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Biofeedback-Based Stress Management Training with a Population of Business Managers[1]

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A biofeedback-based stress management training program was experimentally evaluated using populations of middle-level managers from a large corporation. The training program, once-weekly 1-hour sessions for 6 weeks, combined frontal and other site EMG biofeedback, progressive relaxation and breathing exercises, cognitive stress management, and generalization techniques. Control groups participated in either the assessment procedures only or the assessment procedures and six once-weekly discussions of stress and the job on both an individual (two sessions) and group (four sessions) basis. Significant effects were found in self-report measures, state and trait anxiety, experience of stress; in physiological measures, basal frontal EMG and frontal EMG during recovery from stress, and finger temperature; and in ratings of overall job performance. However, no consistent advantage for the training group or either control group was found. Several possible explanations for the failure of the biofeedback-based stress management training condition to achieve a consistent advantage over the control conditions are presented.

Although much attention has been paid recently to the role of stress and stress management in business and industry in both the popular press (Norman, 1978; Shepard, 1978; Slobogin, 1977; Smith, 1978) and pro-

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fessional literature (Benson, 1974; Kroes, Hurrell, & Margolis, 1974; Margolis, Kross, & Quinn, 1974; Student, 1977), both concepts remain somewhat vague. A variety of techniques that have demonstrated utility in the treatment of psychophysiological disorders in clinical populations (Silver & Blanchard, 1978) are currently being marketed to nonclinical populations in business and industry. Combinations of relaxation training, meditation, biofeedback, and other procedures have been introduced as stress management programs with the goals of reducing stress levels, increasing productivity, and decreasing absenteeism. With the exception of the study by Peters, Benson, and Porter (1977) (also reported in Peters, Benson, & Peters, 1977), the empirical tests of such programs are only suggestive of benefits to participants (Frew, 1974); the widespread application of stress management programs to populations of employees does not seem justified by the empirical evidence currently available. The study by Peters et al. (1977) on office personnel in medium-size firms is the exception. This study showed that regular practice of one particular procedure, the so-called "relaxation response" (Benson, 1974), a passive meditative form of relaxation, led to significant improvement in self-report of work performance, general health, and psychological well-being, as well as to significant lowering of blood pressure.

The present study differed from the Peters et al. (1977) study in that (1) it attempted an empirical evaluation of combination of procedures commonly used in stress management training programs including biofeedback training, as opposed to a single procedure and (2) the population used was exclusively middle-level management personnel rather than primarily clerical and lower-level employees. It was similar to the Peters et al. (1977) study in that (1) the training was conducted under field conditions at the employment site and (2) a multifaceted evaluation of training effects was made.

METHOD

Subjects

The sample for this study was drawn from a population of middle-level managers of a large corporation based in the Albany area. (The corporation has requested that its participation in this research remain confidential; hence its name will not be mentioned in this report.) The sample came from the third organizational level of the company; the first level is that of foreman. Each participant thus had supervisory responsibility for from 15 to 80 employees. Salaries ranged from $35,000 to $50,000. There were 8 females and 22 males who ranged in age from 40 to 60 years.

From the potential population 30 volunteers were recruited by a company agent. A general outline of the purpose of the training program, time requirements, and assessment procedures were given the participants before they signed consent statements. All participants were screened by the company medical director prior to participation.

Apparatus

EMG assessment and biofeedback training were done with an Autogen 30 Myograph with a standard band pass of 100–200 Hz. Integration over time of the EMG was done with an Autogen HT-10 Integrator.

Therman assessment was conducted using a Cyborg model J-42 thermal feedback unit.

Assessment Instruments and Procedures

Self-Report Measures. Four previously described self-report scales were used: Rotter's (1966) Locus of Control Scale; the State-Trait Anxiety Inventory developed by Spielberger, Gorsuch, and Lushene (1970); a self-report of psychosomatic symptom frequency and intensity developed by Cox, Freundlich, and Meyer (1975); and a Subjective Stress Scale developed by Schar, Reeder, & Dirken (1973), a four-item scale to measure the relation between stress and cardiovascular disorder that yields a single score on degree of subjectively experienced stress.

These four measures were administered prior to treatment by the trainer, within a week after the end of treatment by someone otherwise not connected with the study, and again by the same person at a follow-up approximately 6 weeks after the end of treatment.

Job Performance. Job performance was assessed by the use of ratings made by each participant on the four-item scale developed by Peters et al. (1977). It includes ratings, on 6-point Likert scales, of (1) level of physical energy, (2) strength of concentration, (3) handling of problems, and (4) overall work efficiency. These ratings were made for 2-week periods prior to training, at the end of training, and at the time of the follow-up assessment.

Finally, days of leave due to illness for each participant were tallied for the 10-week period from the end of training to the follow-up assessment.

Physiological Assessment. Two variables were measured during this aspect of the assessment procedure: frontal EMG in units of average microvolts per minute and average index finger temperature for the dominant hand in degrees Fahrenheit. The physiological assessment had four parts: adaptation (15 min), instructions to relax (5 min), stressful imagery (5 min), and a second instructions to relax (5 min).

Subjects were comfortably seated in an upholstered chair. During the adaptation they were instructed to sit quietly. In the two instructions to relax conditions they were asked to become as relaxed as possible, paying special attention to relaxing the forehead. During the stressful imagery period, subjects were asked to visualize a scene that they had previously reported to be stressful to them and to keep imagining it for the entire period.

The trainer conducted the pretreatment assessment. The previously mentioned independent party conducted the other two assessments.

Informed consent for all procedures was obtained prior to the pretreatment assessment.

Treatment Procedures

The purpose of this study was to evaluate the efficacy of the principal procedure, a biofeedback-based stress management training package, under conditions as similar as possible to those in which it might be typically employed. Thus training was limited to six once-per-week sessions of approximately 55 minutes in duration. All training was conducted on the company premises during business hours. Participants were released from their duties to attend.

Similar to the Peters et al. (1977) study, two control conditions were employed. The first, an individual and group discussion condition, sought to control for amount of time with the trainer and time off the job. It was initially planned as being an attention-placebo (Paul, 1969) condition and thus was planned to be therapeutically inert. The second control condition sought to control for participation in the assessment procedures and the naturally occurring events with the passage of time and was a waiting-list group. These subjects were treated after the follow-up assessment.

Thus the 30 subjects were randomly assigned to one of three conditions: (1) biofeedback-based stress management training (8 male, 2 female); (2) individual and group discussion (8 male, 2 female); and (3) a waiting-list control (6 male, 4 female).

Biofeedback-Based Stress Management Training. Participants were seen on an individual basis for all six sessions. At each session there was always 10 minutes of frontal EMG biofeedback training. There was also 10 more minutes of EMG biofeedback training in the first four sessions, utilizing a different sensor placement for each session. These placements were, respectively, (1) wrist-to-wrist, (2) trapezius, (3) sternomastoid, (4) masseter. All are placements recommended in the Autogenic Systems Inc.'s manual for the EMG device.

In each of the first three sessions 15 minutes was devoted to instruction in progressive relaxation and abdominal breathing. Written

instructions for home practice were given and participants were asked to practice daily between sessions.

For session 4, instruction in using relaxation in everyday settings and in recognizing small increases in tension were given. For sessions 5 and 6, approximately 20 minutes of each session was devoted to stress inoculation training, modeled after the work of Meichenbaum (1977). Practice in imagining stressful situations, attending to concurrent cognitions, and changing to adaptive self-talk was given. Also, following Suinn and Richardson (1971), practice in visualizing stressful scenes, particularly work scenes, was given with instructions to learn to recognize tension produced by the imagined scene and then to substitute relaxation for the tension and to image successful coping.

Individual and Group Discussion. Two individual sessions and four group sessions were held. The discussions followed brief lectures by the trainer on stress and how to recognize it in others and oneself. No specific techniques for managing it were mentioned. Participants were instructed to try to relax at the session and to try to build relaxation into their day. No specific training in relaxation was given.

Trainer

The trainer for all conditions was an advanced student in counseling psychology. He had conducted three previous projects in stress management utilizing all of the procedures described. He had also had about 2 years' part-time experience using biofeedback with a variety of problems.

A research assistant with no other part in the study conducted the posttraining and follow-up assessments.

RESULTS

Since this was an exploratory study conducted under field conditions, the .10 level of significance was adopted. It was felt wiser to sacrifice some Type I error in order to discover possible directional differences.

All variables were initially subjected to two-way analyses of variance, Groups by Time of Assessment. In order to maximize the discovery of trends toward differences among the groups, all variables were also compared using two-way analysis of covariance, using pretest scores as the covariate. The Tukey B procedure was used for post hoc comparisons among appropriate pairs of means.

Significant findings emerged from each category of dependent variables.

Table I. Summary of Physiological Variables that Showed Significant Effects

Condition	Pretraining	Posttraining	Follow-Up
Basal frontal EMG (average microvolts)			
Stress management	3.50	1.93	2.63
Group discussion	2.48	2.13	2.59
Wait list	3.18	2.58	2.70
Frontal EMG during stress recovery (average microvolts)			
Stress management	3.05	1.89	2.83
Group discussion	2.01	1.60	2.09
Wait list	3.18	2.65	2.82
Finger temperature during stress recovery (°F)			
Stress management	88.7	89.1	90.7
Group discussion	92.3	88.9	88.5
Wait list	89.1	87.3	88.9

Physiological Variables

In Table I are the mean scores on the three physiological variables that showed significant effects, tabulated by training group and time of assessment.

There was a main effect of time of assessment for basal frontal EMG, $F(2,54) = 4.72$, $p < .05$, and for frontal EMG during recovery from stress, $F(2,54) = 3.68$, $p < .05$. In both instances EMG level at posttest was significantly lower than at pretest for all three groups combined, but there was no differential group effect. Moreover, the overall value at follow-up was not different from the pretest value.

There was a main effect for group for frontal EMG during recovery from stress, $F(2,54) = 3.21$, $p < .10$. The values for the group discussion condition were lower overall than the values for the waiting list condition. This was especially true at the posttest, where the significance level for the comparison was .05. The values for the stress management condition fell in between and did not differ from each other.

For finger temperature during recovery from stress there was a significant difference among the groups at the posttest, $F(2,26) = 2.53$, $p < .10$. The mean temperatures, adjusted for the covariance analysis, of the stress management condition ($\bar{X} = 91.1$) were significantly ($p < .05$) higher than that for the group discussion condition ($\bar{X} = 87.7$).

Self-Report Measures

In Table II are the means for the four self-report measures that showed significant effects, tabulated again by training condition and time of assessment.

Table II. Summary of Self-Report Variables that Showed Significant Effects

Condition	Pretraining	Posttraining	Follow-Up
State anxiety (higher score is more anxious)			
Stress management	37.6	34.1	32.4
Group discussion	36.7	33.9	32.9
Wait list	33.5	31.3	30.7
Trait anxiety (higher score is more anxious)			
Stress management	42.8	35.9	33.9
Group discussion	36.5	36.6	34.3
Wait list	35.6	35.7	33.6
Self-rating of stress experienced on Job (higher score is *less* stress)			
Stress management	9.9	9.6	10.1
Group discussion	10.3	10.2	9.7
Wait list	10.8	10.5	11.4
Self-rating of degree of fatigue experienced on Job (higher score is *lower* fatigue)			
Stress management	2.7	2.6	2.9
Group discussion	3.0	2.8	2.5
Wait list	2.9	2.9	3.2

There was a main effect of time of assessment for state anxiety, $F(2,54) = 3.86$, $p < .05$, and trait anxiety, $F(2,54) = 3.86$, $p < .10$. For state anxiety there was a significant decrease, for all three groups combined, from pretest to posttest; the value for follow-up was also significantly lower than the pretest value but did not differ from the posttest score. For trait anxiety the posttest value did not differ significantly from the pretest value. However, the value for the follow-up assessment, for all three groups combined, was significantly ($p < .05$) lower than the pretest value.

For self-rating of the subjective experience of stress, at follow-up the groups differed significantly, $F(2,27) = 2.55$, $p < .10$. The waiting list group was significantly ($p < .10$) lower in report of experienced stress (higher numerical value) than the discussion group, with the stress management group falling between the two.

Analysis of the self-rating of degree of fatigue experienced revealed a significant interaction of Time of Assessment by Group, $F(4,54) = 2.21$, $p < .10$. Multiple comparisons revealed that participants in the group discussion condition reported more fatigue at follow-up than at pretest, while the wait list condition experienced *less* fatigue at follow-up than at pretest or posttest. Those in the wait list condition were significantly lower at the follow-up than participants in the discussion condition. Subjects in the stress management condition did not change across the experiment.

Locus of control and the psychosomatic symptom report showed no significant variation across the experiment.

Table III. Summary of Ratings of Job Performance

Condition	Pretraining	Posttraining	Follow-Up
Overall efficiency (higher score means more efficient)			
Stress management	3.5	3.7	3.6
Group discussion	3.8	4.2	4.5
Wait list	4.1	4.2	4.4
Handling of problems (higher score means better performance)			
Stress management	3.8	3.8	3.9
Group discussion	4.1	4.4	4.4
Wait list	4.2	4.5	4.3

Performance Ratings

The two ratings for which there were significant effects are tabulated in Table III.

For rated overall efficiency, there was a main effect for experimental conditions, $F(2,54) = 2.67$, $p < .10$. The participants in the wait list condition rated themselves as significantly more efficient, across assessment times, than the participants in the stress management condition.

Rated handling of problems also showed a main effect of experimental conditions at the posttest in the covariance analysis, $F(2,27) = 2.66$, $p < .10$. The wait list condition was again superior to the stress management condition at the .10 level.

Absenteeism showed no significant variation.

DISCUSSION

The results of this study show little in the way of consistent effects: the subjects receiving the biofeedback training show a trend toward better physiological responding than other subjects after treatment; all subjects report somewhat lessened subjective distress at the end of treatment, with the untreated subjects (wait list) having a slight differential advantage; and the untreated subjects tended at follow-up to have better job performance ratings than the participants receiving biofeedback. Clearly, the results of the present study do not support the conclusion that a biofeedback-based stress management training program demonstrably decreases the level of stress or distress, or increases the job performance, of managers. It seems important in the face of this failure, however, to explore the possible explanations for the lack of consistent significant effects observed in this study, especially as contrasted with the successful outcome of Peters et al. (1977). The bulk of the discussion will be devoted to this.

Four alternative explanations are offered and discussed. They are (1) that there were treatment effects but that they were not detected by the experimental design or the assessment procedure; (2) that the techniques used in the treatment package were not powerful enough or that the delivery of the package was not powerful enough; (3) that there were organizational constraints upon the potential for success of the treatment program; and (4) that the biofeedback-based stress management training may be differentially effective with different types of individuals.

One possible explanation for the lack of consistent significant results observed in this study is that there were indeed treatment effects, but the dependent measures used in this study were not sensitive to them. This explanation does not seem a likely one. A large number of dependent measures were used in this investigation, including physiological, self-report of symptoms and affective states, and rating of behavioral parameters. In light of the fairly comprehensive nature of the assessment battery, it seems unlikely that a powerful treatment effect was produced but was not detected in the assessment procedures. It is possible that with larger sample sizes, effects could have been detected. Peters et al. (1977) used sample sizes three to five times larger than the ones used in the present study.

A second possible explanation for the lack of treatment effects is that the treatment package was not powerful enough. Assertions that the training was not long enough, that the subjects did not practice enough, that the intersession interval was too long—essentially questions about the delivery of the treatment—are all possible explanations for the lack of consistent powerful treatment effects. Although these alternative explanations can be addressed authoritatively only by future research, the constraints of treatment delivery confronted in the present investigation are not likely to change dramatically as a result of such research. In other words, problems in scheduling sessions, in getting subjects to comply with practice regimens, or in releasing subjects from work for training at all in light of the excessive demands placed upon them are problems likely to be encountered in the application of any stress management program in an applied setting. In fact, one authority in this area (Manuso, personal communication, 1980) states that the typical stress management training program in business is conducted on a 1-, or possibly 2-consecutive-day basis on a weekend.

The Peters et al. (1977) study differed in this aspect in two major ways from our study: (1) only a single stress management or relaxation technique was used and (2) time and facilities were made available *on the job* for the regular practice of the relaxation response. In using a training program with many aspects, we had hoped to be effective with a wider range of the sample. It may well be that using only one powerful technique is better.

Although 1 hour per week of company time was made available for the training, no time was available, *on the job,* for regular practice in our study in contrast to the Peters et al. (1977). We strongly suspect that this may have been a crucial difference.

A second question to be addressed regarding the power of the treatment program is the power of the techniques used in making up the treatment package. Perhaps the techniques used were not good enough? Though plausible, this explanation seems unlikely. Both frontal EMG biofeedback training and progressive muscle relaxation, the two primary components of the treatment program, have experimentally demonstrated effectiveness in the treatment of a variety of disorders in clinical populations (Budzynski, Stoyva, Adler, & Mullaney, 1973; Jacobson, 1938; Wolpe, 1958). The clinical utility of cognitive stress management techniques has also been experimentally demonstrated (Meichenbaum & Cameron, 1974). In light of these considerations, the stress management program under consideration in this investigation seems to present an adequate test of the efficacy of such training in an applied setting.

Another possible explanation for the lack of consistent powerful effects observed in the study is that there may be limits on the potential for stress management training to change characteristic work behavior. Following the completion of this investigation, approximately 2 months after the follow-up assessment, each subject was debriefed and given the general results of the study as well as his or her own results. During this session, subjects in the stress management condition were asked what effect, if any, the program had had on their ability to detect and manage stress. The answers to this question were consistent. Participants felt that they could detect and manage tension and stress if they thought about it. They were able to relax on the way home from work or at home; however, when someone's supervisor deposited a large stack of work on the desk and asked that it be completed by yesterday, that person generally was not thinking about managing stress.

Perhaps this answer reflects a failure to generalize the training to the work situation. However, a more likely explanation would be that in a large organization in which the reward system is quite clearly based upon productivity and hard work, there may be limitations on the ability of individual training to change characteristic work behavior that is strongly rewarded by the organization. The Peters et al. (1977) study was actually able to engineer "relaxation breaks" into the regular work day. Programs designed to reduce the effects of stress on workers might be more effective (1) if they could replicate the company policy of Peters et al. (1977) or (2) if they were directed toward periods of time when the manager has more control, essentially off-work time.

Our final explanation for the lack of consistent and significant results observed in this investigation is the possibility that biofeedback-based stress management training may be more effective with some individuals than with others. Clearly, the present study showed that biofeedback-based stress management training is not a panacea; however, there may be

individuals for whom such a program would be beneficial. For example, two individuals in the biofeedback-based stress management training group verbally reported significant change in symptomology as a result of training. One individual reported a cessation of tension headaches that had been troublesome for several years. The other individual reported that he was able to use the training as an aid in falling asleep, especially when sleeping was difficult due to a demanding day.

This information must be regarded as anecdotal, and it is possible that comparable therapeutic gains were made in the other groups though not reported, or that these changes were precipitated by the demand characteristics of the experimental situation. Nevertheless, these changes represent significant therapeutic benefits for these two individuals.

It is important to note that the changes that these two individuals reported were symptom-specific. That is, they did not report a change in general anxiety or in overall efficiency but in the specific symptoms of headache and insomnia. This suggests that biofeedback-based stress management training may be effective in the treatment of psychophysiologicl disorders but not effective in general stress reduction. This finding is similar to the results obtained by Raskin, Johnson, and Rondestvedt (1973) in training chronically anxious patients with frontal EMG biofeedback and home practice. While ratings of general anxiety in this patient group showed little or no differential improvement as a result of training, more favorable results were obtained in ratings of headache and insomnia.

In a sense, the notion of a stress management technique or program that will demonstrably benefit all individuals is somewhat utopian. Anecdotal information generated in the present investivgation raises the possibility that though stress management training may not yield significant beneficial effects on all individuals, some individuals will significantly benefit from such training.

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