive relaxation operates primarily within the somatic mode or system, and is likely to be most effective in the reduction of somatic anxiety; while TM or autogenic training operate primarily within the cognitive mode or system, and are likely to be most effective in the reduction of cognitive anxiety.

Schwartz (1975) has explored the implications of these theoretical assumptions regarding relaxation techniques in laboratory investigations of the effects of biofeedback. Citing the limitations of most self-regulation research which addresses only single responses or response systems, Schwartz emphasizes the more normal but complex phenomenon of the voluntary coordination of multiple physiological processes. In this regard, he suggests that biofeedback and related relaxation procedures need to be investigated in terms of the interrelated patterns of physiological responses associated with such procedures, and the role of these patterns in the generation of subjective experiences of relaxation.

In relation to the pattern concept, Schwartz found that when subjects were taught to lower both heart rate and blood pressure simultaneously (as opposed to lowering either function alone), they spontaneously and consistently began to report feelings of relaxation and calmness. This finding is especially significant given the fact that subjects were told nothing about what to expect from the feedback training.

In light of their multi-process conceptualization, Davidson and Schwartz also emphasize that the choice of dependent variables is a crucial determinant of the outcome of any particular study, in so far as they assess the somatic, cognitive and attentional components of the relaxation experience. An important contribution in their analysis and classification of various measures used in relaxation research is the recognition that physiological and self-report measures often cut across the somatic vs. cognitive systems. For example, electrodermal activity has been used both as a measure of arousal or activation (somatic) and as an index of emotional (cognitive) activity. This differentiation has been clarified by the research of Kilpatrick (1972) which suggests that tonic skin conductance (skin conductance level or SCL) is primarily a cognitive measure while phasic electrodermal activity (skin conductance response or SCR) is primarily a somatic measure.

This type of delineation has generally not been done for self-report anxiety inventories typically used in relaxation research. Davidson and Schwartz did an item analysis of the Taylor Manifest Scale (Taylor, 1953), and the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970) in terms of somatic, cognitive or mixed (somatic/cognitive) processes implied. They found that the Taylor was composed of 30 percent somatic items, 44 percent cognitive items, and 26 percent cognitive/somatic items; the State-Trait consisted of 15 percent somatic items, 55 percent cognitive items and 30 percent cognitive/somatic items.

Given the inadequacy of such commonly used instruments for assessing the differential effects of various relaxation strategies, Schwartz, Davidson, and Goleman (1978) developed an instrument, the Cognitive-Somatic Anxiety Questionnaire (CSAQ), with dual scales to separately assess cognitive and somatic trait anxiety. They then utilized this instrument to test the assumptions of their model in a comparison of the effects of meditation (a cognitive strategy) vs. exercise (a somatic strategy). The results of this study provided tentative support (correlational) for their hypothesis that meditation would be associated with decreased cognitive anxiety and physical exercise would be associated with decreased somatic anxiety. In evaluating their findings, they suggest that the relaxation phenomenon can be understood on two levels. First, there is a generalized reduction in multiple physiological systems (the relaxation response of Benson); and second, there is a more specific pattern of changes superimposed upon this general reduction, which is elicited by the particular relaxation technique employed.

The above considerations help to explain many of the conflicting findings in comparative research which has evaluated EMG biofeedback in relation to other relaxation training techniques. Several key points emerged from the discussion of Davidson and Schwartz' multi-process psychobiological model for understanding anxiety and relaxation phenomena. First, there is a need in evaluating the effects of different relaxation treatments to discriminate various dimensions associated with anxiety or relaxation states. In particular, there is a need to differentiate cognitive (or psychic) vs. somatic (or physiological) processes and systems involved in the experience of these phenomena. Second, it is important to conceptualize the specific impact of different relaxation strategies; recognizing that in addition to the generalized relaxation response which they are capable of facilitating, particular techniques are likely to produce specific patterns of changes across the various dimensions of anxiety. Finally, the empirical issue related to an accurate assessment of the various dimensions of anxiety stands out as an important methodolgical concern in treatment evaluation research on the effects of relaxation training strategies. Such research needs to employ multiple physiological and subjective measures in order to assess general relaxation phenomena as well as specific effects associated with various relaxation procedures.

Individual Differences in Relaxation Training

In addition to a need for further specification of the effects of various relaxation training strategies, an important issue to consider in treatment outcome research is the role of individual differences and possible interaction effects with type of treatment (Beutler, 1979; Garfield & Bergin, 1978; Smith, 1978). In the context of this investigation, the issue can be conceptualized in terms of what personality characteristics may render a certain type of relaxation training more effective with certain individuals. A consideration of the role of individual differences may help to clarify many of the conflicting findings and unanswered questions associated with previous research in the area of biofeedback and relaxation training.

Several studies have focused on individual differences in the capacity for attending in relation to the outcome of relaxation training procedures. The capacity for attending has been conceptualized as a personality trait, moderately correlated with hypnotizability, which represents a disposition for having episodes of "total" attention, termed absorption (Roberts, Schuler, Bacon, Zimmerman, & Patterson, 1975; Shor, 1960; Shor, Orne, & O'Connell, 1962; Tellegen & Atkinson, 1974).

Quallo and Sheehan (1979) examined the relationship between absorption capacity and relaxation during EMG biofeedback and no-feedback self-relaxation treatment conditions. They found that subjects who were high on the trait of absorption tended to achieve significantly greater levels of relaxation (in terms of EMG levels) in the self-relax condition than in the biofeedback condition. Conversely, subjects with a limited capacity for absorbed attention perform better with the attentional demand placed on them by the biofeedback procedure. Postexperimental interviews indicated that significantly more high absorption than low absorption subjects reported an interference effect for the feedback condition.

The authors conclude that the interaction between the capacity for absorption and experimental condition may help to explain the conflicting findings in EMG biofeedback research comparing EMG feedback and self-relax conditions. Specifically, they suggest that individual differences in the capacity for absorption, rather than expectation or motivation (Alexander et al., 1977), may be a more critical factor explaining the findings of equivalence between biofeedback and no-feedback conditions.

In the area of meditation research, the capacity for attending has been examined both as a subject variable and as an outcome measure. Two correlational studies present conflicting findings regarding the effects of meditation on absorption. Davidson, Goleman, and Schwartz (1976) compared short- and long-term meditators with controls and found that the practice of meditation was associated with increases in absorption and decreases in trait anxiety. However, Spanos, Steggles, Radtke-Podorik, and Rivers (1979) found no differences between non-meditators and experienced TM meditators on the same measure of absorption (Tellegen Absorption Scale).

Approaching the attention factor from a different theoretical perspective, Di Nardo and Raymond (1979) hypothesized that since meditation involves control over attentional processes, individual differences in meditation may be mediated by individual differences in attention styles. They suggested that Rotter's (1966) locus of control construct may be useful in predicting the influence of attentional styles in meditation, since previous research (Lefcourt, 1976) had indicated that internals are usually more attentive than externals during various tasks. In a meditation task involving focused attention, they found that internals reported significantly fewer intruding thoughts, thus maintaining greater attention. This supports the hypothesis of Weiner (1972) that a subject variable tapping differences in attention may significantly affect meditation outcome. However, a recent study by Goldman et al. (1979) found no effect of locus of control on meditation outcome.

Other studies have investigated the role of differences in locus of control on outcome of EMG biofeedback-mediated relaxation training. Bunce (1977) investigated the predictive value of locus of control on the effects of EMG biofeedback vs. progressive relaxation training with a chronically anxious outpatient population. Both treatments were found to be effective in reducing anxiety in comparison to attention-placebo and no-treatment controls, but internal locus of control did not predict greater reduction in anxiety in the biofeedback condition as hypothesized. Modell (1977) also found no significant relationship between locus of control and reduction of muscle activity in EMG training.

More promising findings have been reported in several studies which examined initial levels of anxiety as a subject variable affecting treatment outcome. Haynes et al. (1975) found that subjects whose initial scores on the Taylor Manifest Anxiety Scale (1953) were high demonstrated higher resting EMG levels and were unable to achieve EMG levels as low as that of subjects with initially low Taylor scores.

Smith (1978) found that initial level of trait anxiety showed a significant positive relationship to TM meditation outcome, measured as reduction in trait anxiety.

A recent study by Weinberger, Schwartz and Davidson (1979) provides clarifying data relevant to the use of self-report anxiety measures as predictors of responsiveness to relaxation training procedures. The authors observe that a long-standing problem in research on stress-related disorders has been that individual's reports on trait anxiety scales are often inconsistent with relevant behavioral and physiological indices (Hodges, 1976; Levitt, 1967). They suggest that one source of these discrepancies may lie in inaccurate self-perceptions of anxiety level due to an underlying repressive coping style.

Their study investigated the distinction between (a) truly low-anxious subjects, who report low trait anxiety on the Taylor Manifest Anxiety Scale (1953) and low defensiveness on the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960), and (b) repressors, who report low anxiety but high defensiveness. These two groups were compared with a moderately high anxiety group on heart rate, spontaneous skin resistance responses and forehead muscle tension as well as three behavioral measures (reaction time, content avoidance, and verbal interference) during a "stressful" phrase association task. Significant differences in the three physiological measures as well as the behavioral ones all indicated that the repressors were more stressed than the truly low-anxious subjects despite their claims of lower trait anxiety. The high-anxious subjects manifested a third pattern characterized by an intermediate level of stressful responding and generally lacking the repressors' defensiveness.

Of particular importance was the finding that both low-anxious and high-anxious subjects manifested significantly lower frontalis EMG levels than the repressors. This suggests that a measure of defensiveness, such as the Marlowe-Crowne, can be useful in discriminating low-anxious vs. repressive personality styles in evaluations of the effects of relaxation training programs.

Another interesting finding of this study was manifested in subject's responses on the Cognitive-Somatic Anxiety Questionnaire (Schwartz et al., 1978). As predicted, repressors reported that they usually do not experience as much cognitive anxiety as somatic anxiety, while no similar dissociation occurred in the respective self-reports of the high-anxious or low-anxious subjects. In addition, the repressors reported significantly less cognitive anxiety than the low-anxious subjects, while reporting a similar amount of somatic anxiety.

Other studies have examined a variety of personality characteristics associated with biofeedback and other relaxation training procedures. Consistent with the above studies which found initial trait anxiety related to outcome, Page and Schaub (1978) found a combined treatment of EMG biofeedback and progressive relaxation training to be more effective in lowering EMG levels with a group of highly tense and anxious alcoholics, as determined by MMPI profiles. The authors compared this group to a heterogeneous sample of personality types from the same alcoholic population. They concluded that while relaxation-biofeedback procedures may be useful for many types of patients, it can be an especially effective technique when administered to a patient population which is experiencing a specific problem with tension and anxiety.

However, one qualification in their study was the finding that in spite of the interaction between personality type (MMPI-Highly anxious) and success in reducing EMG level, there was no difference between groups of personality types on self-reported mood as measured by the Profile of Mood States (McNair, Lorr, & Droppleman, 1971). This highlights the importance of examining individual differences in relation to multiple outcome measures which differentially assess various components or factors associated with the experience of anxiety and/or relaxation.

Pardine and Napoli (1977) found that exhibition, succorance, deference and aggression on the Edwards Personal Preference Schedule were reliable predictors of success in heart-rate biofeedback training with a group of male college students. With a similar population Cooley (1978) found that subjects who were higher in personality integration (according to Seemans, 1959) were more successful in increasing peripheral skin temperature as a result of feedback training than subjects who were lower in personality integration.

Several studies have examined personality correlates of positive responsiveness to meditation training. Maupin (1965) found that individuals having greater capacity for regression in the service of the ego and tolerance for unrealistic experience (as measured by Rorschach responses) responded more favorably to a Zen meditation exercise. Akers, Tucker, Roth, and Vidiloff (1977) found higher scores on the MMPI Hypochondriasis scale to be associated with increased alpha (EEG) during a Christian meditation experience. Smith (1978) found Sizothymia and Autia on the 16 Personality Factor Questionnaire (Catell, Eber, & Tatsuoka, 1970) to be positively correlated with TM meditation outcome, measured as reductions in trait anxiety.

Toward a model for understanding individual differences in relaxation training. Borkovec (1976) presents an integrative descriptive model of anxiety process which has focused on the role of physiological arousal, cognitive processes, their interaction, and the importance of individual differences in those variables as they affect the maintenance and the reduction of anxiety. Citing the work of major researchers in anxiety (Spielberger, 1966; Land, 1968; Paul, 1969), Borkovec offers an operational definition of anxiety consisting of the multiple measurement of three general response components: cognitive, overt behavioral, and physiological. These general components are presented as gross categories which may contain several subsets of response measures potentially reflecting several responses within a given category.

Beyond the importance of clarifying the anxiety construct, Borkovec suggests that a critical factor in this conceptualization is the realization that anxiety may involve any one or all three of these general response components, precisely in a separate but interacting manner. Cognitive behavior, motor behavior, and physiological reactions may be separately influenced by different environmental conditions at different points in time and may follow different learning principles.

Most important in the context of individual differences is that individuals differ in terms of the learning history associated with each response component, resulting in individual differences in the intensity and/or the functional importance of the response from each component in reaction to an anxiety arousing stimulus. Some individuals, for example, will report intense distress (cognitive) and display rapid avoidance (overt behavioral) when confronted with an anxiety provoking situation, but show no evidence of increases in physiological arousal. Others may show such autonomic increases but differ in the degree to which they are aware of the arousal, the degree of avoidance behavior, or the level of reported distress. According to Borkovec, the separateness of the response components associated with anxiety allows for such important individual differences in anxiety-response patterns, and he suggests that the interaction of these differences can account for the development, maintenance, and reduction of anxiety over time.

Summarizing the implications of a series of research studies employing behavior therapy and self-control procedures, Borkovec (1976) arrives at several conclusions related to his model which are relevant for the present investigation. First, to the extent that the immediate anxiety experience involves a weak physiological component, simple manipulations of the cognitive and behavioral components of anxiety, such as by demand or suggestion, are likely to be effective in changing those components. In contrast, to the extent that the immediate anxiety experience involves a strong physiological component, such interventions are not likely to be effective in themselves or until after the autonomic component is reduced. Thus, individual differences in the physiological response component of anxiety can account for many of the conflicting biofeedback research findings, particularly when comparing results from studies with normal vs. clinical populations, studies comparing false vs. accurate feedback, and studies examining the effects of demand/expectancy factors.

Second, in addition to individual variation in the actual physiological anxiety response component, there are important individual differences associated with the perception of physiological arousal, specifically, in the awareness of autonomic cues associated with the experience of anxiety. Preliminary research by Borkovec (1976) suggests that those who are high perceivers (of physiological arousal) tend to manifest increased arousal when instructed to attend to physiological cues under stressful conditions. This difference in awareness may account for much of the discrepancy between physiological and self-report measures in relaxation training outcome studies. Furthermore, this perceptual difference, which Borkovec suggests is associated with cognitive style, may help to account for individual differences in responding to biofeedback mediated relaxation procedures.

To summarize this discussion on the role of individual difference variables in relation to treatment outcome, previous research has indicated that differences in initial level of anxiety, capacity for absorbing, self-altering experiences, social desirability response bias, degree of autonomic awareness, and various personality traits have been found to be related to relaxation training outcome. In addition, several authors (Borkovec, 1976; Davidson & Schwartz, 1976) have related the issue of individual differences to the issue of assessing differential components or response dimensions of anxiety.

Borkovec (1976) has suggested that individual variation in the physiological response component of anxiety, as well as in the perception or awareness of such anxiety, can explain manifested individual variations in the maintenance and/or reduction of anxiety over time. In a similar vein, the multi-process model of Davidson and Schwartz (1976) discussed previously, also suggests that cognitive vs. somatic components of anxiety can be understood as antecedent intra-subject variables which may interact with dependent variables measuring these components. For example, if somatically anxious individuals were given a treatment which facilitated somatic relaxation, a treatment effect is likely to be found with a dependent measure sensitive to somatic rather than cognitive changes. Alternatively, if the same high somatic anxiety treatment group and somatically oriented treatment were employed, but a cognitive measure was used as the dependent variable, one would not expect this measure to be as sensitive to the changes in somatic relaxation as a somatic measure.

Such conceptualizations, which relate individual difference factors to treatment outcome effects associated with different response components of anxiety, not only help to explain many of the conflicting findings in previous research on EMG biofeedback and other relaxation strategies, but also provide a more comprehensive and adequate theoretical foundation for designing future research.

Hypotheses

The present study was designed to compare the effectiveness of four different relaxation treatments administered to a clinical population seeking treatment for anxiety or tension. Specifically, it compared the following treatment conditions: EMG feedback alone, EMG feedback with taped music, EMG feedback with taped progressive relaxation exercises, EMG feedback with a taped Zen meditation exercise, and a waiting list control. To assess treatment effectiveness, self-report, physiological, cognitive, and somatic measures of anxiety, and mood state profiles were used.

The following hypotheses were put forth in relation to the present investigation:

1. All active treatment groups will manifest significant improvement on self-report and physiological measures

of anxiety and relaxation in comparison to a waiting list control group.

2. The EMG-meditation treatment group will manifest significantly greater improvement on subjective cognitive measures of anxiety than the other active treatment groups.

3. The EMG-progressive relaxation treatment group will manifest significantly greater improvement on subjective somatic measures of anxiety than the other active treatment groups.

4. The EMG-meditation and EMG-progressive relaxation treatments will manifest significantly greater improvement on self-report and physiological measures of anxiety and relaxation than the EMG-alone and EMG-music treatments.

In conjunction with this comparative treatment evaluation, this study also explored the relationship of individual difference factors to treatment outcome across several types of variables: Basic personality style, pathological personality syndromes, clinical symptomatology, stress reactivity, capacity for absorption, and initial levels of various dimensions of anxiety and other mood states. In addition, the relationship of several nonspecific treatment variables to treatment outcome were examined, including the following: Patient expectancy of benefit from treatment, patient need for approval (in terms of social desirability), experimenter influence, treatment rationale credibility, and patient compliance with home practice prescribed with treatment.

CHAPTER III

METHOD

Subjects

Subjects were male and female college students between the ages of 19 and 55 who contacted the Loyola Counseling Center in response to an announcement of a biofeedback training program for anxiety and stress management. Approximately one-half the subjects were undergraduates, mostly nursing students, and one-half were graduate students, primarily in religious studies. All subjects were treated during the second semester of the academic year, except the graduate religious studies students, who were treated during the six-week summer session.

All students who applied for the program were served by the Center; however, the following criteria were used to screen participants for inclusion in the treatment evaluation research: 1) they presented no signs of a thought disorder as determined by initial clinical screening, and 2) they were not taking any medication for anxiety or tension relief.

There were 75 qualified students who agreed to participate in the treatment evaluation research and signed a consent form approved by the University research review board. Of these students, eight were concurrently receiving psychotherapy. These 75 subjects were randomly assigned in equal numbers to the following treatment groups: EMG-alone, EMG-music, EMG-progressive relaxation, EMG-meditation, or No-treatment control. The eight students receiving psychotherapy were evenly distributed across treatment groups. In all, 58 subjects completed the treatment program and were included in the final analysis. Each group contained 12 subjects, with the exception of the EMG-progressive relaxation group which contained 13 subjects, and the No-treatment control group with nine. Of the 17 subjects who were not included in the evaluation, 16 failed to complete the program (two each from the EMG-alone and EMG-meditation groups, three each from the EMG-progressive relaxation and No-treatment control groups, and six from the EMG-music group). One subject who completed treatment was excluded because of equipment difficulties during the assessment sessions.

Materials

A J&J portable electromyograph unit, Model M-55, with an accompanying digital integrating scorekeeper, Model LSG-150, was utilized to assess average frontalis EMG levels during the pre- and post-treatment evaluation sessions. Three silver/silver chloride electrodes, two positive and one ground, were filled with standard electrode gel and attached to the forehead with J&J electrode discs. Prior to attachment, the skin was cleaned with alcohol and slightly abraded. Pulse rate was taken with the aid of a hand-held stopwatch. During treatment sessions, two Biodyne portable electromyograph units with auditory feedback were used in training subjects to decrease frontalis muscle tension.

The following inventories were used: Millon Clinical Multiaxial Inventory (MCMI; Millon, 1976); the Absorption and Stress Reaction scales of the Differential Personality Questionnaire (DPQ, A and SR scales; Tellegen, 1978); Taylor Manifest Anxiety Scale (TMAS; Taylor, 1953): State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970); Marlowe-Crowne Social Desirability Scale (M-C; Crowne & Marlowe, 1964); and the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971).

The MCMI is a broad based clinical inventory designed for use as a diagnostic instrument with clinical populations. The inventory consists of 20 clinical scales which are organized into three broad categories to reflect distinctions between persistent personality features, levels of pathological severity, and current symptom states. The clinical characteristics of each scale were derived from theory-based formulations of personality types and symptom syndromes, as well as diagnostic criteria used in the DSM-III. Although they are not factorially pure, each scale is sufficiently distinct to be associated with significant clinical criteria.

Scales 1 through 8 assess basic personality styles, which are conceptualized as reflecting relatively enduring and pervasive traits that typify patient styles of behaving, perceiving, thinking, feeling and relating to others. These scales are designated as follows: Passive-detached (Asocial), Active-detached (Avoidant), Passive-dependent (Submissive), Active-dependent (Gregarious), Passive-independent (Narcissistic), Active-independent (Aggressive), Passive-ambivalent (Conforming), and Active-ambivalent (Negativistic).

The next three scales assess pathological personality syndromes, which are understood as describing patients who clearly evidence a chronic or periodically severe pathology in the overall structure of personality. These scales are designated as follows: Schizoid-Schizophrenic (S), Cycloid-Cyclophrenic (C), and Paranoid-Paraphrenic (P).

The final nine scales assess symptom disorders of the reactive kind, and of relatively brief duration. These scales include the following: Anxiety (A), Hysterical (H), Hypomanic (N), Neurotic Depression(D), Alcohol Misuse (B), Drug Misuse (T), Psychotic Thinking (SS), Psychotic Depression (CC), and Psychotic Delusions (PP).

The MCMI has been validated across several groups of non-clinical subjects and numerous samples of clinical patients currently involved in psychological assessment or psychotherapy. Raw scores on the MMCI scales have been transformed into base rate scores on the basis of known personality and syndrome prevalence data obtained from two large-scale validation studies.

The Differential Personality Questionnaire was designed to assess a number of distinct and major or "focal" personality dimensions or traits. Data from over 3,000 subjects was collected and factor analyzed in several stages to yield core discriminant dimensions of personality. The inventory consists of 11 substantive scales, two of which were used in this study--the Stress Reaction scale and the Absorption scale. The Stress Reaction scale is strongly related to Eysenck's Neuroticism factor, although the item content of this scale seems to identify it more unequivocally as a measure of a stress reaction syndrome. Low scores on this scale are interpreted as describing individuals who are not easily upset or disturbed, while high scores are associated with individuals who are nervous, tense, and prone to worry. The Absorption scale assesses a personality trait related to hypnotic susceptibility, conceptualized primarily as a capacity for episodes of absorbed and "self-altering" attention that are sustained by imaginative representations. The internal consistency coefficient of the Stress Reaction scale has been evaluated at .90; that of the Absorption scale at .89; and both have test-retest reliability coefficients (one week) of at least .90.

The Taylor Manifest Anxiety Scale is a widely used research measure of anxiety developed from MMPI (Minnesota Multiphasic Personality Inventory) items judged by clinicians to be indicative of manifest anxiety. Originally designed as an instrument for selecting subjects for experiments in human motivation, it has been validated in a comparison of college students vs. in- and outpatient psychiatric populations. The inventory has a test-retest reliability coefficient of .88 over a four-week period.

The State-Trait Anxiety Inventory is comprised of separate self-report scales for measuring two distinct anxiety concepts: state anxiety (A-State) and trait anxiety (A-Trait). Although originally developed as a research instrument for investigating anxiety phenomena in "normal" (non-psychiatrically disturbed) adults, the STAI has also been found to be useful in the measurement of anxiety in student populations, and in neuropsychiatric, medical, and surgical populations.

The A-Trait scale has been used as a research device for selecting subjects who vary in their disposition to respond to psychological stress, as well as a clinical screening instrument to identify anxiety-prone individuals. The A-State scale is a sensitive indicator of the level of transitory anxiety experienced by clients receiving various types of psychological treatment. It has been demonstrated that scores on the A-State scale increase in response to various kinds of stress and decrease as a result of relaxation training.

The STAI has been validated on sizeable populations of high school and college students, and neuropsychiatric and medical patients. Test-retest correlations for the A-Trait scale range from .73 to .86 over a three-month period, while correlations for the A-State scale are low (.16 to .54), as would be expected. Internal consistency coefficients for both A-Trait and A-State scales range from .83 to

.92.

The Marlowe-Crowne Social Desirability Scale was designed to measure individual differences in social desirability response bias which may affect subject's performance on self-report inventories. Specifically, this construct is understood as reflecting a need for approval and, therefore, a tendency to present oneself in a more favorable manner in test-taking situations. This scale was developed from various personality inventory items carefully selected and rated as socially desirable or socially undesirable. It has been validated on college student populations and across various clinical populations. The authors report test-retest (one month interval) and internal consistency coefficients of .88.

The Profile of Mood States is a factor analytically derived inventory which was developed to assess transient, fluctuating affective states. Specifically, it consists of six scales which measure identifiable mood or affective states: Tension-Anxiety (T); Depression-Dejection (D); Anger-Hostility (A); Vigor-Activity (V); Fatigue-Inertia (F); and Confusion-Bewilderment (C). The POMS has been validated through six factor analytic replications, and in several studies across various normal and clinical populations which demonstrate its predictive and construct validity. The authors report test-retest reliability coefficients (three week interval) ranging from .66 to .74 for the six scales; and internal consistency coefficients ranging from .84 to .94.

Additional instruments included the Self-Report Form (SRF; Holmes, Note 2), an inventory with separate scales to assess cognitive anxiety, physiological (somatic) anxiety, and resting (non-arousal) level; an Expectancy and Credibility questionnaire; a Semantic Differential scale used to evaluate individual training sessions; a Treatment Evaluation Questionnaire; a home practice instruction form; a home practice monitoring form; and a subject consent form. With the exception of the Self-Report Form, the above instruments were specifically constructed for use in this study. (Copies of these instruments are contained in Appendix A.)

Procedure

Subjects in the four treatment groups attended a total of nine sessions. The nature and order of these sessions was as follows: a) Pretraining Physiological Assessment Session, b) Pretraining Self-Report Assessment Session, c) Training Sessions, and d) Posttraining Assessment Session. The pre- and posttraining assessments followed standardized procedures and were conducted by the author, who was a trained clinician on the staff of the Counseling Center, and two trained graduate students in clinical psychology. Subjects were assigned to experimenters on the basis of availability, and once assigned each subject was pre- and posttested by the same experimenter. The author administered the training program to all subjects.

Pretraining physiological assessment session. This session was designed to measure subject's baseline muscle tension level and pulse rate prior to training. The procedure for this session was as follows: Subjects were given a brief introduction to the EMG recording equipment and explanation of the assessment procedures. Following this orientation, they were instructed to relax comfortably in a recliner chair while the experimenter took their pulse rate by hand, using a stopwatch and recording for one minute. Next, subject's foreheads were cleansed with alcohol and three elctrodes for monitoring muscle tension were attached. Once it had been determined that the EMG equipment was working properly, subjects were instructed to recline in the chair, close their eyes, and relax as deeply as possible. The lights were dimmed while the experimenter recorded EMG level over a 30-minute period by means of the digital integrating scorekeeper, which averaged and recorded muscle activity over 2-minute intervals. At the end of the 30 minutes subject's pulse rates were again taken, and they were instructed to return to the Counseling Center within the next two days to complete a battery of self-report inventories to be used in the treatment evaluation.

Pretraining self-report assessment session. Within two days of their physiological assessment, subjects were given a battery of self-report inventories which included instruments for determining pretreatment levels on anxiety and relaxation measures used in the treatment evaluation, as well as instruments for exploring the effect of individual difference variables on treatment outcome. This pretest battery included the following inventories: MCMI, DPQ (SR and A scales), TMAS, STAI, POMS, SRF, and M-C (see above, Materials section). In addition subjects completed a brief demographic data sheet. Upon completion of these inventories, subjects in the treatment groups were scheduled for their first training session within the next week.

Training sessions. Each treatment subject attended six training sessions which were administered on a once-a-week basis, with some variability due to scheduling factors. All subjects completed their six training sessions within a six- to eight-week period. In addition, all treatment subjects were required to practice their relaxation at home once a day for 15 to 20 minutes and keep a written record of this practice which they submitted to the therapist each week. The basic procedure and structure of the training sessions were the same for subjects in all four treatment groups.

The first session lasted approximately 50 minutes and consisted of an orientation to the training program, a 30-minute training period, an explanation of home practice procedures, and a subjective evaluation of the training session. As part of their orientation, each subject listened to a taped message which explained the general nature of EMG biofeedback as a relaxation training technique, emphasized that this type of training involved learning skills in self-regulation, and introduced the treatment procedure to which that subject was assigned. These taped introductory messages were designed to foster high treatment rationale credibility and subject's expectancy of success for all four treatment conditions. Following the taped introduction, all subjects completed a Credibility and Expectancy Questionnaire in order to evaluate potential differences between treatment groups on these factors, as well as their relationship to treatment outcome.

These orientation procedures were followed by a 30-minute relaxation training period during which subjects were connected to an EMG unit, as in the pretraining assessment, but with the addition of an auditory feedback signal which became higher in pitch and louder as muscle tension increased and lower in pitch and softer as it decreased. Additional relaxation-inducing procedures were employed in three of the four treatment groups (see below). Following this first training period subjects were given general written instructions related to the home practice of their learned relaxation skills and the importance of regular practice was emphasized. In addition, specific instructions for home practice were given which varied according to treatment group (see below, description of treatment groups). Finally, subjects completed a Semantic Differential scale, which provided a subjective evaluation of the training session; and the Self-Report Form, which assessed their immediate experience of anxiety and relaxation.

Subsequent training sessions were essentially the same with the exception that the period before beginning their training was devoted to discussing subject's progress in home practice. In addition, prior to the third through the sixth training sessions, subjects completed the POMS as a measure of ongoing mood changes over the course of treatment.

The actual 30-minute training period and home practice instructions varied as follows according to the subject's treatment group:

1. EMG-alone. During the training sessions subjects received EMG feedback about the level of muscle tension in their forehead (frontalis muscles). They were instructed to use the information from the feedback to try to reduce their level of muscle tension. They were not given specific instructions in any additional techniques to relax themselves, but were instructed to use whatever strategy or technique they wished in attempting to achieve a state of overall relaxation during the training sessions and in their daily home practice.

2. EMG-music. In addition to receiving the same EMG feedback as in treatment #1, subjects in this group listened to a tape of relaxing music of their choice during their daily home practice. Although not commonly used as a clinical procedure, music can have a relaxing effect. Moreover, this treatment condition controlled for the effect of listening to taped instructions while utilizing the EMG feedback, as in treatments #3 and #4.

3. EMG-progressive relaxation. In addition to receiving the same EMG feedback as above, subjects in this group listened to two tapes (one during the first three training sessions, the second

during the last three training sessions) which provided instructions for systematic progressive relaxation of various muscle groups throughout their body. These tapes were from the Budzynski Relaxation Training Series, #1 and #5, (Budzynski, 1974). Subjects were instructed to use the progressive relaxation exercises to assist them in achieving a state of overall relaxation, while utilizing the EMG feedback to lower their muscle tension. They were also instructed to use these exercises in their daily home practice.

4. EMG-meditation. In addition to receiving the same EMG feedback as above, subjects in this group listened to two tapes (for three sessions each) providing instructions in two forms of a Zen breathing meditation exercise (Shapiro & Zifferblatt, 1976) designed to facilitate mental and physical relaxation. Subjects were instructed to use the meditation exercises to assist them in achieving a state of overall relaxation, while utilizing the EMG feedback to lower their muscle tension. They were also instructed to use the meditation exercises in their daily home practice.

Posttraining assessment Session. This final session essentially combined the physiological assessment and the assessment by self-report inventories administered in the two pretraining sessions. The physiological assessment included the same procedures for evaluating pulse rate and muscle tension level used in the pretraining assessment. Immediately after the physiological assessment, subjects were administered a battery of the same self-report inventories previously given for the purpose of evaluating treatment effects. This battery included the following inventories: TMAS, STAI, POMS, and SRF. In addition subjects completed a Treatment Evaluation Questionnaire designed to assess the following: Degree to which the training program fulfilled their expectations; any specific physical, emotional or mental benefits they experienced; and any particular areas of their lives where they benefited (e.g., school, work, home, socially). Following completion of the evaluation materials, subjects were given feedback on their EMG performance, and the ongoing benefits of practicing their learned relaxation skills was discussed. Finally, subjects were invited to return for a follow-up session to receive feedback on the personality testing instruments used to study individual differences in treatment.

No-treatment control group. This group was essentially a waiting list control. Subjects in this group attended pretraining physiological and self-report assessment sessions idential to that of treatment subjects. Following completion of the self-report inventories, these subjects were informed that they were on a waiting list to receive treatment, that there would be a wiat of several weeks, and that they would be contacted as soon as possible to begin their treatment. Following a waiting period of five to six weeks, they attended an additional assessment session that was identical to the posttraining assessment session of the treatment subjects, with the exception that they were not asked to complete the Treatment Evaluation Questionnaire. After this session, they were then offered either the EMG-progressive relaxation or EMG-meditation treatments on the basis of clinical judgment.

CHAPTER IV

RESULTS

The four hypotheses put forth in this study were tested with an analysis of covariance procedure which used multiple regression with "dummy" variables (Nie, Hull, Jenkins, Steinbrunner, & Bent, 1975). Each hypothesis was treated as a dummy variable, a procedure which involved coding the treatment groups to evaluate the planned contrast associated with each hypothesis. Four dummy variables, corresponding to the four hypotheses, were created in this fashion and entered into a multiple regression equation for each of the thirteen treatment outcome measures used in this study. The pretest for each of the outcome measures was used as a covariate. Means and standard deviations and results of the analyses of covariance are contained in Tables 2 and 3, respectively.

Overall Treatment Effects

Since it was hypothesized (Hypothesis 1) that all four treatment groups (EMG-alone; EMG-music; EMG-progressive relaxation; EMG-meditation) would manifest significant improvement on physiological and self-report measures of anxiety and relaxation in comparison to a waiting-list control group, an analysis of covariance (as described above) comparing the four treatment groups to the control group was done for each of the thirteen treatment outcome measures (see Tables 2 and 3).

Table 2

Means and Standard Deviations on All Outcome Measures for All Treatment Groups

Treatment Outcome Measures	Groups		EMG-Alone (n=12) M	SD	EMG-Music (n=12) M	SD	EMG-Progressive Relaxation (n=13) M	SD	EMG-Meditation (n=12) M	SD	Control (n=9) M	SD
EMG		pre	2.48	0.85	2.71	0.90	2.94	1.38	3.26	1.73	2.49	0.68
		post	2.09	0.76	1.87	0.53	2.05	0.85	1.96	0.83	2.58	0.59
TMAS		pre	16.67	9.17	16.42	6.93	18.00	12.06	15.33	10.08	13.22	5.17
		post	15.83	8.05	15.67	4.70	14.69	8.26	14.67	9.75	14.22	6.57
STAI	A-State	pre	32.83	6.79	38.42	7.32	38.00	13.69	34.92	11.74	28.78	5.63
		post	30.17	9.81	32.83	13.50	25.92	7.08	30.50	8.89	30.89	10.61
	S-Trait	pre	40.42	11.61	41.17	6;24	42.33	13.28	35.42	7.97	33.89	3.52
		post	37.92	8.91	38.67	3.85	36.92	8.16	35.25	9.27	36.33	6.30
POMS	Tension	pre	12.25	6.72	11.67	4.46	13.69	8.12	13.25	8.93	6.44	3.61
		post	9.83	4.73	9.83	4.95	8.69	5.65	7.17	5.04	11.00	6.24
	Depression	pre	8.17	7.33	8.67	8.18	14.00	15.14	9.75	12.54	5.78	3.53
		post	8.25	11.13	7.83	5.80	4.77	4 82	5.33	6.31	5.33	4.72
	Anger	pre	10.08	8.72	6.00	5.26	10.62	8.27	4.75	5.51	3.89	3.06
		post	6.33	7.73	7.42	6.07	7.08	10.47	5.50	4.72	6.11	5.64
	Vigor	pre	18.33	5.00	17.33	3.94	20.00	6.10	17.42	8.13	22.33	4.58
		post	17.50	5.62	19.17	3.27	22.38	5.20	19.50	6.74	19.33	6.38
	Fatigue	pre	7.92	5.71	10.08	5.37	10.54	6.51	10.00	8.78	5.44	3.47
		post	7.00	5.83	9.17	6.49	7.00	7.34	6.17	5.34	8.78	2.99
	Confusion	pre	7.00	3.81	7.50	5.18	8.54	5.27	6.25	4.54	3.67	2.00
		post	6.00	3.25	6.25	3.65	4.31	2.66	4.42	3.03	5.33	3.16
SRF	Somatic	pre	10.00	3.33	4.00	2.83	10.38	3.31	11.42	6.32	9.22	1.39
	Anxiety	post	9.25	3.91	9.92	2.43	8.46	2.26	8.58	1.56	11.22	4.32
	Cognitive	pre	7.67	1.30	9.50	3.42	11.69	5.84	10.08	5.62	7.00	1.50
	Anxiety	post	8.17	3.66	8.08	2.81	6.54	1.20	7.58	2.50	8.33	3.00
	Resting	pre	31.00	4.45	28.33	3.73	27.85	7.10	27.67	8.38	32.56	4.28
	(nonarousal)	post	32.92	6.50	30.42	5.09	35.77	5.46	32.67	6.40	28.33	11.10

EMG = Electromyograph level (30 minute average)
TMAS = Taylor Manifest Anxiety Scale
STAI = State-Trait Anxiety Inventory
POMS = Profile of Mood States
SRF = Self Report Form

Table 3

Multiple Regression Analyses of Covariance for the Effects of Treatment on 13 Anxiety, Relaxation, and Mood Outcome Measures with Pretest Covaried

Hypotheses Tested		Analyses of Covariance: All Treatments vs. Control		EMG-Meditation vs. Other Treatments		EMG-Progressive Relaxation vs. Other Treatments		EMG-Progressive Relaxation and EMG-Meditation vs. EMG-Alone and EMG-Music	
Treatment Outcome Measures		$F(1,55)$	p	$F(1,55)$	p	$F(1,55)$	p	$F(1,55)$	p
EMG		9.79	<.01	0.87	ns	0.62	ns	1.18	ns
TMAS		0.45	ns	0.06	ns	0.75	ns	1.42	ns
STAI	A-State	0.86	ns	0.18	ns	2.06	ns	3.61	<.10
	A-Trait	1.86	ns	0.17	ns	1.20	ns	1.53	ns
POMS	Tension	7.29	<.01	2.42	ns	0.56	ns	3.99	<.06
	Depression	0.00	ns	0.42	ns	0.54	ns	5.10	<.05
	Anger	0.17	ns	0.00	ns	0.05	ns	0.10	ns
	Vigor	1.23	ns	0.02	ns	0.78	ns	3.27	<.10
	Fatigue	1.83	ns	0.78	ns	0.09	ns	1.29	ns
	Confusion	1.83	ns	0.42	ns	0.70	ns	5.82	<.02
SRF	Somatic Anxiety	5.49	<.02	0.58	ns	0.01	ns	1.35	ns
	Cognitive Anxiety	1.99	ns	0.00	ns	1.84	ns	6.15	<.02
	Resting (nonarousal)	6.61	<.02	0.00	ns	1.35	ns	4.67	<.05

N = 58

EMG = Electromyograph level (30 minute average)
TMAS = Taylor Manifest Anxiety Scale
STAI = State-Trait Anxiety Inventory
POMS = Profile of Mood States
SRF = Self-Report Form

The four treatment groups manifested significantly lower EMG levels after treatment than the control group, F (1,55) = 9.79, $p < .01$; lower scores on the POMS Tension scale, F (1,55) = 7.29, $p < .01$; lower scores on the SRF Somatic Anxiety scale, F (1,55) = 5.49, $p < .02$; and higher scores on the SRF Resting scale, F (1,55) = 6.14, $p < .02$. Since the POMS Tension scale primarily assesses the somatic dimension of anxiety and the SRF Resting scale is a general index of low arousal, these results across physiological (EMG) and self-report measures indicate that the main effect of all four treatments was to reduce somatic anxiety and foster a subjective state of low arousal.

Treatment groups vs. control group did not significantly differ on the other nine outcome measures when assessed independently. However, an additional overall evaluation of the combined effects of treatment which utilized all 13 outcome measures was done as follows. The four treatment groups and control group were rank ordered according to their mean scores on each of the thirteen dependent measures, with rank 1 assigned to the lowest scores on the anxiety measures. Ranks on the positively valenced outcome measures, the SRF Resting scale and the POMS Vigor scale, were reverse scored. The control group ranked lowest on 10 of the 13 outcome measures. The probability of this occurring was analyzed with a modified binomial test, $Z = 5.14$, $p < .001$, which indicated a significant positive effect of treatment across combined physiological and self-report measures of anxiety. Moreover, the three measures on which the control group did not rank lowest were not anxiety measures (POMS Depression, Anger and Vigor scales), and it did rank last on all nine anxiety measures.

These results, which indicate small, consistent effects of treatment across all anxiety and relaxation outcome measures, point toward the general efficacy of EMG biofeedback as a relaxation training procedure, either alone or in conjunction with other relaxation techniques.

Differential Effects of Treatment

Since it was also hypothesized (Hypothesis 4) that the EMG-progressive relaxation and the EMG-meditation groups would manifest significantly greater improvement on physiological and self-report measures of anxiety and relaxation than the EMG-alone and EMG-music groups, an analysis of covariance comparing the former two groups with the latter two groups was done for each of the treatment outcome measures (see Tables 2 and 3).

The EMG-progressive relaxation and EMG-meditation groups manifested significantly lower scores than the EMG-alone and EMG-music groups on the POMS Depression scale, F (1,55) = 5.10, $p < .05$; the POMS Confusion scale, F (1,55) = 5.82, $p < .02$; and the SRF Cognitive Anxiety scale, F (1,55) = 6.15, $p < .02$; and significantly higher scores on the SRF Resting scale, F (1,55) = 4.67, $p < .05$. In addition, there was a strong trend toward lower scores on the POMS Tension scale, F (1,55) = 3.99, $p < .06$; as well as a trend toward lower scores on the STAI A-State scale, F (1,55) = 3.61, $p < .10$; and a trend toward higher scores on the POMS Vigor scale, $F\ (1,55) = 3.27$, $p < .10$.

These results indicate the overall superiority of EMG feedback in conjunction with other specific relaxation techniques (in this case progressive relaxation or meditation) vs. EMG-alone for the purpose of training individuals to reduce anxiety and achieve a relaxed state. The inclusion of the EMG-music group in this comparison provided a control for the additional component involved in the combined treatments, i.e., listening to the taped relaxation exercises. Of further significance is the finding that the EMG-progressive relaxation and EMG-meditation groups performed better on both measures associated with the cognitive dimension of anxiety.

In addition to the overall comparison between EMG-alone and EMG in conjunction with progressive relaxation or meditation, it was further hypothesized that the EMG-meditation group would manifest significantly greater improvement on measures of cognitive anxiety than the other treatment groups (Hypothesis 2), and that the EMG-progressive relaxation group would manifest significantly greater improvement on measures of somatic anxiety than the other treatment groups (Hypothesis 3). These group differences were also evaluated with an analysis of covariance for each of the treatment outcome measures (see Tables 2 and 3). No significant differences were found, thus, the hypotheses concerning differential effects of the two combined procedures were not supported.

An examination of treatment group means for each of the outcome measures indicated that the EMG-progressive relaxation group performed best on eight of the 13 measures. Using a rank-order procedure (as in the overall comparison of treatment groups vs. control described above) the probability of this occurring was analyzed with a modified binomial test, $Z = 3.04$, $p < .01$. These results, which indicated consistent small favorable effects across outcome measures, suggested that the EMG-progressive relaxation treatment was the most effective procedure in terms of overall clinical improvement.

Individual Differences in Treatment

The relationship of several individual difference variables to posttreatment levels on outcome measures was examined with Pearson r correlations (see Tables 4 and 5). These variables included basic personality style, pathological personality syndromes, and symptom disorders from the MCMI; reactivity to stress and capacity for absorption from the DPQ; and pretreatment levels of the following: average resting EMG; manifest anxiety (TMAS); state and trait anxiety (STAI); various mood states (POMS); somatic and cognitive anxiety, and resting (nonarousal) level (SRF).

An examination of the correlation matrices generated by these analyses indicated many significant relationships. In order to clarify and further understand these relationships, an intercorrelational analysis using the Pearson r was done for all the individual difference measures (see Appendix B).

Table 4

Correlation Matrix for Basic Personality Style, Pathological Personality Syndromes, Symptom Disorders, Stress Reactivity, and Absorption in Relation to Posttreatment Levels on Outcome Measures

Posttreatment Levels on Outcome Measures		Millon Multiaxial Clinical Inventory: Basic Personality Scales 1	2	3	4	5	6	7	8	Pathological Personality Scales S	C	P	Symptom Disorder Scales A	H	N	D	B	T	SS	CC	PP	Differential Personality Questionnaire: Stress Reaction (SR) Scale	Absorption (A) Scale
EMG		.27	.38		-.26	-.28										.33			.26			.38	
TMAS		.33	.51	.30	-.30	-.26		-.38	.61	.36	.49		.45	.39		.53	.39		.58	.55	.33	.71	
STAI	A-State																						
	A-Trait	.37	.51	.34	-.35	-.45			.48	.46	.52		.56	.49		.56			.56	.62		.65	
POMS	Tension													.26								.32	
	Depression		.29	.27		-.34	-.28			.34			.30	.29		.31				.30		.38	
	Anger			.39					.26				.31	.40			.29			.30		.38	
	Vigor	-.37	-.40		.37				-.31							-.26			-.47	-.46	-.34	-.41	
	Fatigue		.30	.26																.34		.40	
	Confusion																						
SRF	Somatic Anxiety													.32	.32								.26

N=58
$r \geq .26$, $p < .05$
$r \geq .34$, $p < .01$

EMG = Electromyograph level (30 minute average)
TMAS = Taylor Manifest Anxiety Scale
STAI = State-Trait Anxiety Inventory
POMS = Profile of Mood States
SRF = Self Report Form

Basic Personality Scales

1=Passive-detached
2=Active-detached
3=Passive-dependent
4=Active-dependent
5=Passive-independent
6=Active-independent
7=Passive-ambivalent
8=Active-ambivalent

Pathological Personality Scales

S = Schizoid
C = Cycloid
P = Paranoid

Symptom Disorder Scales

A = Anxiety
H = Hysterical
N = Hypomanic
D = Neurotic Depression
B = Alcohol Misuse
T = Drug Misuse
SS = Psychotic Thinking
CC = Psychotic Depression
PP = Psychotic Delusions

Table 5

Correlation Matrix for Pretreatment Levels of Anxiety, Relaxation, and Mood States in Relation to Posttreatment Levels on Outcome Measures

Posttreatment Levels on Outcome Measures		Pretreatment Levels on Outcome Measures: EMG	TMAS	STAI: A-State	STAI: A-Trait	POMS: T	POMS: D	POMS: A	POMS: V	POMS: F	POMS: C	SRF: Somatic Anxiety	SRF: Cognitive Anxiety	SRF: Resting (Nonarousal)
EMG		.47	.38		.36		.43	.26			.31		.28	
TMAS			.77	.49	.69	.57	.60	.51	-.29	.39	.51	.41	.45	-.41
STAI	A-State		.27	.26		.41	.29					.40		-.32
	A-Trait		.59	.52	.72	.55	.60	.45	-.41	.45	.64	.27	.47	-.48
POMS	Tension		.39	.28	.34	.41	.32				.27			-.26
	Depression		.40	.28	.45	.48	.41			.30	.50	.28	.27	
	Anger		.47	.45	.47	.51	.48	.36		.37	.42		.26	-.29
	Vigor		-.38	-.32		-.29			.45			-.33		.35
	Fatigue		.47	.27	.40	.40	.38	.27		.31	.27			-.33
	Confusion				.31	.34	.27				.45		.27	-.32
SRF	Somatic Anxiety					.27								
	Cognitive Anxiety					.37								
	Resting (nonarousal)					-.32	-.27							

N = 58
$r \geq 26$, $p < .05$
$r \geq 34$, $p < .01$

EMG = Electromyograph level (30 minute average)
TMAS = Taylor Manifest Anxiety Scale
STAI = State-Trait Anxiety Inventory
POMS = Profile of Mood States
SRF = Self Report Form

Examination of intercorrelational patterns suggested that several individual difference measures could be combined to form meaningful cluster variables which might be related to treatment outcome. These pretreatment measures were combined according to the following criteria: (1) consistent patterns of significant correlations with posttreatment levels on outcome measures, (2) high intercorrelations among themselves and (3) theoretical relevance (see Table 6). This procedure of forming cluster variables produced a trait anxiety factor (comprised of scores on the STAI A-Trait scale, the DPQ Stress Reaction scale and the Taylor Manifest Anxiety scale); a depression factor (comprised of scores on the MCMI Neurotic Depression scale and the POMS Depression scale); and a thought disturbance factor (comprised of scores on the MCMI Psychotic Thinking scale, the POMS Confusion scale, and the SRF Cognitive Anxiety scale).

The effect of these individual difference factors on treatment outcome were analyzed with a series of hierarchical analyses of covariance, which controlled for the effects of the different treatments as well as the pretest (see Table 7). Trait anxiety was positively related to posttreatment EMG level, F (1,51)= 14.72. $p < .001$; the Anger scale of the POMS, F (1,51) = 5.71, $p < .05$; and the Fatigue scale of the POMS, F (1,51) = 8.05, $p < .01$. Depression was positively related to posttreatment EMG level, F (1,51) = 13.58, $p < .001$; and negatively related to the Tension scale of the POMS, F (1,51) = 5.42, $p < .05$, and the Confusion scale of the POMS, F (1,51) = 4.26, $p < .05$. Thought disturbance was positively related

Table 6

Correlation Matrix for Trait Anxiety, Depression and Thought Disturbance in Relation to Posttreatment Levels on Outcome Measures

Posttreatment Levels on Outcome Measures	Trait Anxiety			Depression		Thought Disturbance		
	STAI	DPQ	TMAS	MCMI	POMS	MCMI	POMS	SRF
	A-Trait	Stress Reaction		Neurotic Depression	Depression	Psychotic Thinking	Confusion	Cognitive Anxiety
EMG	.36	.38	.38	.33	.43	.26	.31	.28
TMAS	.69	.71	.77	.53	.60	.58	.51	.45
STAI A-State			.27			.29		
A-Trait	.72	.65	.59	.56	.60	.56	.64	.47
POMS Tension	.34	.32	.39		.32		.27	
Depression	.45	.38	.40	.31	.41		.50	.27
Anger	.47	.38	.47		.48		.42	.26
Vigor		-.41	-.38	-.26		-.47		
Fatigue	.40	.40	.47		.38		.27	
Confusion	.31				.27		.45	.27
SRF Resting (nonarousal)					-.27			

N = 58
$r \geq 26$, $p < .05$
$r \geq 34$, $p < .01$

EMG = Electromyograph level (30 minute average)
TMAS = Taylor Manifest Anxiety Scale
STAI = State-Trait Anxiety Inventory
POMS = Profile of Mood States
SRF = Self-Report Form
DPQ = Differential Personality Questionnaire
MCMI = Million Clinical Multiaxial Inventory

Table 7

Analyses of Covariance for the Effects of Trait Anxiety, Depression and Thought Disturbance on Treatment Outcome Measures Controlling for the Effects of Treatment and with Pretest Covaried

	Analyses of Covariance								
	EMG			POMS Anger Scale			POMS Fatigue Scale		
Source	df	MS	F	df	MS	F	df	MS	F
Main-Treatment	4	0.75	2.49	4	7.02	0.16	4	18.9	0.68
Covariates-Pretest	1	8.70	28.92**	1	396.5	9.07**	1	221.5	7.94**
Trait Anxiety	1	4.43	14.72**	1	249.6	5.71*	1	224.6	8.05**
Error	51	0.30		51	43.7		51	27.9	

	EMG			POMS Tension Scale			POMS Confusion Scale		
Source	df	MS	F	df	MS	F	df	MS	F
Main-Treatment	4	0.75	2.46	4	22.9	1.20	4	9.67	1.36
Covariates-Pretest	1	8.70	28.42**	1	412.8	21.63**	1	134.4	18.88**
Depression	1	4.15	13.58**	1	103.4	5.42*	1	30.3	4.26*
Error	51	0.31		51	19.1		51	7.12	

	EMG			STAI A-Trait			POMS Vigor Scale		
Source	df	MS	F	df	MS	F	df	MS	F
Main-Treatment	4	0.75	2.16	4	21.0	0.86	4	39.2	1.85
Covariates-Pretest	1	8.70	25.11**	1	1675.6	68.56**	1	343.1	16.21**
Thought Disturbance	1	2.10	6.07*	1	176.4	7.22**	1	191.9	9.06**
Error	51	0.35		51	24.4		51	21.2	

N+58; *p < .05; ** p < .01

EMG = Electromyograph level (30 Minute average)
POMS = Profile of Mood States
STAI = State-Trait Anxiety Inventory

to posttreatment EMG level, F (1,51) = 6.07, $p < .05$; the Trait Anxiety scale of the STAI, F (1,51) = 7.22, $p < .01$; and negatively related to the Vigor scale of the POMS, F (1,51) = 9.07, $p < .01$.

These results suggested that individuals high in trait anxiety, depression, or thought disturbance were not as successful in reducing EMG level as a result of biofeedback relaxation training. In contrast, the influence of these factors on treatment outcome as assessed by self-report measures was not as clear. Pretreatment levels of trait anxiety and thought disturbance were both negatively associated with improvement due to treatment as reflected by two of the 12 self-report measures. On the other hand, pretreatment level of depression was positively associated with improvement on self-reported tension and confusion.

A further examination of the relationship of specific personality styles, as measured by the eight scales of the MCMI, to pretreatment and posttreatment levels on outcome measures indicated several patterns (see Appendix B and Table 4). The passive-detached (No. 1), the active-detached (No. 2), the passive-dependent (No. 3), and the active-ambivalent (No. 8) scales tended to be positively related to both pretreatment and posttreatment levels on outcome measures. Conversely, the active-dependent (No. 4), the passive-independent (No. 5), the active-independent (No. 6), and the passive-ambivalent (No. 7) scales tended to be negatively related to both pretreatment and posttreatment levels on outcome measures.

This suggested forming two clusters of personality styles: (1) a cluster consisting of scales 1, 2, 3, and 8, which was associated with high anxiety; and (2) a cluster consisting of scales 4, 5, 6, and 7, which was associated with low anxiety. Subjects who received treatment were then classified by personality style according to criteria presented by Millon (1977), which calls for a base rate of 75 as the scale cut-off point. Following these procedures, subjects were assigned to one of three groups: (1) a high anxiety group (Group 1) consisting of those subjects with a base rate greater than 75 on either scales 1, 2, 3, or 8 on the MCMI; (2) a low anxiety group (Group 2) consisting of those subjects with a base rate greater than 75 on either scales 4, 5, 6, or 7 on the MCMI; and (3) a mixed group (Group 3) consisting of those subjects with base rates greater than 75 on scales from both the low anxiety and the high anxiety clusters. Thus, this third group included subjects manifesting personality styles which were not clearly associated with either high or low anxiety. This procedure eliminated 6 of the 49 subjects in treatment who did not meet the cut-off criterion (base rate greater than 75) on any of the eight MCMI basic personality style scales.

In order to test for the independent effects of MCMI type and treatment condition on treatment outcome, a two-way analysis of covariance was done for each of the 13 treatment outcome measures, using the pretest for each measure as a covariate (see Table 8). Significant main effects were found for the effect of MCMI type on

Table 8

Two-Way Analyses of Covariance for the Effects of Treatment and MCMI Personality Type on Treatment Outcome Measures with Pretest Covaried

					Analyses of Covariance						
					Treatment Group Means[a]				MCMI Group Means[a]		
	Source	df	MS	F	I	II	III	IV	1	2	3
EMG	Covariates-EMG	1	8.16	25.70**							
	Main-Treatment	3	0.64	2.01	2.32	2.09	1.94	1.71			
	MCMI	2	1.32	4.16*					2.84	1.97	1.83
	Error	36	0.32								
POMS Anger Scale	Covariates-Anger	1	356.1	6.79**							
	Main-Treatment	3	41.7	0.80	7.43	9.59	5.38	5.05			
	MCMI	2	198.2	3.78*					16.55	5.09	8.22
	Error	36	52.5								
POMS Confusion Scale	Covariates-Confusion	1	93.3	13.11**							
	Main-Treatment	3	21.3	2.99*	6.62	6.64	4.27	4.99			
	MCMI	2	0.66	0.09					4.93	5.40	5.69
	Error	36	7.12								

N = 43
*p < .05
**p < .01

[a]Adjusted for the effects due to the covariate and the other main factor.

Treatment Groups
I = EMG-alone (n=11)
II = EMG-music (n=10)
III = EMG-progressive-relaxation (n=12)
IV = EMG-meditation (n=10)
EMG = Electromyograph (30 minute average)
POMS= Profile of Mood States

Million Clinical Multiaxial Inventory (MCMI) Personality Groups

1=Passive-and Active-detached, Passive-dependent, Active-ambivalent — high (anxiety) n=4

2=Active-dependent, Passive-and Active-independent, Passive-ambivalent — low (anxiety) n=30

3=Mixed personality types (includes features of both groups 1 & 2) (n=9)

EMG level, F (2,36) = 4.16, $p < .05$; and on the POMS Anger scale, F (2,36) = 3.78, $p < .05$; and for the effect of treatment on the POMS Confusion scale, F (2,36) = 2.99, $p < .05$.

Examination of MCMI group means indicated that the high anxiety group (Group 1) manifested higher levels of EMG and higher scores on the Anger scale than the low anxiety group (Group 2) or the mixed group (Group 3). Examination of Treatment group means indicated that the EMG-progressive relaxation and EMG-meditation groups (Groups III and IV) manifested lower scores on the Confusion scale than the EMG-alone and EMG-music groups (Groups I and II).

These results, which suggested that basic personality types characterized by high anxiety are not as successful in reducing EMG level, confirmed the above results which indicated a similar relationship between trait anxiety and EMG performance. These results also provide further clarification concerning the effects of different treatments. Specifically, they confirm that EMG-progressive relaxation and EMG-meditation are superior to EMG-alone and EMG-music in facilitating a reduction in the cognitive dimension of anxiety (as assessed by the POMS Confusion scale), and that this effect holds independent of personality type.

Practice Effects

The potential relationship of home practice variables to treatment was examined in two ways. First, a series of one-way ANOVAs were done with treatment condition as the independent variable and five home practice variables as the dependent variables to determine if type of treatment affected either the commitment to or consistency of home practice. The five home practice variables were: (1) average time of daily home practice, (2) total time of home practice, (3) total days practiced, (4) total days in treatment, and (5) average days practiced per week. The ANOVAs indicated no significant differences between treatment conditions on any of the home practice variables (these results are summarized in Appendix C). Thus it seemed clear that the demonstrated superiority of the combined treatments was not due to differences in the average level or total amount of home practice, nor to length in treatment.

Second, the relationship between home practice variables and improvement on treatment outcome measures was examined with Pearson *r* correlations (see Table 9). Improvement was assessed in terms of the difference between pretest and posttest scores on each of the 13 treatment outcome measures. Examination of the correlation matrix indicated that measures of average level of daily practice as well as total amount of practice were not significantly related to degree of improvement on treatment outcome measures. In contrast, measures reflecting days practiced and days in treatment were positively related to several measures of treatment improvement.

Nonspecific Effects

Several other variables which were not specific to the treatment conditions were examined as potential sources of influence on treatment outcome. These included: (1) pretreatment perceptions of

Table 9

Correlation Matrix for Home Practice, Expectancy and Credibility, and Social Desirability in Relation to Improvement on Treatment Outcome Measures

Improvement on Treatment Outcome Measures[a]	Home Practice Measures: Total Time Practiced (Min.)	Average Daily Practice (Min.)	Total Days Practiced	Total Days in Treatment	Average Weekly Practice (in Days)	Expectancy and Credibility Questionnaire	Marlowe-Crowne Social Desirability Scale
EMG	-.08	-.14	-.04	.03	-.06	.00	.00
TMAS	.05	-.12	.15	.35	-.23	-.01	-.01
STAI A-State	.30	.07	.35	.44	-.10	.04	-.04
A-Trait	.18	-.03	.27	.37	-.09	.23	-.14
POMS Tension	.08	-.19	.25	.27	.01	-.04	-.11
Depression	.17	-.07	.29	.35	-.04	.05	-.03
Anger	.08	.03	.09	-.00	.08	.13	.17
Vigor	-.02	.12	-.07	-.28	.15	.12	.06
Fatigue	.07	-.13	.18	.14	.10	.16	.05
Confusion	.02	-.23	.21	.23	-.02	.07	.03
SRF Somatic Anxiety	.09	-.03	.16	.31	-.18	-.01	-.09
Cognitive Anxiety	.22	.06	.27	.25	.02	.07	.01
Resting (non-arousal)	-.15	.03	-.25	-.26	.05	-.01	-.03

N = 49
r ≥ 28, p < .05
r ≥ 36, p < .01

[a]Computed as the difference between pretest and posttest scores.

EMG = Electromyograph level (30 minute average)
TMAS = Taylor Manifest Anxiety Scale
STAI = State-Trait Anxiety Inventory
POMS = Profile of Mood States
SRF = Self Report Form

treatment rationale credibility and expectation of benefit from treatment; (2) social desirability; and (3) experimenter effects.

A one-way ANOVA with treatment condition as the independent variable and scores on the Credibility and Expectancy Questionnaire as the dependent variable indicated no significant differences between treatment groups in perceived credibility of treatment or expectation of benefit from treatment, $\underline{F}$ (3,45) = 0.18, ns. In addition, no significant correlations were found between scores on the Credibility and Expectancy Questionnaire and improvement on any of the 13 treatment outcome measures (see Table 9). Thus, it appeared that subject's perceptions of treatment rationale credibility or expectations of benefit from treatment did not exert a nonspecific influence on treatment outcome.

In addition, no significant correlations were found between scores on the Marlowe-Crowne Social Desirability Scale and improvement on treatment outcome measures (see Table 9). Thus, it appeared that a social desirability response bias did not influence subject's reports of improvement due to treatment.

Finally, to determine the potential impact of experimenter differences on treatment evaluation measures, a series of one-way ANOVAs were done with experimenter as the independent variable and pre- and post-scores on the 13 treatment outcome measures as the dependent variables. No significant differences between the three experimenters were found for any of the 26 dependent variables (these results are summarized in Appendix C). These findings suggested that experimenter differences in assessing clients did not exert a nonspecific influence on the evaluation of treatment outcome.

CHAPTER V

DISCUSSION

The discussion is divided into three sections. The first section addresses the findings related to the comparative evaluation of relaxation treatments which utilized frontalis EMG biofeedback. The second section examines the findings related to the question of individual differences affecting responsibility to EMG biofeedback mediated relaxation training. The final section summarizes conclusions stemming from this investigation and presents suggestions for future research.

Comparative Treatment Evaluation

Davidson and Schwartz' (1976) psychobiological model for understanding anxiety and relaxation states provides a general theoretical framework for interpreting the results of this investigation relative to the comparative evaluation of treatments. In particular, several assumptions of this model have a direct bearing on the empirical findings of this study. First, the model suggests that anxiety and relaxation states need to be understood as multi-process phenomena. Specifically, it suggests that such phenomena can be understood in terms of the interrelationship of three basic processes or dimensions--cognitive, somatic, and attentional. A distinction is made between the cognitive or psychic dimension of anxiety vs. the somatic or physiological dimension. The attentional dimension is understood in terms of an active/passive continuum of awareness, which interacts with the above two components to account for the overall experience of anxiety or relaxation.

Second, the model suggests that different relaxation techniques operate differentially in facilitating reductions in the cognitive vs. somatic components of anxiety. In particular, it suggests that techniques which focus primarily on cognitive processes will be more effective in reducing cognitive anxiety, and that techniques which focus primarily on somatic processes will be more effective in reducing somatic anxiety. It also suggests that measures of the effects of relaxation training need to be differentiated in terms of whether they assess the cognitive, somatic or combined components of anxiety.

Finally, the model suggests that in spite of this mode specificity of relaxation techniques in relation to components of anxiety, there is a carryover of effects from one mode or system to another. For example, a relaxation technique which primarily facilitates a reduction in cognitive anxiety is also likely to contribute, although to a lesser degree, to a reduction in somatic anxiety.

Within the context of this model, the present study examined the effectiveness of four EMG biofeedback-asssisted relaxation training treatments--EMG feedback alone, EMG feedback with music, EMG feedback with progressive relaxation, and EMG feedback with meditation. In addition to measures of frontalis muscle tension, multiple self-report measures of cognitive and somatic anxiety, relaxation, and general mood were used to assess the effects of these four treatments. It was expected that the four treatments would effectively reduce anxiety, and that they would also differentially affect the various components of anxiety.

The results of the present study indicated that all treatment groups manifested significant improvement in comparison to a waiting-list control group on EMG recorded muscle tension levels and on self-reported measures of somatic tension and relaxation (low arousal). Since the common treatment component across groups was EMG biofeedback, the failure of treatment vs. control comparisons to yield significant differences on general anxiety measures (e.g., TMAS, STAI), as well as on measures of cognitive anxiety, suggested that the main impact of EMG training itself was to facilitate a reduction in the somatic or physiological dimension of anxiety.

The above finding, which was consistent across physiological and self-report measures, helps to clarify the often found inconsistency in previous research between phsyiological vs. self-report measures of the effects of EMG-mediated relaxation training (see Alexander & Smith, 1979; Ray et al., 1979; Tarler-Benlolo, 1978). A likely explanation for this inconsistency is to be found in the fact that such research generally has not utilized self-report measures which differentiate between the somatic vs. cognitive components of anxiety and relaxation. The general measures of anxiety typically used may not be adequate to provide a sensitive and comprehensive assessment of changes in specific components of anxiety. The finding in the present study of different effects of EMG training on cognitively sensitive vs. somatically sensitive outcome measures, provided support for Davidson and Schwartz' (1976) distinction between cognitive vs. somatic processes associated with anxiety and relaxation states.

Although the results of this study demonstrated the effectiveness of EMG-mediated relaxation training for reducing the somatic or physiological component of anxiety, this finding needs some qualification in terms of the control procedure used. The use of a waiting-list group who attended only pretest and posttest sessions did not control for effects of adaptation to the treatment situation. It is possible therefore that the reductions in EMG activity that were observed in all treatment groups may have been due to adaptation rather than to a genuine learning produced by the EMG biofeedback. As many authors have observed (Alexander & Smith, 1979; Ray et al., 1979; Smith, 1978), a more effective control procedure would utilize a placebo treatment group which would approximate active treatment conditions as much as possible, but exclude the critical treatment component. In the current study, such a control group was not deemed feasible for ethical reasons. In spite of this limitation, the overall positive results on both EMG and self-report measures provided strong evidence supporting the clinical use of EMG biofeedback to facilitate reductions in the physiological or somatic response component of anxiety. For as Wilkins (1979) has observed, to conclude that a therapy procedure is effective, it is not necessary to demonstrate that its effects are independent of all potential nonspecific effects, many of which may be inextricably linked to the actual therapeutic procedure.

In addition to the support for treatment effectiveness in general, the results indicated differential effects on self-report measures across treatment conditions. Of most importance was the finding that the two treatment groups which received EMG feedback in conjunction with a specific additional relaxation strategy, i.e., EMG-progressive relaxation and EMG-meditation, manifested significantly greater improvement than the EMG-alone and EMG-music treatment groups on measures of depression, confusion, cognitive anxiety and relaxation (low arousal); and manifested a trend toward greater improvement on measures of state anxiety, somatic tension and vigor.

The general superiority of the combined treatment groups over the EMG-alone and EMG-music groups provided evidence which argued against explaining the significant treatment effects in terms of nonspecific or placebo factors. Results related to the assessment of potential nonspecific factors indicated that the four treatments did not differ in credibility or in generated expectancy of treatment success. Thus, the EMG-alone and EMG-music groups could be utilized as an alternative type of treatment controls that were equated for nonspecific effects. The failure of these treatment groups to perform as well as the combined treatment groups on self-report measures suggested that nonspecific factors could not toally account for the superior performance of the latter. The fact that social desirability response bias was not related to improvement on self-report measures adds further support to this interpretation.

In general, the above findings supported the conclusion which emerged from a review of previous research (see Tarler-Benlolo, 1978) that a combination of training in a specific relaxation technique along with biofeedback would generally provide the optimal relaxation treatment. Specifically, the addition of progressive relaxation or meditation training to the basic EMG biofeedback component of treatment produced additional beneficial effects on measures of cognitive anxiety, depression and relaxation (low arousal). Since the depression measure (POMS, Depression scale) and the relaxation measure (SRF, resting scale) both include a substantial number of cognitively (as opposed to somatically) oriented items, these findings suggested that the progressive relaxation and meditation treatment components had a major impact on cognitive processes associated with the experience of anxiety or relaxation. Thus, the results of this study provided strong evidence that a relaxation training strategy which combines cognitively and somatically oriented techniques produces a better overall relaxation experience, as well as better specific improvement in terms of the psychic or physiological components of anxiety, than a procedure focussed primarily within one response subsystem. It also highlighted the emphasis of several authors on the importance of addressing the cognitive dimension in biofeedback training (Lazarus, 1977; Meichenbaum, 1976).

In addition, the trend for the combined treatments to also produce superior benefits on somatic or physiological measures, supports Davidson and Schwartz' prediction of a carryover from one response subsystem to another (in this case, from the cognitive to the somatic). In other words, the combined treatments were more effective in the cognitive area because they included techniques to facilitate gains within that response subsystem, but they also tended to produce better results within the somatic sybsystem than techniques which were primarily somatically effective (such as EMG-alone), because of the carryover of gain.

Although the present investigation supported the efficacy of EMG-progressive relaxation and EMG-meditation training as relaxation strategies, it failed to differentiate between these two treatments as hypothesized. In particular, previous research by Schwartz et al. (1978) had suggested that specific relaxation techniques, which differed in their focus on cognitive vs. somatic processes (i.e., meditation vs. exercise), would produce different effects on measures independently assessing these response components associated with anxiety and relaxation. Given the emphasis of meditation on cognitive processes and progressive relaxation on somatic processes, one would expect respective differences in treatment outcome. However, the results of this study across all 13 outcome measures failed to indicate any significant differences between the EMG-progressive relaxation and EMG-meditation treatments.

Several possible explanations may be put forth for the failure of this study to yield such differences. First, although meditation in general is a more cognitive technique, different meditative techniques may vary in terms of their relative cognitive/somatic emphasis. For example, according to Davidson and Schwartz (1976), Transcendental Meditation with its use of a mantra has a more cognitive focus, while Zen meditation with its emphasis on attending to breathing has a more somatic focus. In the present study, a variation on basic Zen breath meditation was used which required subjects to count (from one to ten initially, later to merely repeat "one") while attending to their breathing. As Chang (1978) has observed, this type of meditative exercise is a form of "concentrative meditation" designed to clear the mind of distracting thoughts and free mental energy, similar in purpose and function to Transcendental Meditation.

Indeed, in the Schwartz et al. (1978) study, both TM and Zen meditative breathing with counting were used interchangeably and classified by the authors as <u>cognitively</u> based, passive meditation. Taking this observation in conjunction with the Davidson and Schwartz (1976) explanation of basic Zen breathing meditation (without the counting) as a passive <u>somatic</u> relaxation technique, it appeared that the meditation procedure used in the present study can best be understood as tapping both cognitive and somatic processes.

In a similar vein, a more careful analysis of the progressive relaxation procedure used in this study suggested that it also can best be understood as a combined cognitive/somatic technique. Although the traditional Jacobsonian systematic muscle relaxation exercises, which were the core of the progressive relaxation treatment, clearly have a somatic focus, the procedure used in this study also included a tape which integrated some autogenic training exercises with the systematic muscle relaxation exercises. Specifically, subjects were asked to employ cognitive self-generated statements associated with sensations of heaviness and warmth in their limbs, and calm and regular autonomic functioning, such as heartbeat and respiration. These type of exercises associated with autogenic training led Davidson and Schwartz (1976) to classify it as a combined cognitive/somatic technique.

In terms of the present study, then, it appears that the EMG-meditation and EMG-progressive relaxation treatments were not substantially different in terms of the nature and function of the relaxation technique they offered subjects to use in conjunction with their biofeedback training. Thus, it is not surprising that different effects on cognitive vs. somatic outcome measures were not found.

A second, more obvious explanation is to be found in the fact that both meditation and progressive relaxation were combined with EMG feedback in the context of an overall relaxation training program, and not utilized as separate independent treatments. Aside from the limitations imposed by this experimental design, which prohibited a direct comparison of meditation vs. progressive relaxation, there is a strong likelihood, given the above discussion about carryover of gain between somatic/cognitive subsystems, that the EMG biofeedback component may have washed out some of the true differential effects of meditation vs. progressive relaxation training. However, that question was beyond the scope of this investigation and is left for future research.

In spite of the failure to find significant differences between the EMG-progressive relaxation and EMG-meditation treatments in terms of specific outcome measures, it is noteworthy that an analysis of the relative performance of the four treatment groups across all 13 outcome measures suggested that the EMG-progressive relaxation treatment was superior. One explanation for this finding is suggested by the more "active" nature of this treatment in comparison to the other treatments (see above, Table 1, p.55 , for Davidson and Schwartz' classification of relaxation techniques). Although the EMG-meditation treatment is ostensibly more "active" than the EMG-alone or EMG-music treatments (which can be understood primarily as passive procedures) the Zen meditation component is classified primarily as a passive relaxation procedure.

Davidson and Schwartz suggest that this active/passive distinction reflects the attentional dimension associated with the experience of relaxation and with various techniques designed to facilitate such experience. Specifically, they suggest that this active/passive attentional dimension can be understood as a continuum which differentiates procedures involving the active self-generation of behavior from those involving a more passive process associated with the self-regulation of behavior. Thus, subjects in the EMG-progressive relaxation treatment may have been more engaged or involved in their overall treatment by virtue of a more "active" attentional process associated with this procedure than with the procedures used in the other three treatments. This interpretation in terms of patient involvement has motivational implications and is consistent with the posttreatment finding of Staples and Coursey (1975) that subjects preferred progressive relaxation to EMG biofeedback.

Individual Differences in Relaxation Training

The present study confirms the conclusion of several authors (Benson, 1975; Davidson & Schwartz, 1976; Ray et al., 1979; Smith, 1978; Tarler-Benlolo, 1978) concerning the importance of considering the role of individual difference variables in relation to relaxation training outcome. An overall analysis of individual differences across various measures of general and specific personality characteristics, general and specific anxiety and mood states, and clinical symptomatology, identified three factors which were related to outcome (across several measures) of treatment: A trait anxiety factor, a depression factor, and a thought disturbance factor.

The most important finding, in terms of the present investigation, was that all three of these individual difference factors were associated with higher posttreatment EMG levels, independent of the variance due to pretreatment EMG level and differences across treatment conditions. In other words, there was a direct relationship between these factors and posttreatment EMG performance: Subjects who initially tended to be high in trait anxiety, depression or thought disturbance did not benefit as much from treatment, in terms of EMG muscle tension reduction, as their counterparts.

The effect of these individual difference factors on EMG-mediated relaxation treatment can be understood in light of Borkovec's (1976) model of anxiety process and the role of individual differences on the maintenance and reduction of anxiety. Specifically, this model suggests that the experience of anxiety involves three interacting response components--cognitive, motor, and physiological, and that individuals differ in terms of their pattern of anxiety across these components. In particular, Borkovec (1976) suggested that there are critical individual differences associated with the <u>perception of physiological arousal</u>, specifically, in the awareness of autonomic cues associated with the experience of anxiety. Preliminary research testing these assumptions indicated that individuals who were high perceivers of physiological arousal tended to manifest increased arousal under stressful conditions.

Relating Borkovec's research to the findings of the present study, it is possible that individuals who are initially high in trait anxiety, depression or thought disturbance may not be as successful in lowering their EMG muscle tension level due to their subjective level of distress. In other words, individuals who significantly manifest these characteristics, which are associated with psychological dysfunction, are likely to be experiencing an internal level of stress which inhibits their EMG performance. This may be due, as Borkovec suggests, to an acute sensitivity to their own physiological arousal--a sensitivity which may even contribute to increased muscle tension in the face of demands associated with EMG biofeedback training procedures. Or it may be that the subjective distress of such individuals interferes with their ability to attend to the EMG feedback procedure, both in terms of their awareness of muscle tension and its relationship to the feedback information provided, and consequently, they do not learn as effectively to decrease their muscle tension.

Although trait anxiety, depression and thought disturbance were all negatively associated with posttreatment EMG performance, there were no consistent effects of these factors across the 12 self-report outcome measures used in this study. Initial levels of trait anxiety and thought disturbance were both negatively associated with posttreatment performance on two of the 12 measures. In contrast, initial level of depression was positively associated with reductions in self-reported tension and confusion.

One possible explanation for the superior performance of individuals high in depression, in contrast to those high in trait anxiety or thought disturbance, may be due to the ability of the overall relaxation treatment to foster a sense of self-control and self-mastery in regard to psychophysiological states. One might expect such a treatment, if effective, to have a greater impact on depressed individuals, who characteristically manifest a sense of helplessness in regard to their symptomatology.

In addition to the above three factors, the present study provided some evidence indicating that basic personality style, in terms of the MCMI (Millon, 1977) may be related to responsiveness to EMG biofeedback mediated relaxation training. Results indicated that individuals with characteristically passive-detached, active-detached, passive-dependent, or active-ambivalent personality styles were not as successful in lowering their EMG muscle tension level; and manifested greater frustration, as reflected by higher posttreatment scores on the POMS Anger scale, in comparison to other personality styles.

A common feature of these four personality styles was that they all were associated with high anxiety. Thus, high trait anxiety consistently emerged as a predictor of poorer response to relaxation treatment in the present study. This finding is consistent with that of Haynes et al. (1975) but stands in contrast to the finding of Page and Schaub (1978) that subjects who were initially high in anxiety (according to MMPI profiles) responded better to a combined EMG-progressive relaxation treatment than a heterogeneous sample of personality types who were not highly anxious.

These inconsistent research findings regarding the impact of initial anxiety on treatment outcome may be due to the different populations, or to differences in treatment conditions associated with these studies. For example, Page and Schaub (1978) treated a highly anxious alcoholic population, while the Haynes et al. (1975) study and the present study treated a college population. One possible explanation consistent with the research findings across different populations (see Alexander & Smith, 1979; Tarler-Benlolo, 1978) is that individual difference factors, such as personality type and initial trait anxiety, may be differentially related to responsiveness to treatment in different types of clinical populations.

Another explanation for these inconsistent findings is suggested by an examination of the different treatment conditions used and different length of treatments. The Haynes et al. (1975) study compared EMG-alone to progressive relaxation alone, in one training session, while the Page and Schaub study (1978) included a combination EMG-progressive relaxation treatment over 14 sessions. Thus, the finding in the latter study that high anxious alcoholics responded better to treatment may be due to the fact that they received a more comprehensive, efficacious relaxation treatment over a longer period of time.

Relating this discussion to the previously discussed findings of the present study concerning the overall superiority of the EMG-progressive relaxation treatment, and the negative association between initial trait anxiety and EMG performance, an interpretation which is consistent with all of these findings is that there may be an interaction effect on treatment outcome between initial level of anxiety and type of relaxation treatment received. In other words, it is possible that high anxious subjects, whether from a normal or a clinical population, may not benefit as much from EMG biofeedback alone as low anxious subjects, but may benefit more from a combination of EMG and progressive relaxation exercises than low anxious subjects. The present study was not able to test directly for such interaction effects due to the limited number of subjects in each treatment condition. Future research needs to clarify the impact of initial level of anxiety on responsiveness to relaxation training by using research designs which allow for the evaluation of such interaction effects.

The present study failed to confirm the finding of Qualle and Sheehan (1979) that capacity for absorption (Tellegen & Atkinson, 1974) was negatively associated with relaxation effects resulting from EMG biofeedback. However, the present study differed in two significant ways from the Qualle and Sheehan study. First, they utilized college student volunteers who manifested extreme high or low absorption scores (16 high and 16 low from a sample of 253 subjects. Second, they contrasted EMG feedback vs. no-feedback in a counterbalanced design. These differences in population and treatment procedure are substantial and may account for the failure of the present study to find a significant association between absorption and treatment outcome.

The above discussion concerning the role of individual difference factors on relaxation training outcome points to the need for future research to use eqivalent designs across different populations to further clarify the question of individual differences in relation to outcome of EMG biofeedback mediated relaxation training.

Conclusions

In conclusion, the present study provided support for the utility of EMG biofeedback in facilitating physiological relaxation with a university student population in a clinical setting. It further suggested that the optimal use of EMG biofeedback as a relaxation training procedure is in combination with specific relaxation techniques, such as progressive relaxation or meditation, which appear to enhance the effectiveness of the biofeedback training and lead to better overall clinical results.

In terms of the role of individual differences in EMG-mediated relaxation training, this study provided some evidence which suggested that individuals high in trait anxiety, depression or thought disturbance are not as successful at lowering EMG muscle tension levels in a short-term biofeedback training program. In addition, personality types associated with high anxiety did not respond as successfully to treatment. Future research needs to clarify these findings by examining the role of such subject variables across different populations. It also needs to investigate potential interactions between subject variables and variations in type of relaxation treatment, such as different combinations of biofeedback training and relaxation exercises and various lengths of treatment. In particular, such research needs to determine the optimal relaxation treatment program for those who are most in need of relaxation, namely, the highly anxious.

SUMMARY

The present investigation compared the clinical effectiveness of four different relaxation treatments which utilized EMG biofeedback. Specifically, it compared the following treatment groups: EMG feedback alone, EMG feedback with taped music, EMG feedback with taped progressive relaxation exercises, EMG feedback with a taped Zen meditation exercise, and a waiting-list control. These groups were compared across multiple physiological and self-report measures of anxiety, relaxation and mood states, with particular attention given to discriminating between cognitive (psychic) vs. somatic (physiological) dimensions of anxiety.

The following hypotheses were advanced: (1) all four EMG-mediated relaxation treatment groups would manifest significant improvement across outcome measures in comparison to the control group, (2) the EMG-progressive relaxation and EMG-meditation groups would manifest greater improvement across outcome measures, (3) the EMG-progressive relaxation group would manifest greater improvement on measures of somatic anxiety, and (4) the EMG-meditation group would manifest greater improvement on measures of cognitive anxiety.

In conjunction with the above hypotheses, this study explored

the relationship of individual difference factors to treatment outcome across a range of variables, including basic personality style, stress reactivity, capacity for absorption (self-altering experiences), initial clinical symptomatology, and initial levels of anxiety and other mood states.

Subjects were students between the ages of 19 and 55 who participated in a biofeedback training program for anxiety and stress management at a university counseling center. Subjects were evaluated across all outcome measures before and after treatment, which consisted of six weekly 30-minute relaxation training sessions with prescribed daily home practice. Individual differences and potential nonspecific factors were assessed prior to treatment.

Results related to specific treatment effects across groups were analyzed with a series of one-way analyses of covariance (treatment effect X group, pretest as covariate) using planned contrasts to test the four hypotheses. These analyses indicated the following: (a) all treatment groups manifested a significant reduction in somatic (physiological) anxiety and level of arousal in comparison to the control group; (b) the EMG-progressive relaxation and EMG-meditation groups manifested significantly greater reductions on cognitive (psychic) anxiety, level of arousal, and depression than the EMG-alone and EMG-music groups; and (c) there were no significant differences between the EMG-progressive relaxation and EMG-meditation groups on specific measures of somatic and cognitive anxiety.

The relationship of individual difference variables to treatment outcome was analyzed with Pearson r correlations, which indicated several patterns of interrelationships. Exploratory analyses of individual difference variables identified three general factors which seemed to be related to treatment outcome--trait anxiety, depression, and thought disturbance. Higher scores on each of these factors were negatively related to posttreatment EMG performance, but were not consistently related to self-report outcome measures. Higher initial levels of trait anxiety and thought disturbance were negatively related to improvement on two of 12 self-report outcome measures, while depression was positively related to reductions in self-reported tension and confusion.

Overall, these findings indicated that EMG biofeedback may contribute to reductions in EMG muscle tension, but that a combined treatment of EMG feedback and specific relaxation exercises is needed to significantly reduce anxiety and facilitate overall relaxation. They also provided support for a multi-process psychobiological approach in evaluating the effects of biofeedback mediated relaxation training strategies. Suggestions for future research included the need for further specification of the role of individual difference factors in relaxation training outcome.

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APPENDIX A

I. SELF-REPORT FORM

NAME______________________________ DATE____________________ SEX______

DIRECTIONS: On the blank in front of each statement, please place a number indicating how much that statement reflects how you are feeling right now. Use numbers from the scale provided below. There are no right or wrong answers, and your answers will be kept strictly confidential. Do not spend too much time on any one item. Remember, we are interested in how your are feeling now.

1 = Not at all 2 = Slightly 3 = Somewhat 4 = Moderately 5 = Very Much

____I feel physically "tight"

____I feel frustrated

____My heart is beating fast

____I feel worried

____I feel pressured

____I feel defeated

____I feel physically relaxed

____I feel physically shaky

____I feel scared

____I feel secure

____I feel mentally calm

____I feel physically calm

____I feel physically at ease

____My chest feels tight

____I feel physically jittery

____I feel mentally at ease

____My stomach feels tight

____I feel contented

____I feel hopeless

____I feel mentally rested

____I feel physically restless

II. RELAXATION TRAINING PROGRAM

CONSENT FORM

The Counseling Center is offering a program of intervention to aid students in learning how to manage anxiety. The program will essentially attempt to teach participants how to relax and will use the techniques of biofeedback and/or relaxation training exercise to aid in accomplishing this goal. The relaxation training exercises will involve tensing and relaxing muscles or focused breathing.

Biofeedback is the use of an electronic monitoring device as a means of informing a person about certain body functions associated with anxiety, and in this way helping them to control these functions and ultimately anxiety. The body function to be monitored in the Relaxation Training Program is muscle tension in the forehead. The program will consist of eight relaxation training sessions, and participants will be asked to practice at home.

In order to assess the effectiveness of the program as well as to measure the progress of any one student in the program, a program evaluation research project will be conducted. This will require pre- and post-training sessions. The assessment measures will include muscle tension levels, pulse rate, and skin resistance (a measure of perspiration) as well as paper and pencil tests of personality and anxiety. In addition, all students will be invited to participate in a follow-up evaluation approximately one month after completion of training. All research data will be coded and therefore kept anonymous.

My signature below indicates that I have read the above, understand it, and have agreed to participate in this Relaxation Training Program and the program evaluation research associated with it. I understand that I am free to discontinue the program at any time.

____
(Date)

____
(Signature)

____
(Witness)

Date: ____________ Name: ________________________________

Please answer the following questions by placing a number from the scale (0 = lowest; 10 = highest) in the blank before each question.

0 1 2 3 4 5 6 7 8 9 10

_____ 1. Now that the relaxation training program has been explained to you how helpful do you think it will be in improving your ability to relax?

_____ 2. To what extent do you think this is a reasonable approach for improving your ability to relax?

_____ 3. How helpful do you think this program will be in improving your general ability to cope with stress?

_____ 4. How helpful do you think this program will be in reducing your level of physical tension?

_____ 5. How helpful do you think this program will be in decreasing the degree to which you worry about things?

IV. HOME PRACTICE INSTRUCTIONS

1. Practice at least once a day for a minimum of 10 to 15 minutes, even on days when you come to the Counseling Center for training.
2. Find a quiet, comfortable place to practice. A nice easy chair similar to the one we have in the Center would be ideal. Try to find a place away from noise and other people.
3. Before you begin, record the date and the time you start practicing on your record sheet. Next, estimate your level of tension on a scale of 0 (Completely calm) to 10 (Very tense, anxious) and record this under "Before Practice".
4. After recording your before-practice tension level, get comfortable in your chair, clear your mind of other thoughts,and begin to relax using the training you have received at the Center.
5. At the end of your relaxation time, record the amount of time (in minutes) that you practiced. Also, estimate your tension level as you did before and record it in the "After Practice" column. In the final column, make some brief comments about your relaxation experience; i.e., any special feelings you had, any particular thoughts, any problems, etc.
6. Please bring your Home Practice Record with you when you come to your training sessions.

Name: ______________________ Week of ______________

V. HOME PRACTICE RECORD

DATE	STARTING TIME	Record how tense you feel on a scale of 0 to 10 Before Practice	 After Practice	Amount of time practiced (in minutes)	Note any special feelings (tingling, warmth, lightness, etc.) or difficulties (mind wandering, interruptions, etc.) you had during your practice today.

VI. SEMANTIC DIFFERENTIAL SCALE

Place a check mark in the appropriate segment to indicate how you would describe THIS RELAXATION SESSION.

Pleasant	____ :	____ :	____ :	____ :	____ :	____ :	____	Unpleasant
Deep	____ :	____ :	____ :	____ :	____ :	____ :	____	Shallow
Worthless	____ :	____ :	____ :	____ :	____ :	____ :	____	Valuable
Active	____ :	____ :	____ :	____ :	____ :	____ :	____	Passive
Boring	____ :	____ :	____ :	____ :	____ :	____ :	____	Interesting
Good	____ :	____ :	____ :	____ :	____ :	____ :	____	Bad
Weak	____ :	____ :	____ :	____ :	____ :	____ :	____	Strong
Fast	____ :	____ :	____ :	____ :	____ :	____ :	____	Slow
Tense	____ :	____ :	____ :	____ :	____ :	____ :	____	Relaxed
Light	____ :	____ :	____ :	____ :	____ :	____ :	____	Heavy
Hard	____ :	____ :	____ :	____ :	____ :	____ :	____	Soft
Cold	____ :	____ :	____ :	____ :	____ :	____ :	____	Hot
Refreshing	____ :	____ :	____ :	____ :	____ :	____ :	____	Tiring
Uneffective	____ :	____ :	____ :	____ :	____ :	____ :	____	Effective

Date: ______________ Name: ______________________

Please answer the following questions by placing a number from the scale (0 = lowest; 10 = highest) in the blank before each question.

0	1	2	3	4	5	6	7	8	9	10

____ 1. Now that you have completed the relaxation training program, how helpful was it in improving your ability to relax?

____ 2. To what extent do you think the program is a useful and sensible approach for training people to relax?

____ 3. How helpful was the program in improving your general ability to cope with stress?

____ 4. How helpful was the program in reducing your level of physical tension?

____ 5. How helpful was the program in decreasing the degree to which you worry about things?

____ 6. To what extent did the program meet your general expectations?

____ 7. To what extent did the program help you to cope more effectively with specific sources of stress in your life.

In the space below, please indicate any particular benefits this program has provided for you (e.g., physically, emotionally, mentally).

Finally, indicate any particular areas of your life where you think this program has helped you (e.g., school, work, home, socially).

APPENDIX B

I. Correlation Matrix for Basic Personality Style, Pathological Personality Syndromes, Symptom Disorders, Stress Reactivity, and Absorption

		Millon Clinical Multiaxial Inventory																				Differential Personality Questionnaire	
		Basic Personality Scales								Pathological Personality Scales			Symptom Disorder Scales										
		1	2	3	4	5	6	7	8	S	C	P	A	H	N	D	B	T	SS	CC	PP	Stress Reaction (SR) Scale	Absorption (A) Scale
Basic Personality Scales	1	X	.78		-.69	-.63			.47	.68	.46		.54		-.52	.65		-.26	.47	.49		.47	
	2	.78	X	.47	-.68	-.67			.58	.77	.67		.66	.49	-.32	.82			.68	.70	.28	.69	
	3		.47	X		-.47	-.62			.44	.45		.51	.66		.42	.32		.45	.38		.46	
	4	-.69	-.68		X	.74			-.56						.60	-.39		.45	-.38	-.37	-.26	-.35	
	5	-.63	-.67	-.47	.74					-.69	-.30	.29	-.47	-.30	.62	-.53	.27	.61	-.29	-.39		-.45	.35
	6			-.62		.58	X			-.35		.47	-.30	-.41	.32		.32	.51			.34		.26
	7							X			-.54		-.47	-.39	-.45	-.53	-.64	-.51	-.33	-.50		-.47	
	8	.47	.58					-.77	X	.46	.72		.69	.51		.77	.55	.33	.57	.72		.68	
Pathological Personality Scales	S	.68	.77	.44	-.56	-.69	-.35		.46	X	.67		.71	.56	-.29	.73			.61	.65		.54	
	C	.46	.67	.45		-.30		-.54	.72	.67	X	.37	.84	.78		.81	.46		.66	.80		.71	
	P					.29	.47				.37	X			.44		.51	.62	.47	.30	.73		.54
Symptom Disorder Scales	A	.54	.66	.51		-.47	-.30	-.47	.69	.71	.84		X	.79		.84	.40		.52	.72		.72	
	H		.49	.66		-.30	-.41	-.39	.51	.56	.78		.79	X	.26	.65	.40		.52	.60		.55	
	N	-.52	-.32		.60	.62	.32	-.45		-.29		.44		.26	X		.59	.76			.26		.50
	D	.65	.82	.42	-.39	-.53		-.53	.77	.73	.81		.84	.65		X	.34		.64	.78		.76	
	B			.32		.27	.32	-.64	.55		.46	.51	.40	.40	.59	.34	X	.81	.40	.39	.39	.34	-.46
	T	-.26			.45	.61	.51	-.51	.33			.62			.76		.81	X	.30		.46		.54
	SS	.47	.68	.45	-.38	-.29		-.33	.57	.61	.66	.47	.52	.52		.64	.40	.30	X	.75	.56	.61	
	CC	.49	.70	.38	-.37	-.39		-.50	.72	.65	.80	.30	.72	.60		.78	.39		.75	X	.38	.73	
	PP		.28		-.26		.34					.73			.26		.39	.46	.56	.38	X		.45
Stress Reaction Scale	SR	.47	.69	.46	-.35	-.45		-.47	.68	.54	.71		.72	.55		.76	.34		.61	.73		X	
Absorption Scale	A					.35	.26					.54			.50		.46	.54			.45		X

N = 58
$r \geq .26$, $p < .05$
$r \geq .34$, $p < .01$

Basic Personality Scales
1 = Passive-detached
2 = Active-detached
3 = Passive-dependent
4 = Active-dependent
5 = Passive-independent
6 = Active-independent
7 = Passive-ambivalent
8 = Active-ambivalent

Pathological Personality Scales
S = Schizoid
C = Cycloid
P = Paranoid

Symptom Disorder Scales
A = Anxiety
H = Hysterical
N = Hypomanic
D = Neurotic Depression
B = Alcohol Misuse
T = Drug Misuse
SS = Psychotic Thinking
CC = Psychotic Depression
PP = Psychotic Delusions

II. Correlation Matrix for Pretreatment Levels of Anxiety, Relaxation, and Mood States

Pretreatment Levels on Outcome Measures	1	2	3	4	5	6	7	8	9	10	11	12	13
1. EMG	X				.28	.29					.27	.28	
2. TMAS		X	.67	.81	.68	.78	.67	-.48	.51	.61	.43	.49	-.56
3. STAI A-State		.67	X	.67	.73	.76	.40	-.59	.56	.61	.55	.71	-.76
4. A-Trait		.81	.67	X	.69	.74	.73	-.50	.53	.73	.30	.57	-.61
5. POMS Tension	.28	.68	.73	.69	X	.84	.48	-.55	.69	.75	.50	.68	-.67
6. Depression	.29	.78	.76	.74	.84	X	.65	-.46	.70	.81	.46	.76	-.67
7. Anger		.67	.40	.73	.48	.65	X		.46	.61		.40	-.42
8. Vigor		-.48	-.59	-.50	-.55	-.46		X	-.57	-.41	-.34	-.37	.58
9. Fatigue		.51	.56	.53	.69	.70	.46	-.57	X	.73	.32	.59	-.55
10. Confusion		.61	.61	.73	.75	.81	.61	-.41	.73	X	.29	.72	-.60
11. SRF Somatic Anxiety	.27	.43	.55	.30	.50	.46		-.34	.32	.29	X	.56	-.66
12. Cognitive Anxiety	.28	.49	.71	.57	.68	.76	.40	-.37	.59	.72	.56	X	-.68
13. Resting (nonarousal)		-.56	-.76	-.61	-.67	-.67	-.42	.58	-.55	-.60	-.66	-.68	X

N = 58
$r \geq 26$, $p < .05$
$r \geq 34$, $p < .01$

EMG = Electromyograph level (30 minute average)
TMAS = Taylor Manifest Anxiety Scale
STAI = State-Trait Anxiety Inventory
POMS = Profile of Mood States
SRF = Self Report Form

III. Correlation Matrix for Basic Personality Style, Pathological Personality Syndromes, Symptom Disorders, Stress Reactivity, and Absorption in Relation to Pretreatment Levels of Anxiety Relaxation and Mood States

Pretreatment Levels on Outcome Measures		Millon Clinical Multiaxial Inventory: Basic Personality Scales 1	2	3	4	5	6	7	8	Pathological Personality Scales S	C	P	Symptom Disorder Scales A	H	N	D	B	T	SS	CC	PP	Differential Personality Questionnaire: Stress Reaction (SR) Scale	Absorption (A) Scale
EMG																							
TMAS		.42	.65	.42	-.34	-.38		-.44	.72	.43	.61	.28	.64	.50		.70	.40		.62	.67	.28	.88	.28
STAI	A-State	.50	.61	.45	-.37	-.53		-.34	.58	.46	.52		.57	.45		.66	.31		.48	.58		.64	
	A-Trait	.43	.61	.45	-.26	-.41		-.39	.65	.51	.67		.75	.61		.74	.29		.53	.69		.87	
POMS	Tension	.43	.55	.39	-.29	-.41		-.40	.61	.51	.51		.66	.48		.63	.35		.41	.59		.67	
	Depression	.46	.63	.50	-.26	-.38		-.38	.68	.46	.60		.71	.59		.72	.43		.53	.61	.27	.72	.27
	Anger		.28	.34				-.39	.57		.46		.53	.50	.42	.47	.37	.27	.34	.45		.62	.27
	Vigor	-.53	-.54	-.27	.39	.54			-.41	-.57	-.46		.59	-.35		-.58			-.35	-.53		-.58	
	Fatigue	.33	.44	.38		-.33		-.31	.51	.52	.53		.72	.57		.58	.39		.37	.55		.50	
	Confusion	.35	.49	.42		-.38	-.31		.52	.51	.51		.68	.59		.65	.31		.48	.58		.60	
SRF	Somatic Anxiety	.26	.33					-.41	.46	.33	.42		.36	.31		.41	.31		.38	.33		.40	
	Cognitive Anxiety	.41	.47	.29				-.33	.55	.44	.48		.51	.36		.57	.37		.49	.50		.47	
	Resting (non-arousal)	-.38	-.45	-.27		.32		.35	-.58	-.45	-.54		-.57	-.51		-.57	-.31		-.43	-.53		-.51	

N = 58
$r \geq 26$, $p < .05$
$r \geq 34$, $p < .01$

EMG = Electromyograph level (30 minute average)
TMAS = Taylor Manifest Anxiety Scale
STAI = State-Trait Anxiety Inventory
POMS = Profile of Mood States
SRF = Self Report Form

Basic Personality Scales
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Symptom Disorder Scales
A = Anxiety
H = Hysterical
N = Hypomanic
D = Neurotic Depression
B = Alcohol Misuse
T = Drug Misuse
SS = Psychotic Thinking
CC = Psychotic Depression
PP = Psychotic Delusions

APPENDIX C

I. Analyses of Variance for the Effect of Treatment Condition on Home Practice Variables

	Source	*df*	*MS*	*F*
Total Time Practiced*	Group	3	17316.4	0.51
	Error	45	33797.6	
Average Daily Practice*	Group	3	20.2	1.64
	Error	45	12.3	
Total Days Practiced	Group	3	28.3	0.45
	Error	45	62.3	
Total Days in Treatment	Group	3	24.8	0.24
	Error	45	101.9	
Average Weekly Practice**	Group	3	2.3	1.22
	Error	45	1.9	

* in minutes

** in days

N=49

Treatment Groups = EMG--alone
EMG--music
EMG--progressive relaxation
EMG--meditation

II. Analyses of Variance for the Effect of Experimenter on Pretest and Posttest Scores on Treatment Outcome Measures

Treatment Outcome Measures		Source	Pretest MS	Pretest F	Posttest MS	Posttest F
EMG		Group	1.02	0.71	0.22	0.39
		Error	1.44		0.56	
TMAS		Group	106.62	1.32	74.54	1.35
		Error	80.95		55.27	
STAI	A-State	Group	269.92	2.84	40.72	0.40
		Error	95.22		103.15	
	A-Trait	Group	114.86	1.22	95.41	1.76
		Error	94.55		54.36	
POMS	Tension	Group	54.36	1.10	37.38	1.37
		Error	49.27		27.40	
	Depression	Group	288.73	2.76	33.97	0.70
		Error	104.53		48.78	
	Anger	Group	63.64	1.31	59.76	1.18
		Error	48.78		50.64	
	Vigor	Group	108.19	2.41	9.46	0.30
		Error	44.82		31.86	
	Fatigue	Group	66.40	1.67	15.87	0.46
		Error	39.66		34.78	
	Confusion	Group	27.71	1.35	7.40	0.74
		Error	20.52		10.03	
SRF	Somatic	Group	29.69	2.24	13.43	1.49
	Anxiety	Error	13.23		9.03	
	Cognitive	Group	45.62	2.63	5.02	0.68
	Anxiety	Error	17.32		7.43	
	Resting	Group	67.14	1.97	47.45	0.93
	(nonarousal)	Error	34.01		50.85	

N=58
Degrees of freedom for all analyses (2,55)

EMG = Electromyograph level (30 minute average)
TMAS = Taylor Manifest Anxiety Scale
STAI = State-Trait Anxiety Inventory
POMS = Profile of Mood States
SRF = Self Report Form

APPROVAL SHEET

The dissertation submitted by Donald J. Miro has been read and approved by the following committee:

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

April 23, 1981
Date

Patricia A. Rupert
Director's Signature