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An Investigation of Relaxation Training Effects and Generality Using Biofeedback and Verbal Instructions

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AN INVESTIGATION OF RELAXATION TRAINING EFFECTS AND GENERALITY USING BIOFEEDBACK AND VERBAL INSTRUCTIONS

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Training and self-control conditions within each session were incorporated in a multiple baseline design with replications across subjects. The generality of relaxation skills acquired through relaxation training to a self-control condition where the subjects relaxed without assistance was assessed. EMG biofeedback was initially employed as a training technique; however, it was not effective in assisting the subjects to relax. A training procedure using verbal instructions was then introduced to replace the biofeedback. Verbal instructions were effective in assisting the subjects to relax, and the relaxation skills tended to show generality to the self-control condition. To assess the effects of the successful instruction-assisted relaxation training on subsequent performance with biofeedback, EMG biofeedback training was reintroduced. Although the performance of the subjects in the second biofeedback phase was quite variable, the ability of two of the three subjects to relax in the presence of the feedback was significantly improved. Verbal instructions may be a critical component of feedback-assisted relaxation training.

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Introduction

Training in general muscular relaxation has been successfully applied as a treatment for a number of physiological dysfunctions, including muscle-contraction headache (Budzynski, 1978; Epstein and Abel, 1977; Haynes, Griffin, Mooney, and Parise, 1975; Cox, Freundlich, and Meyer, 1975; Budzynski, Stoyva, Adler, and Mullaney, 1973), bruxism (Kardachi and Clarke, 1977), insomnia (Haynes, Sides, and Lockwood, 1977; Nicassio and Bootzin, 1974; Borkovec and Fowles, 1973), and chronic anxiety (Townsend, House, and Addario, 1975) among others (Basmajian, 1979). Two approaches commonly used to train subjects in general relaxation are electromyographic (EMG) biofeedback (Stoyva, 1979; Haynes, Mosely, and McGowan, 1975; Budzynski and Stoyva, 1969) and assistance through verbal instructions (Haynes, et al., 1975; Luthe, 1973; Silver and Blanchard, 1978).

In many of the studies where relaxation training was used as a treatment modality, subjects were instructed to practice the relaxation skills demonstrated in training sessions on their own during their daily lives (Holroyd, Andrasik, and Noble, 1979; Hutchings and Reinking, 1976; Haynes, et al., 1977; Budzynski, et al., 1973, 1970; Cox, et al., 1975; Nicassio and Bootzin, 1974). Implicit to the use of these instructions was the assumption that the relaxation skills would show generality to situations where no external assistance was provided. Indeed, the generalization of relaxation skills to the natural environment is discussed by a number of authors as an essential component to the success of relaxation training in alleviating clinical disorders (Stoyva, 1979; Budzynski, 1978; Hutchings and Reinking, 1976).

The generality of relaxation skills acquired through biofeedback or verbal instructions to the natural environment, however, has not been directly examined, possibly because of the methodological difficulties inherent in assessing this behavior outside of the training setting. Studies of the generality of relaxation skills to non-assisted or "self-control" (Epstein and Blanchard, 1977) conditions within the experimental setting itself have been inconclusive and have led researchers to conflicting conclusions with respect to this issue. Based on their research in this area, some investigators (Stoyva and Budzynski, 1974; Budzynski and Stoyva, 1969) have asserted that generalization to non-assisted conditions does occur, while others (Epstein and Blanchard, 1977; Epstein and Abel, 1977; Epstein, Herson, and Hemphill, 1974) contend that generalization beyond the training condition does not reliably occur. These studies all involved EMG feedback assisted relaxation training.

It appears that much of the current confusion with respect to generality arises from methodological weaknesses in the research, as well as the inconsistencies among procedures and criteria used to assess generality in the various studies. In a study using EMG biofeedback training as a treatment for tension headache, Epstein and Abel (1977) attempted to assess the ability of the subjects to reduce muscle tension during a non-feedback period which followed training in each session. They concluded that the subjects did not demonstrate self-control of EMG activity because EMG levels were slightly higher during the self-control period relative to the feedback period for blocks of sessions in the latter half of the study. However, another interpretation is that the data are only indicative of the fact that the subjects were generally unable to maintain the degree of muscular relaxation attained with the assistance of feedback when the feedback was removed, especially as greater reductions were attained during the feedback period. This may represent a criterion for self-control that is too stringent. Changes in the ability of subjects to reduce EMG activity without feedback from a baseline or resting level were not assessed. Furthermore, since "change-scores" were used, improvements in the ability of subjects to maintain lower absolute levels of EMG activity cannot be assessed. Generality was also examined in an earlier case study by Epstein, Herson, and Hemphill (1974) which also involved the treatment of tension headache with EMG biofeedback training. The study employed a reversal design (ABAB), with 6 sessions in each of four phases. The dependent variable was the mean number of seconds-per-minute above 10 microvolts (uV) for each session. Using an analysis of variance, the 12 feedback sessions were compared with the 12 baseline sessions and found to be significantly lower. If one is interested in the generality of the training effects, however, inclusion of the pre-training baseline sessions is inappropriate for this comparison. Because the first baseline values tended to be high, the significance of the difference between the two conditions may be a highly biased index. Also, a phase shift occurred after 6 sessions during the second baseline phase, while the data were trending downward sharply. A final weakness in this study is that the response measure used was insensitive to the magnitude of change in EMG activity. Within this same case study, a second experiment was conducted to compare self-controlled relaxation to feedback assisted relaxation across time blocks with single sessions. Without feedback the subject could not reduce EMG activity from the initial baseline levels, although he showed some success at maintaining lowered EMG levels in post-feedback time blocks. It is difficult to draw any conclusions from these data because clear trends do not appear in this data from a very few sessions. The procedures used in the two studies described above do not allow for a clear analysis of generality.

Budzynski and Stoyva (1974) have primarily used two studies to support their position that generalization does occur. The first study (Budzynski and Stoyva, 1969) employed a reversal design, with 5 subjects receiving 1 day of baseline, 3 days of EMG feedback training, and 1 day of baseline. Two other groups of 5 subjects received either 5 days of baseline or 5 days of a continuous low tone during the sessions. The subjects exposed to the feedback condition achieved lower EMG reductions, and these reductions continued into the post-training baseline session. The primary weakness in this study is that very few sessions were run. A single post-training baseline session is not an adequate measure of generality. Also, only group data were presented in the study, and no descriptions of variability across subjects was provided. It is not clear if the effect represented in the group data is representative of trends demonstrated by individual subjects. A second study (Stoyva and Budzynski, 1974) also employed a reversal design. Subjects were divided into 3 groups of 7 each: high pretraining EMG group, low pretraining EMG group, and control group. The high- and low-EMG groups received 2 sessions of baseline, 5 sessions of feedback training, and 2 post-training baseline sessions. Both groups lowered EMG activity across feedback sessions. In the post-training baseline sessions, the high EMG group attained even lower reductions, while the low EMG group increased. Both groups of subjects showed a sharp upward trend across the 2 post-training baseline sessions. Again, the brevity of the baseline phases weakens the study, and the representativeness of the data for individual subjects is not clear. The authors contended that the data indicated generalized relaxation skills in the subjects with high EMG levels. If this was indeed the case, the upward trend that appears across the 2 post-training baseline sessions suggests that this generality may have been short-lived. Although these two studies suggest that skills developed through EMG feedback training may show generality to self-control situations, they are not procedurally adequate to provide definitive answers.

In another study using headache patients as subjects, relaxation skills in self-control periods were evaluated, as the subjects received concurrent EMG feedback within the sessions (Sturgis, Tollison, and Adams, 1978). The self-control periods were only 2 minutes in length, however, and were too short for adequate comparisons.

The present study seeks to improve upon these previous studies with respect to the question: do relaxation skills acquired under typical training conditions show generality to a self-control condition? In addition to pre-training assessment, self-control relaxation skills will be assessed throughout relaxation training. Except for the presence of auditory training stimuli, the self-control relaxation periods will be identical to the training periods within each session. Muscular relaxation will be evaluated in terms of absolute reductions in EMG activity. To add consistency across sessions and conditions, subjects will begin each relaxation period at a predetermined EMG level. This will require that the subjects produce a mild tension level within a specific range prior to engaging in relaxation and will have the effect of restricting the ability of the subject to relax except during the appropriate experimental period. Averaging of data across subjects will be avoided by making within-subject comparisons, with across-subject replication.

EMG biofeedback has become increasingly popular in recent years (Holroyd, et al., 1980; Butler, 1978) and has been considered by many authors to be a superior form of relaxation training over instructional training (Stoyva, 1979; Haynes, Mosely, and McGowan, 1975; Hutchings and Reinking, 1976; Coursey, 1975). For these reasons EMG biofeedback training was initially chosen as the method of relaxation training in the present study. However, in this study, feedback proved to be ineffective in assisting the subjects to lower EMG levels so an instruction-assisted training procedure was implemented. Previous research (Haynes, et al., 1977; Haynes, et al., 1975; Cox, et al., 1975; Luthe, 1973) has found that instruction-assisted training was an effective means of teaching subjects to relax. After the effectiveness of the verbal instructions was established, feedback training was reintroduced. Thus in addition to examining generality to self-control conditions, this study also investigates the effects of successful instructional training on subsequent feedback training.

Method

Subjects

Three female university students, ages 20-22, participated as subjects in the experiment. Two of the subjects were given time off from a course practicum to participate in the study, while the third subject volunteered to participate in the experiment after seeing an announcement posted in a classroom. The subjects agreed to refrain from consuming alcohol, caffeine, or other mood altering substances on the days when experimental sessions were conducted. All of the subjects reported that they did not use any medications during the course of the study. All subjects attended a screening interview prior to acceptance in the study. Each subject also attended one adaptation session where EMG activity was recorded while the subject sat quietly in a reclining chair and listened to soft music. Although instructed to relax as much as possible, each of the subjects exhibited moderate to high frontal EMG levels, a criterion for inclusion in the study.

Setting and Apparatus

The study was conducted at the Center for Holistic Medicine, a small outpatient facility at the Borgess Medical Center in Kalamazoo, Michigan. The center is located in a house adjacent to the main hospital complex. The experimental sessions were conducted in a therapy room which measured 3.7m x 2.7m and contained a reclining chair, a floor lamp, a small table, and a small cabinet in which preamplifiers were concealed. The room was dimly lit during sessions.

Subjects sat in a semireclined position in the reclining chair. The experimenter remained outside the experimental room during the sessions in an adjacent hallway where the equipment used to monitor and process the EMG signal was located. The experimenter could observe the subject through a half-silvered mirror. A headphone set and small microphone worn by the subject allowed for communication between subject and experimenter.

Differential surface EMG measurements were obtained using three Beckman silver-silver chloride electrodes interfaced with the skin by Beckman electrode paste. A frontal placement was used, with the two active electrodes centered over each eye, 2cm above the eyebrow and the reference electrode placed 3cm directly above the nasion. Prior to attaching the electrodes, the forehead skin was prepared by briskly wiping the area with an alcohol-soaked pad and rubbing a small amount of electrode paste into the electrode placement sites. After electrode attachment, reference to active resistance was checked and maintained below 10k ohms. The EMG signal was amplified and processed by a modular component system manufactured by Med

Associates, Incorporated. This equipment was also used to deliver the audio feedback signal to the subject during biofeedback training conditions. The EMG was measured across a 90-1000 Hz bandwidth to reduce cardiac and 60 Hz electrical interference. Recording intervals 50 seconds in length were utilized for data acquisition. Within each interval EMG activity was automatically averaged to yield the mean microvoltage (peak-to-peak) level measured across the interval. Prior to each session, the preamplifier and analogue-to-digital conversion modules were calibrated.

Dependent Variable

The average level of EMG activity for each recording interval was measured. The lowest value for a single interval occurring within a relaxation condition was used as an index of the degree of relaxation attained during that condition for that session. For the purpose of comparison, only the first 15 intervals of a relaxation condition were used in the data analysis if the length of that condition extended beyond 15 intervals (unless otherwise indicated).

Procedure

A multiple baseline design across subjects (Baer, Wolf, and Risley, 1968) was employed to assess the effects of two relaxation training procedures on EMG activity during training and in a self-control relaxation condition in which no assistance for relaxation was provided.

Subjects attended approximately 3 sessions per week which were spaced at least 2 days apart. Session length ranged from approximately 25 minutes during the baseline phase to approximately 50 minutes during the intervention phases. All sessions began with a 5 minute adaptation period. The study incorporated four phases: baseline, Feedback I, guided instruction, and Feedback II. In the baseline phase, skills in reducing EMG activity during a non-assisted self-control condition were assessed. In subsequent intervention phases the self-control relaxation condition occurred in the first half of the session while the second half of the session was devoted either to an EMG feedback-assisted relaxation condition (in the Feedback I and II phases) or to an instruction-assisted relaxation condition (in the guided instruction phase).

To discourage subjects from engaging in relaxation behaviors prior to the relaxation periods, they were required to produce and maintain an elevated level of tension for one 50 second interval before a relaxation condition began. For each subject a specific range of EMG values was designated as the "high resting range." This range was determined for each subject from EMG data obtained in 2 pre-baseline sessions where subjects were instructed to relax comfortably in a reclining chair while they listened to soft music. After initial adaptation periods, 15 intervals of EMG data were collected in each of the sessions. The median value for the total of 30 intervals of data obtained for each subject was determined and designated as the lower boundary of the high resting range. The upper boundary of the high resting range was place 7 microvolts (uV) above the median value. This range represented a mildly elevated tension level that could easily be produced by the subjects, for example, by clenching their teeth.

Prior to the self-control and assisted relaxation conditions within the sessions, subjects were given instructions specific to the relaxation condition which would follow. After the instructions for the subsequent condition were presented, they were told to produce the high resting level of tension. When the subject had successfully produced an EMG activity level within the high resting range, a recording interval began. After maintaining an EMG level within the high resting range for 90% of a recording interval the relaxation condition began. The subjects were given the instruction, "Now relax." Production of an EMG level within the high resting range by the subjects was assisted by presenting a tone to the subjects when they deviated from the high resting range. The subjects did not appear to have any difficulty producing and maintaining EMG levels within the high resting range, and their exposure to the tone was minimal.

Self-controlled relaxation (SCR). Subjects were instructed to relax as deeply as possible during the self-control relaxation condition (see Appendix A for complete instructions). The self-control condition was 12.5 minutes (15 recording intervals) in length. No assistance or feedback was provided to the subjects for the relaxation task. The self-control relaxation task provided a session to session probe of the acquisition of skills in reducing muscle tension in the absence of external assistance.

Feedback-assisted relaxation (FAR) I. During this period an audio signal which provided an analogue to frontal EMG activity was presented to the subjects. This feedback signal had both proportional and analogue characteristics. The pitch of the tone would vary proportionally to the strength of the EMG signal measured. When EMG levels fell below a specific threshold value the tone would shut off. Subjects were instructed to relax and use the feedback to assist them during this period (see Appendix B for complete instructions). The feedback period lasted 12.5 minutes. During the first two recording intervals feedback was not provided so that a threshold could be set relative to the subjects' EMG level. In the third interval of the period, the tone was presented and a threshold set approximately .5 uV below the EMG level occurring at the end of the second interval. When EMG levels remained below the threshold value for at least 95% of two consecutive intervals, the threshold was lowered. A new threshold was then set at a value 5-15% below the EMG level recorded for the second of the two consecutive intervals.

Instruction-assisted relaxation (IAR). The instruction-assisted condition was implemented after reliable reductions in EMG activity did not occur in the feedback condition. In the instruction-assisted condition the subjects listened to taped relaxation instructions. In the first session of the guided instruction phase, "tense-relax" progressive muscle relaxation exercises were used. In all subsequent sessions during this phase, tapes using autogenic phrases for limb heaviness and warmth were used. The tapes used were part of an audio cassette series developed by Budzynski (1974). The verbal instruction period within each session lasted 20 minutes.

Feedback-assisted relaxation (FAR) II. The feedback condition was implemented again in the final phase of the study after each subject demonstrated improved relaxation skills during the verbal instruction condition of the previous phase. This allowed for an assessment of the effects of successful relaxation training through verbal instructions on subsequent feedback training. It was reasoned that the instructional training could improve subsequent performance in the presence of feedback. The FAR condition used in the Feedback II phase was identical to the one in the Feedback I phase, except that the feedback condition was extended from 12.5 minutes to 19.66 minutes in the final 5 sessions for Subjects 1 and 2, and in the final 3 sessions for Subject 3.

Results

Table 1 presents the mean values of lowest EMG levels attained per session by individual subjects in the relaxation conditions of each phase.

Table 1

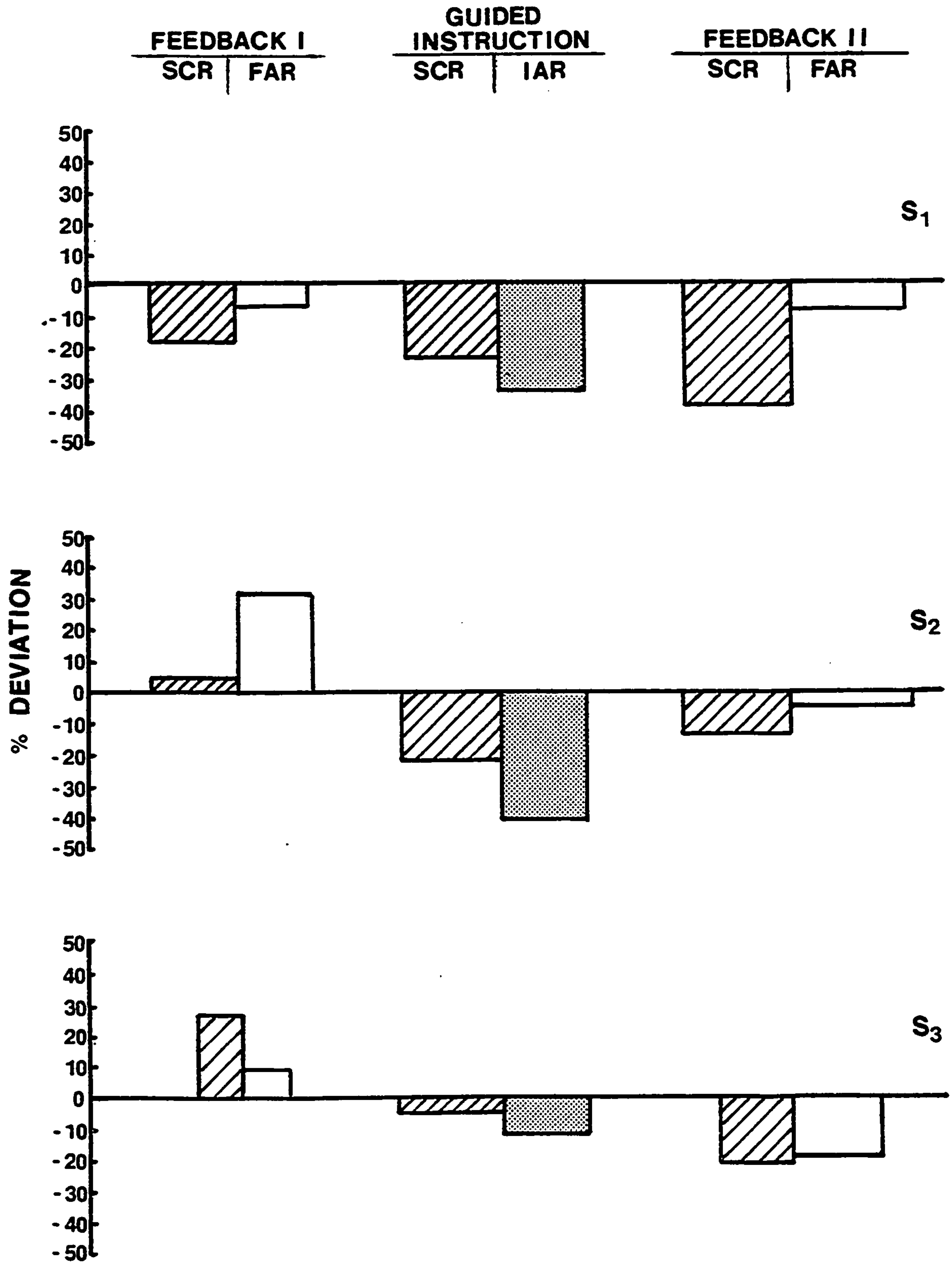
Mean Values of Lowest EMG Levels Attained Per Session for Each Condition of Each Phase

Phase/Condition	Subject 1	Subject 2	Subject 3
Baseline			
SCR	7.43 uV	8.07	5.15
Feedback I			
SCR	6.12	8.42	6.56
FAR	6.98	10.60	5.65
Guided Instruction			
SCR	5.76	6.34	4.99
IAR	5.00	4.83	4.54
Feedback II			
SCR	4.56	6.90	4.06
FAR	6.87	7.70	4.18

Figure 1 depicts the mean percent of deviation from the baseline SCR EMG level during the SCR, FAR, and IAR conditions for each subject. Figure 2 shows lowest EMG levels attained during each condition within each session.

Figure 1. The mean percent deviation from the baseline SCR mean level during the SCR, FAR, and IAR conditions within each phase for each subject. The width of each bar is proportional to the number of sessions included in the average for that condition.

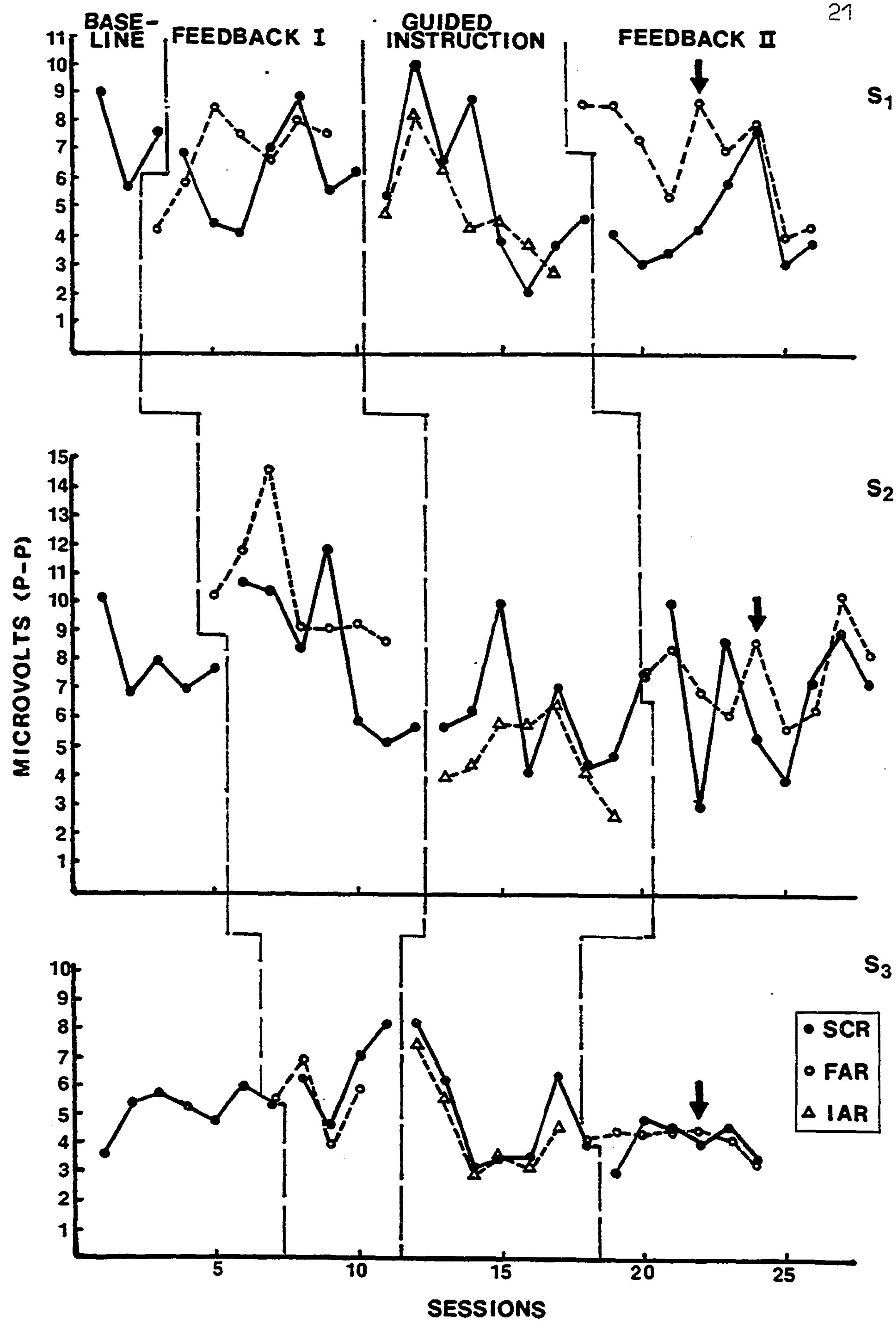
FIGURE 1



FEEDBACK I
SCR
FAR
GUIDED INSTRUCTION
SCR
IAR
FEEDBACK II
SCR
FAR
% DEVIATION
50
40
30
20
10
0
-10
-20
-30
-40
-50
S_1
S_2
S_3

Figure 2. For each subject, the mean microvoltage of the lowest interval occurring within each condition of each session. The vertical arrows in the Feedback II phase indicate the first session where the length of the FAR condition was extended, although the data presented are based only on the first 15 recording intervals.

FIGURE 2


BASE-LINE
FEEDBACK I
GUIDED INSTRUCTION
FEEDBACK II
S1
S2
S3
MICROVOLTS (P-P)
SESSIONS
5
10
15
20
25
• SCR
○ FAR
△ IAR

The EMG levels attained during the Feedback I phase indicate that feedback was not effective in assisting the subjects to relax. Although Subject 1 showed a slight reduction, relative to the SCR baseline, in her average EMG level during the FAR condition, there was an ascending trend in EMG levels across the phase, as Figure 2 indicates. With respect to reductions in the SCR condition of the Feedback I phase, only Subject 1 had a lower EMG level relative to the SCR baseline level. As Figure 2 indicates, however, reductions attained within individual sessions tended to be quite variable across the phase. Only Subject 2 had a descending trend in EMG levels within the SCR condition across sessions of the Feedback I phase, although this is not associated with similar concurrent reductions in EMG levels during the FAR condition across sessions. EMG levels attained by Subject 2 during the FAR condition stabilized at a higher level across the final 4 sessions of the phase. It appears that for Subjects 1 and 2 the audio feedback signal had paradoxically inhibited their abilities to reduce muscle tension. Subject 3 attained lower levels of EMG activity during the FAR condition relative to the SCR condition during the Feedback I phase, however, EMG levels in both conditions remained above her SCR baseline levels.

As Figure 1 indicates, Subjects 1, 2, and 3 attained average EMG reductions of 32.7%, 40.2%, and 11.8%, respectively, in the IAR condition of the guided instruction phase relative to their baseline SCR levels. Across sessions within the phase, Subjects 1 and 3 showed a descending trend in EMG levels attained during the IAR condition. For Subjects 1 and 3 this trend concurrently appears in the levels attained during the SCR condition in this phase, indicating the generality of relaxation skills to the non-assisted condition for these subjects. Although Subject 2 attained substantial reductions in EMG levels during the IAR condition, levels attained during the SCR condition remained quite variable. However, the mean SCR level for the phase is much lower than the baseline SCR level and in a number of sessions very low EMG levels were attained. Thus it appears that Subject 2 showed at least limited generality to the SCR condition.

When the feedback condition was reintroduced each subject responded differently, although average EMG levels attained during both the FAR and SCR conditions of the phase were lower than baseline SCR levels for all subjects. In the SCR condition of the Feedback II phase, Subject 1 attained EMG levels in 6 of 8 sessions which were at least 45% below her average baseline SCR level. Feedback was still an ineffective means of reducing EMG activity, however, since EMG levels attained during the SCR condition were lower than those attained during the FAR condition across all sessions in this phase. The data for Subject

2 in this phase are characterized by continued high variability, although in 2 sessions very low EMG levels were attained. The EMG levels attained by Subject 3 remained quite stable across the Feedback II phase in both the SCR and FAR conditions. These stable, low EMG levels demonstrated by Subject 3 would suggest that she had developed a greater degree of control over EMG activity than previously demonstrated, but that control was not enhanced by the presence of the feedback tone.

The EMG reductions attained during both conditions of the Feedback II phase were on the average greater than those attained during the baseline SCR for all subjects, none of the subjects had a greater average reduction during the FAR condition relative to the SCR condition within the phase itself. Thus even after successfully improving their relaxation skills during the IAR condition of the previous phase, EMG feedback was still not effective in assisting the subjects to relax. Extension of the feedback condition during the latter sessions in the phase did not change this characteristic of the data. The addition of 8 intervals (6' 40") to the condition was associated with further reductions of less than 5% in all of the subjects, when the lowest interval values attained in the full 23 intervals were compared to the lowest attained in the first 15 intervals across sessions where the condition was extended. Thus the extension of the condition was not associated with significant further reductions in EMG activity.

Discussion

In the present study the major issue of interest concerned the generality of skills acquired through relaxation training to self-control situations. Electromyographic feedback was chosen as the training method primarily because of its reported effectiveness and current popularity as a clinical tool (Basmajian, 1979). Unexpectedly, however, when training was initiated, the audio feedback of EMG activity was not effective in assisting the subjects to reduce muscle tension. These results contradict those of a number of studies in the literature (Stoyva, 1979; Holroyd, et al., 1979; Sturgis, et al., 1978; Hutchings and Reinking, 1976; Reinking and Kohl, 1975; Haynes, et al., 1975; Alexander, 1975; Budzynski, et al., 1973, 1970, 1969), yet are not unprecedented (Neilson and Holmes, 1980; Haynes, et al., 1977; Alexander, White, and Wallace, 1977).

This inconsistency among the various studies points to a need for a more complete analysis of the role of separate procedural components in determining the effectiveness of relaxation training which incorporates EMG biofeedback. It is clear that "biofeedback training" does not refer to a single procedure, but to procedural "packages." The procedural components within these packages can vary a great deal across studies and even within a single study. As Neilson and Holmes (1980) point out, the contribution of the various procedural components, other than the feedback per se, in determining the success of training has not been adequately assessed. Some of these components may be critical to successful training in relaxation with biofeedback. In fact, it has been suggested (Alexander, et al., 1977; Alexander, 1975) that the primary contribution of the feedback stimulus itself to the training of relaxation is related to its effects on general motivational aspects of the training situation, rather than as a direct controlling variable of EMG reductions. The data obtained in the Feedback I phase of the present study clearly support the notion that there are essential components to the success of relaxation training which go beyond the mere presentation of the feedback stimulus and brief instruction on its use.

Since the generality of the relaxation skills could not be assessed until the subjects demonstrated them successfully in the training conditions, the training procedure was changed from EMG biofeedback to the use of verbal instructions. The effectiveness of this alternative training strategy was then assessed and its generality to self-control conditions examined. It also allowed for an assessment of the effects of successful instruction-assisted relaxation training on subsequent biofeedback training.

The verbal instructions proved to be an effective method of assisting the subjects in attaining significant reductions in EMG activity. The results from the guided instruction phase also support the hypothesis that successful relaxation training will lead to significant improvements in self-controlled relaxation skills. This support is qualified, however, since Subject 2 was quite inconsistent in the degree of relaxation that she could attain in the absence of the instructional assistance.

It is noteworthy that the generality of these skills was assessed in the same physical environment in which the training was conducted. Whether or not these relaxation skills show generality to other environments is not clear. If the development of reliable self-control relaxation skills is of importance, then procedures to foster the transfer of training beyond the training environment remain an important concern (Stoyva, 1979). It is also important to note that the assessment of generality was conducted concurrent with the training. The maintenance of these skills was not examined in the current study.

When training with verbal instructions was terminated, and feedback subsequently reintroduced, responses were quite variable among the subjects. In the SCR condition, Subjects 1 and 3 continued to show improved relaxation skills, while Subject 2 remained quite variable and some-what less proficient in relaxing relative to the SCR condition in the guided instruction phase. In the FAR condition of the Feedback II phase, Subjects 2 and 3 showed clear reductions in the EMG levels that they attained relative to their performance in the FAR condition of the Feedback I phase. Only Subject 3 was able to achieve consistently low reductions in EMG activity in the presence of feedback during the Feedback II phase. Although it does appear that the instructional relaxation training did improve the subsequent ability of Subjects 2 and 3 to relax in the presence of feedback, the reductions they achieved in the concurrent SCR condition were as low or lower than those achieved in the FAR condition. Thus the feedback signal still did not seem to enhance their relaxation skills. The performance of Subject 1 in the FAR condition of the Feedback II phase appeared relatively unaffected by the prior instructional relaxation training. The presence of the feedback signal still seemed to interfere with relaxation in this subject.

The variability of the data across the subjects in the Feedback II phase makes it difficult to draw any conclusions with respect to the effects of instructional relaxation training on the subsequent performance during the EMG feedback condition. Also, performance in the FAR condition of the Feedback II phase may have been strongly influenced by subjects' prior histories with respect to the feedback condition. That is, this previous exposure to feedback further confounds the results from the Feedback II phase. Overall, however, it does appear that verbal instruction did have a significant positive effect on relaxation skills demonstrated by the subjects. Since the use of extensive verbal instruction prior to and during biofeedback training is a common practice among investigators (Stoyva, 1979), the present results suggest that this procedure is an important component to relaxation training with biofeedback.

It is possible that the lack of success with EMG feedback training was related to the fact that feedback training periods used were relatively short compared with those frequently used (Stoyva, 1979). Although it can be argued that this factor may at least partly account for the lack of success with feedback in the present study, other investigators (Alexander, 1975; Epstein, et al., 1974) have reported success in training relaxation skills with similarly short training conditions. Also, if the brevity of the feedback condition is an important factor in this lack of success, questions still remain as to why the SCR and IAR conditions were not effected in a similar way. The subjects were able to demonstrate large reductions in EMG activity during these conditions within the same length of time. Furthermore, in the present study, an extension of the FAR condition was not associated with significant further EMG reductions.

The present study raises more questions than it answers. Further research into the variables that effect the success of relaxation training is warranted. In biofeedback training, this is especially true with respect to the importance of the feedback stimulus itself. The increased cost associated with the use of biofeedback equipment suggests that its importance must be established if it is to be recommended for training general relaxation. The superiority of biofeedback training over instructional methods of training relaxation in alleviating psychophysiological disorders such as tension headaches has not been established (Silver and Blanchard, 1978). It does appear that the burden of proof falls on those who recommend its use.

The variables related to the effectiveness of verbal instruction as a relaxation training procedure should also be investigated. It is clear that instruction-assisted relaxation training is also comprised of a number of components. For example, instructions for "passive" relaxation, such as those used in the present study, have been found to be more effective than instructions for "active" methods which require the subject to alternate tensing and relaxing muscle groups (Haynes, et al., 1975).

The effectiveness of any relaxation training procedure can also be related to individual characteristics of the subjects. It is evident that in the present study there was a high degree of variability among the subjects. This variability showed up in both basal EMG levels and in responses to the training. It has been found that basal EMG levels can influence the success of training (Stoyva and Budzynski, 1974). Other, more subtle characteristics such as individual histories with respect to the verbal stimuli used in training would be expected to influence the success of training. Investigations into the role of various behavioral characteristics exhibited by the subjects could be useful in the development of effective relaxation training procedures.

In addition to the ability of a person to produce average reductions in EMG activity over time, the consistency with which an individual can reduce EMG activity also appears to be a relevant index of the acquisition of relaxation skills. By presenting data from each session, the present study allows for an examination of this aspect of the data. Also, the masking of trends across sessions which occurs when data from individual sessions are averaged is avoided when data from each session are provided. It is recommended that in future research the data from individual sessions be provided so that intra-subject variability and trends can be examined as an aspect of relaxation skill acquisition.

Appendix A

Instructions Given Prior to the SCR Condition in Each Session

Before we begin today let me once again briefly review the tasks which you will be doing at this time. The first task is to produce the high resting level of tension. In your case this means _______ to _______ microvolts of muscular activity. As long as your EMG levels stay within this range the tone will remain off. If you fall below ___uV or above ___uV the tone will come on. If you hear the tone come on this will signal you to either tense-up slightly or relax slightly so that the tone shuts off. When you have successfully kept the tone off for an appropriate period of time the relaxation period will begin. I will say the words "now relax" to signal you that the relaxation period has begun. When I say these words I would like you to respond by saying "OK" so that I know that you heard me. Once the relaxation period has started continue to relax as deeply as possible until I come back on the intercom with further instructions -- about 13 minutes later.

Remember, relaxation involves releasing or letting go of any tension or tightness you find in your body. Cultivate feelings of calm, heaviness, and tranquility in your body and mind. Also, try to avoid attending to any outside distractions.

OK, begin by producing the high tension level.

Appendix B

Instructions Given Prior to the FAR Condition in Each Session

Once again I am going to ask you to produce the high tension level just as you did prior to the previous relaxation period. When you have successfully kept the tone off for a sufficient period of time the biofeedback relaxation period will begin. I will signal you when the biofeedback period begins by saying the words "now relax." I would like you to respond by saying "OK."

Remember, the pitch of the tone is controlled by the amount of tension in your muscles. The lower the pitch goes, the more relaxed you are becoming. When you go below a certain threshold, that is, a certain level of muscular activity, the tone will shut off. When the tone is off you will know that your tension levels have reduced significantly. If the tone remains off for a while I will lower the threshold slightly, requiring you to relax even further before it will shut off again. Whenever I lower the threshold, I will inform you of this. This feedback period will last about 13 minutes (in the later sessions of the Feedback II phase this phase was changed to: "about 20 minutes").

Remember, relaxation involves <u>releasing</u> or <u>letting go</u>

of any tension or tightness you find in your body. Cultivate feelings of calm, heaviness, and tranquility in your body and mind. Also, it is important to remember not to become overly concerned with whats happening with the tone, especially if you are having trouble lowering it. Just allow yourself to become relaxed. Use the feedback for information, but the less you worry about the tone the easier it will be to lower it.

OK, begin by producing the high tension level.

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