The differential effects of matched stimuli maintenance methods upon the continued relaxation practice and headache activity of tension headache clients.

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THE DIFFERENTIAL EFFECTS OF MATCHED STIMULI MAINTENANCE METHODS UPON THE CONTINUED RELAXATION PRACTICE AND HEADACHE ACTIVITY OF TENSION HEADACHE CLIENTS

A Dissertation Presented
By
DAVID L. COWLES

Submitted to the Graduate School of the University of Massachusetts in partial fulfillment of the requirements for the degree of DOCTOR OF EDUCATION
September 1980
School of Education
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Approved as to style and content by:

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Ena V. Nuttall, Member

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This work is dedicated to my wife, Carole, and my daughter, Virginia Lee-Anne, for all they did to make this accomplishment possible.
ACKNOWLEDGMENTS

A task such as this requires the efforts and support of many and cannot be accomplished alone. Many people have assisted me in this process and although it is not possible to name them all here, I would like to express my gratitude to them nonetheless.

A few individuals have been most instrumental in guiding me to the completion of this dissertation and I would like to acknowledge each one personally.

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helpful.

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ABSTRACT

The Differential Effects of Matched Stimuli Maintenance Methods upon the Continued Relaxation Practice and Headache Activity of Tension Headache Clients

(September 1980)

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Directed by Professor Ronald H. Fredrickson

This research assessed the effects of four matched stimuli maintenance methods on the continued practice of learned relaxation procedures and the headache activity of tension headache subjects over time after training.

The four matched stimuli employed were: home relaxation practice alone (R); home relaxation practice and use of taped instructions (R+T); home relaxation practice and self monitoring of electromyographical (EMG) output (R+EMG); and self monitoring of EMG output without home relaxation practice (EMG). The four maintenance methods were arranged in a series of ten single-subject experimental sequences to assess the specific effects of the matched stimuli on individual subjects over a fifteen-week post-training period. Subjects were assigned to a particular sequence in the order in which they volunteered for this study. After two weeks of baseline and eight, one-hour, EMG-assisted relaxation training sessions, twenty females, ages 21 to 64, with medically diagnosed
tension headaches were placed in one of ten maintenance sequences. All subjects received the same relaxation training and instructions prior to the introduction of each maintenance method. Headache activity and continued home relaxation practice were recorded daily and reported by each subject throughout the study.

Results for individual subjects support the equivalence of the four matched stimuli maintenance methods used in the continued practice of home relaxation and self-reported reduction of frequency and intensity of headaches. However, clinically significant differences, a change of 20 percent or more in the desired direction, did occur for 16 subjects. Six achieved clinical significance in continued practice of home relaxation; six in mean hourly headache activity; and four in both.

Of the ten subjects who achieved clinical significance in continued home relaxation practice, nine did so in the first maintenance period and in the (R) condition. It may be significant that of these ten subjects, nine had twelve years or less education; eight had moderate expectations about outcome; seven were not employed; and five had headache activity from one to four years.

Of the ten subjects who achieved clinical significance in their mean hourly headache activity, nine demonstrated it in the third maintenance period regardless of the method employed. It may be significant that of these ten subjects, eight had moderate expectations about outcome; seven had thirteen years or more education; seven were employed outside the home; seven had low level headache activity (.106-.518); and seven were between the ages of 21 and 35. Five had headache activity from one to four years.
The results for each maintenance method generally support their equivalence. However, the mean percent of improvement in headache activity from training indicated that R+T (68.7%) might have been more effective than R+EMG (49%) as a maintenance method. Because R occurred more frequently in the maintenance sequences, however, discretion must be used in interpreting these results.

It was concluded that further research was necessary to establish the efficacy of these matched stimuli maintenance methods. However, there was evidence to suggest that continued home practice of relaxation alone might be used in place of one of the other methods employed in this study when time and finances are of important consideration. Because this method does not require the use or purchase of additional equipment, i.e., tapes, tape recorder, or EMG machine, it may be the most cost-efficient method.
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CHAPTER I

INTRODUCTION

Headaches, which are the most common of all complaints, have been an almost continuous source of excruciating pain for many (Freidman & Frazier, 1973; Brayil & Green, 1960; Wolf & Wolff, 1953). Comprehensive survey data which were gathered by Walters and O'Connor (1971) and by Wolff (1972) indicate that between 50% and 70% of the adults in this country experience headaches, and according to Kashiwagi, McClure and Wetzel (1972) at least 40% of those afflicted suffer from tension or muscle-contraction headaches.

Muscle-contraction headaches are generally described as a tight, vise-like, "hat-band" distribution of discomfort and pain. They are usually of gradual onset with associated sensations of tightness, pressure, soreness, knots and lumps which may affect the bilateral, occipital or frontal areas of the head and the back of the neck as well. These sensations may be accompanied by dizziness and nausea. The neurological signs typically characteristic of muscle-contraction headaches are sustained contraction of muscles in the bilateral, occipital, frontal or neck areas, tender spots in the scalp and neck and in some cases limitation of neck movement. The associated pain may last for indeterminate periods of time, for days, weeks, months, or even years (Wolf & Wolff, 1953; Brayil & Green, 1963; Freidman & Frazier, 1973).

Headache sufferers spend millions of dollars a year seeking relief
from headache pain emanating from contracted muscles (Wolf & Wolff, 1953). Traditional treatment has included aspirin, empirin, tranquilizers, muscle relaxants, and analgesics. Individual psychotherapy is also often recommended for muscle-contraction headache sufferers (Cox, Freundlich & Meyer, 1976).

Beginning with his publication of Progressive Relaxation in 1929, Edmund Jacobson revealed an effective clinical procedure, which he called progressive muscle relaxation, for dealing with the problems of anxiety, tension and related disorders. In his second edition of Progressive Relaxation published in 1938, Jacobson offered evidence that his technique of progressive muscle relaxation training was capable of lowering muscle anxiety and suggested its use in the treatment of tension (muscle-contraction) headaches. In a detailed case report in 1970, Jacobson described the effective application of relaxation training in the remediation of chronic muscle-contraction headaches.

Progressive relaxation training, often referred to as "deep muscle relaxation training," requires teaching a person how to systematically tense and relax various skeletal muscle groups, i.e., muscles of the forehead, face, neck, and legs (Jacobson, 1934). Despite its potential for reducing muscle-contraction headaches, Jacobson's technique was not widely used. The 100 to 200 training sessions with the therapist and one- to two-hour daily practice sessions at home may have been prohibitive factors (Goldfried & Trier, 1973).

In 1958, however, Wolpe developed a modified version of Jacobson's method which he used as a reciprocally inhibiting procedure in his own technique of systematic desensitization. Others (Schultz & Luthe,
1959; Mitchell, 1969; Tasto & Hinkle, 1973; Fichtler & Zimmerman, 1973) went on to demonstrate that this briefer method of muscle relaxation training can produce significant reductions in reported muscle-contraction headache activity.

In 1969, Budzynski and Stoyva demonstrated that deep muscle relaxation could be induced in a relatively shorter period of time by presenting subjects with analog information feedback on the electromyographical (EMG) activity of skeletal muscle groups. With 15 normal subjects, it was shown that actual EMG feedback from the frontalis muscle led to greater decreases in muscle activity than pseudofeedback or a relaxation control.

In a second study in 1970, Budzynski, Stoyva and Adler treated five subjects with tension headaches with a combination of EMG auditory feedback training and home relaxation practice in a series of systematic case study replications. Group data indicated a steady decrease in headache intensity and duration and EMG levels over the treatment period. Three subjects responded favorably to the treatment procedure. Two subjects reported that tension headaches had been eliminated; a third reported that they had been markedly reduced. The other two subjects reported a return of their tension headaches soon after the treatment ended. These subjects were treated again with EMG auditory feedback and home relaxation practice. With these subjects, the use of home relaxation practice was subjected to a systematic A-B-A-B design, while the auditory feedback was continued over time. There was a successful reduction of headaches accompanying each introduction of home relaxation practice and a return of symptoms following the withdrawal of home
practice. Although no control or attention-placebo group or conditions were employed in this study, these results suggest that home practice was an important part of the treatment procedure.

In a third study in 1973, Budzynski, Stoyva, Adler and Mullaney treated eighteen subjects with tension headaches using a controlled group outcome design over a 16-week period. One treatment and two control groups were employed. The six subjects in the treatment group received a combined procedure of actual EMG feedback and home relaxation practice. In the first control group, the subjects received false EMG feedback and home relaxation practice while in the second control group the subjects had weekly contact with the therapists, but no treatment. Subjects in the treatment group showed a significantly lower level of headache activity (p < .001) and a significant decrease in the amount of drugs used (3 to 4 major tranquilizers per day to 0 to 2 per month) than either control group at the completion of treatment and at the end of a three-month follow-up period. Most striking, however, were the results in terms of individual subjects. Four of six subjects in the treatment group reported virtually no headaches as compared to one in six in the false feedback control group and none in six in the no treatment control group. Those two subjects in the treatment group who continued to have headaches also reported little or no home relaxation practice and the one successful subject in the false-feedback group reported practicing relaxation at home on a regular basis.

While Budzynski et al.'s studies support the value of combining EMG feedback training and relaxation practice at home in the treatment of tension headaches, the results do not make it possible to discern the
specific effect each had in contributing to the overall results.

Hutchings and Reinking (1976) conducted a controlled group outcome study to attempt to answer the unresolved questions about the comparative effectiveness of the treatment components—relaxation and biofeedback in dealing with muscle-contraction headaches. In this study, eighteen subjects with medically diagnosed muscle-contraction (tension) headaches were randomly assigned to three groups: (1) Jacobson-Wolpe autogenic-relaxation training, (2) EMG relaxation training, or (3) EMG relaxation training combined with Jacobson-Wolpe autogenic relaxation training. Each subject received 10 one-hour training sessions and were instructed to practice what they had learned in the training session at least twice a day at home. Data assessing the groups on the reduction of EMG levels and daily mean headache scores indicated that all subjects showed improvement. However, those in the biofeedback alone and the biofeedback-relaxation group decreased their headache activity scores by approximately 66% from baseline levels, whereas the relaxation only group reduced their headache activity scores by approximately 20% from baseline levels. Those in the biofeedback alone and biofeedback-relaxation groups were able to lower EMG levels and mean headache scores faster, demonstrated more significant improvement and showed greater stability of treatment effects over the follow-up period.

In an effort to assess the long-term effectiveness of the relaxation training procedures used in the above study, Reinking (1976) sent out questionnaires to the previous subjects at 3-, 6- and 12-month intervals. At three months, fifteen out of the eighteen original subjects reported improvement at about the same levels achieved at the end of the
treatment follow-up period (28 days after the end of treatment). However, at six and twelve months less than 50% of the subjects reported improvement regardless of the treatment they had received. Analysis of the responses to the question of continued practice was reported as showing statistical significance (level not reported) between reported continued practice and the maintenance of treatment improvement. Analysis of the responses to the question of reported headache return and lack of practice were not significant.

Although Hutchings and Reinking's initial study was limited by the absence of a control group, Reinking's follow-up data suggest that EMG training may have led to a rapid learning of relaxation procedures. However, the maintenance of those relaxation procedures seemed to depend upon whether or not the subject continued to practice what he/she had learned over a sufficient length of time.

Although the use of EMG biofeedback training has been well documented as a clinical procedure for dealing with the problem of tension (muscle contraction) headaches, the usefulness of its effects over time appears dependent upon continued practice. Reinking called attention to the dissipation of treatment effects which seem to occur when subjects discontinued practicing the tension reducing procedures they had learned during treatment. Since the great deal of time, effort and money which are invested on both the part of the subject and therapist are lost when treatment effects are of short duration, research with regard to the maintenance of treatment effects seems warranted.

The problem for this research then is to compare specific methods used to maintain treatment effects with tension headache subjects over
a sufficient length of time to be considered beneficial.

The implications of the study are threefold. One, the resultant data will provide information about cost efficient ways to treat tension headaches. Two, the results will provide data on the impact of different methods of maintenance of treatment effects. If these findings are viable and future replications support them, a way to assure maintenance of treatment effects will extend the benefits of biofeedback treatment to more individuals with tension headaches. Three, the results will fill a need in the research literature, since there has been limited research which attempts to evaluate methods for maintaining treatment effects with tension headache subjects treated with EMG relaxation training procedures.
CHAPTER II
HISTORY OF THE PROBLEM

Relaxation and the treatment of tension headaches. Edmund Jacobson (1970), in a detailed case report, described the effective application of progressive relaxation training in the remediation of chronic muscle-contraction (tension) headaches. His method which requires as many as 100 to 200 training sessions with a therapist, as well as one to two hours of daily practice at home, was not widely used. Despite the effectiveness of Jacobson's procedure, the extensive training time involved (anywhere from six months to 18 months depending on the frequency of sessions) plus daily home practice are prohibiting factors.

Because of the effectiveness of Jacobson's technique, others (Wolpe, 1958; Schultz & Luthe, 1959; Mitchell, 1969; Tasto & Hinkle, 1973; Fichtler & Zimmerman, 1973) went on to demonstrate that a briefer method of muscle relaxation (basically a modification of Jacobson's method) could produce significant reductions in reported tension headache activity.

Biofeedback and the treatment of tension headaches. Recently, the technique of electromyography (EMG) biofeedback has been used in the successful training of tension headache victims in the relaxation of relevant muscular structures for the prevention of muscle-contraction headaches (Budzynski & Stoyva, 1969; Budzynski, Stoyva & Adler, 1970; Wickramasekera, 1972; Budzynski, Stoyva, Adler & Mullaney, 1973;
Budzynski and Stoyva and their colleagues demonstrated the effectiveness of this approach in a series of three studies which systematically applied EMG feedback training to the treatment of individuals suffering from tension headaches. In their initial study (1969) of 15 subjects, the equipment and the procedure were well described. It was demonstrated that accurate feedback of frontalis muscle EMG led to greater decreases in muscle activity than false feedback or a relaxation control.

In their second study (1970) five subjects with muscle contraction headaches were treated with EMG feedback and home practice in relaxation. A systematic case study approach was used and tension headaches were eliminated in two subjects and markedly reduced in a third. For two subjects, headaches returned shortly after the end of treatment. The reinstitution of home practice for both subjects, plus feedback sessions for another one, led to cessation of headaches. Although no control or attention-placebo condition or group was used in this study, the outcome does suggest the possible efficacy of a combined treatment approach. The use of an A-B-A-B experiment with the two subjects who experienced a resumption of headache activity soon after the termination of treatment strongly suggested the importance of home relaxation practice in the maintenance of treatment effects beyond the treatment condition. For these two subjects, a successful reduction of their headache activity was accomplished with each introduction of home relaxation practice and a return of headache activity occurred with the removal of home practice.
In 1973 Budzynski et al. significantly reduced muscle-contraction headache activity in six patients suffering from tension headaches by teaching relaxation of the forehead musculature through EMG biofeedback. The training in relaxation consisted of sixteen semiweekly twenty-minute EMG feedback sessions augmented by daily home practice. A pseudofeedback control group and a no-treatment control group failed to show significant reductions. A three-month follow-up questionnaire revealed a greatly decreased medication usage among the patients in the treatment group. Although the primary intent of this study was to teach relaxation of the frontalis muscle, no specific relaxation procedure or instructions were given for either the laboratory or the home-practice sessions. In the laboratory patients were told, "Your job will be to find out what makes the EMG click rate slow down, because this means lower muscle tension. Try to eliminate those things that make the click rate go faster. Do not try too hard, or this will defeat your goal of deep relaxation. Remember to keep your attention focused on the clicks--do not let your mind wander" (p. 487). Although daily practice in relaxation is deemed of critical importance, the subjects were told "to relax in the same way they had in the laboratory--but without the aid of any instruments" (p. 487). As a result of the data received on follow-up questionnaires, approximately 1-1/2 years after the completion of feedback training, they concluded that the three patients who continued to maintain appreciably reduced or eliminated tension headache activity had learned to relax in the face of stress to such an extent that the ability to relax had "eventually become an over-learned habit resulting in a change in life style" (p. 491). To what
extent this could have been achieved with all patients remains speculative because of the absence of the use of specific deep-muscle relaxation training procedures in the original study. Several patients stated they would have preferred more explicit relaxation instructions for home practice. Budzynski himself concluded that in the present study only a minimal sort of training (relaxation) was employed (EMG feedback from the frontalis muscle).

If specific relaxation instructions and training had been included along with the feedback treatment procedure in this study, more patients may have learned to discriminate the internal cues of thorough relaxation and achieved even greater and longer lasting changes in tension headache activity. This training may have been strengthened further by using cassette tapes containing specific relaxation training instructions and portable EMG feedback units to guide relaxation training and practice in the laboratory and at home.

In sum, these aforementioned studies indicate that both relaxation and EMG feedback are useful in the treatment of tension headaches. However, they leave unresolved questions about the comparative effectiveness of either relaxation training or EMG feedback in the treatment of individuals with muscle-contraction headaches. Further, the design of the Budzynski et al. study (1973) did not make it possible to systematically isolate the effects of EMG feedback and home relaxation practice, although the results do suggest that the combination of the two procedures is an effective treatment approach.

Comparative studies. In 1975, Cox, Freundlich and Meyer conducted a
group outcome study designed to compare the specific effects of progressive relaxation instructions and auditory EMG feedback with tension headache sufferers. Twenty-seven adults who most closely fit the criteria of experiencing headaches of a steady bilateral pain originating in the frontal or suboccipital region, occurring three or more times a week and having no organic basis according to their family physician were selected from a group of 93 who responded to a newspaper article. Nine were randomly placed in an auditory EMG feedback group, nine in a progressive relaxation instruction group, and nine given a medicine-placebo treatment. All of the subjects came for two weeks of pre- and post-treatment assessment with four intervening weeks of treatment. Measures were taken on headache frequency, intensity and duration, frontalis EMG recordings, medication intake, locus of control, and additional psychosomatic complaints. Comparisons of post-assessment and four-month follow-up data indicated that biofeedback and verbal progressive relaxation instructions were equally superior (p < .001) to the medicine placebo treatment on all measured variables in the direction of clinical improvement. Although the subjects were instructed to practice relaxation at home during the study, they did not report the frequency of their practice thus making it impossible to determine the specific contribution the rate of continued practice may have made to the outcome. In addition, cue-controlled breathing and covert self-instructions to relax were combined with both the EMG biofeedback training and the verbal relaxation instructions, thus making impossible to clearly discern the specific effects of each of these procedures.

Haynes, Griffin, Mooney and Parise (1975) also attempted to assess
the comparative effectiveness of relaxation instructions and frontalis EMG biofeedback in the treatment of muscle-contraction (tension) headaches using a group outcome design. Twenty-one volunteers were randomly placed into either a relaxation training group, a biofeedback group or a no-treatment control group. Each group met for six one-half-hour sessions. The EMG biofeedback and the relaxation instructions resulted in significant decreases \( (p < .01) \) in reported headache activity. Both procedures were significantly more effective than the control procedure \( (p < .01) \) but did not differ from each other in effectiveness (both significant at the .01 level). When phoned five to seven months later for follow-up, subjects in the biofeedback and relaxation instructions groups reported continued improvement. The efficacy of the results may have been strengthened if a fourth group, false EMG feedback only, was employed to control for placebo effects. Although home relaxation practice was encouraged, the subjects did not report the frequency of their practice during the follow-up period. Thus, it was not possible to isolate the specific effect continued practice may have had on the subjects' maintenance of decreased headache activity over time after training.

Hutchings and Reinking (1976) conducted a group outcome study whose purpose was to assess the comparative effectiveness of verbal relaxation instructions (Jacobson-Wolpe autogenic relaxation), EMG biofeedback, and a combined procedure in the treatment of muscle-contraction headaches. The two EMG-assisted relaxation groups showed significantly better results \( (p < .05) \), compared to the verbal relaxation instruction group, in terms of reduction of headache activity and the rate at which reduc-
tion took place. Post-hoc analysis of the significant interaction effect (Newman-Kuehl) revealed that the EMG groups had their impact earlier in treatment than did the verbal relaxation instruction group. Follow-up (28 days) analysis revealed that the subjects in the two EMG groups had decreased their headache activity scores by 66% from the baseline period, while those subjects in the verbal relaxation instructions group had decreased their headache activity scores by 20% from the baseline period. Both treatment changes, the speed of effect and the extent of headache activity reduction were significant at the .05 level respectively. Although the study could have been strengthened by the addition of an attention-placebo group, the results do suggest that a combined procedure--EMG biofeedback and verbal relaxation instructions--may be more effective than verbal relaxation instructions alone in the treatment of tension headaches. In terms of the maintenance of treatment effects, however, the follow-up survey by Reinking (1976) indicates that EMG and EMG-assisted relaxation training alone is not sufficient to sustain the post-treatment decreases in headache activity over an extended period of time (six months to a year). Reinking concluded that while EMG and EMG-assisted relaxation training resulted in rapid and extensive headache activity reduction during treatment, that the continuation of these effects over time is dependent upon continued practice of the relaxation procedure learned during treatment.

Epstein, Hersen and Hemphill (1976) substantiated the importance of home practice in relaxation, suggested by Reinking (1976) and Budzynski (1973). In a controlled single subject experiment, they treated an individual with a long standing history of tension headaches with EMG bio-
feedback. The first phase of the treatment was conducted while the subject was hospitalized. During this time only EMG feedback was used as treatment, with no practice in relaxation. Using an A-B-A-B design, both headache activity (frequency, intensity and duration) and EMG activity during treatment were reduced during experimental (B) phases and returned during the second baseline (A) phase. Further EMG feedback training during outpatient follow-up also led to decreases in headache activity with resultant increases in headache activity reoccurring with a return to baseline conditions. The institution of home practice in relaxation led to marked reductions of headache frequency, regardless of medicine used. Although this study was limited by the absence of a placebo control condition the results point to apparent value of home practice in relaxation.

In sum, all of the aforementioned studies indicate the following: (1) that relaxation training, regardless of the procedure, will have an effect on muscle-contraction headache activity; (2) that modified relaxation procedures work, but they may not be as effective as EMG-assisted methods in terms of speed of effect and extent of headache activity reduction; (3) that combining EMG biofeedback assisted relaxation training with home practice in relaxation seems to be a potentially effective procedure at this time for the treatment of tension headaches; (4) that the maintenance of treatment effects over time is dependent on the continued practice of the relaxation procedure learned during treatment.

Methods for maintaining treatment effects. According to Koegel and Rincover (1977),
to develop a successful treatment program, one must be concerned with at least three major results: first, the initial acquisition of a behavioral change; second, the generalization of that change to settings outside of treatment; and third, the maintenance of change over time in settings outside treatment (p. 1).

In general, applied behavioral research has concentrated on promoting change in the treatment setting regardless of the nature of the behavior being treated (Koegel & Rincover, 1977). However, there is some evidence that some researchers are becoming aware of the need to devote more attention to both the generalization and maintenance of behavioral change (Atthowe, 1973; Barrish, Saunders & Wolf, 1969; Forehand & Atkinson, 1977; Kazdin, 1973a, 1973b; Kazdin & Bootzin, 1972; MacPherson, Candee & Holman, 1974; O'Leary and Drabman, 1971; Wahler, 1969; Walker & Buckley, 1972). These authors indicate that if interventions take place in one environment, then transfer of behavior change to other situations cannot be assumed unless there is comparability across situations.

Response maintenance cannot be assumed to occur automatically upon completion of treatment. It must be systematically programmed across settings (Baer et al., 1968; Mash & Terdal, 1976). Several ways of programming response maintenance are reported in a review of the literature by Kazdin (1975). The use of naturally occurring reinforcers (Reisinger, 1972; Hopkins, 1968; O'Leary & Drabman, 1971); training relatives or others in the clients' environment to reinforce the desired behavior (Ayllon & Wright, 1972; Guerney, 1969; O'Leary, O'Leary & Becker, 1967; Wahler, 1969; Henderson & Scales, 1970; Lovaas, Koegel, Simmons & Long, 1973); generally removing or fading the contingencies (Atthowe & Krasner, 1968; Phillips, Phillips, Fixsen & Wolf, 1971; Kazdin, 1975; Kelly
& Henderson, 1971); varying the conditions of training (Isaacs et al., 1960; Lovaas & Simmons, 1969; Koegel & Rincover, 1974); employing intermittent schedules of reinforcement (Kale et al., 1968; Kazdin & Polster, 1973; Phillips et al., 1971); creating as much similarity as possible between the treatment environment and the natural environment (O'Leary & Drabman, 1971); and providing the individual with a self-controlling strategy that may be employed across a number of situations (Mash, Hamerlynck & Handy, 1976). In essence these studies indicated that changes can be durable as long as the stimulus conditions are supportive. However, there was no systematic, well-controlled study of the variables maintaining changes in behavior over time and across settings. In addition, Kazdin (1975) concluded that the results of many of these studies lacked the necessary clarity to allow unambiguous interpretation of the effectiveness of the maintenance methods employed and indicated that further research was warranted to establish their efficacy.

With the exception of Reinking's (1976) follow-up survey data, there have been few, if any, direct attempts made to systematically investigate variables that may influence the maintenance of treatment effects of tension headache subjects treated with a combination of EMG-assisted relaxation training and home relaxation practice. Reinking (1976) called attention to the dissipation of treatment effects which seem to occur when subjects discontinued practicing the tension reducing procedures they had learned during treatment. His findings suggest that continued practice is an important variable in the maintenance of treatment effects. While some studies (Budzynski et al., 1970, 1973; Epstein et al., 1976) demonstrate the importance of home relaxation prac-
tice in the treatment of tension headaches, no direct systematic attempts were made in these studies to facilitate the continuation of the tension reducing procedure over time. In fact, only one study was found in the literature which attempted to either assess and/or systematically compare the effectiveness of various maintenance methods over time and across settings.

Walker and Buckley (1972) conducted a two-year evaluation of the effectiveness of three experimental methods and one control procedure in facilitating the generalization and maintenance of a variety of appropriate academic and social behaviors in the regular classroom with primary-age school children after two months of treatment in a token economy. The maintenance methods were peer reprogramming, equating stimulus conditions between the treatment and classroom situation, and teacher training in behavior management techniques.

The peer reprogramming method utilized the active support and cooperation of the subjects' peer group. By maintaining a high percentage of appropriate social and academic behavior, the subject was able to earn points which could be exchanged for reinforcements for him/herself and the class. The equating stimulus conditions method was designed to maintain treatment effects by establishing as many common stimulus elements between the treatment and regular classroom settings as possible. Three sources of stimulus matching were used: (1) academic materials, (2) systematic social reinforcement, and (3) token reinforcement. The teacher training method was designed to facilitate maintenance of treatment effects by training the teacher to reinforce and support the subjects' modified behaviors. Walker and Buckley concluded that this
method might have been more effective if the teachers had received more intense training and feedback about their own performances.

The control procedure consisted of returning subjects to their regular classrooms after two months of treatment without follow-up support or efforts at programming maintenance. Observations of the subjects' appropriate and inappropriate social and academic behaviors were continued during the maintenance period. The mean per cent appropriate behavior for those in the peer reprogramming and equated stimulus conditions maintenance strategies was significantly greater (p < .05) than the mean for the control subjects. The teacher training and control group means were not significantly different.

Although the specific effects of each of the matched stimuli were not separated out and independently assessed, they were effective in combination in maintaining specific academic and social behaviors over time after treatment.

Despite this methodological problem, the equating of stimulus conditions between the treatment setting and the home environment seems to be most practical and economical of the three experimental maintenance methods employed in this study. Tension headache subjects could be provided with the same equipment, i.e., tape recorder, tapes, portable, battery operated, EMG unit and hand temperature thermometer for use in relaxation practice, both in the treatment and home setting. They could also be taught to use the same relaxation procedure at home and in treatment.

From this literature review, two things are clear: (1) systematic evaluation of maintenance strategies are crucial to the development of effective treatment approaches; and (2) research which attempts to assess
systematically methods of maintaining treatment effects with subjects treated with EMG relaxation training for tension headaches is needed.

Statement of the problem. The problem for this research was to provide data on whether there were any differences in the specific effects of four matched stimuli maintenance methods; continued home relaxation practice alone; continued home relaxation practice and use of taped instructions; continued home relaxation practice and self monitoring of EMG output; self monitoring of EMG output without home relaxation practice, on the continued practice of tension reducing procedures learned during EMG relaxation training and on the frequency and intensity of tension headaches over time after treatment.

Data on the specific effects of these four matched stimulus maintenance methods were provided by testing the following two hypotheses:

Hypothesis 1: There will be no clinically significant differences among the sequencing of four maintenance methods used in the continued practice of tension reducing procedures and in the frequency and intensity of tension headaches.

Hypothesis 2: There will be no clinically significant differences among four maintenance methods used (tapes, EMG, combined tape/EMG and practice) in the decrease of the frequency and intensity of tension headaches over time after treatment.

Purpose of the study. In general the purpose of this study was to provide information about viable, cost efficient and economical ways to treat tension headache sufferers. Specifically, this study investigated
the use of stimulus matching as a way of maintaining the treatment effects of tension headache subjects who received EMG-assisted relaxation training.
CHAPTER III

METHOD

Subjects. Twenty women, 21 to 64 years old, who lived in a rural New England two-county area and suffered from tension headaches, participated in this study. The subjects varied greatly in the length of time they had been experiencing tension headaches (6 months to 41 years), and in their ages and the events reported as coinciding with the onset of their headaches (see Table 1). The subjects were referred by local physicians, health and social agencies, college health and counseling services to a local out-patient mental health center where this study was conducted. Prior to scheduling a pre-study interview, each subject was required to produce a physician's statement based on a recent medical examination which confirmed the diagnosis of tension headache.

The experimenter, a 40-year-old male, licensed clinical psychologist, held a pre-study interview with each subject. Each subject was informed of the general nature of the relaxation training and what the study would require of her:

You are here because you have tension headaches. As you may know, tension headaches are primarily due to sustained contraction or tightness of the muscles of the scalp and neck. The goal of this treatment program is to teach you to relax your muscles so that tension levels may never get too high, and you may no longer experience headaches. Reports and studies in scientific and medical journals indicate that many others have used similar procedures (biofeedback assisted relaxation) successfully to control tension and reduce headache activity. Learning to relax in this manner will involve a great deal of work and commitment on your part, both here at the Center and
Table 1

Descriptive Characteristics of Subjects

<table>
<thead>
<tr>
<th>Subject</th>
<th>Age</th>
<th>Marital Status</th>
<th># Children at Home</th>
<th>Yrs. Education Completed</th>
<th>Employment Status</th>
<th># Yrs. Since Onset of Current Distress</th>
<th>Reported Intensity of Pain</th>
<th>Expectation</th>
<th>Factors Coincidental with Present Onset</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>51</td>
<td>Married</td>
<td>0</td>
<td>6</td>
<td>Home</td>
<td>12</td>
<td>1-5</td>
<td>Mod</td>
<td>Husband retired from military</td>
</tr>
<tr>
<td>2</td>
<td>27</td>
<td>Married</td>
<td>3</td>
<td>14</td>
<td>Sales-clerk (PT)</td>
<td>2(10)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1-4</td>
<td>Mod</td>
<td>Began job</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>Married</td>
<td>0</td>
<td>12</td>
<td>Secretary (U)</td>
<td>7 mo.</td>
<td>1-4</td>
<td>High</td>
<td>Laid off</td>
</tr>
<tr>
<td>4</td>
<td>49</td>
<td>Divorced</td>
<td>1</td>
<td>12</td>
<td>Unemployed</td>
<td>41</td>
<td>1-5</td>
<td>Mod</td>
<td>None identified</td>
</tr>
<tr>
<td>5</td>
<td>43</td>
<td>Married</td>
<td>2</td>
<td>12</td>
<td>Home</td>
<td>1(26)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5</td>
<td>Mod</td>
<td>Husband's job change &amp; move urban to rural</td>
</tr>
<tr>
<td>6</td>
<td>54</td>
<td>Married</td>
<td>0</td>
<td>12</td>
<td>Home</td>
<td>36</td>
<td>1-5</td>
<td>Mod</td>
<td>Marriage</td>
</tr>
<tr>
<td>7</td>
<td>35</td>
<td>Divorced</td>
<td>0</td>
<td>20</td>
<td>Student (FT) 1(20)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5</td>
<td>Mod</td>
<td>Entering college</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>21</td>
<td>Single</td>
<td>0</td>
<td>16</td>
<td>Asst. Manager (FT)</td>
<td>8</td>
<td>1-5</td>
<td>Mod</td>
<td>Pubescence</td>
</tr>
<tr>
<td>9</td>
<td>28</td>
<td>Married</td>
<td>0</td>
<td>15</td>
<td>Student Nurse (FT)</td>
<td>2</td>
<td>1-4</td>
<td>High</td>
<td>Entering nursing school</td>
</tr>
</tbody>
</table>

Note. a indicates the total number of years of headache activity; FT indicates full time; PT indicates part time; U indicates unemployed.
<table>
<thead>
<tr>
<th>Subject</th>
<th>Age</th>
<th>Marital Status</th>
<th># Children at Home</th>
<th>Yrs. Education Completed</th>
<th>Employment Status</th>
<th># Yrs. Since Onset of Current Distress</th>
<th>Reported Intensity of Pain</th>
<th>Expectation</th>
<th>Factors Coincidental with Present Onset</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>31</td>
<td>Separated</td>
<td>1</td>
<td>16</td>
<td>Graphic artist (FT)</td>
<td>18</td>
<td>1-5</td>
<td>Mod</td>
<td>Pubescence</td>
</tr>
<tr>
<td>11</td>
<td>24</td>
<td>Divorced</td>
<td>0</td>
<td>14</td>
<td>Student (FT)</td>
<td>2</td>
<td>1-3</td>
<td>High</td>
<td>Entering college</td>
</tr>
<tr>
<td>12</td>
<td>42</td>
<td>Married</td>
<td>2</td>
<td>14</td>
<td>Nurse (PT)</td>
<td>1(18)(^a)</td>
<td>1-5</td>
<td>Mod</td>
<td>Marital conflict</td>
</tr>
<tr>
<td>13</td>
<td>25</td>
<td>Divorced</td>
<td>1</td>
<td>12</td>
<td>Home</td>
<td>9</td>
<td>2-5</td>
<td>Mod</td>
<td>None identified</td>
</tr>
<tr>
<td>14</td>
<td>46</td>
<td>Single</td>
<td>0</td>
<td>15</td>
<td>Nurse (FT)</td>
<td>33</td>
<td>1-5</td>
<td>Mod</td>
<td>None identified</td>
</tr>
<tr>
<td>15</td>
<td>51</td>
<td>Married</td>
<td>0</td>
<td>12</td>
<td>Secretary (FT) (FT)</td>
<td>6 mo. (38)(^a)</td>
<td>1-5</td>
<td>High</td>
<td>Job promotion</td>
</tr>
<tr>
<td>16</td>
<td>31</td>
<td>Married</td>
<td>1</td>
<td>17</td>
<td>Teacher (FT) Student (PT)</td>
<td>6 mo.</td>
<td>1-5</td>
<td>High</td>
<td>Birth of handicapped child</td>
</tr>
<tr>
<td>17</td>
<td>37</td>
<td>Married</td>
<td>3</td>
<td>12</td>
<td>Nursing assistant (FT)</td>
<td>3(21)(^a)</td>
<td>1-4</td>
<td>Mod</td>
<td>Began job</td>
</tr>
<tr>
<td>18</td>
<td>41</td>
<td>Married</td>
<td>3</td>
<td>12</td>
<td>Home</td>
<td>1</td>
<td>1-5</td>
<td>Mod</td>
<td>Son &amp; wife moved in</td>
</tr>
<tr>
<td>19</td>
<td>64</td>
<td>Widowed</td>
<td>0</td>
<td>12</td>
<td>Volunteer</td>
<td>2</td>
<td>1-5</td>
<td>Mod</td>
<td>Husband's death</td>
</tr>
<tr>
<td>20</td>
<td>29</td>
<td>Married</td>
<td>1</td>
<td>12</td>
<td>Beekeeper</td>
<td>4</td>
<td>1-5</td>
<td>Mod</td>
<td>Back injury &amp; subsequent loss of job</td>
</tr>
</tbody>
</table>

Note. \(a\) indicates the total number of years of headache activity; FT indicates full time; PT indicates part time; U indicates unemployed.
also at home. For two weeks you will need to keep daily records of your headache activity and medication intake. Then, you will be coming to the Center twice a week for four weeks to learn relaxation procedures. Do you wish to participate in this treatment program? Do you have any questions?

The subjects were then told:

I am studying the effects of relaxation training on tension headache activity over time. If you are interested I would like you to continue relaxation practice for fifteen weeks beyond the four-week training period. We would meet every fifth week to discuss the way in which you will practice relaxing for the following five weeks. During these fifteen weeks on a daily basis you will also need to continue to record your headache activity, medication intake and the times you practiced relaxation. You will receive the four weeks of relaxation training whether you choose to participate in the study or not. Do you wish to participate in the study? Do you have any questions?

Only those subjects who agreed to these requirements were included in this study. Six individuals from the twenty-six who applied chose not to participate. Three were given the relaxation training but not included in the study and three were referred back to their personal physicians.

Apparatus and materials. All meetings (pre-study, training and maintenance) with subjects were held in a 10' x 12' office which contained a small desk and chair, a small table and bookcase. A comfortable but firm, well-padded, high-backed chair with arms was used for the relaxation training. Bernstein and Borkovec (1974) suggest the use of such a chair because the subjects may sit comfortably with their legs, arms, backs, shoulders, neck and head well supported.

EMG activity was used to determine the subjects' pre- and post-
training tension levels and to provide information about their relaxation training progress. A portable EMG J33 feedback unit, serial no. 6067, manufactured by Cyborg Corporation was used to measure each subject's pre- and post-relaxation training frontalis electromyographical activity levels.

EMG activity was recorded in microvolts on a range from 0.7 UV to 1,000 UV and feedback auditorily through built-in speakers and visually on a meter readout on the front of the unit. The unit was equipped with three surface cup sensors 0.6" in diameter which were attached to specific muscles to measure electromyographical activity. In addition, the unit had electrode check circuits which automatically indicated faulty sensor contact with the skin. Explicit detailed instructions for attaching the sensors and operating the unit were provided in the EMG J33 Handbook.¹

A 5-1/2" x 8" wipe saturated with a solution containing 50% witch hazel, 10% Glycerin U.S.P., Purified Water U.S.P. deionized, q.s. Methylparaben U.S.P. 0.0% and Benzalkonium chloride U.S.P. 0.003% as preservatives was used to wipe the skin surface of each subject's forehead area to prepare it for sensor placement. The wipes were also used to clean subject's forehead area of any excess sensor cream when the sensors were removed.

EC-2 electrode cream, manufactured by Grass Instruments Company, was used in the sensor cups to provide contact between the sensors and

¹Handbook is available from Cyborg Corporation, 342 Western Avenue, Boston, Massachusetts.
the subject's skin. Each cup was filled to the top with the cream and the excess cream was leveled off before attaching the sensors.

A Brenet No. 15 stopwatch, which was mounted on a clipboard, was used as a timing device.

A Realistic cassette tape recorder, Cat. No. 14-879, Model No. CTR-19 with DC 6 volts, AC 120 volts, 4 watts and a 60H2 band was used in the relaxation training sessions by the experimenter. Subjects used their own cassette tape recorders during the maintenance period. Realistic C-60, Cat. No. 44-602, low noise, high frequency tensilized polyester compact cassette 60-minute (30 x 2) tape cartridges were used by the subjects to play relaxation training instructions during both the training and maintenance phases of this study.

The BMT Life History Questionnaire developed by Joseph Wolpe, M.D., was administered by the experimenter to elicit standard background information from each subject.

A Headache Data Chart was designed by the experimenter employing the ratings and definitions of headache intensity developed by Budzynski et al. (1973). Headache activity was rated on a 0 to 5 scale of intensity and subjects recorded one level of intensity for each waking hour. The frequency of medication intake and home relaxation practice was also recorded on this chart. The purpose of these recordings was to provide the experimenter with quantitative data throughout the study (see Appendix A).

A data form was designed by the experimenter to record pre- and post-training EMG levels for each subject during the eight training sessions. The form was 8-1/2" x 11-1/2" and provided a place to record
the subject's name and the data from each of eight training sessions, including the date of each session, the minute-by-minute EMG levels for five minutes pre- and post-training, the total pre- and post-EMG levels and the average pre- and post-EMG levels (see Appendix B).

Procedure.

Baseline period. Following their acceptance for participation in the study, each subject was instructed in the use of the Headache Data Chart (see Appendix A). Each subject was told to begin hourly charting of the level of headache intensity and medication intake. In addition, each subject was asked to keep a daily record of any stimuli which she felt contributed to tension and/or headache pain. Each subject was instructed to be honest and accurate in her recording of data.

Training period. Upon completion of the two-week baseline period, each subject was scheduled for an initial training session with the experimenter.

During the initial training session, each subject's baseline data were reviewed and discussed as needed. The nature of the relaxation training procedure (see Appendix C) and the equipment (see Apparatus section) was explained by the experimenter. Any questions the subjects had about the procedure and/or equipment were answered by the experimenter.

After answering any questions as briefly as possible, each subject was told the following:

Today I am going to have you spend the next twenty minutes using the EMG (electromyographical) unit here so that you will become accustomed to it. The EMG unit will be very useful to
you as you learn to relax because it will provide you with information as to the level of muscle tension in your forehead area. This unit operates on regular flashlight batteries much like your portable radio. You will not feel anything as the unit is operating and it will not be harmful to you in any way. Any questions so far?

Any questions were answered as briefly as possible and the experimenter then proceeded to attach the EMG sensors (see Apparatus section) to the subject's forehead area. The experimenter gave each subject the following explanation:

Now I am going to wipe your forehead area with this alcohol swab. The alcohol will remove excess oil on your forehead and allow the sensors to assess your muscle tension level accurately. Any questions before I do this?

Any questions were answered and then the experimenter proceeded to wipe the subject's forehead with the alcohol swipe. As the alcohol was drying, the experimenter explained the attachment procedure to the subject.

Now I am going to place the sensors on your forehead. The sensors act like miniature antennae. They pick up the muscle tension in your forehead area and relay it to the unit. Once the sensors are in place and the unit is operating, you will hear a series of clicks coming from the unit speaker. The click rate will be proportional to the level of tension in your forehead muscle. Any questions?

Any questions were answered as briefly as possible and then the experimenter attached the sensors following the procedure, developed by Budzynski (1973):

The sensors, containing EC-2 electrode cream, were placed one inch above each eyebrow and spaced four inches apart on the subject's fore-
head. One reference sensor was located in the center of the subject's forehead.

Once the sensors were properly attached, the experimenter then gave the following instructions to each subject:

Today I want you to spend the next twenty minutes trying to relax as best you can. Try to remain as quiet as possible while you are relaxing as movement of any kind will be picked up by the EMG unit. Do not feel you have to remain rigid while relaxing but do try to keep as still as you can. So that you will not be distracted while you are relaxing, I will be sitting over there out of sight and I will not speak with you until the twenty minutes are up. Any questions?

Any questions were answered as briefly as possible and the experimenter then moved to a chair out of the subject's view and remained there while the subject relaxed for the next twenty minutes. The experimenter quietly monitored and recorded the subject's EMG activity output during this time on the treatment progress report form (Appendix B). All subsequent recording of the subject's EMG output were done in this manner on the same form.

When the twenty minutes were up, the experimenter removed the sensors and asked the subject if she had any questions. After answering any questions as briefly as possible, the experimenter had the subject remove the excess conductive paste from her forehead and then began relaxation training with the subject.

The experimenter gave each subject the following specific introduction and instructions:

Learning to relax is a very important part of the treatment program. By learning to relax you can reduce tension and feel more relaxed. If you are relaxed, you cannot be tense, and,
if you are tense you cannot be relaxed. This is a simple fact since one condition is the opposite of the other. The goal, therefore, is to teach you how to become relaxed, so that you feel less tense and thereby reduce the frequency and intensity of the headaches you are seeking relief from.

I am going to teach you one of the simplest and most effective ways of learning to relax. The procedure basically consists of first systematically tensing and relaxing various muscle groups while you sit in a chair. Then, quietly with your eyes closed, you will practice letting your body and mind fill up with calmness and emptying yourself of tension. Although it is a simple method, a period of instruction is necessary for it to be effective. It must become a habit. When practiced daily it will help keep tension at low levels. Do you have any questions?

Following the answering of any questions, each subject was told:

I am going to ask you not to talk during the training procedure so that you can concentrate fully on relaxing. Please hold any further questions you may have until the end of the session.

The experimenter then began the relaxation training with each subject following the format presented in Appendix C.

Upon completion of the relaxation training, each subject was given the following instructions for home practice:

Learning to relax well will require a continuous, sustained effort; thus, it is crucial that you do not miss any of the treatment sessions. If you must cancel, please call me right away so that I may reschedule your session as soon as possible.

So that you will become more proficient at relaxing, daily practice is necessary. I am going to ask you to practice at least twice a day on the five days you do not come here for treatment. You will be coming here twice weekly for biofeedback assisted relaxation training. On those days you will need to practice only once at home since your session here will count as a practice session. Do you have any questions?
Any questions were answered and the experimenter continued as follows:

When you practice at home you should do it the same way we just did it here. It is important to relax all the muscle groups twice. First go through the muscle groups tensing them, then relaxing them. Be sure to notice the difference. After you have done this, go through the muscle groups again and relax them without tensing. Make sure you relax each muscle group as much as possible before going on to the next one. Any questions?

Any questions were answered and the experimenter then indicated:

Finding a quiet place where you can practice undisturbed each day is very important. What place and times are best for you?

After the place and times for practice were established, each subject was then given a cassette tape recording of the relaxation training instructions used by the experimenter in the training session to guide her practice at home. (See Appendix C for a specific description of the relaxation training text.) The subjects provided their own tape recorder whenever possible. Any questions were answered and the subject was given an appointment for her next training session.

For each subject, sessions two through eight began with the review of the Headache Data Chart. The experimenter made a copy of the Headache Data Chart and placed it in the subject's file. The subject was given a new chart whenever needed. Questions were answered as briefly as possible and the experimenter tried to refrain from discussing with the subject anything that was not directly related to the training experience itself.

Then, a five-minute baseline of the subject's EMG activity level
was taken to assess pre-training tension level before relaxation training began. The subject was given the following explanation and instructions:

I am going to attach the EMG sensors just as I did last session. Again, I would like you to sit quietly. For the next five minutes, try to relax as deeply as possible. I will let you know when the time is up. Any questions?

Questions were answered as briefly as possible and the experimenter moved to a chair out of the subject's view. As soon as the experimenter sat down in his chair, he started a stopwatch. The experimenter quietly monitored and recorded (see Appendix D) the subject's EMG activity output for five minutes.

The subject was then instructed in relaxation training (see Appendix C for specific description of training) while receiving visual and auditory EMG feedback.

Upon completion of the relaxation training, the subject's EMG activity level was measured to assess post-training tension level. The subject was told to sit quietly for the next five minutes, relaxing as deeply as possible. The experimenter monitored and recorded the subject's EMG output each minute for five minutes and then informed the subject that the five minutes were up. The experimenter removed the sensors from the subject's forehead, and had the subject use an alcohol swipe to clean off any sensor cream residue. Any questions the subject had about the training and/or practice procedures were answered at this time and then the subject was given an appointment for her next training session. Each training session was of one hour's duration.
At the end of the eighth relaxation training session, each subject was given the following instructions:

Now that the training sessions are over it is very important for you to continue to practice the relaxation exercises you have learned here if you are to maintain the effects you have derived from the relaxation training so far. I would like you to practice relaxing in different ways for the next fifteen weeks. Beginning today and then every fifth week thereafter, we will meet to discuss how you will practice relaxation. You will not be asked to do anything you do not know how to do already or to use equipment (tape, EMG unit) which you are not already familiar with. Any questions?

Maintenance methods. Each 15-week post-training period was divided into three five-week periods. The following four matched home/training stimuli were employed as maintenance methods:

1. Continued home relaxation practice (R)
2. Continued home relaxation practice and use of audio-taped instruction (R+T)
3. Continued home relaxation practice and self monitoring of EMG output (R+EMG)
4. Self monitoring of EMG output without home relaxation (EMG).

The four maintenance methods were arranged in a series of ten single-subject experimental designs to assess the effects of the maintenance methods on individual subjects over the 15-week post-training period (see Table 2). The first 10 subjects were assigned to one of the ten sequences in the order in which they volunteered for the study and the order of assignment was repeated for subjects 11 through 20.

The experimenter met with each subject following each five-week maintenance period to review their data and assign them to the next
Table 2
Assignment of Maintenance Sequence

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Maintenance Period 1</th>
<th>Maintenance Period 2</th>
<th>Maintenance Period 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 11</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>2 and 12</td>
<td>R</td>
<td>R+T</td>
<td>R</td>
</tr>
<tr>
<td>3 and 13</td>
<td>R</td>
<td>R+T</td>
<td>R+EMG</td>
</tr>
<tr>
<td>4 and 14</td>
<td>R</td>
<td>R+EMG</td>
<td>R+T</td>
</tr>
<tr>
<td>5 and 15</td>
<td>R</td>
<td>R+EMG</td>
<td>R</td>
</tr>
<tr>
<td>6 and 16</td>
<td>EMG</td>
<td>EMG</td>
<td>EMG</td>
</tr>
<tr>
<td>7 and 17</td>
<td>R</td>
<td>R+T</td>
<td>EMG</td>
</tr>
<tr>
<td>8 and 18</td>
<td>R</td>
<td>EMG</td>
<td>R</td>
</tr>
<tr>
<td>9 and 19</td>
<td>EMG</td>
<td>R+T</td>
<td>R</td>
</tr>
<tr>
<td>10 and 20</td>
<td>R</td>
<td>EMG</td>
<td>R+T</td>
</tr>
</tbody>
</table>

Note.  
R = continued home relaxation practice

R+T = continued home relaxation practice and use of audio-taped instruction

R+EMG = continued home relaxation practice and self monitoring of EMG output

EMG = self monitoring of EMG output without home relaxation
maintenance method.

Questions were answered as briefly as possible and depending on which maintenance sequence the subject has been assigned to they were then given the following additional instructions.

Those subjects assigned to Method R (relaxation practice only) were told:

Today I want you to begin to practice relaxing at home daily without the use of the tape. Continue to do the exercises just as you have been doing them. Continue to record headache, practice, and medication data. In five weeks we will meet here to discuss your post training progress. My assistant will call you in four weeks to confirm the time and date of our post training meeting. Any questions?

Those subjects assigned to Method R+T (practice and tape) were told:

Today I want you to continue to practice relaxing at home the same way you did during the training period. Continue to do the exercises just as you did then and to use the tape to guide your practice. Continue to record headache, practice, and medication data. In five weeks we will meet here to discuss your post training progress. My assistant will call you in four weeks to confirm the time and date of our post training meeting. Any questions?

Those subjects assigned to Method R+EMG (practice and EMG unit) were told:

Today I want you to begin to practice relaxing at home daily without the use of the tape. Continue to do the exercises just as you have been doing them and use the portable EMG unit for feedback when you are relaxing without tensing. Continue to record headache and practice data. In five weeks we will meet here to discuss your post training progress. My assistant will call you in four weeks to confirm the time and date of our post training meeting. Any questions?
Those subjects assigned to Method EMG (EMG unit and no practice) were given the following instructions:

Today I want you to begin to use the portable EMG unit to give you feedback about how relaxed you are each day. I do not want you to practice your relaxation exercises during this time. Just measure how relaxed you can get without trying to relax in any particular way. Spend the same amount of time each day measuring your state of relaxation that you would for a practice session. Continue to record headache practice and medication data. In five weeks we will meet here to discuss your post training progress. My assistant will call you in four weeks to confirm the time and date of our post training meeting. Any questions?

In all cases questions were answered by the experimenter and a mutually convenient time arranged with the subject for the post training meeting.

An assistant, who was not appraised of the hypothesis of the study, telephoned each subject following the first four weeks of each five-week maintenance period. The purpose of the call was to confirm the post training meeting with the experimenter and to remind the subject to bring their data forms with them. The same assistant was utilized throughout the study.

**Post-training sessions.** Every five weeks the experimenter met with each subject and collected and reviewed their headache and practice data and gave them instructions regarding their maintenance method re-assignment.

During the final post training session (fifteen weeks) each subject was told that that was the last scheduled treatment meeting and that in order to continue to maintain the treatment effects they had achieved so far, they should continue to practice the relaxation exercises as often
as possible. They were encouraged to relax immediately, whenever they felt the least bit tense, so that eventually relaxing in the face of stress would come easily without much conscious effort to do so.

Analysis of the data.

**Headache activity** \( (H_D) \). Each subject recorded one level of headache intensity for each waking hour. The daily headache activity total was divided by 24 to derive the mean hourly headache activity \( (H_D) \) for each day of the study.

For each subject:

The mean \( H_D \) for the baseline period was derived by summing the mean daily \( H_D \) for each subject during baseline and dividing by 14 (number of days in baseline).

The mean \( H_D \) for the training period was derived by summing the mean daily \( H_D \) for each subject during training and dividing by 28 (number of days in training).

The mean \( H_D \) for each maintenance period was derived by summing the mean daily \( H_D \) for each subject during maintenance and dividing by 35 (number of days in each maintenance period).

These data were used to calculate the percent of mean \( H_D \) change from the baseline \( (B) \) period to the training \( (T) \) period, maintenance period one \( (M_1) \), maintenance period two \( (M_2) \) and maintenance period three \( (M_3) \).

**Home relaxation practice.** The mean percent of home relaxation practice was derived for each subject by summing the actual number of practices during each period \( (T, M_1, M_2, M_3) \) and dividing by the number
of practice opportunities, two per day, i.e., Training--56 opportunities, Maintenance period one or Maintenance period two or Maintenance period three--70 opportunities.

**EMG measurement.** Frontalis EMG levels were measured five minutes pre and post during the second through the last (eight) training sessions. The frontalis muscle was selected because of its sensitivity, correlation with other physiological systems, and possible function in the etiology of muscle contraction headaches (Stoyva & Budzynski, 1973). EMG activity was measured in the .7 to 1,000 microvolt range. EMG activity in the two to five microvolt range was considered to demonstrate frontalis muscle relaxation (Forgione, 1976; Stroebel, 1976). According to Budzynski (1973), a peak-to-peak microvolt level of three or less for fifteen minutes is suggestive of deep muscle relaxation. The five pre- and post-scores were summed individually and divided by five to derive a mean pre- and post-EMG activity level for each training session. A review of Table 5 (Appendix D) indicates that all subjects' frontalis EMG activity was within the .7 to five microvolt range before the conclusion of training.

**Matched stimuli maintenance methods.** The percent of improvement in \( H_D \) was derived for each subject by dividing the mean \( H_D \) during training by the mean \( H_D \) of \( M_1, M_2, M_3 \).

The mean percent of improvement in headache activity from the training period was derived by summing the mean percent of improvement in \( H_D \) scores for all subjects for each matched stimuli maintenance method and dividing by the total number of occurrences of each matched stimuli maintenance method in the study.
**Headache free days.** The percent of headache free days was derived by dividing the number of headache free days by the number of opportunities during T, M₁, M₂, M₃.

The mean percent of headache free days was derived for each matched stimuli maintenance by summing the percent of headache free days for each matched stimuli maintenance method and dividing by the total number of occurrences of each matched stimuli maintenance method in the study.

**Clinical significance.** Clinical significance was determined by applying the criteria suggested by Bergin and Strupp (1972) and Hersen and Barlow (1976). They indicated that any improvement in behavior that is clear, relevant, and readily observable by inspection or description and does not require the use of statistics to determine if any change actually occurred is clinically significant. For the purposes of this study, a variance of 20% or greater among the maintenance periods or methods was considered to fit this criteria and therefore be clinically significant.
Purpose of the study. The purpose of this study was to investigate the specific effects of four matched stimuli maintenance methods used—continued home relaxation practice alone; continued home relaxation practice and use of taped instructions; continued home relaxation practice and self-monitoring of EMG output; self-monitoring of EMG output without home relaxation practice—on the continued practice of tension reducing procedures learned during relaxation training and on the frequency and intensity of tension headaches over time after treatment (training).

Two specific hypotheses were tested:

Hypothesis 1: There will be no clinically significant differences among the sequencing of four matched stimuli maintenance methods used in the continued practice of tension reducing procedures and in the frequency and in the intensity of tension headaches.

Hypothesis 2: There will be no clinically significant differences among the four matched stimuli maintenance methods used in the decrease of the frequency and intensity of tension headaches over time after treatment.

A single-subject design was employed in this study since the primary focus was on the specific and sequential effects that four matched stimuli maintenance methods had on individual subjects' continued practice of learned tension reducing procedures and maintenance of treatment effects over time after treatment.

Clinical significance was determined by applying the criteria sug-
gested by Bergin and Strupp (1972) and Hersen and Barlow (1976). For the purposes of this study a variance of 20 percent or greater among the maintenance periods or methods was considered to be clinically significant.

**Hypothesis 1.** The first part of hypothesis one stated: there will be no clinically significant differences among the sequencing of four matched stimuli maintenance methods in the continued practice of tension reducing procedures.

For the first part of hypothesis one, each subject's frequency of home relaxation practice was repeatedly measured by self-report during the training and each assigned maintenance period. These data were then used to determine the mean percent of home relaxation practice vs. opportunities for each subject for the training and each assigned maintenance period.

The second part of hypothesis one stated: there will be no clinically significant differences among the sequencing of four matched stimuli maintenance methods used. . . in the frequency and in the intensity of tension headaches.

For the second part of hypothesis one, each subject's headache activity was repeatedly measured by self-report during the baseline, training and each assigned maintenance period. These data were then used to calculate the mean hourly headache activity for each subject during baseline, training and each assigned maintenance period, and the mean percent of change from baseline of headache activity during training and each assigned maintenance period.
Figures 1-20 show for each of the subjects the mean percent of home relaxation practice, and the mean percent of headache activity from baseline (B) during training (T) and each assigned maintenance (M_1, M_2, M_3) period; and, the mean hourly headache activity during baseline (B), treatment (T) and each assigned maintenance (M_1, M_2, M_3) period. These data are presented in the pairs in which the subjects were assigned in the order in which they volunteered for the study (see summary, Table 6, Appendix E).

An examination of Figure 1 indicates that for Subject 1 there was no clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(90.0%)/R(91.4%)/R(90.0%). Therefore, the first part of hypothesis one was not rejected for Subject 1.

The mean percent of headache activity did not vary sufficiently among the three assigned maintenance periods, R(57.0%)/R(42.6%)/R(59.8%), to be considered clinically significant. Therefore, the second part of hypothesis one was not rejected for Subject 1.

An examination of Figure 2 indicates that for Subject 11 there was no clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(88.6%)/R(97.1%)/R(91.4%). Therefore, part one of hypothesis one was not rejected for Subject 11.

The mean percent of headache activity did not vary sufficiently among the three assigned maintenance periods, R(6.9%)/R(3.9%)/R(1.0%), to be considered clinically significant. Therefore, part two of hypothesis one was not rejected for Subject 11.
Figure 1. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (H₀) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 1.
Figure 2. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (Hₐ) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 11.
An examination of Figure 3 indicates that for Subject 2 there was no clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(72.8%)/R+T(75.7%)/R(71.4%). Therefore, the first part of hypothesis one was not rejected for Subject 2.

The mean percent of headache activity varied sufficiently among the three assigned maintenance periods, R(19.6%)/R+T(38.2%)/R(6.7%), to be considered clinically significant. Maintenance period three (R) demonstrated a decrease in mean percent of headache activity significantly greater (21.5%) than maintenance period two (R+T). Therefore, the second part of hypothesis one was rejected for Subject 2.

An examination of Figure 4 indicates that for Subject 12 there was no clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance periods, R(95.7%)/R+T(92.9%)/R(94.3%). Therefore, the first part of hypothesis one was not rejected for Subject 12.

The mean percent of headache activity did not vary sufficiently among the three assigned maintenance periods R(22.0%)/R+T(16.8%)/R(2.4%) to be considered clinically significant. Therefore, the second part of hypothesis one was not rejected for Subject 12.

An examination of Figure 5 indicates that for Subject 3 there was a clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(81.4%)/R+T(72.8%)/R+EMG(51.4%). Maintenance period one (R) and maintenance period two (R+T) demonstrated a mean percent of practice greater (30.0% and 21.4%) than maintenance period three (R+EMG). Therefore, the first part
Figure 3. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (H₀) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 2.
Figure 4. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (Hₚ) from Baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 12.
Figure 5. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (H₀) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 3.
of hypothesis one was rejected for Subject 3.

The mean percent of headache activity did not vary sufficiently among the three assigned maintenance periods R(28.3%)/R+T(10.4%)/R+EMG (19.9%) to be considered clinically significant. Therefore, the second part of hypothesis one was not rejected for Subject 3.

An examination of Figure 6 indicates that for Subject 13 there was a clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(85.7%)/R+T(82.9%)/R+EMG(64.3%). Maintenance period one (R) demonstrated a mean percent of practice greater (21.4%) than maintenance period three (R+EMG). Therefore, the first part of hypothesis one was rejected for Subject 13.

The mean percent of headache activity varied sufficiently among the three assigned maintenance periods, R(29.2%)/R+T(34.5%)/R+EMG(11.2%) to be considered clinically significant. Maintenance period three (R+EMG) demonstrated a decrease in mean percent of headache activity significantly greater (23.3%) than maintenance period two, (R+T). Therefore, the second part of hypothesis one was rejected for Subject 13.

An examination of Figure 7 indicates that for Subject 4 there was no clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(75.5%)/R+EMG(70.0%)/R+T(72.9%). Therefore, the first part of hypothesis one was not rejected for Subject 4.

The mean percent of headache activity did not vary sufficiently among the three assigned maintenance methods R(33.3%)/R+EMG(37.7%)/R+T (21.2%) to be considered clinically significant. Therefore, the second
Figure 6. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (Hₚ) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 13.
Figure 7. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (H₀) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 4.
part of hypothesis one was not rejected for Subject 4.

An examination of Figure 8 indicates that for Subject 14 there was no clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(78.6%)/R+EMG(91.4%)/R+T(97.1%). Therefore, the first part of hypothesis one was not rejected for Subject 14.

The mean percent of headache activity varied sufficiently among the three assigned maintenance methods, R(74.9%)/R+EMG(21.5%)/R+T(15.0%) to be considered clinically significant. Maintenance periods two (R+EMG) and three (R+T) demonstrated a decrease in mean percent of headache activity significantly greater (53.4% and 59.9%) than maintenance period one (R). Therefore, the second part of hypothesis one was rejected for Subject 14.

An examination of Figure 9 indicates that for Subject 5 there was a clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(81.4%)/R+EMG(61.4%)/R(68.6%). Maintenance period one (R) demonstrated a mean percent of practice greater (20.0%) than maintenance period two (R+EMG). Therefore, the first part of hypothesis one was rejected for Subject 5.

The mean percent of headache activity varied sufficiently among the three assigned maintenance methods, R(44.1%)/R+EMG(36.9%)/R(10.4%) to be considered clinically significant. Maintenance period three (R) demonstrated a decrease in mean percent of headache activity significantly greater (33.7% and 26.5%) than maintenance period one (R) and maintenance period two (R+EMG). Therefore, the second part of hypothesis one was rejected for Subject 5.
Figure 8. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (H₅) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 14.
Figure 9. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M1, M2, M3), mean percent of hourly headache activity (Hd) from baseline (B) during training (T) and maintenance periods (M1, M2, M3), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M1, M2, M3), for Subject 5.
An examination of Figure 10 indicates that for Subject 15 there was a clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(94.3%)/R+EMG(48.6%)/R(91.4%). Maintenance periods one (R) and three (R) demonstrated a mean percent of practice greater (45.7% and 42.8%) than maintenance period two (R+EMG). Therefore, the first part of hypothesis one was rejected for Subject 15.

The mean percent of headache activity did not vary sufficiently among the three assigned maintenance methods, R(18.0%)/R+EMG(11.2%)/R(5.5%), to be considered clinically significant. Therefore, the second part of hypothesis one was not rejected for Subject 15.

An examination of Figure 11 indicates that for Subject 6 there was a clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, EMG(55.7%)/EMG(47.1%)/EMG(35.7%). Maintenance period one (EMG) demonstrated a mean percent of practice greater (20.0%) than maintenance period three (EMG). Therefore, the first part of hypothesis one was rejected for Subject 6.

The mean percent of headache activity did not vary sufficiently among the three assigned maintenance methods EMG(3.9%)/EMG(.4%)/EMG(3.1%) to be considered clinically significant. Therefore, the second part of hypothesis one was not rejected for Subject 6.

An examination of Figure 12 indicates that for Subject 16 there was no clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, EMG(34.3%)/EMG(22.9%)/EMG(28.6%). Therefore, the first part of hypothesis one was not rejected for Subject 16.
Figure 10. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (Hp) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 15.
Figure 11. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (Hₚ) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 6.
Figure 12. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (H_D) from Baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 16.
The mean percent of headache activity varied sufficiently among the three assigned maintenance methods, EMG(80.7%)/EMG(56.2%)/EMG(28.6%) to be considered clinically significant. Maintenance period three, EMG, demonstrated a decrease in mean percent of headache activity significantly greater (52.1% and 27.6%) than maintenance period one (EMG). Maintenance period two (EMG) demonstrated a decrease in mean percent of headache activity greater (24.5%) than maintenance period one, (EMG). Therefore, the second part of hypothesis one was rejected for Subject 16.

An examination of Figure 13 indicates that for Subject 7 there was no clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(65.7%)/R+T(58.6%)/EMG(68.6%). Therefore, the first part of hypothesis one was not rejected for Subject 7.

The mean percent of headache activity varied sufficiently among the three assigned maintenance methods, R(75.9%)/R+T(88.6%)/EMG(61.2%) to be considered clinically significant. Maintenance period three (EMG) demonstrated a decrease in mean percent of headache activity significantly greater (27.4%) than maintenance period two (R+T). Therefore, the second part of hypothesis one was rejected for Subject 7.

An examination of Figure 14 indicates that for Subject 17 there was a clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(92.9%)/R+T(87.1%)/EMG(51.4%). Maintenance period one (R) and maintenance period two (R+T) demonstrated a mean percent of practice greater (41.5% and 35.7%) than maintenance period three (EMG). Therefore, the first part
Figure 13. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (H_D) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 7.
Figure 14. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (Hₐ) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 17.
of hypothesis one was rejected for Subject 17.

The mean percent of headache activity did not vary sufficiently among the three assigned maintenance methods $R(48.7\%)/R+T(45.7\%)/EMG(58.6\%)$ to be considered clinically significant. Therefore, the second part of hypothesis one was not rejected for Subject 17.

An examination of Figure 15 indicates that for Subject 8 there was a clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, $R(74.3\%)/EMG(52.9\%)/R(62.9\%)$. Maintenance period one (R) demonstrated a mean percent of practice greater (21.4\%) than maintenance period two (EMG). Therefore, the first part of hypothesis one was rejected for Subject 8.

The mean percent of headache activity varied sufficiently among the three assigned maintenance methods, $R(40.0\%)/EMG(25.7\%)/R(12.6\%)$ to be considered clinically significant. Maintenance period three (R) demonstrated a decrease in mean percent headache activity significantly greater (27.4\%) than maintenance period one (R). Therefore, the second part of hypothesis one was rejected for Subject 8.

An examination of Figure 16 indicates that for Subject 18 there was a clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, $R(92.8\%)/EMG(47.1\%)/R(91.4\%)$. Maintenance period one (R) and maintenance period three (R) demonstrated a mean percent of practice significantly greater (45.7\% and 44.3\%) than maintenance period two (EMG). Therefore, the first part of hypothesis one was rejected for Subject 18.

The mean percent of headache activity did not vary sufficiently among the three assigned maintenance methods $R(26.3\%)/EMG(35.0\%)/R(18.6\%)$
Figure 15. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃) mean percent of hourly headache activity (H₀) from Baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 8.
Figure 16. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃) mean percent of hourly headache activity (H_D) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 18.
to be considered clinically significant. Therefore, the second part of hypothesis one was not rejected for Subject 18.

An examination of Figure 17 indicates that for Subject 9 there was no clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, EMG(75.7%)/R+T(70.0%)/R(62.9%). Therefore, the first part of hypothesis one was not rejected for Subject 9.

The mean percent of headache activity varied sufficiently among the three assigned maintenance methods, EMG(32.7%)/R+T(11.3%)/R(6.8%) to be considered clinically significant. Maintenance period two (R+T) and maintenance period three (R) demonstrated a decrease in mean percent of headache activity significantly greater (21.4% and 25.9%) than maintenance period one (EMG). Therefore, the second part of hypothesis one was rejected for Subject 9.

An examination of Figure 18 indicates that for Subject 19 there was a clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, EMG(61.4%)/R+T(88.6%)/R(90.0%). Maintenance period two (R+T) and maintenance period three (R) demonstrated a mean percent of practice greater (27.2% and 28.6%) than maintenance period one (EMG). Therefore, the first part of hypothesis one was rejected for Subject 19.

The mean percent of headache activity varied sufficiently among the three assigned maintenance periods, EMG(32.2%)/R+T(20.5%)/R(15.3%) to be considered clinically significant. Maintenance period three (R) demonstrated a decrease in mean percent of headache activity significantly greater (16.9%) than maintenance period one (EMG). Therefore, the sec-
Figure 17. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (H_D) from Baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 9.
Figure 18. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (H_D) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 19.
ond part of hypothesis one was rejected for Subject 19.

An examination of Figure 19 indicates that for Subject 10 there was no clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(78.6%)/EMG (81.4%)/R+T(77.1%). Therefore, the first part of hypothesis one was not rejected for Subject 10.

The mean percent of headache activity varied sufficiently among the three maintenance methods, R(76.6%)/EMG(12.5%)/R+T(4.2%) to be considered clinically significant. Maintenance period two (EMG) and maintenance period three (R+T) demonstrated a decrease in mean percent of headache activity significantly greater (64.1% and 72.4%) than maintenance period one (R). Therefore, the second part of hypothesis one was rejected for Subject 10.

An examination of Figure 20 indicates that for Subject 20 there was a clinically significant difference in the mean percent of home relaxation practice among the three assigned maintenance methods, R(87.1%)/EMG(52.9%)/R+T(84.3%). Maintenance period one (R) and maintenance period three (R+T) demonstrated a mean percent of practice greater (34.2% and 31.4%) than maintenance period two (EMG). Therefore, the first part of hypothesis one was rejected for Subject 20.

The mean percent of headache activity did not vary sufficiently among the three assigned maintenance methods, R(19.4%)/EMG (4.9%)/R+T (2.9%) to be considered clinically significant. Therefore, the second part of hypothesis one was not rejected for Subject 20.

Hypothesis 2. Hypothesis 2 stated there will be no clinically signifi-
Figure 19. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M₁, M₂, M₃), mean percent of hourly headache activity (H₃) from baseline (B) during training (T) and maintenance periods (M₁, M₂, M₃), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M₁, M₂, M₃), for Subject 10.
Figure 20. The mean percent of relaxation practice achieved during the training (T) and maintenance periods (M1, M2, M3), mean percent of hourly headache activity (Hd) from baseline (B) during training (T) and maintenance periods (M1, M2, M3), and mean hour headache activity during baseline (B), training (T) and maintenance periods (M1, M2, M3), for Subject 20.
cant differences among the four matched stimuli maintenance methods used in the decrease of the frequency and intensity of tension headaches over time after treatment.

Each subject's headache activity was measured daily and reported by the subject during the baseline training and the assigned matched stimuli maintenance methods. The mean per cent of change in headache activity was determined for each assigned matched stimuli maintenance method from training. In addition, the mean per cent of headache-free days for each matched stimuli maintenance method was determined from training.

Table 3 displays the greatest, least and mean per cent of improvement in the frequency and intensity of headache activity for each maintenance method from the training period. The greatest and least percent of improvements were determined by identifying the highest and the lowest individual mean score that had occurred for each maintenance method. The mean per cent of improvement in Hq from the training period was derived by summing the mean per cent of improvement in Hq scores for all subjects for each matched stimuli maintenance method and dividing by the total number of occurrences of each matched stimuli maintenance method in the study.

These scores were analyzed for clinical significance by applying the criteria suggested by Bergin and Strupp (1972). Because there was less than 20 percent variation among the mean percent of improvement for each maintenance method used, these differences were not considered to be clinically significant.

Table 4 displays the highest, lowest and mean percent of headache-free days that occurred during each matched stimuli maintenance period.
Table 3
Percent of Improvement in Mean Hourly Headache Activity from Training Period for Each Matched Stimuli Maintenance Method

<table>
<thead>
<tr>
<th>Maintenance Method</th>
<th>Range of Percent of Improvement Scores</th>
<th>Mean % of Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relaxation (R)</td>
<td>95.6% to -47.0%a</td>
<td>56.9%</td>
</tr>
<tr>
<td>Relaxation and Audio Tape (R+T)</td>
<td>97.5% to 16.2%</td>
<td>68.7%</td>
</tr>
<tr>
<td>Relaxation and EMG (R+EMG)</td>
<td>87.9% to 22.0%</td>
<td>49.0%</td>
</tr>
<tr>
<td>EMG (EMG)</td>
<td>97.5% to 5.4%</td>
<td>54.0%</td>
</tr>
</tbody>
</table>

Note. 100.0% maximum percent of improvement.

^Indicates an increase in headache activity.
Table 4
Percent of Headache-free Days for Each Matched Stimuli Maintenance Method

<table>
<thead>
<tr>
<th>Maintenance Method</th>
<th>Range of Percent of Headache-free Days Scores</th>
<th>Mean % Headache-free Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relaxation (R)</td>
<td>94.3% to 0.0%</td>
<td>55.8%</td>
</tr>
<tr>
<td>Relaxation and Audio Tape (R+T)</td>
<td>94.3% to 0.0%</td>
<td>64.8%</td>
</tr>
<tr>
<td>Relaxation and EMG (R+EMG)</td>
<td>88.6% to 14.3%</td>
<td>56.3%</td>
</tr>
<tr>
<td>EMG (EMG)</td>
<td>97.1% to 0.0%</td>
<td>52.0%</td>
</tr>
</tbody>
</table>

Note. 100.0% maximum percent of headache-free days.
The greatest and least percent of headache-free days were determined by identifying the highest and lowest individual mean score that had occurred for each maintenance method. The mean percent of headache-free days was derived by summing the mean percent of headache-free days for all subjects for each matched stimuli maintenance method and dividing by the total number of occurrences of each matched stimuli maintenance method in the study.

These scores were analyzed for clinical significance by applying the criteria suggested by Bergen and Strupp (1972). Because there was less than 20 percent variation between the mean percent of headache-free days among the four matched stimuli maintenance methods used, these differences were not considered to be clinically significant.

The results of the analysis of the mean percent of headache-free days and mean percent of improvement in headache activity indicates that no clinically significant differences occurred among the four matched stimuli maintenance methods employed in this study (relaxation alone, relaxation and taped instructions, relaxation and EMG self-monitoring and EMG self-monitoring alone). Therefore, hypothesis 2 was not rejected.

Summary. The first part of hypothesis one stated: There will be no clinically significant differences among the sequencing of four matched stimuli maintenance methods used in the continued practice of tension reducing procedures.

The results indicated that clinically significant differences occurred for half (ten) of the subjects (Subjects 3, 5, 6, 8, 13, 15, 17, 18, 19 and 20) and that clinically significant differences did not occur
for half (ten) of the subjects (Subjects 1, 2, 4, 7, 9, 10, 11, 12, 14 and 16).

The second part of hypothesis one stated: There will be no significant differences among the sequencing of four matched stimuli maintenance methods used. . . in the frequency and in the intensity of tension headaches.

The results indicated that clinically significant differences occurred for half (ten) of the subjects (Subjects 2, 5, 7, 8, 9, 10, 13, 14, 16 and 19) and that clinically significant differences did not occur for half (ten) of the subjects (Subjects 1, 3, 4, 6, 11, 12, 15, 17, 18 and 20).

Thus, hypothesis one which states: There will be no clinically significant differences among the sequencing of four matched stimuli maintenance methods used in the continued practice of tension reducing procedures and in the frequency and in the intensity of tension headaches, was, therefore, not rejected for four subjects (Subjects 1, 4, 11 and 12), partially rejected for twelve subjects (Subjects 2, 3, 6, 7, 9, 10, 14, 15, 16, 17, 18 and 20) and rejected for four subjects (Subjects 5, 8, 13 and 19).

Hypothesis two states: There will be no clinically significant differences among the four matched stimuli maintenance methods used in the decrease of the frequency and intensity of tension headaches over time after treatment.

The results of the analysis of the mean percent of headache-free days and the mean percent of improvement in headache activity indicated that no clinically significant differences occurred among the four
matched stimuli maintenance methods employed in this study (relaxation practice alone; relaxation practice and taped instructions; relaxation practice and EMG self monitoring; EMG self monitoring alone); therefore, hypothesis two was not rejected.
CHAPTER V

DISCUSSION

The purpose of this study was to investigate the specific and sequential effects of four matched stimuli maintenance methods used—continued home relaxation practice alone; continued home relaxation practice and use of taped instructions; continued home relaxation practice and self monitoring of EMG output; self monitoring of EMG output without home relaxation practice—on the continued practice of tension reducing procedures learned during relaxation training and on the frequency and intensity of tension headaches over time after training.

In addition, it was expected that the resultant data would provide information about the specific effectiveness and viability of four home/training practice matched stimuli as maintenance methods (which would allow for the drawing of conclusions about); cost efficient ways of treating tension headache sufferers; the ramifications for future treatment of individuals with tension headaches; the implications for counselor training programs and further research needed.

Clinically significant differences—hypothesis one. The present findings generally support the equivalence of the four matched stimuli maintenance methods used in maintaining (and in some cases increasing) the effects of EMG-assisted relaxation training. However, clinically significant differences did occur for 16 subjects during one or two of their assigned maintenance methods, either in the continued home prac-
tice of relaxation procedures or in the frequency and the intensity of tension headaches or both.

The following possible sources of variability were examined for the subjects demonstrating clinically significant results in relation to continued practice and decreased $H_D$ over time after training: age, marital status, number of children at home, level of education, type of employment, outcome expectation, years since onset of headache activity, level of mean hourly headache activity ($H_D$) during baseline, and the maintenance phases ($M_1, M_2, M_3$) during which the clinically significant results occurred.

**Continued practice.** There were sixteen clinically significant occurrences for ten subjects for part one, continued practice, of hypothesis one during the maintenance period.

**Eleven** (out of twenty-eight possibilities for clinical significance) occurred in the $R$ condition. Eight of these instances of clinical significance occurred in the $M_1$ phase of the maintenance period.

**Four** (out of twelve possibilities) occurred in the $R+T$ condition. Three of these instances of clinical significance occurred in the $M_2$ phase of the maintenance period.

**One** (out of fourteen possibilities) instance of clinical significance occurred in the $EMG$ condition during the $M_1$ phase of the maintenance period.

No clinical significant results (out of six possibilities) occurred for the $R+EMG$ condition during maintenance.

These results indicate that for the ten subjects who demonstrated clinically significant results for part one, of hypothesis one (con-
tinued practice), 68.8 percent of the occurrences were in the R condition; 25 percent of the occurrences were in the R+T condition; and 6.3 percent of the occurrences were in the EMG condition.

Of the nine subjects (3, 5, 8, 13, 15, 17, 18, 19 and 20) who demonstrated clinically significant results in continued practice in the R condition, two subjects, 15 and 18, achieved significance twice in this condition during maintenance. Examination of these nine subjects' descriptive characteristics (Table 1) indicated that eight of the subjects had twelve years or less education and moderate expectations about outcome. Six subjects had children living at home, had headache activity one to four years since onset and had high level $H_D$ ($0.718-1.546$).

Subjects 3, 17, 19, and 20 also demonstrated clinically significant results for continued practice in the R+T condition. Examination of their descriptive characteristics (Table 1) indicated that all of these subjects had twelve years or less of education. Three of them were between the ages of 24 and 37, were at home, had children living with them, were married, had experienced headache activity one to four years and had low level $H_D$ ($0.106-.518$).

Subject 6 demonstrated clinically significant results for continued practice in the EMG condition. Descriptively speaking she was married, had twelve years education, no children at home, was not employed, had moderate expectations about outcome, experienced headaches for 36 years and had low level $H_D$ ($0.106-.518$).

Mean hourly headache activity ($H_D$). There were thirteen clinically significant occurrences for ten subjects for part two ($H_D$) of hypothesis one during the maintenance period.
Five (out of twenty-eight possibilities for clinical significance) occurred in the R condition and in the M3 phase of the maintenance period.

Four (out of fourteen possibilities) occurred in the EMG condition. Two of these instances of clinical significance occurred in the M3 phase of the maintenance period and two in the M2 phase.

Two (out of six possibilities) occurred in the R+EMG condition. One instance of clinical significance occurred in the M2 phase and the other occurred in the M3 phase during the maintenance period.

Two (out of twelve possibilities) occurred in the R+T condition. One instance of clinical significance occurred in the M2 phase and the other in the M3 phase during the maintenance period.

These results indicate that for the ten subjects who demonstrated clinically significant results for part two, H0, of hypothesis one, 38.5 percent of the occurrences were in the R condition; 30.8 percent were in the EMG condition; 15.4 percent were in the R+EMG condition; and 15.4 percent were in the R+T condition.

Five subjects (2, 5, 8, 9, and 19) demonstrated clinically significant results in H0 in the R condition. Examination of their descriptive characteristics (Table 1) indicated that four of the subjects had experienced headache activity one to four years and had moderate expectations about outcome. Three subjects were between the ages of 21 and 28, were employed outside the home, had thirteen years or more education, no children living at home, were married and had low level H0 (.106-.518).

Three subjects (7, 10 and 16) demonstrated clinically significant results for H0 in the EMG condition. Subject 16 demonstrated signifi-
cance twice in this condition during the maintenance period, and Subject 10 also demonstrated clinically significant results in R+T condition, M3 phase, during maintenance. Examination of their descriptive characteristics (Table 1) indicated that they were 31 and 35 years of age, had thirteen or more years of education, worked outside the home, experienced low level Hq (.106-.518), and two had children living at home and had moderate expectations about outcome.

Two subjects, 13 and 14, demonstrated clinically significant results for Hq in the R+EMG condition. Subject 14 also demonstrated clinically significant results in R+T condition, M2 phase, during maintenance. Examination of their descriptive characteristics (Table 1) indicated that both had moderate expectations about outcome. Otherwise, they were dissimilar.

Two subjects, 10 and 14, demonstrated clinically significant results for Hq in the R+T condition. Examination of their descriptive characteristics (Table 1) indicated they were both single, had thirteen or more years education, worked outside the home and had moderate expectations about outcome.

Clinically significant differences—hypothesis two. The results of this study found no clinically significant differences among the four matched stimuli maintenance methods used: R, R+T, R+EMG, EMG. Generally speaking, all four methods were equally effective in maintaining decreases in Hq over time after training. However, examination of the percent of improvement in Hq over time after training (Table 3) did indicate an interesting finding. Although only suggestive, the mean percent of im-
provement in $H_D$ for the $R+T$ condition (68.7%) did approach the limit of clinical significance (a 20% or more variation in scores) in relation to the mean percent of improvement in $H_D$ for $R+EMG$ (49%). The difference, 19.7 percent, between these two scores was .3 percent from the criteria for clinical significance. Although further research is needed, these results suggest that $R+T$ may have been more effective as a maintenance method than $R+EMG$ in this study.

**Clinically significant differences summary.** The results for individual subjects support the equivalence of the four matched stimuli maintenance methods used in the continued practice of home relaxation and self-reported reduction of frequency and intensity of headaches. However, clinically significant differences, a change of 20 percent or more in the desired direction, did occur for 16 subjects. Six achieved clinical significance in continued practice of home relaxation; six achieved clinical significance in mean hourly headache activity; and four achieved clinical significance in both.

Of the ten subjects who achieved clinical significance in continued home relaxation practice, eight did so in the first maintenance period and in the $R$ condition. Of these ten subjects, nine had twelve years or less education; eight had moderate expectations about outcome; seven were not employed; six had low level mean hourly headache activity (.106-.518); five had been experiencing headache activity from one to four years; five had children and five did not; and five were from 21 to 37 years of age and five between the ages of 41 and 64.

Of the ten subjects who achieved clinical significance in their
mean hourly headache activity, nine demonstrated it in the third main-
tenance period regardless of the method employed. Of these ten sub-
jects, eight had moderate expectations about outcome; seven had thirteen
years or more education; seven were employed outside the home; seven had
low level headache activity (.106-.518); and seven were between the ages
of 21 and 35. Five had been experiencing headache activity from one to
four years; five had children at home and five did not.

Of the 16 subjects who achieved clinically significant results, 13
did so in the third maintenance period and 11 did so in the R condition
regardless of its position in the sequence. Of these 16 subjects,
twelve had moderate expectations about outcome; 11 had low level head-
ache activity (.106-.518); ten were between the ages of 21 and 37; ten
were married; nine had twelve years or less education; nine worked out-
side the home; eight had children and eight did not; and eight had been
experiencing headache activity from one to four years.

The results for each of the matched stimuli maintenance methods (R, R+T, R+EMG, EMG) generally support their equivalence. However, the mean
percent of improvement in headache activity from training indicated that
R+T (68.7%) might have been more effective than R+EMG (49%) but not R
(56.9%) or EMG (54%) as a maintenance method. Because R occurred more
frequently in the maintenance sequences, however, discretion must be
used in interpreting these results.

Implications. Although the use of biofeedback-assisted relaxation has
been well documented as an effective clinical technique for dealing with
the problem of tension headaches (Cox, Freundlich & Meyer, 1975; Haynes,
Griffin, Mooney & Durise, 1975; Hutchings & Reinking, 1976; Budzynski, 1973), its usefulness over time appeared to be questionable because of the dissipation of the treatment effects which seemed to occur when clients stopped practicing the tension reducing procedures they learned during treatment (Reinking et al., 1976).

Because the great deal of time, effort and money which are invested on both the part of the client and the therapist are lost when treatment effects are of short duration, the major purpose of this study was to investigate specific methods of maintaining the practice of learned relaxation procedures by clients over time after treatment.

It was expected that the resultant data from this study would provide clinical practitioners with an effective, cost- and time-saving method for maintaining treatment effects with tension headache clients. In addition, since few studies had been found which compared methods for maintaining the treatment effects of subjects treated with EMG-assisted relaxation training for tension headaches, the results of this study were expected to fill a gap in the literature.

Generally speaking, the results of this study suggest that the four matched stimuli maintenance methods employed--R, R+T, R+EMG, EMG--can be used to successfully maintain the training effects, decreased $H_D$ and continued practice of learned tension reducing procedures over time after training with tension headache subjects.

These results support the conclusions of Koegel and Rincover (1977) that a successful treatment program must be concerned with and plan for the maintenance of change over time outside the treatment setting. The implications here are clear for training programs for counselors and
other professional therapists. More attention needs to be devoted to
and emphasis placed on the importance of the maintenance of treatment
effects and the available methodology and research findings.

Although further research is necessary to establish the efficacy of
matched stimuli maintenance methods, there was evidence to suggest that
maintenance condition R might be used in place of one of the other me-
ths employed in this study when time and money are of important con-
sideration. Because R maintenance method does not require the use or
purchase of additional equipment, i.e., tape, tape recorder or EMG ma-
chine, it may be the most cost efficient method.

Limitations and suggestions for further research. The results of the
present study are limited to the matched stimuli used (R, R+T, R+EMG,
EMG), the ten maintenance sequences utilized, the relaxation training
method employed, the subjects who participated, the condition treated,
the setting in which the study was conducted, as well as the specific
time periods used for baseline, training and maintenance. It should
also be noted that R occurred alone or as a part of a matched stimuli
maintenance method a greater percentage of the time. Therefore equal
comparisons were not made and caution must be used in judging the equi-
valency of the four maintenance methods employed.

Haynes et al. (1975) indicate that particular care must be exer-
cised in the design of studies involving self-report measures to mini-
mize the sensitivity of the data to suggestions, demand characteristics,
or placebo effects. In the present study attempts were made to minimize
these sources of bias. They included a two-week baseline period (self-
observation) to control for the reactive effects of self observation and standardizing instructions and demand and expectation variables for all subjects. In addition self report of behavior (i.e. headache ratings) rather than self report of behavior change (i.e. improvement) was used to minimize response bias. Data sheets to record headache activity and rate of home practice were employed. The use of a physiological measure (EMG) to determine frontalis EMG levels before and after each relaxation training session was also included.

While subjects were instructed to record their medication intake throughout this study, no attempt was made to make significant comparisons between the subjects' medication intakes and maintenance methods because of the wide diversity (see Appendix F) and dosages of medication used. However, all subjects reported a reduction in medication intake during the maintenance period of this study. Four subjects indicated continued reduction in medication intake when followed up a year to a year and a half later. Other studies (Budzynski et al., 1973; Haynes et al., 1975; Reinking et al., 1976) also reported reduced medication usage among their tension headache subjects after treatment for similar lengths of time.

The employment of a single-subject design in this study allowed the investigator to discern the differential effects of the four methods of stimulus matching on the individual subject's maintenance of training effects and to analyze the results for each subject. However, the way in which the maintenance methods were ordered in this study did not allow for a return to baseline between application of maintenance methods with individual subjects. Although a basic A-B-A-B design would provide for
the direct demonstration of the effects of each maintenance method employed, such a procedure presents ethical and moral problems in a clinical setting, especially with tension headache subjects. Since the subject is there to achieve relief from a painful condition, it behooves the clinician-investigator to continue the treatment without denying full benefits to the subject. An alternative might be to employ a multiple baseline design across subjects provided the study was conducted in a setting that treated a large number of tension headache subjects on a daily basis. Otherwise, large amounts of time might pass between subjects making the use of this design unfeasible.

In this study a two-week baseline was employed. Although it is recommended that baseline measurement be continued until a stable pattern emerges (Wolf & Risley, 1968), it raises logistical and ethical problems as to how long (McNamara & MacDonough, 1972) a clinician-investigator can withhold treatment from a subject who is seeking relief from a painful condition.

In this study the investigator was present during training and the assignment of the maintenance methods. What would be the effect if he were absent during one or the other or both?

Because a single-subject design was used in this study, it was possible to isolate some common characteristics among the 16 subjects who achieved clinically significant results. Twelve had moderate expectations about outcome; 11 experienced low level H$_{\text{D}}$ activity (.106-.518); 10 were between the ages of 21 and 37; 10 were married; nine had 12 years or less education; eight had been experiencing headache activity for one to four years; nine worked outside the home; and eight had chil-
dren living with them. The significance of these descriptive characteristics should be explored in further research as they may provide important prognostic information to the clinician-investigator working with tension headache subjects.

In addition, an important question to be considered is: How long and how frequently does a person have to practice relaxation to maintain his/her treatment effects? During follow-up, four subjects reported continued practice of some kind (relaxing with and/or without tensing) on a daily basis for a year to a year and a half. They all indicated continued reduced headache activity and medication intake. One subject reported a brief period of increased headache activity when she stopped practice for a while and a resultant decrease in headache activity when she resumed practice a short time later. Although this anecdotal information is supportive of the results reported by Epstein et al. (1975), further studies need to be conducted to determine the specific effects different rates of practice have on the maintenance of treatment effects with tension headache subjects over time after training.

In this study there was some evidence to suggest the need for this kind of research. Although the average mean percent of reported home relaxation practice for each matched stimuli maintenance method suggested that subjects practiced more often in the R (83.5%) and R+T (80.0%) conditions than in the R+EMG (64.5%) and EMG (51.1%) conditions, there were no clinically significant differences noted in mean percent of improvement in headache activity from the training period (Table 3) for these four methods. This would suggest that those subjects who reported practicing home relaxation less often in the R+EMG and EMG conditions still
achieved results similar to those subjects in R and R+T who reported practicing more often.

In this study, the use of EMG equipment as a maintenance method may have some limitations. One subject reported that although she practiced the exercises she used the equipment infrequently because she found it "too messy and time consuming" a procedure. Another subject commented that she used the equipment only during the times she practiced at home but not when at work. While anecdotal in nature this information suggests that the subject's choice of a maintenance method may be an important consideration in the determination of the maintenance method to be employed particularly in a clinical setting. In this study, subjects were assigned to various maintenance methods by the order in which they volunteered. In a future study, after receiving relaxation training, subjects could select the matched stimuli maintenance method they preferred. Then, the effects of that method could be assessed over time.

Although further research needs to be done to establish the effectiveness of the matched stimuli (R, R+T, R+EMG, EMG) used as methods for maintaining continued practice and decreased H_D over time after treatment, with tension headache subjects, this study is important in that it is most likely the first study that has compared these methods. Also, the results of this study offer support for the continued use of, and research into, these potentially effective ways of maintaining treatment effects with tension headache sufferers treated with EMG-assisted relaxation training.
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APPENDIX A

Headache Data Chart
HEADACHE DATA CHART

Please indicate the time of day when each headache occurs by rating the intensity of it using the following scale. Put the appropriate number in the appropriate time slot on the chart below.

0 - No headache.

1 - A very low level type of headache which entered awareness only when I paid attention to it.

2 - A headache pain level that I could ignore some of the time.

3 - A painful headache, but one that would allow me to continue at my job.

4 - A very severe headache which made concentration difficult, but one that allowed me to perform tasks of an undemanding nature.

5 - A very intense, incapacitating headache.

Please bring your chart with you to every training session.

<p>| Days of month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 6-7 a.m.      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 7-8 a.m.      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 8-9 a.m.      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 9-10 a.m.     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 10-11 a.m.    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 11-12 a.m.    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 12-1 p.m.     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 1-2 p.m.      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 2-3 p.m.      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 3-4 p.m.      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 4-5 p.m.      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 5-6 p.m.      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 6-7 p.m.      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |</p>
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Practice--Please record the number of times you practice relaxation each day.

Medication--Please record the number of times you take medication each day.
APPENDIX B

EMG Data Form
EMG DATA FORM

Subject: ________________________________

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APPENDIX C

Text of Relaxation Training
RELAXATION TRAINING

A. Initial Instructions

To begin, sit in your chair with your head squarely, but loosely on your shoulders, not bending it forward or backward. Keep your legs uncrossed with your feet flat on the floor. Rest your hands in your lap. Now, just generally try to relax. Get as relaxed as you can.

When we do relaxation here, or even by ourselves, there will occasionally be sounds or movements. There is no need to let them bother you. They are just something that is there, but should have no effect on you. Just let them be there and go on with your relaxing. Just concentrate on your relaxing.

Now I'm going to ask you to tighten certain parts of your body, notice when they are tense and then I'll tell you when to gradually let them go, paying particular attention to the feelings of relaxation. The general idea, then, is to first tense the muscle, noticing the feelings of tenseness, then relax them attending to the feelings of relaxation and noticing the contrast between the feelings of tension and the feelings of relaxation.

The first time through will be mainly for the purpose of learning the procedure for relaxing each muscle group.

(*All paragraphs preceded by an asterisk are included in Part A of the instructions, but excluded from Part B.)

1. Forehead. Let's begin with your forehead muscles. Deliberately tense your forehead. Wrinkle your forehead up by lifting your eye-
brows up. Notice where it feels tense—high over each eye and on the sides of the temple. Now relax it. Let it go. Smooth it out more. Notice it is an active process. It is you tensing and you relaxing. Notice the difference between the feeling of tension and the feeling of relaxation.

*Let's do it once more. First tense your forehead, noticing where it feels tense. Now, slowly let it go feeling the contrast.

2. Eyes. Now let's do your eyes. Close your eyes very tightly, notice where the tension is—above, below and on the sides of your eyes. Now gradually let them go noticing the difference. Notice the relief that accompanies the relaxation.

*Now let's do it again. Tighten your eyes. Notice where the tension is. Now slowly let them go noticing the difference between tension and relaxation.

3. Nose. Next we will do your nose. Wrinkle your nose. Notice where the tension is—on the bridge and sides of your nose and your upper lip. Now relax it, let it go. Notice how it feels. Sometimes people have more trouble with one part than another. You'll be able to do them with practice.

*Let's try it again. Tense your nose by wrinkling it. Notice how it feels. Now slowly let it go.

4. Face. Next we will do the face. This is done by making a forced smile, making sure to include your cheeks. Now relax and notice the difference. Notice the relief that comes with relaxation.

*Let's try it again. Make a forced smile, even tighter. Now let it go and notice the difference.
5. **Tongue.** Next we will do the tongue. Press your tongue hard against the roof of your mouth. Notice where the tension is--inside your mouth, under your tongue and under your jaws as well. Now let go and notice the contrast. Notice the relief that comes from relaxation.

*Let's try it once more. Press your tongue against the roof of your mouth. Notice the tension. Now slowly let it go, noticing the difference.

6. **Jaw.** Next we will do your jaws. Clench your teeth as tight as possible. Notice where it feels tense--on the side of your face, as well as your temples. O.K. Let them go and notice the release of tension. Enjoy the feeling of relaxation.

*Let's try it again. Clench your jaws, now slowly let them go noticing the contrast.

7. **Lips.** Now we will do your lips. Pucker your lips by squeezing them together in a circular shape. Notice where it feels tense--all around your lips, above, below and on the sides. Now slowly let them go noticing the relief that comes from relaxation.

*Let's try it again. Pucker your lips. Hold them. Now slowly let them go noticing the difference.

8. **Neck.** Next we will do your neck. Tighten your neck all the way around by tensing it so as the tendons and muscles stand out. Notice where it feels tense--under your chin, on the sides of your Adam's apple and the back of your neck. Now let it go and notice the contrast. Notice the relief.

*O.K. Let's try it again. Tense your neck so as the tendons and muscles stand out. Hold it. Now slowly let it go noticing the differ-
ence.

So far, we have done your whole head and neck region. Let's review them to see if they are still relaxed. As I mention a group, just try to relax it as much as you can. Your forehead—just let it go as much as you can. You can always relax the muscles a little more. Your eyes, your nose, your face and cheeks, your tongue, your jaws, your lips and your neck.

O.K. Try to keep the head and the neck region as relaxed as you can while we go on to do your arms and legs.

9. Right arm. Put your right arm straight out shoulder high at your side. Make a fist and tighten your whole arm from your hand to your shoulder. Notice where the tension is—in your biceps and forearm as well as in the back of your arm, your elbow, above and below your wrist and in your fingers. Now slowly let it go noticing the difference between the feelings of tension and the feelings of relaxation. Just let it go more and more as you return your right arm and hand to your lap. Notice the release of tension. Enjoy the feeling of relaxation.

*Let's try it again. Put your right arm straight out shoulder high at your side and tighten your whole arm and your side and tighten your whole arm and your hand. Now slowly let go as you return your hand to your lap noticing the contrast.

10. Left arm. Now let's do your left arm in the same manner. Put your left arm straight out shoulder high at your side. Make a fist and tighten your whole arm from your hand to your shoulder. Notice where the tension is—in your biceps and forearm as well as in the back of your arm, your elbow, above and below your wrist and in your fingers.
Now slowly let it go noticing the difference between the feelings of tension and the feelings of relaxation. Just let it go more and more as you return your left arm and hand to your lap. Notice the release of tension. Enjoy the feelings of relaxation. Keep in mind that it is you doing the tensing and you doing the relaxing.

*Let's try it again. Put your left arm straight out shoulder high at your side and tighten your whole arm and your side and tighten your whole arm and your hand. Now slowly let it go as you return your hand to your lap noticing the contrast.

11. Right leg. Next we will do your right leg. This is done by extending your right leg out in front of you at the knee and bending your toes back towards you. Now tighten your whole leg. Notice where it feels tense—at the top and bottom side of your thigh, in your knee, calf, your ankle (both front and back) and in your foot and toes. Now slowly relax your leg, let it return to the floor noticing the contrast between tension and relaxation. Let it go more and more enjoying the relaxed feeling in your leg.

*Let's try it again. Make your right leg tense by extending it out in front of you at the knee and bending your toes back towards you, and tightening your whole leg. Notice where it feels tense. Now slowly let it go noticing the contrast.

12. Left leg. Now let's do the left leg in the same manner. This is done by extending your left leg out in front of you at the knee and bending your toes back towards you. Now tighten your whole leg. Notice where it feels tense—at the top and bottom side of your thigh, in your knee, calf, your ankle (both front and back) and in your foot and
toes. Now slowly relax your leg. Let it return to the floor noticing the contrast between tension and relaxation. Let it go more and more enjoying the relaxed feeling in your leg.

*Let's try it again. Make your left leg tense by extending it out in front of you at the knee and bending your toes back towards you, and tightening your whole leg. Notice where it feels tense. Now slowly let it go noticing the contrast.

So far we have done your head and neck region, your arms and legs and now we will go on to the third and last major area--your body. Try to keep the muscles that we have already done as relaxed as you can while we go on to the body.

13. **Back.** Now we are going to do your back. You do this by leaning your upper body forward in your chair while bringing your elbows back and up--attempting to get them to meet behind you. As you bring your shoulder blades and tighten them, notice where it feels tense--in your shoulders and all along the middle of your back. Now relax. Slowly let your muscles go and return to your relaxed sitting position. Notice again the contrast between feelings of tension and relaxation. Enjoy the feelings of relaxation. It is you making yourself tense and you making yourself relaxed. You can always let your muscles go just a little bit more.

*O.K. Let's do it again. Make your back tense by leaning your upper body forward in your chair while bringing your elbows back and up--attempting to get them to meet behind you. Notice where the tension is. Now slowly let them go noticing the difference.

14. **Chest.** Next we are going to do your chest. You do this by
pulling your shoulders forward and tightening your chest as if you were caving it in. Notice where the tension is—in the middle of your chest and above and below each breast. Now slowly let it go noticing the difference. Notice it is an active process. It is you tensing and letting go. Again, notice the contrast between tension and relaxation. Enjoy the relaxation.

*O.K. Let's do it again. Tense your chest by caving it in slightly. Notice the tension. Now slowly let it go. Let it go more and more and notice the difference between tension and relaxation. Just sit there and relax. Just don't do anything at all. Relaxing is doing nothing at all.

15. Stomach. Next we will do the stomach. Tighten your stomach as if you were preparing for someone to hit you in the stomach. Tighten it as hard as you can. Notice where the tension is—the center of the stomach in an area for about four inches around the navel. Now slowly let it go noticing the contrast between tension and relaxation and the feeling of relief that comes from relaxing the stomach area. Let it go more and more.

*Let's try it again. Tighten your stomach as hard as you can. Now slowly let it go noticing the difference between feelings of tension and feelings of relaxation.

16. Below the waist. The last area to be done is below the waist. This is done by tightening everything below the waist, mainly your thighs and buttocks. If you do it right, you should feel yourself rise from the chair a bit. Notice where the tension is—in the buttocks, in the top, side and underside of your thighs and in the muscles that make
contact with the back of the chair. Hold them tight. Now slowly let
them go noticing the difference between tension and relaxation. Feel
the relief that comes from relaxation. Enjoy the relaxation.

*O.K. Let's try it again. Tense your thighs and buttocks until
you rise from the chair a bit. Notice the tension. Now slowly let it
go, noticing the difference between tension and relaxation.

Now close your eyes and relax your whole body. Go over your whole
body in your mind from head to toe. Notice any part that might be tense
and just let it go. Just sit there and relax and enjoy it. Just do no-
thing at all. Relaxing is just doing nothing at all.

In a few moments I'm going to count backwards from four to one. On
the count of four, start moving your legs; three, your hands and arms;
two, your head; and one, sit up and open your eyes.

Now we will go through them again to better learn the procedure for
relaxing each muscle group and to learn the order of the muscle groups
for when you practice on your own.

B. Tensing and Relaxing

This phase of instruction consists of all of phase A, i.e., Initial
Instructions, with the exception of paragraphs preceded by an asterisk.

C. Relaxing without Tensing

Now let's go through them once more. This time do not tense the
muscles first, just relax them as much as you can. You can always let
them go a little more. I'll mention each muscle group as I did before.
As I mention each one, let it go as completely as you can.
O.K. Let's begin. Sit in your chair with your head squarely, but loosely on your shoulders, not bending it forward or backwards. Keep your legs uncrossed with your feet flat on the floor. Rest your hands in your lap. Now, just generally try to relax. Get as relaxed as you can.

1. **Forehead.** Let's begin with your forehead muscles. Let your forehead muscles go as completely as you can. Just relax them by turning them off. Do nothing at all in your forehead muscles.

2. **Eyes.** Now let's do your eyes. Let your eyes go as completely as you can. Relax them as completely as you can. Remember you can always let them go a little more.

3. **Nose.** O.K. Now your nose. Let your nose go as completely as you can. Let all the tension disappear.

4. **Face.** Now your face. Let your face and cheeks go as completely as you can--more and more. Let all the tension disappear in your face and cheeks.

5. **Tongue.** Now let your tongue go. Just let it relax in your mouth. Just let it go more and more until all the tension is gone.

6. **Jaws.** Now your jaws. Let your jaws go. Just let them relax as completely as you can.

7. **Lips.** Now your lips. Let all the tension flow out of them. Let them relax completely.

8. **Neck.** Now your neck. Just relax the muscles all around your neck and throat. Let them go more and more until they feel completely relaxed.

So far, we have done your whole head and neck region. Let's review
them to see if they are still relaxed. As I mention a muscle group, just try to relax it even more--your forehead--remember you can always relax it a little more. Now your eyes, your nose, your face and cheeks, your tongue, your jaws, your lips, and your neck.

O.K. Keep your head and neck region as relaxed as you can while we go on to relax your arms and legs and the rest of your body.

9. **Right arm.** Relax your right arm as much as you can. Let it go all the way from your shoulder to the tips of your fingers. Let all the tension go.

10. **Left arm.** Now do the same with your left arm. Let it go a little more.

11. **Right leg.** Now let your right leg go from your thigh to the tips of your toes. Let all the tension flow right out. Let it go and relax it as completely as you can.

12. **Left leg.** Now do the same with the left leg. Let all the tension go from your thigh to the tips of your toes. Turn all your muscles off.

13. **Back.** Now your back and shoulders. Let your shoulders and back go and relax them as completely as you can.

14. **Chest.** Now your chest. Just let your chest go. Let it relax as completely as you can. Turn all the muscles off in your chest area.

15. **Stomach.** Now your stomach. Let your stomach go. Let it relax more and more. Let all the tension flow right out of it until it is completely relaxed.

16. **Below the waist.** Now below the waist. Let your buttocks,
lower back and thighs go as completely as you can. Let all the tension disappear. Turn off all your muscles and just relax.

Now keeping your eyes closed, relax your whole body. Go over your whole body in your mind from head to toe, noticing any parts that might be tense and just let them go. Just sit there and relax and enjoy it. In a few minutes I will ask you to open your eyes. Until then, just relax as completely as you can. Just do nothing at all but enjoy the feeling of relaxation.

Four, start moving your legs; three, your hands and arms; two, your head; and one, sit up and open your eyes.
APPENDIX D

Pre and Post Training Mean EMG Levels
Table 5
Pre and Post Training Mean EMG Levels Sessions Two - Eight

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APPENDIX E

Table of Mean Percent of Home Relaxation Practice, Mean Headache Activity from Baseline and Mean Percent of Headache Activity
Table 6

Mean Percent of Home Relaxation Practice, Mean Percent of Headache Activity (H_D) and Mean Headache Activity (H_D) from Baseline during Baseline (B), Treatment (T), Maintenance Period 1 (M_1), Maintenance Period 2 (M_2) and Maintenance Period 3 (M_3)

Presented in Pairs According to Matched Stimuli Assignment

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Matched Stimuli
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APPENDIX F

Medications Used by Subjects
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