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Sex Differences as Determinants of Initial Response to Biofeedback and Passive Relaxation Training

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SEX DIFFERENCES AS DETERMINANTS OF INITIAL RESPONSE TO BIOFEEDBACK AND PASSIVE RELAXATION TRAINING

by

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VITA

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CHAPTER I

INTRODUCTION

Over the past fifteen years, EMG biofeedback has rapidly become a prominent treatment procedure for a wide variety of physiological and psychophysiological disorders. Researchers and clinicians have acclaimed its usefulness in treating everything from migraine headaches, hypertension and writer's cramp to phobic anxiety. Biofeedback has also become widely accepted as a treatment procedure for bringing about a state of generalized relaxation. It has been used alone and in combination with other procedures such as progressive relaxation and systematic desensitization. And yet, even now, after years of laboratory research and clinical experience with the procedure, many questions about its efficacy remain unanswered.

Several major reviewers of both the clinical and laboratory studies examining EMG biofeedback have raised more questions than answers regarding its efficacy as a treatment procedure. Recent examples of these critical reviews of the literature include the work of Blanchard and Epstein (1977), Neuchterlein and Holroyd (1980), Runck (1980), Surwit and Keefe (1978), Tarler-Benlolo (1978), Qualls and Sheehan (1981a), and Turk, Meichenbaum, and

Berman (1979). As these reviews point out, where EMG biofeedback has been examined as a technique for inducing relaxation, researchers have claimed at various times that it is more effective, less effective, and equally effective in comparison with more traditional treatment procedures. After reviewing the literature in this area, one is left with the conflictual impression that biofeedback both is and is not an effective relaxation treatment procedure.

Most recently the EMG biofeedback research has begun to refine itself and its conclusions in response to the conflicting results of earlier studies. Several authors have initiated investigations of intersubject differences which could account for some of the discrepancies in the findings of previous research. Until relatively recently, biofeedback research had been conducted under the unspoken assumption that all people would respond to a treatment in the same way. In other words, the "patient and treatment uniformity myths" (Kiesler, 1966) have been operative in much of the previous research. Researchers have been asking the question "Is biofeedback training an effective procedure for bringing about relaxation?" A more appropriate question at this juncture might be "What kinds of relaxation training procedures are most effective with what kinds of people, and under what specific circumstances?"

Investigations of individual differences in response to treatment have begun to appear in the literature recently. Qualls and Sheehan (1979, 1981b, 1981c), for example, have isolated the capacity for self-absorption as a possibly relevant individual difference variable in relaxation training. Other investigations have examined locus of control (Carlson, 1978) and basic personality style (Miro, 1981) in relation to the utilization of biofeedback as a relaxation technique. Little research has been done to investigate the possibility of sex differences in response to relaxation training procedures. The results of the few studies examining this variable have suggested that sex differences may exist, but have not provided conclusive data concerning the nature of those differences (Arnone, 1982; Davis, 1980; Haynes, Moseley, & McGowan, 1975; Hiebert & Fitzsimmons, 1981; Malec, Sipprells, & Behring, 1978; Rupert, Baird, & Tetkoski, in press).

The present study was designed to investigate further the relationship between sex differences and initial response to relaxation training. Specifically, the study sought to examine differences in response to several methods of relaxation training taking into account sex of subject, sex of experimenter, and the possible interactions among these factors as influential variables affecting outcome of training.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Laboratory studies with Normal Populations

Many studies have been conducted which have shown that EMG biofeedback training of the frontalis muscle brings about significant reductions in muscle activity at the site. Also, biofeedback has generally been shown to be more effective than simple instructions to relax in reducing muscle tension level at the site of training. Results are inconclusive and contradictory, however, when effective relaxation is considered to be more than merely the reduction of muscle tension at the training site. Whether biofeedback is more effective than simple instructions to relax or other types of relaxation procedures in terms of generalization of the relaxation effect to other indicators such as heart rate and subjective reports of anxiety is open to question. Biofeedback training research has generally been conducted under the assumption that training of the frontalis muscle will generalize to other muscle sites and lead to generalized muscular and psychological relaxation. This section of the literature review focuses on those studies done with normal populations in which EMG biofeedback is examined in terms of its effectiveness in bringing about relaxation. Research with clinical populations and studies involving an examination of individual differences are examined later in the review.

The earliest laboratory studies comparing EMG feedback to no-feedback control groups generally favored biofeedback for producing lowered muscle tension levels. One of these studies attempting to use biofeedback to enable subjects to achieve relaxation was conducted with normal subjects by Budzynski & Stoyva (1969). These authors assigned subjects to either an experimental group receiving true EMG frontalis feedback or one of two control groups. In the first control group, subjects were simply instructed to relax. In the second control group, subjects were given irrelevant feedback. After four treatment sessions, the results of the study clearly showed that the subjects in the experimental group had achieved significantly lower levels of muscle activity as evidenced by lowered frontalis muscle EMG levels than those in either of the control conditions.

Budzynski & Stoyva (1973) later devised an experiment to determine whether a similar procedure could be employed to train subjects to relax the masseter muscle. In the two experimental conditions, subjects received either continuous auditory feedback or visual feedback regarding the activity of the masseter. Control subjects received a steady tone or no feedback. Once again, results indicated that subjects in either experimental group decreased muscle activity significantly more than either of the control groups. The control groups did not differ significantly from each other.

Since the initial work of Budzynski and Stoyva, many other researchers have examined the efficacy of EMG frontalis biofeedback as a relaxation technique. Much of this research has been done as comparison studies in which biofeedback is compared to another form or forms of treatment. A great deal of variation in terms of subject population, number of treatment or training sessions, and control procedures makes it difficult to compare the studies adequately and fairly. The attempt here is to present and review a representative element of this research.

In a study using a normal subject population, Coursey (1975) found that biofeedback training produced a significantly greater reduction in the activity of the frontalis muscle than did either general instructions to relax accompanied by a non-contingent tone or more specific instructions about relaxation accompanied by a non-contingent tone. Frontalis muscle activity was significantly reduced in the feedback group as compared to the control groups, and the control groups did not differ significantly from each other. On subjective measures of anxiety all three groups reported decreases between the beginning and end of each training session, and the biofeedback group showed significantly greater decreases in state anxiety on only one of six measures used.

Thus, while the biofeedback group could be trained to reduce EMG activity in the frontalis muscle to a significantly greater degree than the other groups, no clear relationship existed between physiological muscle relaxation and other measures of relaxation and anxiety.

Reinking and Kohl (1975) also found that training in frontalis muscle reduction with biofeedback was superior to relaxation training without feedback and simple instructions to relax without feedback. This result, however, was accompanied by an equal drop in self-rated anxiety in all of the treatment groups. Reinking and Kohl used a total of five groups. One group was provided with visual and auditory feedback, a second with feedback and Jacobson-Wolpe type passive relaxation training, a third with feedback and monetary reinforcement whenever a criterion level of relaxation was achieved, a fourth with Jacobson-Wolpe relaxation training alone, and a fifth group that was simply instructed to relax. The authors found that there was no difference in performance among the three groups given feedback, and the authors interpreted this to mean that the addition of relaxation training or monetary reinforcement did not enhance the effects of feedback training alone. A particularly interesting finding of this study is that the auditory/visual feedback training group was superior to the Jacobson-Wolpe passive relaxation training group. This finding is in contradiction to the conclusions of a similar study by Haynes, Moseley and McGowan (1975).

The Haynes et al. (1975) study also employed five groups to compare the effectiveness of relaxation training procedures: EMG frontalis auditory feedback group; passive relaxation instructions group (instructions to attend to and relax muscles); active relaxation instructions group (instructions to tense and relax muscle groups); false feedback group; no treatment control group. The results showed that passive relaxation exercises were as effective in reduction of muscle tension levels as was biofeedback.

Another study compared the effects of various types of feedback modalities either alone or in combinations. Kinsman, O'Banion, Robinson and Staudenmayer (1975) compared the muscle tension levels of one group of subjects receiving continuous auditory feedback with those of a second group receiving discrete verbal feedback delivered immediately after subjects' trials to relax their frontalis muscles. A third group in this study received both continuous auditory and discrete verbal feedback, and a fourth group served as a control, hearing only a steady series of clicks which was unrelated to their actual level of muscle tension. The results indicated that subjects who received continuous auditory feedback achieved significantly greater muscular relaxation than did those in the other experimental or control groups. Also, it was determined that the addition of verbal feedback to the auditory feedback did not improve subjects' ability to relax.

One of the most recent and most ambitious studies designed to examine the relative potencies of various treatments to bring about increased relaxation was conducted by Hiebert and Fitzsimmons (1981) using a large population of undergraduates and others volunteering for a study examining treatments for anxiety management. Subjects were randomly assigned to one of the following treatment, placebo, or control groups: EMG biofeedback training, EMG biofeedback training followed by systematic desensitization, EMG biofeedback training and cognitive monitoring, EMG biofeedback training and cognitive monitoring followed by systematic desensitization, high expectancy discussion group (placebo control group), high expectancy discussion group followed by systematic desensitization, and a no contact waiting list control group. The results indicated that significant anxiety reductions were experienced in all of the treatment groups as measured both by decreases in subjective reports of anxiety and also in terms of EMG muscle tension levels. It was also found that treatment groups using EMG biofeedback demonstrated significantly greater decreases in anxiety on both the subjective self-report measure and the physiological measure than did treatment groups not using EMG biofeedback. Finally, adding desensitization or monitoring to the treatment program for subjects already receiving EMG biofeedback did not produce a more powerful effect than using EMG biofeedback alone. Hiebert and Fitzsimmons concluded that EMG biofeedback training was at least as effective a treatment procedure for anxiety as the more traditional treatments such as cognitive monitoring and systematic desensitization.

Two other group studies involving normal subjects can be mentioned at this point. Ohno, Tanaka, Takeya, Matsubara, Kuriya, and Komemushi (1978) compared two groups; one group received frontalis auditory feedback while the second group received only simple instructions to relax the muscles of the forehead. The results showed that EMG levels decreased significantly more for the feedback group than for the control group subjects. Alexander, French and Goodman (1975) devised a study to compare the relative efficacies of auditory and visual feedback in bringing about relaxation of the frontalis muscle. Subjects were assigned to groups receiving either auditory feedback with eyes opened, auditory feedback with eyes closed, visual feedback via a meter, or no feedback with eyes closed. Results indicated that only the eyes closed auditory feedback group achieved significant decreases in the level of frontalis muscle activity.

The Alexander et al. (1975) study is important because the authors also reported that while EMG frontalis levels were significantly reduced in the auditory feedback group, no correlation was found between decreases in EMG levels and in self-reported levels of relaxation. Thus, an important question was raised about the efficacy of biofeedback training as a technique for inducing a general relaxation response.

Several other studies have attempted to investigate the relationship between EMG frontalis biofeedback training and generalization of levels of relaxation. Alexander (1975) devised an experiment to test the underlying assumption of feedback training that relaxation of the frontalis muscle leads to generalized muscle relaxation and that lowered levels of EMG frontalis activity are related to subjective feelings of relaxation. An experimental group received five sessions of relaxation training, three of which were accompanied with EMG frontalis feedback. EMG readings were also taken from the forearm and the lower leg muscles. A control group also received five sessions, but without feedback. The results indicated no evidence of generalization of EMG reduction from the frontalis to the two untrained muscle sites. No evidence was found indicating that successful frontalis EMG reduction resulted in increased feelings of relaxation beyond what was obtainable from relaxing without the benefit of training. Alexander interpreted the results as suggesting that EMG frontalis biofeedback could not yet be accepted as a viable general relaxation technique.

Shedivy and Kleinman (1977) devised an experiment to further investigate the generalization of relaxation during EMG biofeedback training. These investigators wanted to determine if feedback-induced variations (increases and decreases) in frontalis muscle activity would generalize to other muscles as well as correlate with subjects' verbal estimates of tension or relaxation.

The sternomastoid and semispinalis/splenius muscles were chosen as sites to test for the generalization effects because of their proximity to the frontalis muscle and because they are frequently involved in psychosomatic disorders such as tension headache. Estimates of the degree of subjective tension or relaxation were obtained following baseline, increase frontalis, and decrease frontalis periods on each of five treatment days. Frontalis EMG activity showed significant increases and decreases relative to baseline levels during the appropriate periods. EMG levels from the nearby sternomastoid muscle did not change significantly during either increase or decrease frontalis periods. Semispinalis/ splenius activity also did not change during increase frontalis periods, but increased significantly during decrease frontalis periods. Subjects' estimates of subjective tension increased above baseline during increase frontalis EMG activity, but did not change significantly during decreases in frontalis EMG. The authors interpreted these results as supportive of the findings of Alexander (1975) in that changes in frontalis EMG neither generalize to other muscles nor correlate with subjects' verbal reports of tension or relaxation.

In a later study Alexander, White and Wallace (1977) investigated the transfer of training effects in EMG assisted relaxation. The investigators wanted to determine whether the feedback stimulus was necessary in obtaining EMG reductions during laboratory procedures, and whether prior training on one muscle facilitates the training of a second muscle. One group of subjects received forearm feedback training followed by frontalis training. A second group received training in the reverse order. Two control groups relaxed first on their own followed by either forearm training or frontalis training. The unique aspect of this study was that a great effort was made by the experimenters to motivate control subjects to perform maximally during the relaxation without feedback. Control subjects were instructed about the purpose of the experiment in such a way as to involve their interest and motivate them to relax as best they could. It was found that both trained and untrained subjects produced significant EMG reductions but did not differ from each other. No transfer of training effect was found. Furthermore, the results suggested no differences between feedback and no-feedback conditions for the physiological measures or for changes in state anxiety. The authors felt that the results cast doubt on previous EMG biofeedback research because of the quality of control group procedures in the great majority of studies where subjects in control groups are simply told to relax, but are given no motivation to do so and consequently become bored and restless. As a result, the authors felt it has not been surprising to find that subjects receiving biofeedback reduce muscle tension levels more substantially than controls receiving no feedback and little motivation to relax their muscles.

Four more recent studies (Davis, 1980; Gatchel, Korman, Weis, Smith, & Clark, 1978; Glaus & Kotses, 1979; and O'Connell & Yeaton, 1981) have further investigated the relationship between EMG biofeedback training and the generalization of decreases in muscle tension level. The results of these studies are conflicting, but generally do not support the notion of generalized relaxation following EMG training.

Gatchel et al. (1978) randomly assigned subjects to either an EMG biofeedback group or a false feedback group. After five sessions of training, subjects were exposed to a stress-induction procedure; they were told that they would receive a slight electrical shock through an electrode attached to the wrist. The results indicated that during the training sessions subjects in the EMG biofeedback group decreased frontalis muscle tension levels significantly. Heart rate and respiration rate for these subjects also decreased, but skin conductance level increased. Subjects in the biofeedback condition were also able to maintain low levels of frontalis EMG activity during the stress induction procedure, but heart rate, skin conductance level and self-reported anxiety all increased. The authors concluded that while biofeedback training is effective in bringing about decreased EMG levels and this effect can be maintained even under stressful conditions, the effect does not generalize to other indicators of arousal. In other words, the training is specific to one system only. The authors' inference here is clearly that biofeedback training is not a potent treatment because it affects only one indicator of a subject's level of anxiety.

Glaus and Kotses (1979) randomly assigned subjects to either a biofeedback training group in which subjects were trained to raise facial muscle tension levels, to lower facial muscle tension, or to a noncontingent feedback group. Forearm levels were also monitored. The authors found substantial evidence for covariation between muscle tension levels of the face and forearm muscles during EMG conditioning. However, subjects receiving noncontingent feedback also showed covariance in levels of frontalis and forearm muscle tension. The results further indicated that as training continued, there was less covariation of muscle tension levels among those subjects receiving true feedback than in subjects receiving noncontingent feedback. As subjects either increased or decreased the tension in their facial muscles, tension in the forearm muscles also increased or decreased, but in the opposite direction to the facial muscle. The greatest degree of muscle covariation across sessions was actually found in those subjects who were receiving noncontingent biofeedback. The authors concluded that EMG biofeedback training does not lead to a generalized response, but rather to a very specific response, i.e., muscular changes at the site of training only.

In the first of two experiments conducted by Davis (1980), support was given to the notion that generalization of muscle tension does occur during biofeedback training. Davis randomly assigned subjects to one of four conditions: frontalis EMG feedback; frontalis, forearm and semispinalis feedback; frontalis, forearm and masseter feedback; and a no-feedback control group. The results showed significant decreases in muscle tension levels for all three groups receiving biofeedback. Furthermore, it was found that there was no substantial difference between subjects who received only frontalis feedback and subjects who received feedback from the frontalis and another muscle. All three groups showed a generalization response to the feedback training. While these results support the notion of generalization of training effect that has been an assumption in much of biofeedback training and research, equivalent reductions in EMG levels were also found in subjects receiving no feedback.

In the O'Connell and Yeaton (1981) study, subjects were randomly assigned to one of two conditions in which EMG biofeedback was received from either the frontalis or the semispinalis muscle. All subjects received three feedback training sessions during which EMG levels from both muscle sites were monitored. The results showed a tendency for the levels of tension in the two muscles to covary, regardless of which muscle served as the source of the feedback. The authors concluded that it was fair to argue that frontalis feedback can be a useful method for relaxation training because of the moderate degree of association found between these two muscle groups during the training periods in this study.

To summarize, the evidence presented from laboratory research generally supports EMG biofeedback as a technique for bringing about significant reductions in frontalis muscle activity. These reductions are generally greater than those occurring with subjects given only instructions to relax but no feedback (Alexander et al., 1975; Budzynski & Stoyva, 1969, 1973; Coursey, 1975; Kinsman et al., 1975; Ohno et al., 1978; Reinking & Kohl, 1975). In a few studies, however, instructions to relax were as effective in reducing muscle tension as was biofeedback (Alexander et al., 1977; Haynes et al., 1975).

A related issue is that of correspondence between lowered muscle tension levels and subjective reports of anxiety reduction. Several studies have reported that relaxation of the biofeedback trained muscle site produces no corresponding reduction in subjective reports of relaxation (Alexander, 1975; Alexander et al., 1975). Other reports indicate that decreases in self-reported subjective anxiety are equivalent for biofeedback and other training techniques (Alexander et al., 1977; Coursey, 1975; Reinking & Kohl, 1975). Still other research indicates biofeedback to be superior to other techniques in terms of decreases in subjective anxiety (Hiebert & Fitzsimmons, 1981).

The results of the studies which have investigated generalization of training response to other muscle sites are also highly conflictual. The two most recent studies reviewed (Davis, 1980; O'Connell & Yeaton, 1981) point to the conclusion that generalization does in fact occur between trained and untrained muscles. A significant number of studies, however, do not support this conclusion (Alexander, 1975; Alexander et al., 1977; Gatchel et al., 1978; Glaus & Kotses, 1979; Shedivy & Kleinman, 1977). As Surwit and Keefe (1978) pointed out, one of the assumptions upon which frontalis EMG relaxation training and research has rested is that training of the frontalis muscle will lead to a generalized state of relaxation and that this change in muscle activity will further lead to a corresponding change in subjective feelings of relaxation. The results of the research investigating all of these issues are conflicting and inconclusive.

Research with Clinical Populations

The effectiveness of biofeedback as a relaxation training procedure has also been investigated in relation to clinically anxious patients. Interestingly, although the laboratory research does not support biofeedback as the most efficacious treatment in terms of producing a generalized relaxation response, it seems to compare favorably to other forms of relaxation treatments when used clinically.

Budzynski and Stoyva (1973) first argued that biofeedback could be used by itself or in conjunction with traditional relaxation training procedures to induce deep relaxation. They argued that training of the frontalis muscle would generalize to other muscles and result in subjective reports of relaxation. They further believed that the demand characteristics of traditional relaxation procedures are such that patients are inclined to say that they are relaxed even when they are not. By monitoring muscle tension levels, objective evidence could be provided regarding the patient's level of muscular relaxation. Furthermore, relaxation would be facilitated through feedback. Budzynski and Stoyva (1973) described several anxiety cases treated by systematic desensitization with EMG-assisted relaxation in conjunction with traditional relaxation procedures. As Ray, Raczynski, Rogers and Kimball (1979) point out, however, there was no presentation of a comparison of the combination of EMG-assisted and progressive relaxation procedures versus progressive relaxation alone as facilitators of the systematic desensitization. Therefore, while Budzynski and Stoyva claimed that their procedure was more effective than the traditional systematic desensitization procedure, the contribution of the biofeedback cannot be determined from their reports.

Anecdotal case reports of patients treated with EMG-assisted biofeedback as an adjunct to systematic desensitization for the treatment of various phobias and anxieties abound in the literature. Wickramasekera (1972), for example, successfully treated a woman suffering from intense fear of taking examinations by using EMG biofeedback in conjunction with a program of systematic desensitization. This treatment was successful in eliminating the anxiety and allowing the patient to pass an examination that she had avoided taking many times in the past because of her great anxiety.

The first group study to examine the effectiveness of EMG biofeedback as an aid to relaxation in clinically anxious patients was conducted by Raskin, Johnson and Rondestvedt (1973). Patients who had long standing histories of very severe generalized anxiety were selected for the study. All were also resistant to other forms of treatment including psychotherapy and medication. They were given forty hours of training in frontalis muscle activity reduction with feedback over an eight week period. In addition to EMG readings, subjective ratings of degree of relaxation were taken at the beginning and end of each session along with therapist ratings of degree of anxiety. All of the patients were able to produce very significant reductions in frontalis muscle activity, but less than half showed improvement in overall anxiety level. One significant finding in the study was that sometimes deep relaxation was accompanied by subjective feelings of profound anxiety. In other words, the level of frontalis muscle activity did not correlate with subjective reports of anxiety.

Townsend, House and Addario (1975) also assessed the effectiveness of EMG biofeedback assisted relaxation in the treatment of chronically anxious patients. Patients were matched in pairs on a combination of resting frontalis EMG, state-trait anxiety, and mood disturbance scores. They were assigned to either an EMG biofeedback group or to a group receiving group psychotherapy. The biofeedback group also practiced deep muscle relaxation with taped instructions for one-half hour each day, and continued the self-practice without taped instructions during the third and fourth week of therapy. Patients in the group psychotherapy condition received short term structured group therapy dealing specifically with anxiety. Evaluation of change from pre-treatment assessment to change during and after treatment indicated significant decreases in EMG levels, mood disturbance, trait anxiety, and to a lesser extent state anxiety for the patients in the biofeedback group. These same decreases did not appear in the comparison group therapy condition.

While Townsend et al. (1975) used a combination of general relaxation and specific frontalis relaxation training, Canter, Kondo, and Knott (1975) compared the relative efficacy of these two procedures. Psychiatric patients diagnosed as anxiety neurotics were treated in this study. Patients received between ten and twenty-five training sessions in either frontalis biofeedback treatment or progressive relaxation training. Results indicated that both training modalities led to a significant reduction in frontalis muscle activity by the end of the training, but the decline was much greater in the feedback group than in the progressive relaxation group. Furthermore, the reduction in frontalis muscle activity was accompanied by a reduction in subjective reports of anxiety level.

In a more recent treatment comparison study, Jessup and Neufeld (1977) compared frontalis muscle biofeedback, autogenic phrases, unaided self-relaxation and a non-contingent tone in terms of their effectiveness in helping hospitalized psychiatric patients, all of whom were diagnosed as depressed, to relax. The unique feature of this study was the employment of a non-contingent tone serving as the "relaxation training" for one of the control groups. Patients in this condition were told simply to relax, listen to the tape, and "let the tone relax you". Results indicated that heart rate and anxiety scores decreased significantly for subjects receiving the non-contingent tone. Except for decreases in anxiety scores for autogenic-phrase group subjects, the other three treatments did not significantly affect any of the physiological measures. Although Jessup and Neufeld provided only four daily twenty minute training sessions, their findings point up the fact that relaxation procedures, including biofeedback, are subject to non-specific effects.

Beiman, Israel, and Johnson (1978) compared the effects of four kinds of relaxation training procedures: live progressive relaxation exercises, taped progressive relaxation exercises, self-relaxation, and EMG frontalis biofeedback. Subjects were not psychiatric patients, but were individuals who responded to an ad for therapy. The results indicated that during training, live relaxation was superior to taped relaxation on physiological measures. Self-relaxation and biofeedback were equivalent except for the superiority of self-relaxation on reductions in autonomic arousal. After training, live relaxation was superior to the other procedures on self-control of autonomic arousal. In this study, biofeedback was actually found to be inferior to the other forms of training in some respects. For example, self-relaxation training reduced heart rate more than did frontalis EMG feedback.

The clinical studies reviewed thus far do not offer clear cut support for EMG biofeedback as the treatment of choice for anxiety reduction in clinical populations. The evidence is conflictual as was the case with the laboratory studies reviewed earlier. While biofeedback has usually been found to bring about frontalis muscle relaxation, other forms of relaxation training, including in one case a placebo non-contingent tone, sometimes seem to be equally effective training procedures. It can also be argued from the evidence of these studies with clinical populations that subjective reports of decreased anxiety do not necessarily correlate with lowered muscle tension levels as was the case with studies involving normal subjects reported above. It seems, however, that biofeedback has fared better as a treatment in studies with clinical populations than in research with normals.

Some of the research reviewed thus far has supported the effectivenes of EMG biofeedback as a training procedure in bringing about increased relaxation. Although reductions in EMG levels are not necessarily accompanied by subjective reports of increased relaxation and the generalization of muscular relaxation has not been definitively demonstrated, the evidence has generally supported EMG biofeedback as an effective treatment in itself, and in comparison to placebo treatments and other traditional methods of relaxation training.

Another significant body of research has examined the effectiveness of various treatments for tension headache and other tension related disorders. Several of these studies have supported treatements other than biofeedback as equivalent or superior in effectiveness as a means for bringing about relaxation.

Cox, Freundlich, and Meyer (1975) designed a study to assess the contribution of biofeedback to the treatment of tension headaches. Their study pointed to the fact that while biofeedback had been used successfully in combination with relaxation instructions as a treatment for tension headaches, and research had also shown the effectiveness of relaxation exercises alone, there was a lack of evidence concerning the effect of the biofeedback itself in the treatment of tension headaches. Subjects took part in a two week pre-treatment assessment period during which information was gathered relative to headache frequency and duration. They were then matched for headache frequency and assigned to one of three treatment groups. In the first group subjects received eight hour-long treatment sessions which included EMG frontalis training and cue-controlled breathing. In the second group subjects received an equal number of sessions during which they were instructed in the practice of muscular relaxation. Both of these treatment groups were encouraged to practice what they had learned in treatment at home. A third group of subjects received a placebo medication, and were told that it was an effective muscle relaxant. The results indicated that both the biofeedback group and the group receiving relaxation training significantly reduced EMG tension levels and headache frequency both at the end of treatment and at a four month follow-up. The placebo medication group showed no significant improvements. Importantly, there were no significant differences between the two treatment groups.

Haynes, Sides, and Lockwood (1977) reported similar findings in a treatment study with sleep-onset insomnia. Subjects were assigned to one of three groups receiving either EMG biofeedback training, verbal relaxation training, or simple instructions to relax. The results showed equivalent reductions for the biofeedback and verbal relaxation training groups both in terms of EMG levels and insomnia symptoms. The control group showed no significant reductions in either EMG levels or symptoms.

Sime and DeGood (1977) also reported equivalence in the results of their study comparing EMG biofeedback and progressive relaxation training. Subjects in this study were respondents to an advertisement in a university community offering a treatment program for nervous and tense individuals. Subjects were trained in either a biofeedback condition, a taped progressive muscle relaxation condition, or a placebo condition in which music was played as a "guide to relaxation". Both of the treatment groups significantly reduced muscle tension levels while the placebo group did not. Interestingly, while there were differences between treatment groups and the control group in terms of EMG levels, no differences were found in subjective reports of relaxation.

Another report of equivalence between biofeedback training and other methods is found in a study by Counts, Hollandsworth, and Alcorn (1978). College students scoring high on a self-report measure for test anxiety were randomly assigned to one of four conditions including EMG-assisted cue-controlled relaxation, cue-controlled relaxation alone, attention-placebo relaxation, and a no-treatment control condition. The attention-placebo condition consisted of having subjects listen to soothing music during their treatment sessions. The results showed that the two treatment groups were both equally effective in decreasing anxiety and in increasing test performance. The authors interpreted this result as not lending support to the hypothesis that biofeedback can contribute to the effectiveness of the more traditional cue-controlled relaxation training procedure.

One study showed biofeedback to be less effective than other relaxation techniques. Chesney and Shelton (1976) compared the effectiveness of three treatment procedures for muscle tension headaches using an undergraduate student population reporting a history of headache symptoms. Subjects were randomly assigned to one of the following four conditions: biofeedback training, muscle relaxation training, combined muscle relaxation and biofeedback training, and a no-treatment waiting list control group. The results showed that the biofeedback group was not significantly different from the no-treatment control group in reduction of headache symptoms. Both groups showed no significant improvement. The muscle relaxation group and the combined biofeedback and muscle relaxation group were both effective in significantly reducing headache symptomatology. The authors concluded that biofeedback training alone was not an effective treatment for muscle tension headaches.

The last group of studies reviewed above has suggested that biofeedback is not superior to other forms of relaxation training. Most of the studies report equivalence between biofeedback and other procedures. In one case biofeedback proved inferior to other treatments and equivalent to a no-treatment control group.

Earlier, both clinical and laboratory studies were reviewed in which biofeedback was shown to be generally more effective than the other procedures to which it was compared. Qualls and Sheehan (1981a) in their review and reappraisal of the biofeedback research have proposed that the neglect of systematic research with regard to individual difference variables in most of the biofeedback research can account for the discrepancies in the findings of these studies.

Research with Individual Differences

Research investigating individual differences and relaxation training responses has been relatively sparse. Several studies have explored isolated personality variables in relation to relaxation and biofeedback training and have reported mixed results. The studies presented here describe the results of research in these areas.

Locus of control is an individual difference variable which has been examined as a possible correlate in response to treatment. Investigators have also theorized that relaxation training could result in shifts towards internality in locus of control orientation. Kappes and Michaud (1978) devised a study to investigate this latter possibility. Using a population of test anxious female undergraduate college students, these investigators compared the effects of two training conditions: five training sessions of EMG feedback followed by five sessions of non-contingent feedback, and five sessions of non-contingent feedback followed by five sessions of EMG feedback. It was hypothesized that subjects would become more internalized following EMG feedback training, and more externalized following non-contingent feedback training. The results showed only a non-significant tendency for subjects to move towards internality following feedback training and towards externality following non-contingent feedback. The authors suggested that longer training might have resulted in more significant shifts on the locus of control variable since it is reflective of a fairly stable personality trait.

The Cox et al. (1975) study described earlier also examined subjects' pre and post treatment locus of control scores to detect any shifts that might be attributable to treatment. Statistically significant shifts towards internality were found in this study. These differences, however, were found not only in the EMG biofeedback treatment group, but also in the relaxation training group and in the placebo medication group. Meaningful conclusions about biofeedback's effectiveness in promoting a shift towards greater internal locus of control are impossible to draw from the results of this study.

Carlson (1977) has also studied the locus of control variable in EMG feedback training, and reported interesting results. In this experiment subjects were selected for participation on the basis of their extreme scores on a locus of control measure. All subjects received two baseline sessions and were then assigned to groups receiving eight training sessions of either EMG feedback or simple instructions to relax. Among other findings, it was reported that the scores of subjects who showed a high external orientation at pre-testing had shifted significantly towards internality by the end of the eight sessions of EMG feedback training. No shifts were found for internals, or for any subjects in the no-feedback control condition. This result contradicts the results of Cox et al. (1975) who reported shifts towards internality for all groups, and further complicates the issue of the role of locus of control as a relevant individual difference variable.

In summary, the research on the locus of control variable in relation to relaxation training is rather meager and the results inconclusive at best. Some indication that an individual's locus of control orientation may shift after training has been hinted at, but the exact nature of the relationship remains unknown at the present time.

The most systematic exploration of a personality variable has been conducted recently by Qualls and Sheehan (1979, 1981a, 1981b, 1981c). These authors have suggested that the capacity for self-absorption may be a mediating variable in subjects' response to treatment.

In reviewing and commenting on the biofeedback literature, Qualls and Sheehan discuss the evidence of their own research with intersubject differences, and point to the capacity for absorption as one variable which can account for differences in performance among subjects undergoing biofeedback training. These authors feel that previous research has obscured individual differences, particularly along the dimension of self-absorption, and that confusion about the effectiveness of biofeedback as a relaxation training procedure has been the result. A summary review of Qualls' and Sheehan's research is presented here to clarify their hypotheses about absorption capacity as a significant individual difference variable in biofeedback training.

In their earliest study concerning absorption capacity (1979) Qualls and Sheehan hypothesized that a subject's capacity for absorption would mediate the subject's ability to achieve muscular relaxation in either a biofeedback condition or a no-feedback training condition. Tellegen and Atkinson (1974, p.274) have defined absorpton as the capacity for a self-altering type of attention "involving a full commitment of available perceptual, motoric, imaginative, and ideational resources to a unified representation of the representational object". Inherent correlates of the capacity for absorption were a heightened sense of the reality of the attentional object, imperviousness to normally distracting events, and an altered sense of reality in general and of the self in particular. Because of high-absorption subjects' capacity for deep imaginative involvement and their imperviousness to distraction, it was suggested that they would be better able than low absorption subjects to relax without the "distraction" of a biofeedback signal. Subjects without this capacity, however, would likely relax more deeply with the help of biofeedback constantly signalling information about their muscle tension levels, and therefore, demanding their attention.

In their initial investigation of absorption and response to EMG biofeedback, Qualls and Sheehan (1979) tested a large group of subjects using Tellegen and Atkinson's Absorption Scale. Sixteen female subjects from both the high absorption and low absorption ranges were then randomly assigned to one of the two experimental conditons. All subjects received two training sessions: either a biofeedback training session followed by a no-feedback session during which they were told to relax as much as possible, or the same two sessions in the reverse order. During the sessions EMG frontalis levels were monitored as well as heart rate. Following the experiment, subjects were interviewed to determine the strategies they used to relax and which session they preferred.

The results indicated that during the first session frontalis EMG levels decreased significantly for all subjects. A significant interaction also occurred indicating that high absorption subjects decreased muscle tension levels significantly more during the no-feedback condition than during the feedback condition. This interaction supported the absorption interaction hypothesis. There were no significant differences, however, in low absorption subjects' performance in the two conditions. During the second session, a main effect indicated that EMG levels again decreased significantly. This effect was qualified, however, by an interaction effect indicating that high absorption subjects decreased muscle tension significantly while this was not the case for low absorption subjects. The results also indicated differential performance of high and low absorption subjects across the two experimental sessions. High absorption subjects reduced muscle tension levels in the second session significantly when they received biofeedback during that session. This was not the case for high absorption subjects in the reverse condition. Low absorption subjects showed no significant differences across sessions.

Qualls and Sheehan interpreted their results as supportive of the hypothesis that absorption capacity is an important individual difference variable affecting response to biofeedback training. High absorption subjects relaxed more deeply without the "distraction" of biofeedback while low absorption subjects were able to use the biofeedback to bring about significant decreases in muscle tension levels. Also, the authors attached significant meaning to the sessions effect reported above. They interpreted this as indicating that high absorption subjects overcame the interference effect of biofeedback over time. When high absorption subjects received biofeedback during their second session of training, its interference effect could be overcome because of the previous session's experience without biofeedback. When these same subjects received feedback in the first session, however, the feedback interfered with their ability to relax deeply.

Qualls and Sheehan (1981c) devised two experiments to follow up on the results of the post-experimental interview from their initial work. It was hypothesized that the critical role of the feedback signal was an attentional one, and this was tested by varying the amount of attentional demand on subjects in each of three relaxation training conditions. It was further hypothesized that low and high absorption subjects would differ in their response to the relaxation condition to which they were assigned in terms of the amount of attentional demand placed on them. The no-feedback condition was considered to be a low attentional demand situation while EMG biofeedback was considered to demand more of the attention of the subjects. A third condition was employed in these studies in which the experimenters frequently reminded subjects in a soft voice to continue their efforts to relax. This condition was also considered to be one in which attentional demand was high. Female subjects who were selected on the basis of their extreme scores on the Absorption Scale received two training sessions in each study.

The results of these two experiments taken together supported Qualls' and Sheehan's hypotheses. Low absorption subjects in the biofeedback and attentional demand conditions relaxed more deeply than did low absorption subjects in the no-feedback condition. It was reasoned that these subjects performed better because of the attentional focus demanded both by the feedback signal and the verbal encouragements and questions about relaxation from the experimenters. Because low absorption subjects are theoretically limited in their capacity for absorbed attention, the external focus of these two conditions helped them in the relaxation task. High absorption subjects, on the other hand, performed best in the no-feedback condition. When attentional demand was high or when receiving biofeedback, these subjects did not perform as well as those in the no-feedback condition. It was thought that this resulted because high absorption subjects have a preference for directing their attention inwards towards more imaginal activities. Both biofeedback and the attentional demand condition when it was high, interfered with these subjects' natural capacities and preferences.

The results of the post-experimental questionnaire used in the 1979 study described above also indicated that high absorption subjects tended to use imagery to achieve relaxation more than did low absorption subjects. It was found that biofeedback interfered with high absorbers' capacity to generate images. Qualls and Sheehan (1981b) hypothesized that performance could be enhanced for these subjects in a biofeedback conditon if at the same time instructions were given which would encourage the development of imagery. To test this hypothesis an experiment was conducted employing a biofeedback condition along with imagery encouragement, a biofeedback alone condition, and a no-feedback condition. As in the previously mentioned studies, female subjects selected on the basis of their scores on the Absorption Scale received two training sessions in one of the three conditons. The results of the experiment supported the hypothesis. Furthermore, the performance of subjects who received either biofeedback with imagery encouragement or no-feedback was greater than for those in the biofeedback alone condition.

The evidence from these experimental studies by Qualls and Sheehan (1979, 1981b, 1981c) provides some support for the hypothesis that intrasubject differences affect performance in relation to relaxation training methods. Qualls and Sheehan attempted to isolate absorption as a relevant individual difference variable mediating subjects' response to biofeedback training. Their work has supported their contention that the conflicting results of studies comparing biofeedback and no-feedback conditions can be reinterpreted and understood in terms of the differential performances of subjects along the dimension of absorption capacity. Other studies on this same variable, however, have not supported Qualls' and Sheehan's findings (DiScipio and Weigand, 1981; Arnone, 1982; Rupert et al., in press).

DiScipio and Weigand (1981), for example, tested the relationship between hypnotic susceptibility and performance in relaxation training. While Qualls and Sheehan (1979, 1981b, 1981c) used Tellegen and Atkinson's Absorption Scale to select subjects high or low on the absorption variable, DiScipio and Weigand used Spiegel's Hypnotic Induction profile for subject selection. On a theoretical level, these two measures should tap into the same or related personality traits since absorption capacity is related to hypnotic susceptibility (Tellegen & Atkinson, 1974).

Female undergraduate students scoring in the upper, middle and lower 10% of the hypnotic susceptibility measure attended one relaxation training session. Each subject underwent a brief baseline period followed by two treatment conditions, the order of which was counterbalanced. One treatment consisted of a biofeedback tone with no instructions about how subjects were to relax. The other treatment consisted of a biofeedback tone accompanying detailed taped instructions on facial muscle relaxation. The results, unfortunately, were analyzed without regard to the effect of order of the two treatments. The authors' hypothesis that high scoring and low scoring subjects on the hypnotic susceptibility measure would significantly differ from each other was not supported. The two extreme scoring groups of subjects both reduced EMG levels equivalently and significantly from baseline. Subjects in the middle range on the hypnotic susceptibility measure reduced tension levels significantly less than either of the other two groups.

Because this study did not analyze the effect of order of treatment, and consisted of only one training session, it is difficult to compare it to the Qualls and Sheehan (1979) study. It is also possible that the measures used did not reflect the same underlying personality trait.

In order to test the absorption hypotheses further, Arnone (1982) devised a study similar to Qualls and Sheehan's 1979 investigation described above. In this study both males and females were used as subjects. Also, subjects were included who scored in the middle range of Tellegen and Atkinson's Absorption Scale in addition to those scoring on the extreme upper and lower ends of the distribution. All subjects received two sessions of training including a biofeedback session and a no-feedback session. The order of condition was counter-balanced.

The results of this study provided only minimal support for the absorption capacity hypotheses. The reduction of muscle tension was found to be a complicated function of sex of subject interacting with absorption capacity. In fact, sex of subject seemed to be a more important mediating variable than the capacity for absorption in terms of ability to achieve muscular relaxation. Only males were able to achieve significant decreases in EMG levels during the first training session, and this occurred both with and without feedback. In the second training session, only females in the low absorption range who received biofeedback acheived significant reductions in muscle tension levels. Males, on the other hand, from both the low and medium absorption range achieved lowered levels without feedback.

Sex of subject also appeared to be an important mediating variable in terms of self-reported anxiety in this study. In the second session, for example, female subjects who received biofeedback training reported *increased* somatic anxiety and *lowered* relaxation levels while females in the no-feedback condition reported the reverse experience. Males, on the other hand, did not respond differentially to the two treatment conditions. While absorption capacity was only minimally supported as a mediating variable in relation to training, sex of subject emerged here as a relevant factor in terms of both physiological and self-report indicators of relaxation.

While sex differences in response to the training experience emerged clearly in the Arnone study, surprisingly little research has been done in this area. All of the work by Qualls and Sheehan, for example, involved only female subjects. Other studies frequently did not report information about the sex of subjects participating in the research, or if this information was reported it was not usually treated as an important individual difference. Information regarding the sex of experimenters conducting the researach has almost never been reported.

The research that has examined sex differences has yielded conflicting results. Two studies examined the role of sex differences and found that there were no differences between males and females in their performance with EMG biofeedback (Haynes et al., 1975; Malec, Sipprelle, & Behring, 1978). The Haynes et al. (1975) study described earlier does not provide a good test of the effect of sex differences and response to EMG biofeedback, however, because of the methodology employed in the study. These researchers compared five different training conditions, but only reported on the overall lack of correlation between changes in EMG levels and sex of subject. Since only one of the five conditions utilized EMG feedback, the result does not really reflect a test of the relationship between biofeedback and sex of subject.

Similarly, there are methodological problems with the Malec et al. (1978) study. These authors do not report finding significant reductions in EMG levels in response to biofeedback. Since there was no effect for biofeedback in the study, it does not represent a good test of differential response to biofeedback as a function of sex of subject. An interesting and unique feature of this study, however, is that it included both a male and a female experimenter and tested for the effects of this factor on training performance. The results indicated that across three separate training conditions, subjects working with the male experimenter decreased EMG means and standard deviations more than subjects working with the female experimenter. The authors suggested that further research be conducted to investigate the possible interpersonal influences exerted by experimenters in biofeedback research.

Four other studies have reported sex differences in response to relaxation training, but the results are contradictory. O'Connell, Frerker, and Russ (1979) reported that performance during biofeedback training is a complicated function of sex of subject interacting with the type of signal used to provide feedback. The results of their study suggested that males and females reached approximately the same EMG levels by the end of a training period, but that their performance during the training was quite different. Males showed their largest drop in muscle tension during the first three minute trial, while females showed large reductions only during later trials. These differences were thought to be a function of an interaction with three different modes of feedback signal (visual, auditory, and tactile). The authors' conclusion, however, was that males overall produced less muscle tension than females. Because this study failed to include a no-feedback control group, it is impossible to determine whether the sex of subject effect was actually a response to the biofeedback training. As Rupert et al. (in press) point out, the almost spontaneous drop in muscle tension among males suggests that they may not have needed the biofeedback to achieve relaxation. Females, on the other hand, appeared to benefit from the presence of the biofeedback in that their EMG levels were reduced by the end of the session.

Davis (1980) reported that female subjects showed greater decreases in EMG activity than did males. This effect was obtained in three different biofeedback conditions and in a no-feedback condition, and the effect maintained itself during a two minute post-training period as well. In contrast, Hiebert and Fitzsimmons (1981) reported that males had lower initial EMG levels than female subjects, and also experienced greater decreases in EMG levels than females.

Rupert, et al. (in press) reported a differential pattern of results for male and female subjects undergoing feedback or no-feedback relaxation training. Male subjects reduced EMG levels in both a biofeedback and a no-feedback training condition, while female subjects reduced EMG levels only in the biofeedback conditon. These results suggested that males could reduce muscle tension levels without the feedback while females could not. The authors suggested the possibility of a subject-experimenter interaction effect which could explain the sex differences found in their study. If female subjects found the experimental situation to be anxiety provoking or arousing when they were paired with a male experimenter, for example, this may have interfered with their ability to achieve decreased EMG levels without the presence of the biofeedback. This hypothesis could not be adequately tested, however, because there were three male experimenters and only one female experimenters taking part in this study.

The Hiebert and Fitzsimmons (1981) study described earlier also found sex differences in response to treatment. Specifically these authors found that males had lower initial EMG levels than female subjects, and experienced greater decreases in muscle tension levels during the course of training.

Taken together the results of these studies examining sex differences are inconclusive. Sex differences probably have an influential effect on performance in differing relaxation training conditions, but the exact nature of this effect has not been yet determined. This review also raises the question of interpersonal influence in the experimental training situation. It is quite possible, for example, that males and females may respond to an experimenter of the same or opposite sex in different ways. This influence could have an important bearing on their ability to achieve relaxation. More research is needed to examine these variables in a controlled way.

In summary, this examination of research involving individual differences in relaxation training has suggested that both sex of subject and sex of experimenter play a role in an individual's response to the experimental training situation.

Statement of the Problem

As the literature reviewed here indicates, controlled group studies comparing the effectiveness of biofeedback training procedures to other methods of relaxation training or to no-feedback control groups often show conflictual results with regard to the effectiveness of biofeedback training as compared to other relaxation procedures. Relatively few studies have systematically investigated individual differences in relation to relaxation training procedures. The results from these studies have indicated that sex differences may play a role in subject response to relaxation training. Also the suggestion was made that subjects may respond differentially as a function of the sex of the experimenter in light of the possible interpersonal demands made in the experimental training situation. Accordingly, the present study was designed to investigate the role of these individual difference parameters.

Hypotheses

The present study was designed to compare initial response to three relaxation training procedures. Specifically, it compared EMG biofeedback alone, passive relaxation training alone, and EMG biofeedback with passive relaxation training, and a no-training control group who were simply instructed to relax on their own without feedback or relaxation training. The study also compared the responses of male and female subjects, and utilized a male and a female experimenter so that the interaction between sex of subject and sex of experimenter could be assessed. To assess the response to training conditions, physiological (EMG levels) and self-report measures (Cognitive-Somatic Test of Anxiety; semantic differential; evaluation questionnaire) were used.

The hypotheses for this study sought to test differences in response to training conditions in several ways. Four hypotheses related to initial (adaptation level) differences among groups.

1. Adaptation level EMG scores for female subjects are higher than for male subjects.

2. Adaptation level EMG scores are lower for same sex experimenter/subject pairs than for opposite sex groups.

3. No significant differences exist between males and females in initial levels of self-reported anxiety or relaxation levels.

4. Same sex experimenter/subject pairings report lower initial anxiety levels than opposite sex pairings.

Four hypotheses related to differential response to training as measured by changes in muscle tension level.

5. Subjects receiving either biofeedback, relaxation training, or a combination of both evidence greater reductions in EMG levels than subjects in the no-training condition.

6. No difference in the reduction of EMG levels exists between subjects receiving only relaxation training and subjects receiving both relaxation training and biofeedback.

7. In each training condition, subjects paired with an experimenter of the same sex evidence greater reductions in EMG levels than subjects paired with an experimenter of the opposite sex.

8. Males reduce muscle tension levels across trials significantly whether they are in a training condition or a no-training condition, while females reduce muscle tension levels significantly only when receiving some form of training.

Two hypotheses related to differences among groups in self-reported anxiety.

9. In general, all subjects report lower anxiety and increased relaxation after a training session, regardless of condition. An exception is that subjects report increased cognitive anxiety after a biofeedback training session.

10. Subjects paired with an experimenter of the same sex report greater reductions in anxiety levels and increases in relaxation levels than do subjects paired with an experimenter of the opposite sex.

Finally, four hypotheses related to differences in subjects' evaluation of their experience of the training session and experimenter.

11. Subjects in the no-training control group evaluate the session less positively than subjects in any of the other three conditions.

12. Subjects paired with an experimenter of the opposite sex evaluate their training session less positively than subjects paired with an experimenter of the same sex.

13. Subjects paired with an experimenter of the same sex evaluate their own performance during the training session more positively than subjects paired with an experimenter of the opposite sex.

14. Subjects paired with an experimenter of the same sex report enjoying the training session more than subjects paired with an experimenter of the opposite sex.

CHAPTER III

METHOD

Subjects

The subjects who took part in this study were 48 male and 59 female undergraduate students at Loyola University of Chicago. These students took part in the study in order to fulfill a requirement for the introductory psychology course in which they were enrolled. In signing up to participate, students were informed only that they would take part in a research project designed to investigate how different people respond to different relaxation training procedures. Any students who had previous relaxation or biofeedback training were eliminated from participation in the study.

Physiological Measures

The instrument used to record frontalis EMG activity was the J&J Electronics M-55 EMG feedback unit with the accompanying LGS 150 digital integrating scorekeeper. The feedback unit was set to provide auditory feedback through headphones in the form of a pulsating tone that became higher and faster as muscle activity increased and lower and slower as it decreased.

To detect muscle activity, three silver/silver chloride electrodes were placed on the subject's forehead with adhesive collars and using standard placement as suggested by Lippold (1967). Prior to attachment, the skin was cleaned with alcohol and lightly abraded. Lectron II hypo-allergenic conductivity gel was used as the conductivity medium.

The digital integrator was located in a room adjacent to the testing and training room. The training room contained only a reclining chair, a table, and a small empty cart.

Self-Report Measures

Cognitive/Somatic Test of Anxiety. Before and after the training session, each subject completed the 21 item Cognitive/Somatic Test of Anxiety (Holmes, 1981). This instrument assesses the subject's perceived level of state anxiety and yields scores which subdivide the level of anxiety into cognitive, somatic, and relaxation level components.

Semantic Differential. Following the training session subjects completed a Likert-type semantic differential scale designed to assess their affective response to the session. This scale consisted of seven pairs of descriptive adjectives.

Evaluation Quesionnaire. Subjects completed a brief measure designed to evaluate subjects' responses to the appropriateness of the treatment condition as a means of bringing about a state of relaxation. This questionnaire also asked subjects to evaluate the experimenter in relation to descriptors such as helpfulness, competence, likeability, etc. The questionnaire also asked subjects to evaluate their own performance in relation to that of the "average student". Copies of these measures are found in Appendix A.

Design

A 2 (male, female experimenter) X 2 (male, female subject) X 2 (biofeedback session, no-feedback session) X 2 (relaxation training session, no-relaxation training session) experimental design was used in this study.

From six to eight male and female subjects were randomly assigned within sex groups to each of the four treatment conditions described below. Thus a total of 16 groups was used in the design. Nine groups contained six subjects per group; four groups contained eight subjects; and three groups contained seven subjects.

Procedure

In order to examine and control for differences in response to training as a function of sex of experimenter, subjects were randomly assigned within sex groups to work with either the male or the female experimenter who rendered the training for this study.

Upon entering the first session, subjects were given a brief introduction to the study and asked to sign a consent form (Appendix B). Subjects were then seated in a comfortable reclining chair and asked to listen to instructions through a set of headphones. All subjects heard the following taped explanation of the study:

> The purpose of this study is to investigate relaxation procedures. Psychologists have determined through research that the ability to relax is a skill which can be acquired through practice. It has also been learned that people vary in their ability to achieve deep muscular relaxation, and also in the strategies and means they use to help themselves relax. Through your participation in this laboratory experience, we are hoping to gather more information which will help in understanding how people acquire the skill of deep relaxation, and what methods are most suitable for different kinds of people. During your session in this laboratory, you will be attempting to relax the muscles in your body. To allow us to assess your progress in relaxing, the experimenter will attach three electrodes or sensors to your forehead. These electrodes will be taped on, so they will not cause you any discomfort. The electrodes will pick up the electrical activity in the muscles of your forehead, face, and neck. We can thus get periodic readings of your muscle tension levels. During your session in this laboratory, we will be carefully monitoring your progress in attaining relaxation. It is therefore very important that you devote your full attention to relaxation. You will be asked to wear headphones throughout the course of this experiment so that background noise will not interfere with your attempts to relax. Now the experimenter will attach the electrodes. When this has been done you will have some time - approximately fifteen minutes - to simply lean back in the chair and relax while getting used to your surroundings.

After attaching the electrodes the experimenter then allowed a 15 minute adaptation period during which the subject simply relaxed on his/her own and adjusted to the experimental surroundings and equipment. Adaptation level readings were taken during the last two minutes of this time. Following the adaptation period each subject was asked to complete the Cognitive/Somatic Test of Anxiety. The training portion of the session followed. It varied as follows according to the experimental condition to which the subject had been assigned.

Biofeedback Condition. In the biofeedback only condition, the experimenter first played the following taped instructions:

> We are now going to begin the training period of this laboratory session. You will be aided in your efforts to relax by a technique called biofeedback. It will monitor the amount of electrical activity in your forehead and facial muscles and will provide you with information about this tension level in the form of a pulsating tone. The tone will directly reflect your muscle tension. When your muscles are tense, the tone will become faster and higher. As you relax, the tone will become slower and lower. Thus, you will be trying to get the tone to go slow and low. We will not give you any specific instructions on how to relax. We want you to use the information from the biofeedback to help you develop your own relaxation methods. Thus, you should use whatever means are most helpful to you in getting the tone to go as low and as slow as possible. During the next twenty-four minutes, the experimenter will be in the adjoining room periodically monitoring your progress in relaxing by checking the levels of your muscle tension. Remember, your task for the next twenty-four minutes is simply to relax as best you can using the feedback tone as an indicator of your success.

The experimenter then adjusted the equipment so that the feedback tone played through the headphones at a volume comfortable for the subject, and left the subject alone to relax.

No-Training Condition. After the adaptation period of the No-Training session, subjects heard the following taped instructions:

> We will now begin the relaxation training part of this

laboratory session. We will give you approximately twenty-four minutes during which to practice relaxation. We will not give you any specific instructions as to how to relax, because we find that people are able to develop their own effective relaxation methods. During this relaxation period we would like you to sit back, close your eyes, and relax your muscles as deeply as you can, but do not fall asleep during this time. The experimenter will be in the adjoining room monitoring and recording your muscle tension levels. The experimenter will come back into the room at the end of the period to give you further instructions. Now, try and relax as much as possible, without falling asleep during the next twenty-four minutes.

Relaxation Training Condition. Subjects in this condition listened to the following instructions adapted from Goldfried and Davison (1976) during the twenty-four minute training period:

The instructions which you will hear for the next few minutes have been prepared as a guide to help you teach yourself the skill of deep relaxation. As you listen to the tape and follow the instructions, it will help you to relax the muscles of your body while at the same time enabling your mind to remain fully alert and clear. You are lying comfortably with your eyes closed, all parts of your body supported so that there is no need to tense any muscles. Just let go as best you can. (Pause) Focus in on the feelings in your right hand and let go of whatever tensions might be there. (Pause) Just relax. (Pause) Relax all of those muscles to the best of your ability. (Pause) Relax the muscles of the right forearm, just let go further and further. (Pause) Just let go of those muscles more and more, deeper and deeper. Relax. (Pause) Now relax the muscles of the upper right arm, just relax those muscles as best you're able. Continuing to let go further and further your entire right arm, forearm, and hand right down to the fingertips, just relax and let go. (Pause) Relax. While you continue to let go of your right arm and hand, turn your attention to your left hand, and relax your left hand to the best of your ability. (Pause) Just let go further and further. Let go of the muscles in the left forearm, just relax. Further and further relaxed. (Pause) Just feel the relaxation coming now into the upper left arm, those muscles also beginning to relax further an further, more and more. (Pause) Just relaxing further and further, more and more relaxed. (Pause) Relax now both your left and right shoulders, and feel the soft heaviness, the calm relaxation coming more an more into both your left and right arms, hands, fingertips. (Pause) Just let go of those muscles further and further.

(Pause) Now we turn our attention to the muscles of the face. Smooth out your forehead, just relaxing those muscles. (Pause) As you think of relaxing those muscles, you will gradually become more and more able to feel the relaxation coming into them. Your eyes lightly and comfortably closed. (Pause) Your jaws loosely relaxed, more and more, further and further. (Pause) Feel the relaxation moving calmly into your neck, and down into your chest, as you relax further and further. (Pause) As you think of letting go you are somehow able to let go further, more and more than before (Pause) You are breathing slowly and regularly, letting go a little bit more each time you exhale. (Pause) Relaxation coming down into your stomach now, more and more relaxed, just letting go further and further. (Pause) Relax, just relax. Feel the relaxation in your hips and buttocks, as you are resting heavily and comfortably. Further and further relaxed. (Pause) Relaxation spreading out into your thighs, more and more relaxed. (Pause) Deeper and deeper. Just continuing to let go further and further, more and more. (Pause)Relaxation spreading now to the calves of both your left and right legs, further and further relaxed. (Pause) Relaxation down into your feet, further and further relaxed. Just continue to relax. Further and further. (Pause)

To help you to relax even more, I am going to count slowly from 1 to 10. As I call out each number, see if you can relax a little bit more than before. Even when it seems impossible to relax any further, there is always that extra bit of calm and relaxation that you can enjoy, just by letting go further and further. (Pause) 1, relaxing more and more.(Pause) 2, further and further relaxed. (Pause) 3, more and more, further and further. (Pause) 4, more and more relaxed. (Pause) 5, relaxing your whole body, getting heavier and looser and more relaxed. (Pause) 6, deeper and deeper, further and further relaxed. (Pause) 7, your whole body further and further relaxed, heavier and looser, more and more calm. (Pause) 8, further and further, more and more relaxed. (Pause) 9, further and further relaxed. (Pause) And 10, just continuing to relax like that. Continuing to relax further and further. In a few minutes I am going to become silent so that you can practice the following exercise. I want you to think clearly to yourself of the word "calm" every time you exhale. I would like you to let go a little bit more each time you exhale and at the same time to think to yourself the word "calm". This will enable you to associate in your mind the word "calm" with the calm state you are now in. Each time you exhale I would like you to think silently to yourself the word "calm". Go ahead and do that until I return to talk to you once again. (2 minute pause) We are now near the end of the relaxation training period. Before the experimenter returns to the room I will count backwards from 5 to 1. As I

> count, I want you to begin to become aware of and acclimate yourself to your surroundings. At the count of 1 you will open your eyes and be alert, refreshed, and wide awake. 5,....4,....3,....2,....1,....eyes, wide open, and awake. The experimenter will return to the room momentarily.

Biofeedback with Relaxation Training Condition. Subjects in this condition first listened to the taped instructions describing the biofeedback tone. The experimenter then demonstrated the equipment and adjusted the volume of the tone. The subject was instructed that along with the biofeedback tone he or she would hear a series of taped instructions designed to help the subject relax as deeply as possible. Both the feedback tone and the relaxation instructions were played simultaneously through the headphones for the subject.

In all four conditions, the training portion of the session lasted 24 minutes. During this time, the subject's average level of EMG activity was recorded every two minutes. At the end of the session, each subject completed a second Cognitive/ Somatic Test of Anxiety, a semantic differential, and an evaluation questionnaire. After completing the self-report measures, subjects were thanked for their participation, any questions were answered, and subjects were dismissed.

CHAPTER IV

RESULTS

Initial Differences in EMG Levels and Self-Reported Anxiety

Average EMG levels were recorded for the final two minutes of the initial 15 minute adaptation period and at twelve two-minute intervals during the training session. These levels were subsequently averaged in groups of two to produce six training trial scores used in the analysis of the session.

To examine the hypotheses concerning the presence of initial differences in EMG levels among groups, a preliminary analysis was conducted using the adaptation period EMG scores of each subject. The groups were compared in a 2 (male, female experimenter) X 2 (male, female subject) X 2 (biofeedback, no-feedback) X 2 (relaxation training, no-relaxation training) analysis of variance. Summary tables for these analyses can be found in Appendix C. The analysis yielded a significant main effect for sex of subject, $F(1,91) = 13.34$, $p = .0004$, indicating that adaptation level scores for females ($M = 3.39$) were higher than for males ($M = 2.47$). This supported the prediction (hypothesis 1) that EMG adaptation levels for females are higher than for males. The prediction regarding differences among groups containing same sex and opposite sex pairings of experimenter/subject were not supported by these results (hypothesis 2).

The self-report anxiety measure used in this study provided three separate indicators of the level of experienced anxiety: a cognitive component, a somatic component and a relaxation level component. The measure was completed by each subject after the initial 15 minute adaptation period and again at the end of the training session. To examine hypotheses regarding differences among groups in initial levels of anxiety, separate analyses of variance were conducted for each of the three anxiety level scores using the design described above for the EMG adaptation level data.

The analysis of the scores for the cognitive component yielded one significant main effect and one interaction effect. The main effect for sex of experimenter, $F(1,91) = 4.19$, $p = .0436$, indicated that subjects working with the female experimenter reported higher levels of cognitive anxiety ($M = 8.26$) than those working with the male experimenter ($M = 7.17$). The analysis also yielded a significant sex of experimenter by biofeedback level by relaxation level interaction effect, $F(1,91) = 4.38$, $p = .0391$. The means for groups involved in this interaction are presented below in Table 1. Duncan multiple range tests indicated that subjects receiving only relaxation training and working with the female experimenter reported significantly higher initial levels of cognitive anxiety than subjects in any of the other groups. Since no training had been initiated at the time of these initial measures, the interaction did not reflect a differential response to training. Rather, it simply indicates that the main effect for sex of experimenter was primarily due to subjects assigned to the relaxation training only group and working with the female experimenter. None of these effects was hypothesized.

The analysis of the adaptation level scores for the somatic component of anxiety yielded three significant results. First, there was a main effect for sex of experimenter, $F(1,91) = 3.84$, $p = .0532$, which indicated that subjects working with the male experimenter ($M = 11.08$) reported higher levels of somatic anxiety than those working with the female experimenter ($M = 10.02$). This effect was not predicted by the hypotheses. Second, a main effect for sex of subject, $F(1,91) = 5.59$, $p = .0002$, indicated that males reported higher somatic anxiety levels ($M = 11.19$) than females ($M = 9.91$). This result did not support the prediction that no differences exist between males and females in initial levels of self-reported anxiety (hypothesis 3). Third, the analysis yielded a significant sex of experimenter by biofeedback level effect, $F(1,91) = 5.07$, $p = .0267$. Duncan multiple range tests on the means for groups involved in this interaction confirmed a significant difference between subjects working with the male experimenter and assigned to one of the biofeedback con-

TABLE 1

Mean Adaptation Level Scores for Cog and Som Anxiety

	Sex of Experimenter	
Cognitive Anxiety	Male	Female
NT	7.25	7.35
BF	7.44	7.58
Relax	6.74	10.71
BF and Relax	7.24	7.08
Somatic Anxiety		
NT; Relax	10.04	10.18
BF; BF and Relax	12.04	9.75

NT = No biofeedback or relaxation training session
BF = Biofeedback only session
Relax = Relaxation training only session
BF and Relax = Biofeedback and relaxation training

ditions and all other groups. These subjects reported significantly higher levels of somatic anxiety than others. As noted in the previous interaction effect, no training had been initiated at this point in the session. This result was not predicted by the hypotheses. The means for groups inovolved in the interaction appear in Table 1.

Finally, the analysis of the scores for the relaxation level component of the anxiety measure yielded no significant differences among groups.

In sum, the results of these analyses did support the prediction that females would have higher initial EMG levels than males (hypothesis 1). There was no support, however, for the prediction concerning differences among same sex and opposite sex pairings of experimenters and subjects (hypotheses 2 and 4).

Frontalis EMG

To examine the hypotheses relating to differential performance in EMG reduction among groups, a 2 (male, female experimenter) X 2 (male, female subject) X 2 (biofeedback, no-feedback) X 2 (relaxation training, no-relaxation training) x 6 (trials) analysis of variance with repeated measures on the last factor was performed on the EMG data. The summary tables for this analysis appear in Appendix D.

This analysis yielded two significant main effects and two interaction effects. The main effect for sex of subject, $F(1,91) = 5.31$, $p = .0235$, indicated that mean EMG levels for females ($M = 2.85$) were higher than for males ($M = 2.32$). Since EMG adaptation levels for females were higher than for males, the data were further analyzed to determine if this main effect was due solely to the persistence of initial differences in EMG levels between males and females. To investigate the main effect for sex of subject, therefore, an analysis of covariance was performed using the adaptation level EMG scores as the covariate for the six EMG trial scores. The analysis of covariance yielded no significant differences between groups due to sex of subject. It can be assumed that the analysis of variance main effect for sex of subject reflects the persistence of initial differences between males and females which first appeared in the adaptation period. There was no support, therefore, for the prediction that males reduce muscle tension levels across trials whether they are in a training or a no-training condition, while females reduce tension levels only when receiving training (hypothesis 8).

A main effect for trials, $F(5,455) = 4.91$, $p = .0002$, indicated that all subjects reduced frontalis muscle tension levels across trials. EMG means for Trials 1 through 6 were : 2.81, 2.57, 2.55, 2.65, 2.56, and 2.54. Although the pattern of results indicated a general decrease in muscle tension levels across the session, Duncan multiple range tests confirmed a significant difference only between Trial 1 and the other five trial periods. This finding was qualified, however, by two significant interaction effects.

A trials by sex of experimenter effect, $F(5,455) = 2.53$, $p = .0283$, indicated that subjects working with the two experimenters showed differing patterns of EMG reductions across trials. The means for groups involved in this interaction are presented in Table 2. For subjects working with the male experimenter, significant differences in EMG levels were confirmed only between Trial 2 and all other trials. These subjects showed a relatively large initial reduction in EMG tension levels and a subsequently slow incremental return to higher tension levels. Subjects working with the female experimenter, however, showed a less dramatic initial decrease in EMG levels. For these latter subjects Trial 1 was significantly different from all other trials. The means for groups involved in this interaction are presented in Table 2. Differences in the reduction of muscle tension across trials as a function of sex of experimenter were not predicted by the hypotheses.

A second interaction for trials by biofeedback level, $F(4,455) = 2.37$, $p = .0436$, indicated that subjects receiving biofeedback generally reduced muscle tension levels across trials more than did subjects not receiving biofeedback. The means for

TABLE 2

Mean EMG Levels Across Trials

Trial	Experimenter Sex		Biofeedback Level	
Period	Male	Female	No-feedback	Biofeedback
1	2.73	2.89	2.74	2.82
2	2.17	2.56	2.43	2.71
3	2.62	2.50	2.42	2.67
4	2.73	2.59	2.63	2.68
5	2.70	2.43	2.54	2.58
6	2.62	2.46	2.57	2.51

groups involved in this interaction are presented in Table 2. Again the pattern of reduction in EMG levels across trials was different for subjects in different conditions. For subjects training in no-feedback conditions, Trial 1 was significantly different from Trials 2, 3, and 5. The pattern of change indicated an initially large decrease in EMG level. For subjects in the biofeedback training conditions, however, the pattern of trial means was somewhat different. For these subjects Trial 1 was significantly different from Trials 5 and 6, and Trial 2 was different from Trial 6. Also, a greater overall decrease in EMG levels was shown by subjects in the biofeedback training conditions. The lack of differences in the reduction of muscle tension levels between subjects who received only biofeedback and those who received both biofeedback and relaxation training provided support for the hypothesis advanced (hypothesis 6).

To summarize, these results provided partial support for the hypotheses advanced. It had been predicted that subjects receiving either biofeedback or relaxation training or both of these would show significantly greater EMG reductions than subjects who underwent a no-training session (hypothesis 8). While subjects in biofeedback and no-feedback conditions both reduced levels of muscle tension, the presence of biofeedback seemed to aid subjects in reducing EMG levels to a greater degree. These subjects had a greater overall decrease in EMG levels. No support, however, was found for the prediction relating to differences in relation to same sex, opposite sex pairings of experimenter and subject (hypothesis 7).

Self-Report Anxiety

To examine changes in subjects' subjective experience of anxiety during the relaxation training, the pre- and post-training scores for each of the three components of anxiety were subjected to a 2 (male, female experimenter) X 2 (male, female subject) X 2 (biofeedback, no-feedback) X 2 (relaxation training, no-relaxation training) X 2 (pre-, post-training) analysis of variance with repeated measures on the last factor. Summary tables can be found for these analyses in Appendix E.

Cognitive Anxiety. The analysis of the cognitive anxiety component scores yielded one significant main effect and six interaction effects. The main effect for pre- (M = 7.76) to post- (M = 6.84) training, $F(1,91) = 14.01$, $p = .0003$, indicated significantly lowered cognitive anxiety for all subjects after the training session.

The means for groups involved in the sex of experimenter by biofeedback level by relaxation level interaction effect, $F(1.91) = 4.06$, $p = .0469$, are presented in Table 3. Duncan multiple range tests indicated a significant difference between sub-

TABLE 3

Cognitive Anxiety: Exp Sex by Biofeedback by Relax

Training Condition	Sex of Experimenter Male	Female
No Training	7.00	6.97
Biofeedback only	7.24	7.43
Relaxation training only	6.53	8.63
Biofeedback and Relaxation training	7.65	6.85

jects receiving relaxation training with the male experimenter and subjects receiving the same training with the female experimenter. Subjects receiving relaxation training from the female experimenter reported higher levels of cognitive anxiety than those with the male experimenter.

The main effect for pre- to post-training mentioned above was qualified by five interaction effects. First, there was a pre- to post-training by sex of experimenter interaction, $F(1,91) = 10.34$, $p = .0018$. Duncan multiple range tests indicated a significant pre- to post-training decrease in cognitive anxiety only for subjects working with the female experimenter. Means involved are presented in Table 4.

Second, a pre- to post-training by sex of experimenter by sex of subject interaction effect, $F(1,91) = 4.07$, $p = .0466$, further qualified the above findings. The means for groups involved in this interaction are presented in Table 4. Duncan multiple range tests indicated that significant decreases in cognitive anxiety occurred only in the session with the female-female pairing. This finding partially supported the prediction that same sex experimenter/subject pairings report reduced anxiety after a training session than do opposite sex pairings (hypothesis 10).

Third, a pre- to post- by sex of experimenter by relaxation level interaction, $F(1,91) = 5.57$, $p = .0204$, again qualified the above findings. The means involved in this interaction are

in Table 4. Duncan multiple range tests indicated a significant decrease in reported cognitive anxiety levels after the training session only by subjects working with the female experimenter and receiving relaxation training during the session. Interestingly, subjects receiving relaxation training from the male experimenter actually increased reported cognitive anxiety levels, although these increases were not statistically significant.

The fourth interaction effect yielded in this analysis was a pre- to post-training by biofeedback level effect, $F(1,91) = 7.46$, $p = .0076$. The means for groups involved are presented in Table 5. Duncan multiple range tests indicated a significant pre- to post-training decrease in reported cognitive anxiety only when subjects had undergone a training session without biofeedback. This result did not support the prediction that subjects in a biofeedback training session report increased cognitive anxiety levels since no change in cognitive anxiety was found in this group (hypothesis 9).

The fifth interaction effect in this analysis was a pre- to post-training by biofeedback level by relaxation level interaction, $F(1,91) = 7.57$, $p = .0072$. The means for groups involved

TABLE 4

Changes in Cognitive Anxiety Levels

Sex of Subject	Sex of Experimenter	
	Male	Female
Male		
pre-	7.54	7.92
post-	7.13	6.96
Female		
pre-	6.83	8.60
post-	6.97	6.40 **
All Subjects		
pre-	7.17	8.26
post-	7.05	6.68 **
Training Condition:		
Relaxation Conditions (Relax; BF and Relax)		
pre-	6.99	8.90
post-	7.20	6.58 **
No-Relaxation Conditions (NBF; BF)		
pre-	7.35	7.61
post-	6.90	6.78

** Indicates a significant decrease in pre- to post-training level of cognitive anxiety.

are presented in Table 5. Duncan multiple range tests indicated that a significant decrease in anxiety after the training session was reported only in the group receiving relaxation training. This result only partially supported the prediction that subjects generally report lower anxiety after a training session regardless of condition (hypothesis 9) since lowered anxiety was reported only by subjects receiving relaxation training only.

In summary, this complex pattern of interactions appeared to be generated by significant decreases in cognitive anxiety levels in one group, i.e., females who received relaxation training from the female experimenter. This provided partial support for the prediction that subjects paired with an experimenter of the same sex report greater reductions in anxiety than do subjects paired with an experimenter of the opposite sex (hypothesis 10).

Somatic Anxiety Component. The analysis of somatic anxiety component scores yielded two significant main effects. First, a main effect for sex of subject, $F(1,91) = 7.66$, $p = .0069$, indicated that males ($M = 10.74$) reported higher somatic anxiety levels than females ($M = 9.46$). This effect was not predicted by the hypotheses. Second, a pre- ($M = 10.49$) to post- ($M = 9.59$) training effect, $F(1,91) = 7.32$, $p = .0032$, indicated that subjects in all four groups reported significantly lowered levels of somatic anxiety after the training session. This result supported

TABLE 5

Changes in Mean Levels of Cognitive Anxiety by Condition

Biofeedback Conditions		No-feedback Conditions	
BF		NT	
Pre-	7.66	Pre-	7.30
Post-	7.01	Post-	6.67
BF and Relax		Relax	
Pre-	7.16	Pre-	8.72
Post-	7.35	Post-	6.42 **
BF ; BF and Relax		NT; Relax	
Pre-	7.41	Pre-	8.01
Post-	7.18	Post-	6.55 **

** Indicates a significant decrease in pre- to post-training level of cognitive anxiety.

the prediction that subjects generally report lowered anxiety levels after a training session, regardless of training condition (hypothesis 9).

Relaxation Level Component. Analysis of the relaxation level component scores yielded one significant main effect, and two interaction effects. The main effect for pre- (M = 31.57) to post- (M = 34.02) training, $F(1,91) = 18.35$, $p = .0001$, indicated that subjects overall reported increased relaxation levels after the training session.

The first near significant interaction effect was for sex of subject by biofeedback level, $F(1,91) = 3.81$, $p = .0539$. Duncan multiple range tests on the means involved in this interaction indicated that a significant difference existed between male and female subjects whose training session involved no feedback. Females reported greater levels of relaxation in the no-feedback conditions than did males in the no-feedback conditions. No hypothesis was advanced which would predict this effect. The means involved for this interaction are presented in Table 6.

The second interaction effect in this analysis was for pre- to post-training by sex of subject by relaxation level, $F(1,91) = 5.75$, $p = .0185$. The means for groups involved in this interaction are presented in Table 6. Duncan multiple range tests

TABLE 6

Mean Relaxation Levels

Training Conditions	Sex of Subject: Male	Sex of Subject: Female
Biofeedback Conditions (BF and BF+Relax)	32.98	33.15
No-Feedback Conditions (NT and Relax)	31.54	34.45
Relaxation Training Conditions (Relax and BF+Relax)		
Pre-	32.46	31.11
Post-	33.50	35.54
No-Relaxation Training Conditions (BF and NT)		
Pre-	31.17	32.75
Post-	34.00	35.90

indicated that a significant increase existed in pre- to post-training relaxation level for three groups: males not receiving relaxation training, and females in both the groups which did and did not receive relaxation training. This result partially supported the prediction that subjects generally report increased relaxation levels after a training session regardless of condition (hypothesis 9). This increase occurred in three of four groups. The prediction that subjects paired with an experimenter of the same sex report greater increases in relaxation levels than subjects paired with an experimenter of the opposite sex was not supported by these results (hypothesis 10).

In summary, the results of the self-report anxiety measure present a complex pattern of differential response to training among groups. In terms of cognitive anxiety, significant decreases were reported only by females receiving relaxation training from the female experimenter. Somatic anxiety levels for males were higher than for females, while all subjects generally reported decreases after the session, regardless of condition. Finally, increases in relaxation levels were reported by males in no-relaxation training conditions, and by females in both relaxation and no-relaxation training conditions.

Semantic Differential

An abbreviated semantic differential measure was given to each subject after the training session. Subjects were asked to rate their response to the session in relation to seven pairs of descriptive, evaluative adjectives. The subjects' ratings for each pair of adjectives were then summed together for the analyses. It was predicted that subjects who underwent the no-training session would respond less favorably to the session than subjects in the other three training conditions (hypothesis 11). It was further predicted that subjects paired with an experimenter of the opposite sex would evaluate the training session less favorably than subjects paired with an experimenter of the same sex (hypothesis 12). A 2 (Male, Female experimenter) X 2 (Male, Female subject) X 2 (Biofeedback, No-feedback) X 2 (Relaxation training, No-relaxation training) analysis of variance was performed on the semantic differential scores. A summary table of this analysis appears in Appendix F.

A main effect for sex of subject, $F(1,89) = 4.78$, $p = .0314$, suggested that females ($M = 43.19$) reported a more positive experience of the session than males ($M = 40.93$) regardless of the training condition or experimenter to which they were assigned. These results did not support either of the hypotheses mentioned above.

Training Session Evaluation Questionnaire

A questionnaire was given to each subject at the end of the training session to examine differences in subjects' evaluations of the training conditions and in their responses to the experimenters. The questionnaire also asked subjects to rate their own performance on the relaxation task in relation to the "average" student. It was predicted that subjects would evaluate training sessions in which they received biofeedback, relaxation training, or a combination of both as more effective procedures for increasing relaxation and coping with stress than a session during which no relaxation training or feedback was given (hypothesis 11). Furthermore, it was predicted that subjects paired with an experimenter of the same sex would evaluate the experimenter more favorably than subjects working with an experimenter of the opposite sex (hypothesis 12). Finally, it was predicted that subjects paired with an experimenter of the same sex would evaluate their own performance in the task more positively than subjects working with an experimenter of the opposite sex (hypothesis 13).

The first six items of the questionnaire asked subjects to evaluate the training session on a scale from 1 through 10 in terms of its effectiveness as a method for bringing about mental and physical relaxation, and coping with daily stress. The scores of these items were summed and the total used in this analysis. Six other items asked subjects to evaluate the experimenter who worked with them in terms of qualities such as competence, helpfulness, and likeability. The sum of these scores was also used in the analysis. One item asked subjects to evaluate their performance in relation to the "average" student's performance on the same task. The scores from these items were subjected to a 2 (male, female experimenter) X 2 (male, female subject) X 2 (biofeedback, no-feedback) X 2 (relaxation training, no-relaxation training) analysis of variance to examine differences in response among groups.

In the first analysis of the responses to the questionnaire, the first six items were summed together. These questions basically asked subjects to evaluate the effectiveness of the training session as a procedure for bringing about relaxation. The analysis yielded two significant main effects. First, a sex of experimenter effect, $F(1,89) = 5.46$, $p = .0217$, indicated that subjects who worked with the female experimenter ($M = 48.18$) evaluated their training session more favorably than did subjects who worked with the male experimenter ($M = 43.94$). This effect was not predicted by the hypotheses. Second, there was a main effect for relaxation level, $F(1,89) = 11.14$, $p = .0012$. An examination of the means indicated that subjects who received relaxation training ($M = 48.98$) evaluated the session more positively than subjects who did not ($M = 43.18$). This effect was not predicted by the hypotheses. There was no support for the prediction that subjects in same sex subject/experimenter pairings evaluate their training sessions more positively than subjects who worked with an experimenter of the opposite sex (hypothesis 12). Furthermore, there was no support for the prediction that subjects evaluate sessions in which they receive biofeedback and relaxation training more positively than no-training sessions (hypothesis 11).

A separate analysis was performed on the item which asked subjects to indicate simply how much they enjoyed their training session. This analysis yielded one nearly significant main effect for sex of subject, $F(1,89) = 3.70$, $p = .0577$. Regardless of training condition or sex of experimenter, females ($M = 8.57$) enjoyed the session more than males ($M = 7.94$). This result did not support the prediction that subjects who worked with an experimenter of the same sex would report enjoying the session more than subjects who worked with an experimenter of the opposite sex (hypothesis 14).

A separate analysis was also performed for the item which asked subjects to evaluate their training session as a method which would help them in the future to cope with the stresses of their daily lives. The analysis yielded one main effect for relaxation level, $F(1,89) = 6.64$, $p = .0116$. This result indicated that subjects felt more positively about the usefulness of the training session which included relaxation training ($M = 8.24$) in relation to subjects whose training included no relaxation training (M = 7.31). This result partially supported the prediction that subjects whose training session included neither biofeedback nor relaxation training evaluate the session less positively than subjects in the other training conditions (hypothesis 11).

Another analysis was conducted to examine differences in response to those items which asked subjects to evaluate the experimenter with whom they had worked. For the purposes of this analysis, the responses to the last six items of the questionnaire were summed together. This analysis yielded a significant sex of experimenter by sex of subject interaction effect, $F(1,89) = 12.13$, $p = .0008$. Duncan multiple range tests on the means involved in this interaction confirmed two significant differences between groups. First, among female subjects, there was a significant difference in the evaluation of the two experimenters: the response to the female experimenter was significantly more favorable than the response to the male experimenter. Second, there was a significant difference in the evaluation of the female experimenter by male and female subjects; females evaluated the female experimenter's performance more positively than did males. The means for groups involved in this interaction are in Table 7. This result partially supported the prediction that subjects paired with an experimenter of the opposite sex evaluate the experimenter less positively than subjects paired with an experimenter of the same sex (hypothesis 12).

TABLE 7

Post-training questionnaire

Experimenter Sex	Male		Female	
Subject Sex	Male	Female	Male	Female
Questions 8-13 Evaluation of Experimenter	56.83	55.22	54.42	58.55
Question 5 Subject performance Self-evaluation	6.96	5.89	6.67	6.87

The analysis of the responses to the item which asked subjects to evaluate their own performance in relation to the "average" student yielded a nearly significant main effect and a significant interaction effect. The main effect was for biofeedback level, $F(1,89) = 3.86$, $p = .0527$, and indicated that subjects who had a biofeedback session ($M = 6.30$) evaluated their own performance less positively than subjects who had no feedback during their training session ($M = 6.90$). This result was not predicted by the hypotheses. A sex of experimenter by sex of subject interaction effect, $F(1,89) = 5.28$, $p = .0239$, also resulted from this analysis. Duncan multiple range tests on the means involved in this interaction indicated that female subjects who worked with the male experimenter evaluated their own performance during the training session significantly lower than did the other three groups. The means are presented in Table 7. This result offers partial support for the prediction that subjects paired with an experimenter of the same sex evaluate their own performance during the training session more positively than subjects paired with an experimenter of the opposite sex (hypothesis 13).

CHAPTER V

DISCUSSION

The purpose of this study was to investigate initial response to one session of training in one of the following conditions: biofeedback, passive relaxation exercises, biofeedback along with passive relaxation exercises. A no-training control group was also employed. Response to training was measured in several ways. Frontalis EMG levels were monitored, subjective measures of anxiety were compared before and after the training session, and a questionnaire was used to evaluate the effectiveness of the training session. The study also assessed sex differences in response to the various training conditions. In addition, experimenters of both sexes were involved in rendering the training to allow for the evaluation of interaction effects between sex of experimenter and sex of subject.

This discussion is organized into five sections. The first section deals with the findings related to adaptation level differences. The second section examines findings related to the comparative evaluation of the three training conditions and no-training control group as measured by decreases in muscle tension levels. The third section addresses findings concerned with self-reported anxiety and relaxation levels and the responses to the training measured by the semantic differential. The fourth section addresses the results of the evaluation questionnaire. The final section presents conclusions and suggestions for future research.

Adaptation level differences

The present study found several interesting differences among groups in terms of adaptation levels. As predicted, females showed higher initial EMG levels than males. This same initial difference in muscle tension levels between the sexes has been reported elsewhere in the literature (Hiebert and Fitzsimmons, 1981). Also, males generally reported higher somatic anxiety levels than females. Although no actual training had been initiated which could account for these results, subjects had been introduced at this point to the experimenter and had received an introduction to the demands of the experimental situation. They had also experienced skin preparation and the application of the electrodes by the experimenter. The differences between subjects in levels of muscle tension and anxiety could be interpreted as due to differing ways in which subjects processed the demands of the experimental situation.

As Davidson and Schwartz (1976) point out, anxiety can be understood as a multi-process phenomenon involving cognitive and somatic components or dimensions. Within this model, the psychic (cognitive) and physiological (somatic) dimensions of anxiety are to a certain extent distinct phenomena which interact and overlap to produce the overall experience of anxiety. The results of the present study can be interpreted in light of this model for conceptualizing anxiety. It is possible, for example, that the males in this study experienced and reported their initial anxiety more physiologically than psychologically. As a result, males reported higher levels of somatic anxiety. The females, on the other hand, actually had higher muscle tension levels than the males, but did not report somatic anxiety levels which would parallel their muscle tension levels. It may be that females deny the existence of tension, or they may not be aware of it. In any case, it is likely that the males and females in this study really did differ in the ways in which they experienced and reported their initial anxiety in the experimental situation.

The differences in subjects' responses to the two experimenters are also of interest. Subjects working with the female experimenter reported higher levels of cognitive anxiety; those working with the male experimenter reported higher levels of somatic anxiety. Since only one male and one female experimenter took part in the study, it is difficult to generalize from the results. It is quite possible, however, that subtle interpersonal demands of the situation, possibly generated by sex differences, were influential in producing differences in response between subjects working with the two experimenters.

Differences in muscle tension reduction

While subjects generally decreased EMG levels across trials, those working with the two experimenters differed in the patterns of muscle tension reduction. Specifically, those working with the male experimenter showed smaller overall decreases. These subjects showed a relatively large initial decrease after the first four minutes followed by small increases and then small decreases. In other words, the pattern of reduction was somewhat erratic. Those working with the female experimenter, on the other hand, showed a more consistent pattern of small reductions in tension across trials. This finding is similar to that of Malec et al. (1978) who also found differences in the EMG treatment means for subjects working with two experimenters of different sexes. Once again, as was the case with adaptation level differences, these results suggest the possibility of experimenter characteristics which may influence subjects' responses to the training or treatment situation.

This study also found differences in the pattern of muscle tension reduction between subjects whose training included biofeedback and subjects whose training did not include biofeedback. Subjects who received biofeedback during the session showed greater overall reduction in muscle tension. These subjects showed a tendency towards a pattern of small, consistent decreases in EMG levels. Subjects who did not receive biofeedback showed larger initial decreases in muscle tension, followed by a tendency towards small increases. These patterns suggested that the presence of the biofeedback signal aided in the consistent reduction of EMG levels. While subjects not receiving feedback were able to reduce muscle tension levels initially, they were not able to maintain these lower levels across time. If the success of training is measured by lowered EMG levels alone, training which included biofeedback was more effective than the other procedures. These results may be interpreted as supportive of Qualls and Sheehan's (1981c) contention that for some individuals the presence of the biofeedback signal provides an external source of "motivation" in that it serves to focus their attention on the task of relaxing.

One of the surprising and disappointing results in this study was the lack of differences in decreased muscle tension between the group which received no-training and the relaxation training groups. The reasons for this lack of difference can only be speculated, but since the relaxation training consisted of only one session in this study there may not have been sufficient time and practice with the technique.

Another possible explanation for this lack of differences between training and no-training groups may be related to Qualls' and Sheehan's (1981c) attentional demand hypothesis. Their argument was that the critical role of the biofeedback signal was an attentional one, and that subjects' ability to decrease muscle tension varied in relation to both the amount of attention demanded by the training procedure and the subjects' absorption capacity. In the present study it could be argued that the relatively high attentional demand of the three training groups actually interfered with subjects' ability to decrease muscle tension levels instead of fostering it. In all three of these groups, subjects' attention was almost continually focused on the "task" of relaxing. The attentional demands in and of themselves may have been the cause of the lack of differences found between training and no-training groups. With another session of training or a longer training period within the session, differences between these groups might emerge as has been the result in numerous other studies.

Differences in response measured by self-report

Several interesting findings emerged from the self-report data gathered in this study. As predicted, subjects generally reported decreased cognitive and somatic anxiety, and increased relaxation levels after the training session.

Differences did emerge, however, between groups pointing to the relevance of sex of subject and sex of experimenter in the training. Females working with the female experimenter, for example, had significantly greater reductions in cognitive anxiety than other groups. Also, males generally reported higher somatic anxiety levels than females. Differences between the sexes also emerged in reported relaxation levels. Females in the no-feedback conditions reported generally higher relaxation levels than did males in those conditions. Males reported increased relaxation after a session which did not include relaxation training, while females reported increased relaxation levels both with and without relaxation training.

The experimental literature sheds little light on this area of inquiry. Research which has investigated the relative efficacy of biofeedback and relaxation training procedures has yielded inconclusive results in terms of changes in subjective reports of anxiety. Several studies found that experimental and control groups reported similar degrees of increased feelings of relaxation (Alexander, 1975; Alexander, French and Goodman, 1975; Reinking and Kohl, 1975; Sime and DeGood, 1977). Coursey (1975) reported that the biofeedback group experienced less fatigue and could relax more quickly than the control groups, but this was only one of several measures of subjective anxiety used. The other measures showed no differences between the groups.

The present study represents the first systematic attempt to examine sex differences in response to different modes of relaxation and biofeedback training. In light of the sex differences which resulted here, it is possible to reinterpret the results of previous research. It may be that the grouping of males and females together in previous studies to analyze the self-reported changes in subjective anxiety has obscured the presence of these differential responses. Also, the present study differs in another significant respect in that it used a measure which separated anxiety into cognitive, somatic, and relaxation components. In treating these aspects of anxiety as one factor, the previous research again may have obscured any individual differences in response to training as a function of sex of subject and training modality.

Looking with an eye towards the clinical usefulness of relaxation training procedures, and using self-reported anxiety and relaxation levels as a gauge of success, the results of the present study could lead to the interpretation that females might benefit more than males from treatment which includes relaxation training from someone of the same sex. For males, however, the sex of the person doing the training is a less relevant factor. Males would also seem to benefit most from a treatment which does not include relaxation training.

Arnone (1982) and Rupert et al. (in press) have suggested that females may have more to gain from biofeedback training than males. The Rupert et al. study found that males reduced EMG levels in both biofeedback and no-feedback training conditions, where females only achieved reductions when receiving biofeedback. Arnone reported that in the first of two training sessions males achieved significant decreases in muscle tension levels in both biofeedback and no-feedback groups. Only females receiving biofeedback showed lower tension levels. In light of the results of the present study, it seems that females have more to gain *in general* from training since more changes in anxiety and relaxation levels were reported by females following the training. Further support for this interpretation of the results is that females responded more favorably to the training than males in terms of their response to the semantic differential measure.

Evaluation questionnaire

The analysis of the results of the evaluation questionnaire provide further confirmation of much of what has already been offered by way of interpretation . It was suggested, for example, that the two experimenters may have influenced subjects' physiological and psychological response to the experimental situation through some subtle interpersonal demand characteristics which may or may not have been due to sex differences. Both adaptation level differences and changes in EMG levels across trials showed differences in response as a function of sex of experimenter. It follows, therefore, that subjects also showed differences in their evaluation of the training session based on which of the two experimenters they had worked with. This was, in fact, the case.

Although present in the analysis of changes in cognitive anxiety levels, the interaction of sex of experimenter by sex of subject was most clearly evident in the results of the evaluation questionnaire. Here females judged their own performance to be less successful when working with the male experimenter. Also, females evaluated the female experimenter more favorably than the male experimenter. Once again, these results point to the possibility that experimenter/subject interaction effects are quite likely operative in the experimental training situation. Females may be more sensitive and reactive to the person rendering the treatment.

In terms of training modality, subjects whose session included relaxation training rated (questions 1-6) their session as a more effective procedure for bringing about relaxation than other subjects. Subjects who received relaxation training also projected that their training would be a more effective means of helping them to cope with the daily stress in their lives (question 1) than other subjects. This suggests that while EMG levels may show a more consistent pattern of decline when training involved the presence of biofeedback, subjects reported feeling that the training was more effective when it included relaxation exercises. In other words, the training method which results in the steadiest or largest reductions in frontalis muscle tension levels is not necessarily the most efficacious training method in terms of subjective post-treatment evaluation. This is especially true in light of the fact that the literature does not clearly point to either a relationship between declining frontalis muscle tension and declining tension in other muscles, or to a relationship between declining muscle tension levels and subjective feelings of relaxation. Instead, it appears that relaxation training was a more critical variable in allowing subjects to feel helped in learning to deal with anxiety and stress.

Goldfried and Trier (1974) have suggested that individuals who were trained in the use of relaxation as an active coping skill expressed greater post-treatment satisfaction with the procedure than those for whom training was presented as a method for passively reducing anxiety. It is possible that individuals who received relaxation training instructions in the present study also experienced more of a feeling of "being in control" of the training than those who did not. Thus they reported a greater overall satisfaction with the training than the other groups.

Individuals who received biofeedback, on the other hand, may likely have perceived the training as more task oriented because of the presence of the biofeedback tone constantly signalling and focusing attention on the "task" of relaxation. If this interpretation is correct it is not surprising that subjects reported greater overall satisfaction with training which included relaxation instructions.

Conclusions

In conclusion, the present study suggests that factors such as sex of subject, sex of experimenter, and subject/experimenter interaction effects influence the outcome of relaxation training procedures. Also, the study showed that while the presence of biofeedback in a training session leads to larger and steadier decreases in muscle tension levels, it is the presence of relaxation training which leads to a more positive subjective evaluation of the training itself.

This study was very limited in scope in that it included only one session of training and was conducted by only one experimenter of each sex. Because only one male and one female experimenter conducted the training sessions for this study, it is difficult to determine whether differences in response to training are due to gender or to some other factors such as personality style. Even the differences in training and background between the two experimenters may have been influential in the training outcomes. To control for these factors, future research might involve several experimenters of both sexes rendering training for both male and female subjects. Also, because of the limited number of subjects involved in this study, cell sizes for the various analyses were somewhat small. While several predicted differences in response emerged, other differences in the predicted directions did not quite reach statistical significance. One explanation for this may be that cell sizes were simply not adequate to test the hypotheses. Future research might rectify this limitation by increasing the number of subjects per cell.

Finally, the study can only hint at the possible implications of sex differences in response to relaxation training as it would be conducted in a clinical setting. Future research should be conducted to test for sex differences in response to training using several experimenters or trainers of both sexes with a clinical population and setting. Several sessions of training should also be used to test for the endurance over time of the differences due to subject and experimenter factors.

SUMMARY

This study compared initial responses to three different modes of relaxation training. Specifically, it compared EMG biofeedback, taped passive relaxation training, and a combination of EMG biofeedback and passive relaxation training. Also included was a no-training group which simply received instructions to relax. These groups were compared across physiological and self-report measures of anxiety. Also examined in this study were sex differences in response to the various training conditions. A male and a female experimenter worked with both male and female subjects in each of the training conditions so that possible sex of subject by sex of experimenter interactions could be controlled for and examined.

The subjects were 48 male and 59 female undergraduate students. Each subject had one session of training in one of the four conditions. The session included a 15 minute adaptation period at the end of which EMG levels and self-reported anxiety were measured. A 24 minute training period followed during which average EMG levels were recorded every two minutes. Following the session self-reported measures of anxiety were again taken along with a semantic differential measure and a questionnaire which evaluated subjects' response to both the training and the experimenter.

The results indicated that during the adaptation period females had higher EMG levels than males, while males reported higher levels of somatic anxiety than females. Subjects who were assigned to the male experimenter reported greater somatic anxiety during the adaptation period than subjects working with the female experimenter. During the training period of the session all subjects generally reduced muscle tension levels. Differing patterns of reduction existed, however, between subjects working with the male and female experimenters, and between subjects whose training did or did not include biofeedback. Differences also emerged in the analysis of changes in self-reported anxiety. All subjects reported generally decreased levels of somatic anxiety and increased relaxation levels after the training session, but differences existed between males and females and between training conditions.

Several other significant differences emerged in terms of subjects' evaluation of the training session. Subjects who worked with the female experimenter generally evaluated the session as more valuable than did those who worked with the male experimenter. Also, subjects whose session included passive relaxation exercises evaluated the training as more worthwhile than other subjects. Finally, females evaluated the female experimenter more positively than the male experimenter, and subjects' evaluation of their own ability to respond successfully to the training was related to both the type of training session they experienced and to the sex of the person rendering the training.

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APPENDIX A

SELF-REPORT MEASURES

Semantic Differential Scale

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

Pleasant ___ : ___: ___: ___: ___: ___: ___: Unpleasant

Worthless___ : ___: ___: ___: ___: ___: ___: Valuable

Boring ___ : ___: ___: ___: ___: ___: ___: Interesting

Good ___ : ___: ___: ___: ___: ___: ___: Bad

Tense ___ : ___: ___: ___: ___: ___: ___: Relaxed

Refreshing__ : ___: ___: ___: ___: ___: ___: Tiring

Uneffective__: ___: ___: ___: ___: ___: ___: Effective

Cognitive - Somatic Test of Anxiety

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 you 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.

___ 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.

Evaluation Questionnaire

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. How helpful do you think several sessions of training like you received today would be in teaching you to cope more effectively with the stress in your daily life?

___ 2. How helpful was this training session in teaching you a method of relaxation?

___ 3. How helpful was this training session in allowing you to feel physically relaxed?

___ 4. How helpful was this training session in allowing you to feel mentally at ease?

___ 5. How much did you enjoy this session?

___ 6. To what extent do you think this training session represents a sensible approach for teaching people to relax and cope with stress?

___ 7. In relation to the average student, how well do you think you were able to relax during the session? (An average student would rate 5; if you think you did not do as well you would rate yourself somewhere from 1-4; if you think you did better than average, rate yourself from 6-10)

___ 8. How would you rate the competency of the experimenter who worked with you during this session?

___ 9. How would you rate the helpfulness of the experimenter?

___10. How careful was the experimenter in explaining the procedures used in the experiment and in running things smoothly?

___11. How knowledgeable did the experimenter seem to be about the procedures used in this experiment?

___12. How likeable did you find the experimenter to be?

___13. How relaxed did you think the experimenter was?

Please take a minute to list below any method which you found really effective in helping you to become relaxed during the session.

APPENDIX B

CONSENT FORM

Project title: Sex differences in relaxation training procedures

Sponsor: Patricia Rupert, Ph.D.

The following information is provided so that you may decide whether you wish to participate in this research project. You should be aware that, even if you agree to participate, you are free to withdraw at any time without penalty.

This study is concerned with determining how different types of people react to different relaxation training procedures. During this session you will be asked to attempt to relax by reducing your muscle tension. Depending on the research group to which you are assigned, we may give you some guidance and aid in relaxing. To give us an indication of your level of relaxation, we will monitor the muscle tension in your forehead throughout the session. To do this, we will tape three electrodes to your forehead, These electreodes should not cause you any discomfort and will be removed much like a band-aid at the end of the session. We will also ask you to complete a brief rating scale of your feelings at the beginning and end of each session.

There are no known personal risks or dangers in this study. In fact, students generally find participation in this type of study to be interesting and relaxing.

You may be assured that your name will not be associated in any way with the research findings. You will be given a code number that will be used on questionnaires and heart rate and muscle tension recordings. The master sheet pairing your name and code number will be kept in the locked laboratory and will be available only to the graduate students working on this project. Once the study is completed, this master list will be destroyed.

Your participation is solicited, but is strictly voluntary. Please do not hesitate to ask any questions you might have about this study.

I have read the above description of the project "Sex differences in relation to relaxation training" and I hereby consent to participate in the project.

________________________________Signature and Date

________________________________Signature of Witness

APPENDIX C

SUMMARY TABLES FOR ADAPTATION LEVEL DIFFERENCES

Adaptation Level Differences in EMG Levels

Source	df	MS	F	p
Experimenter Sex	1	0.28	0.17	ns
Subject Sex	1	22.26	13.34	***
Biofeedback Level	1	0.27	0.16	ns
Relaxation Level	1	0.61	0.36	ns
E X S	1	0.07	0.04	ns
E X B	1	1.41	0.84	ns
S X B	1	0.13	0.08	ns
E X R	1	0.58	0.35	ns
S X R	1	0.78	0.47	ns
B X R	1	0.46	0.27	ns
E X S X B	1	0.47	0.28	ns
E X S X R	1	0.54	0.33	ns
E X B X R	1	0.82	1.69	ns
S X B X R	1	0.12	0.07	ns
E X S X B X R	1	0.91	0.55	ns
Error	91	1.67		

N = 107   *** $p < .001$

Adaptation Level Differences in Cognitive Anxiety

Source	df	MS	F	p
Experimenter Sex	1	31.23	4.19	*
Subject Sex	1	0.04	0.00	ns
Biofeedback Level	1	9.60	1.29	ns
Relaxation Level	1	5.63	0.75	ns
E X S	1	13.42	1.80	ns
E X B	1	23.72	3.18	ns
S X B	1	0.01	0.00	ns
E X R	1	17.69	2.37	ns
S X R	1	0.77	0.10	ns
B X R	1	24.24	3.25	ns
E X S X B	1	21.68	2.91	ns
E X S X R	1	0.32	0.04	ns
E X B X R	1	32.69	4.38	*
S X B X R	1	18.33	2.46	ns
E X S X B X R	1	4.33	0.58	ns
Error	91	7.46		

N = 107   * $p < .05$

Adaptation Level Differences in Somatic Anxiety

Source	df	MS	F	p
Experimenter Sex	1	29.71	3.84	*
Subject Sex	1	43.31	5.59	*
Biofeedback Level	1	17.49	2.26	ns
Relaxation Level	1	0.02	0.00	ns
E X S	1	8.36	1.08	ns
E X B	1	39.28	5.07	*
S X B	1	0.30	0.04	ns
E X R	1	23.05	2.98	ns
S X R	1	6.93	0.89	ns
B X R	1	1.32	0.17	ns
E X S X B	1	1.82	0.23	ns
E X S X R	1	19.33	2.50	ns
E X B X R	1	0.18	0.00	ns
S X B X R	1	18.99	2.45	ns
E X S X B X R	1	1.86	0.24	ns
Error	91	7.75		

N = 107 * $p < .05$

Adaptation Level Differences in Relaxation Level

Source	df	MS	F	p
Experimenter Sex	1	3.31	0.10	ns
Subject Sex	1	1.93	0.06	ns
Biofeedback Level	1	0.14	0.00	ns
Relaxation Level	1	2.88	0.08	ns
E X S	1	29.75	0.86	ns
E X B	1	86.86	2.51	ns
S X B	1	121.68	3.51	ns
E X R	1	53.11	1.53	ns
S X R	1	16.39	0.47	ns
B X R	1	52.89	1.53	ns
E X S X B	1	10.89	0.31	ns
E X S X R	1	38.67	1.12	ns
E X B X R	1	28.59	0.83	ns
S X B X R	1	43.97	1.27	ns
E X S X B X R	1	80.71	2.33	ns
Error	91	34.65		

N = 107

APPENDIX D

CHANGES IN EMG LEVELS ACROSS TRIALS

Source	df	MS	F	p
Experimenter Sex	1	1.34	0.16	ns
Subject Sex	1	45.55	5.31	*
Biofeedback Level	1	0.70	0.08	ns
Relaxation Level	1	1.61	0.19	ns
E X S	1	3.88	0.45	ns
E X B	1	3.52	0.41	ns
S X B	1	8.96	1.04	ns
E X R	1	3.84	0.45	ns
S X R	1	0.25	0.03	ns
B X R	1	6.73	0.79	ns
E X S X B	1	4.83	0.56	ns
E X S X R	1	7.25	0.85	ns
E X B X R	1	1.27	0.15	ns
S X B X R	1	5.71	0.67	ns
E X S X B X R	1	0.10	0.01	ns
Error	91	8.57		
Trials	5	1.54	4.91	***
T X E	5	0.60	2.53	*
T X S	5	0.25	1.07	ns
T X B	5	0.54	2.31	***
T X R	5	0.08	0.33	ns
T X E X S	5	0.08	0.34	ns
T X E X B	5	0.22	0.92	ns
T X S X B	5	0.03	0.12	ns
T X E X R	5	0.35	1.48	ns
T X S X R	5	0.12	0.50	ns
T X B X R	5	0.17	0.73	ns
T X E X S X B	5	0.33	1.42	ns
T X E X S X R	5	0.14	0.61	ns
T X E X B X R	5	0.18	0.77	ns
T X S X B X R	5	0.22	0.94	ns
T X E X S X B X R	5	0.17	0.71	ns
Error	455	0.24		

N = 107   * $p < .05$ *** $p < .001$

APPENDIX E

CHANGES IN SELF-REPORTED ANXIETY LEVELS

Changes in Self-Reported Cognitive Anxiety Levels

Source	df	MS	F	p
Experimenter Sex	1	6.89	0.88	ns
Subject Sex	1	2.00	0.26	ns
Biofeedback Level	1	0.01	0.00	ns
Relaxation Level	1	3.45	0.44	ns
E X S	1	3.49	0.44	ns
E X B	1	23.69	3.02	ns
S X B	1	0.74	0.09	ns
E X R	1	4.30	0.55	ns
S X R	1	0.25	0.03	ns
B X R	1	5.99	0.76	ns
E X S X B	1	22.24	2.83	ns
E X S X R	1	0.01	0.00	ns
E X B X R	1	31.86	4.06	*
S X B X R	1	12.29	1.57	ns
E X S X B X R	1	0.43	0.05	ns
Error	91	7.85		
Trials	1	37.72	14.01	****
T X E	1	27.85	10.34	**
T X S	1	1.32	0.49	ns
T X B	1	20.10	7.46	**
T X R	1	2.24	0.83	ns
T X E X S	1	10.96	4.07	*
T X E X B	1	4.08	1.52	ns
T X S X B	1	0.49	0.18	ns
T X E X R	1	15.00	5.57	*
T X S X R	1	0.55	0.20	ns
T X B X R	1	20.39	7.57	**
T X E X S X B	1	3.49	1.30	ns
T X E X S X R	1	0.49	0.18	ns
T X E X B X R	1	5.96	2.21	ns
T X S X B X R	1	6.50	2.41	ns
T X E X S X B X R	1	5.25	1.95	ns
Error	91	2.69		

N = 107

* p < .05   ** p < .01   *** p < .005   **** p < .001

Changes in Self-Reported Somatic Anxiety Levels

Source	df	MS	F	p
Experimenter Sex	1	36.08	3.22	ns
Subject Sex	1	85.92	7.66	**
Biofeedback Level	1	21.23	1.89	ns
Relaxation Level	1	0.42	0.04	ns
E X S	1	1.21	0.11	ns
E X B	1	38.39	3.42	ns
S X B	1	6.98	0.62	ns
E X R	1	9.41	0.84	ns
S X R	1	16.33	1.45	ns
B X R	1	4.51	0.40	ns
E X S X B	1	5.83	0.52	ns
E X S X R	1	21.58	1.92	ns
E X B X R	1	0.01	0.00	ns
S X B X R	1	10.12	0.90	ns
E X S X B X R	1	1.30	0.12	ns
Error	91	11.22		
Trials	1	41.81	7.32	**
T X E	1	2.90	0.51	ns
T X S	1	0.00	0.00	ns
T X B	1	1.71	0.30	ns
T X R	1	0.19	0.03	ns
T X E X S	1	8.92	1.56	ns
T X E X B	1	7.12	1.25	ns
T X S X B	1	3.49	0.61	ns
T X E X R	1	13.85	2.42	ns
T X S X R	1	0.10	0.02	ns
T X B X R	1	0.25	0.04	ns
T X E X S X B	1	0.26	0.05	ns
T X E X S X R	1	2.47	0.43	ns
T X E X B X R	1	0.01	0.00	ns
T X S X B X R	1	8.89	1.56	ns
T X E X S X B X R	1	9.41	1.65	ns
Error	91	5.71		

N = 107 ** $p < .01$

Changes in Self-Reported Relaxation Levels

Source	df	MS	F	p
Experimenter Sex	1	50.57	1.00	ns
Subject Sex	1	39.84	0.78	ns
Biofeedback Level	1	12.16	0.24	ns
Relaxation Level	1	0.91	0.02	ns
E X S	1	146.47	2.88	ns
E X B	1	138.48	2.73	ns
S X B	1	193.85	3.81	*
E X R	1	51.50	1.01	ns
S X R	1	13.95	0.27	ns
B X R	1	30.33	0.60	ns
E X S X B	1	25.21	0.50	ns
E X S X R	1	33.81	0.67	ns
E X B X R	1	17.73	0.35	ns
S X B X R	1	51.42	1.01	ns
E X S X B X R	1	31.05	0.61	ns
Error	91	50.81		
Trials	1	285.58	18.35	***
T X E	1	20.61	1.32	ns
T X S	1	18.88	1.21	ns
T X B	1	10.98	0.71	ns
T X R	1	2.09	0.13	ns
T X E X S	1	19.26	1.24	ns
T X E X B	1	2.00	0.13	ns
T X S X B	1	2.81	0.18	ns
T X E X R	1	9.80	0.63	ns
T X S X R	1	89.51	5.75	**
T X B X R	1	22.83	1.47	ns
T X E X S X B	1	0.13	0.01	ns
T X E X S X R	1	8.87	0.57	ns
T X E X B X R	1	11.23	0.72	ns
T X S X B X R	1	4.87	0.31	ns
T X E X S X B X R	1	50.88	3.27	ns
Error	91	15.57		

N = 107 * $p < .06$ ** $p < .01$ *** $p < .001$

APPENDIX F

DIFFERENCES IN RESPONSE TO SEMANTIC DIFFERENTIAL

Source	df	MS	F	p
Experimenter Sex	1	49.18	1.78	ns
Subject Sex	1	131.97	4.78	*
Biofeedback Level	1	7.18	0.26	ns
Relaxation Level	1	66.74	2.42	ns
E X S	1	8.16	0.22	ns
E X B	1	72.93	2.64	ns
S X B	1	0.70	0.03	ns
E X R	1	37.92	1.37	ns
S X R	1	2.08	0.08	ns
B X R	1	6.71	0.24	ns
E X S X B	1	5.37	0.19	ns
E X S X R	1	1.45	0.05	ns
E X B X R	1	6.74	0.24	ns
S X B X R	1	0.36	0.01	ns
E X S X B X R	1	6.10	0.22	ns
Error	89	27.61		

N = 105 * $p < .05$

APPROVAL SHEET

This dissertation submitted by Robert John Arnone 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 Ph. D.

October 10, 1984
Date

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