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ELECTROMYOGRAPHIC BIOFEEDBACK IN THE DENSITIZATION OF TEST ANXI--ETC(U)
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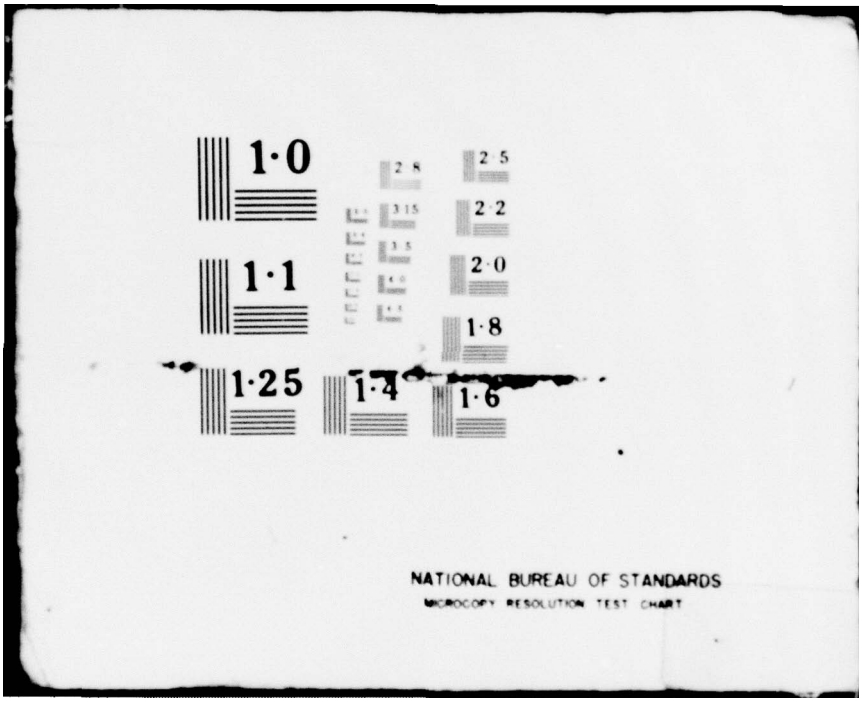
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ELECTROMYOGRAPHIC BIOFEEDBACK IN THE DESENSITIZATION OF TEST ANXIETY

MAJOR RICHARD L. HUGHES

PROJECT 2303

AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE

FJSRL-TR-79-0008

This document was prepared by the Energetic Materials Division, Directorate of Chemical Sciences, Frank J. Seiler Research Laboratory, United States Air Force Academy, Colorado. The research was conducted under Project Work Unit Number 2303-F1-52, Assessment Procedures for Stress Management Training in an Academic Setting. Major Richard Hughes was the Project Scientist in charge of the work.

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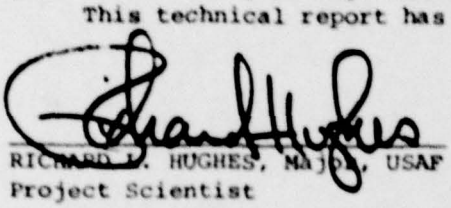

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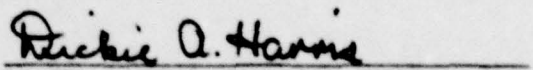

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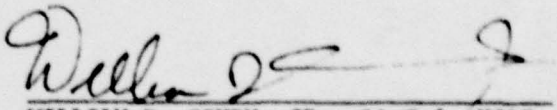

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subjects received multiple sessions of electromyographic biofeedback of frontalis muscle tension as well as standardized systematic desensitization sessions. After treatment frontalis tension levels indicated that significant muscular relaxation was achieved. Also, test anxiety had significantly decreased in the treatment group. However, there had been no improvement on several performance measures relative to a no-treatment control group. These results are interpreted as casting doubt on the view that test anxiety is primarily a problem of physiological overarousal.

ABSTRACT

Electromyographic Biofeedback In The Desensitization Of Test Anxiety

Richard L. Hughes

U. S. Air Force Academy

Systematic desensitization has only been irregularly effective in improving the performance of test-anxious subjects in evaluative situations. It was hypothesized that this was attributable to insufficient levels of muscular relaxation obtained with verbal relaxation procedures and that electromyographic biofeedback would lead to deeper levels of relaxation and hence improved performance scores among test-anxious subjects. Interestingly, despite the theoretical centrality of physiological relaxation in desensitization, few studies have directly assessed actual physiological parameters. In the present study subjects received multiple sessions of electromyographic biofeedback of frontalis muscle tension as well as standardized systematic desensitization sessions. After treatment frontalis tension levels indicated that significant muscular relaxation was achieved. Also, test anxiety had significantly decreased in the treatment group. However, there had been no improvement on several performance measures relative to a no-treatment control group. These results are interpreted as casting doubt on the view that test anxiety is primarily a problem of physiological overarousal.

ELECTROMYOGRAPHIC BIOFEEDBACK IN THE DESENSITIZATION OF TEST ANXIETY

Richard L. Hughes

U.S. Air Force Academy

Recently, cognitive-modification techniques have proven effective in reducing test anxiety in college students and in improving their performance (Meichenbaum, 1972; Holroyd, 1976). This is in contrast with numerous studies evaluating the systematic desensitization of test anxiety (Anton, 1976; Russell, Miller, & June, 1975). While desensitization regularly has led to reductions in test anxiety, it has led to actual performance changes only irregularly.

Most studies of treating test anxiety have involved desensitization or some other relaxation-based treatment (Allen, 1972; Cornish & Dilley, 1973; Deffenbacher and Snyder, 1976). While many researchers (e.g., Liebert & Morris, 1967) conceptualize two factors of test anxiety--an emotionality factor and a worry factor--most treatment approaches have emphasized the former. Most treatments have aimed toward lowering physiological arousal in test anxious subjects rather than toward modifying the subjects' dysfunctional cognitions about testing. However, as noted above, the apparent effectiveness of such treatments in reducing test anxiety often were not matched with comparable improvement in test performance.

The relative success of cognitive-modification procedures in improving performance suggests that altering a student's cognitions may be

a more viable treatment approach than is training relaxation. Furthermore, it supports the view that emotional arousal may not be even a particularly central aspect of test anxiety. Thus, the effectiveness of altering cognitive behavior during tests lends support to the view that test anxiety is primarily a dysfunction of attention. Wine (1971) suggested this and Meichenbaum's work supports it.

Yet, it still may be too soon to dismiss relaxation-based approaches to treating test anxiety. Ironically, this may be because the typical techniques for training relaxation (upon which, of course, other clinical procedures such as desensitization depend) may not, in fact, produce deep muscle relaxation. The distinction here is between reported or subjective relaxation and actual levels of muscle tension. It may be that despite the effectiveness of relaxation-based approaches in altering self-reported test anxiety, the theoretically required levels of muscle relaxation may rarely be achieved. As Spielberger (Spielberger, Anton & Bedell, 1976) has noted, muscle relaxation is assumed to mediate the counter-conditioning of relaxation to anxiety-provoking stimuli, but actual changes in muscle relaxation during desensitization are rarely measured. While most studies have demonstrated less reported test-anxiety following treatment, few have assessed physiological changes following treatment. In fact, only a few studies of treating test anxiety (Holroyd, Westbrook, Wolk, & Badhorn, 1978; Eggleston and Parker, 1977; McManus, 1973) have assessed relaxation in terms of physiological parameters. This is despite the conceptual centrality of muscular

relaxation in so many evaluation studies. Furthermore, Reinking and Kohl (1975) demonstrated that typical verbal relaxation procedures sometimes may be inefficient and weak. They found electromyographic (EMG) biofeedback to be a superior procedure in terms of speed of learning and depth of relaxation.

Since EMG biofeedback is a technique which demonstrably affects real changes in muscle tension (Stoyva and Budzynski, 1973), and since it provides convenient quantification of physiological arousal, it seemed an appropriate technique for use in conjunction with desensitization procedures in the treatment of test anxiety. This would provide a basis for answering whether performance changes can be expected with desensitization if sufficient levels of muscular relaxation are achieved.

METHOD

Subjects

The Text Anxiety Scale (TAS) (Sarason, 1972) was administered to all sophomore cadets (approximately 300) in an undergraduate psychology course. Those who scored in the most-anxious 15% were invited to participate in a program to reduce test anxiety. There were 16 who volunteered. The entire program lasted approximately three months. Ss reported individually for baseline and treatment sessions on a fairly regular basis averaging one session per week.

Conditions

Biofeedback - desensitization. After a brief introduction to biofeedback theory and procedure, Ss received four twenty-minute sessions of EMG feedback of frontalis muscle tension. Ss received both auditory and visual feedback. During the last three sessions Ss received biofeedback, some taped relaxation instructions, and a standardized desensitization tape depicting a number of stressful testing situations. Desensitization is effective in both standardized (Emery & Krumboltz, 1967) and massed modes (Suinn, Edie, & Spinelli, 1970). There were 16 Ss in the treatment condition.

No treatment control. A group of 10 Ss were obtained in a similar fashion during the subsequent semester for evaluation as a no treatment control group. These Ss participated in all pre and posttesting sessions. Pre and posttesting sessions were separated by approximately three months, equivalent to the period separating pre and posttesting for the treatment group.

Dependent Variables

All Ss in the experimental group participated in eleven sessions. The first two and last two sessions were for pre and posttesting. During these sessions Ss completed the comprehension portion of the Nelson-Denny Reading Test, Forms C and D, and equivalent forms of a locally-generated test of analogies and algebra problems. The order of presentation was counterbalanced. Frontalis muscle tension was assessed using a Bio Feedback Systems, Inc. B-1 electromyographic biofeedback

instrument (Ss received no feedback). Frontalis tension was recorded for approximately five minutes while Ss listened to tape-recorded descriptions of academic testing situations and imagined themselves in the situations. The Test Anxiety Scale was readministered after the final physiological assessment period.

At the beginning and end of each of all assessment and training sessions, each S also rated his or her subjective level of tension on a 1 to 10 scale.

Finally, the effectiveness of biofeedback/desensitization was evaluated on the basis of several performance indices. One of these was semester grade point average for the semester preceding and the semester during which the study took place. Academic grades are clearly the most directly relevant and significant measure of a treatment's effectiveness. However, academic grades may also be the least sensitive and least controlled indicator of performance improvement. Therefore, it seemed advisable to also include other performance measures. Another was the comprehension portion of the Nelson-Denny Reading Test. This test has alternate forms that were suitable for the before-and-after assessment periods. The other performance measure was called the BEAST, a locally-devised test composed of verbal analogies and algebraic word-problems. The BEAST was characterized by severe time limits for each problem which caused considerable stress on the test-taker. It was believed that such a test might best reflect the adverse effects of test anxiety and also, therefore, the effects of a stress management treatment. There were comparable forms of the BEAST administered before and after treatment.

Counselors

Several counselors with varying degrees of counseling experience participated in the study. Each counselor worked with the same Ss across treatment sessions and counselors were responsible for Ss from differing treatment conditions.

RESULTS

Ss were assigned to the treatment or control groups on the basis of pretreatment TAS scores only. There was no attempt to match treatment and control groups on any of the other dependent measures, and the two groups did prove to be significantly different at pretesting on several relevant variables. In particular, the control group performed significantly better on the comprehension portion of the Nelson-Denny Reading Test and also on the BEAST.

As a practical matter, these differences do not alter interpretation of the results since there were no interactions between the two main experimental conditions. The control group performed better on the reading test and the BEAST at the outset of the study and at the study's conclusion the control group maintained its superiority, by roughly equivalent amounts. In sum, these pretreatment differences complicate the interpretation of these results but they certainly do not change it.

The statistical analyses reported below all involve repeated measures, two-way analyses of variance.

Frontalis Muscle Tension

Before treatment the mean EMG level in the biofeedback/desensitization group was 3.78 microvolts/minute. After treatment it was 2.63 microvolts/minute. These levels are very comparable to those in the control group. Before treatment the mean EMG level in the control group was 4.16 microvolts/minute. After treatment it was 3.21 microvolts/minute. There was a significant reduction in frontalis muscle tension ($p < .05$) in both groups following treatment, but the biofeedback/desensitization group did not achieve any greater relaxation effects than did the control group, which received no form of treatment whatsoever. Furthermore, there was no significant difference between the treatment and control groups in mean frontalis muscle tension.

In interpreting these results, it is probably mistaken to infer that biofeedback is ineffective as a relaxation treatment (that it had no effect relative to a control group). It is important to put these findings in the context of the relatively low EMG levels that were observed. An EMG frontalis tension level of 3 microvolts/minute is frequently used as a criterion of deep muscle relaxation (Eggleston and Parker) and the pre-treatment levels in both the treatment and control groups approached that criterion. It would have been difficult to demonstrate great relaxation effects using any technique on groups which were already so relaxed. Data about EMG changes are presented in Figure 1 and in Tables 1 and 2.

FRONTALIS MUSCLE TENSION

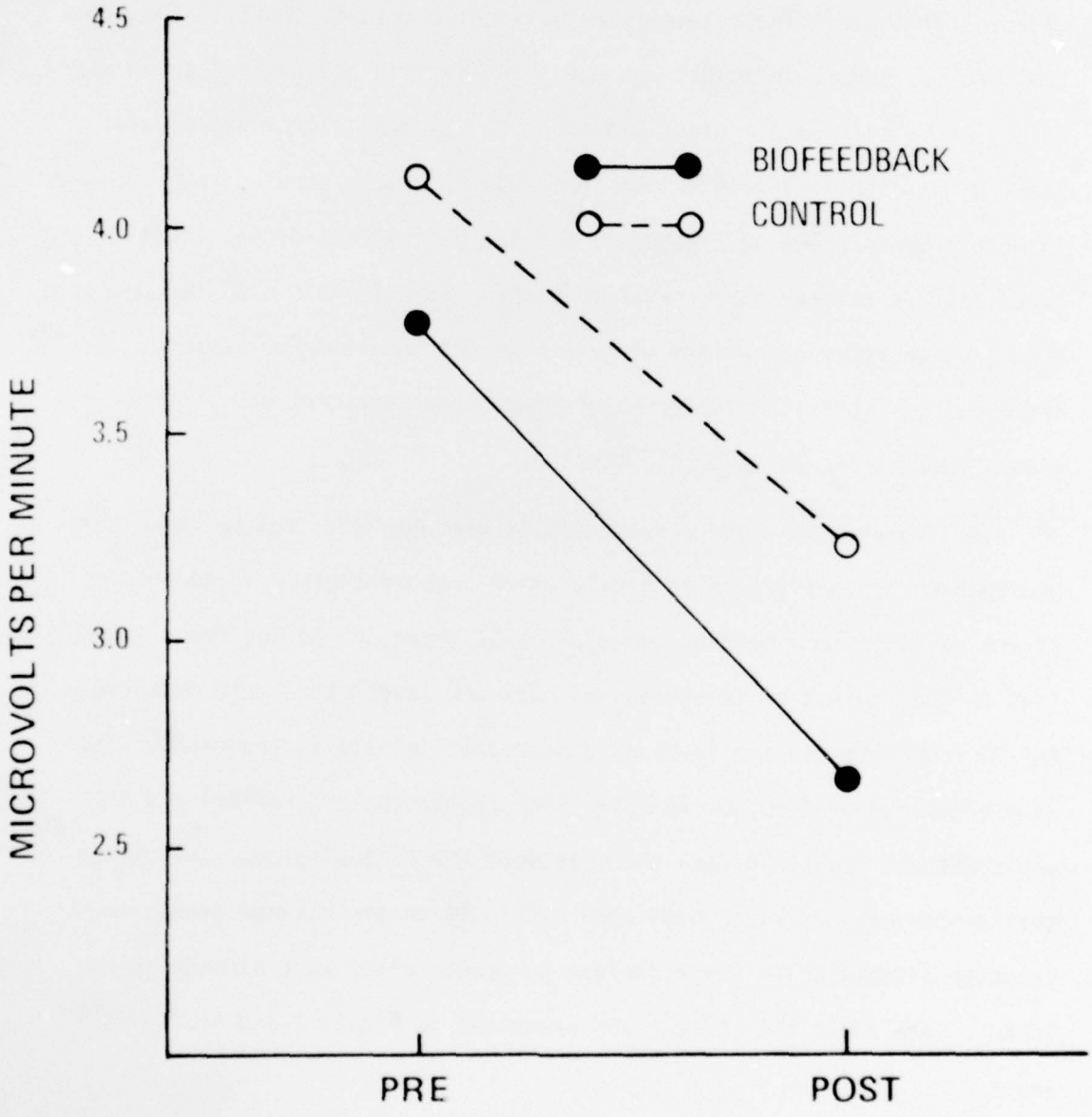

FIGURE 1. Frontalis Muscle Tension In Microvolts/Minute For The Treatment And Control Groups Before And After Treatment.

TABLE 1

MEANS AND STANDARD DEVIATIONS OF FRONTALIS TENSION LEVELS FOR DIFFERENT EXPERIMENTAL GROUPS

Group	$\bar{X}$	S.D.
Biofeedback/Desensitization	3.20	1.70
Control	3.68	2.76
Pretest	3.92	2.49
Posttest	2.85	1.64
Biofeedback/Desensitization pretest	3.77	1.76
Biofeedback/Desensitization posttest	2.63	1.47
Control - pretest	4.16	3.45
Control - posttest	3.21	1.91

TABLE 2

2-WAY ANALYSIS OF VARIANCE OF FRONTALIS TENSION LEVELS (TREATMENT VERSUS CONTROL GROUPS AND PRETESTING/POSTTESTING ASSESSMENT)

Source of Variation	DF	SS	MS	F
Treatment	1	2.8579	2.8579	0.429
Error 1	24	160.0052	6.6669	
Pre-post	1	14.2473	14.2473	5.638*
Interaction	1	0.1155	0.1155	0.046
Error 2	24	60.6522	2.5272	
Error due to approximation		0.6150		
Total	51	238.4931		

*$p < .05$

Subjective Tension Self-Reports

For convenience, only the self-report data at pretesting and at posttesting is reported. Ss in the biofeedback/desensitization group reported less subjective tension immediately after visualizing academic testing situations than they did beforehand ($\bar{X}$ = 4.51 before visualization, $\bar{X}$ = 3.44 after visualization). The act of sitting in a comfortable chair in a quiet room, even while visualizing ostensibly stressful scenes, apparently had a somewhat calming effect on the Ss. Interestingly, this relationship existed prior to treatment as well as after treatment, so it cannot be considered an effect of successful desensitization. The other comparison of interest was that between Ss' mean level of subjective tension before treatment began and after it had terminated. It was expected that relaxation training would have the effect of reducing subjective tension levels in the treatment group so that posttreatment self-reports would reflect greater calmness than pretreatment self-reports.

As it turned out, Ss reported feeling somewhat less tense after treatment although the difference was not statistically significant (pretreatment $\bar{X}$ = 4.20, posttreatment $\bar{X}$ = 3.75). It would appear that sitting rather quietly for a short period of time had a greater calming effect on subjective tension than a lengthy, involved relaxation training program. Data about changes in subjective tension are presented in detail in Figure 2 and Tables 3 and 4.

SELF-REPORT

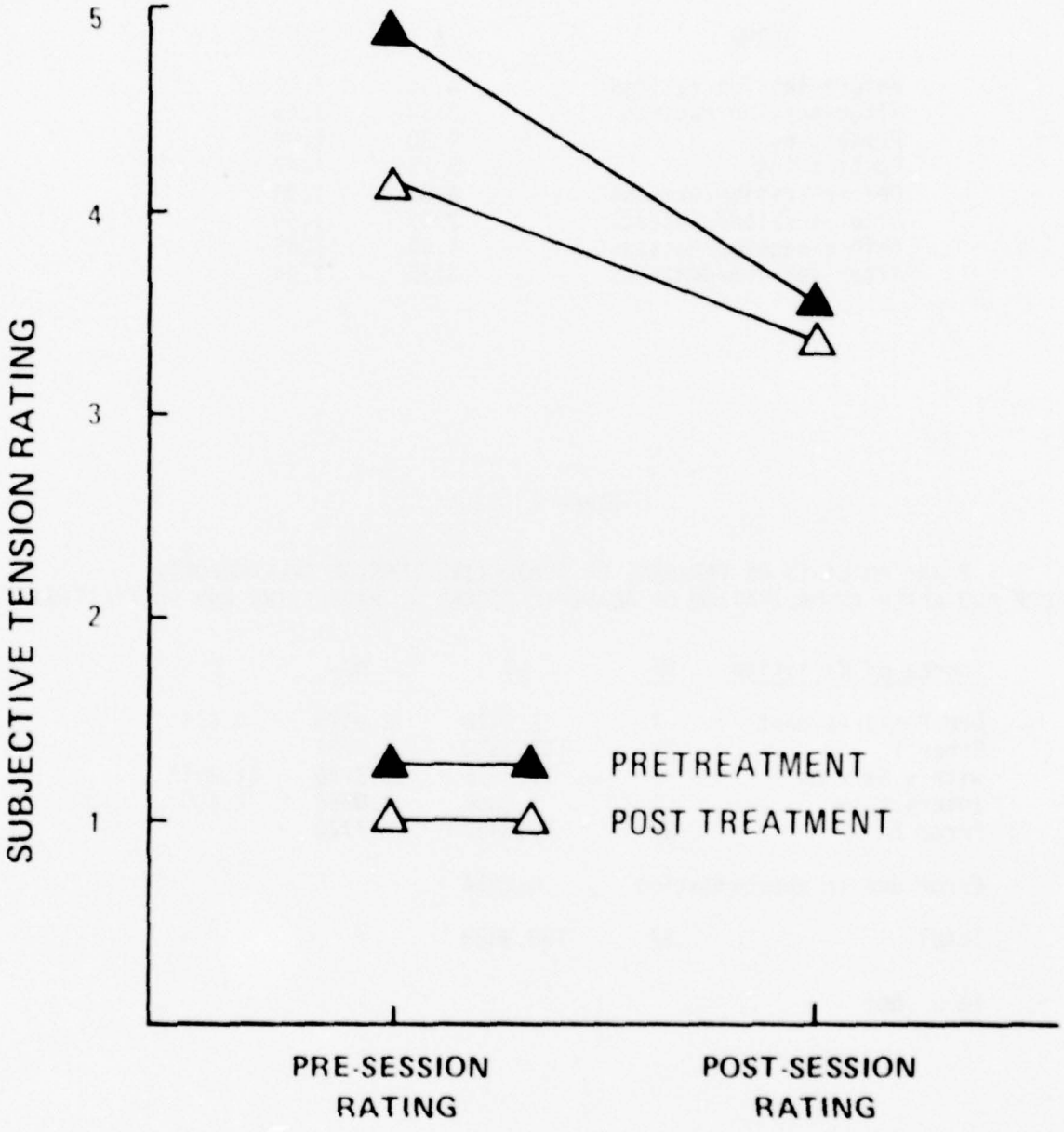

FIGURE 2. Subjective Tension Ratings By Ss In The Treatment Group Before And After Visualizing Testing Scores Before Treatment And After Treatment

TABLE 3

MEANS AND STANDARD DEVIATIONS OF SUBJECTIVE TENSION SELF-REPORTS FOR DIFFERENT EXPERIMENTAL GROUPS

Group	$\bar{X}$	S.D.
Before-session ratings	4.51	1.72
After-session ratings	3.44	1.45
Pretesting	4.20	1.82
Posttesting	3.75	1.47
Before-session/pretest	4.87	1.92
After-session/pretest	3.53	1.50
Before-session/posttest	4.14	1.45
After-session/posttest	3.35	1.44

TABLE 4

2-WAY ANALYSIS OF VARIANCE OF SUBJECTIVE TENSION SELF-REPORTS (BEFORE AND AFTER VISUALIZATION OF ACADEMIC SCENES AT PRETESTING AND POSTTESTING)

Source of Variation	DF	SS	MS	F
Pre-Posttreatment	1	2.9328	2.9328	0.674
Error 1	27	117.5500	4.3537	
Within Session	1	16.2776	16.2776	21.084*
Interaction	1	1.0858	1.0858	1.406
Error 2	27	20.8452	0.7720	
Error due to approximation		0.2914		
Total	57	158.9828		

*$p < .001$

Test Anxiety

Ss in the biofeedback/desensitization group reported significantly less test anxiety following treatment. Although test anxiety also decreased somewhat in the control group (TAS pre $\overline{X}$ = 26.4, TAS post $\overline{X}$ = 23.8), the decrease in the treatment group was significantly greater ($F = 15.1$, $p < .001$).

In sum, the desensitization of test anxiety was successfully accomplished in the treatment group while only a minimal downward change in test anxiety occurred in the control group. Data about changes in test anxiety are presented in detail in Figure 3 and Tables 5 and 6.

Grade Point Average

Grade point average for the semester preceding the study was compared with that for the semester during which the study took place. GPAs for the treatment and control groups were not significantly different before the study, nor were they different at the end of the semester after treatment was completed. Actually, the control group showed a slight though statistically insignificant increase in GPA while the treatment group showed a slight though statistically insignificant decrease in GPA. As with other studies (Finger and Galassi, 1977), desensitization had failed to affect significant improvement in academic performance despite affecting reductions in test anxiety. Data about changes in GPA are presented in Figure 4 and Tables 7 and 8.

TEST ANXIETY

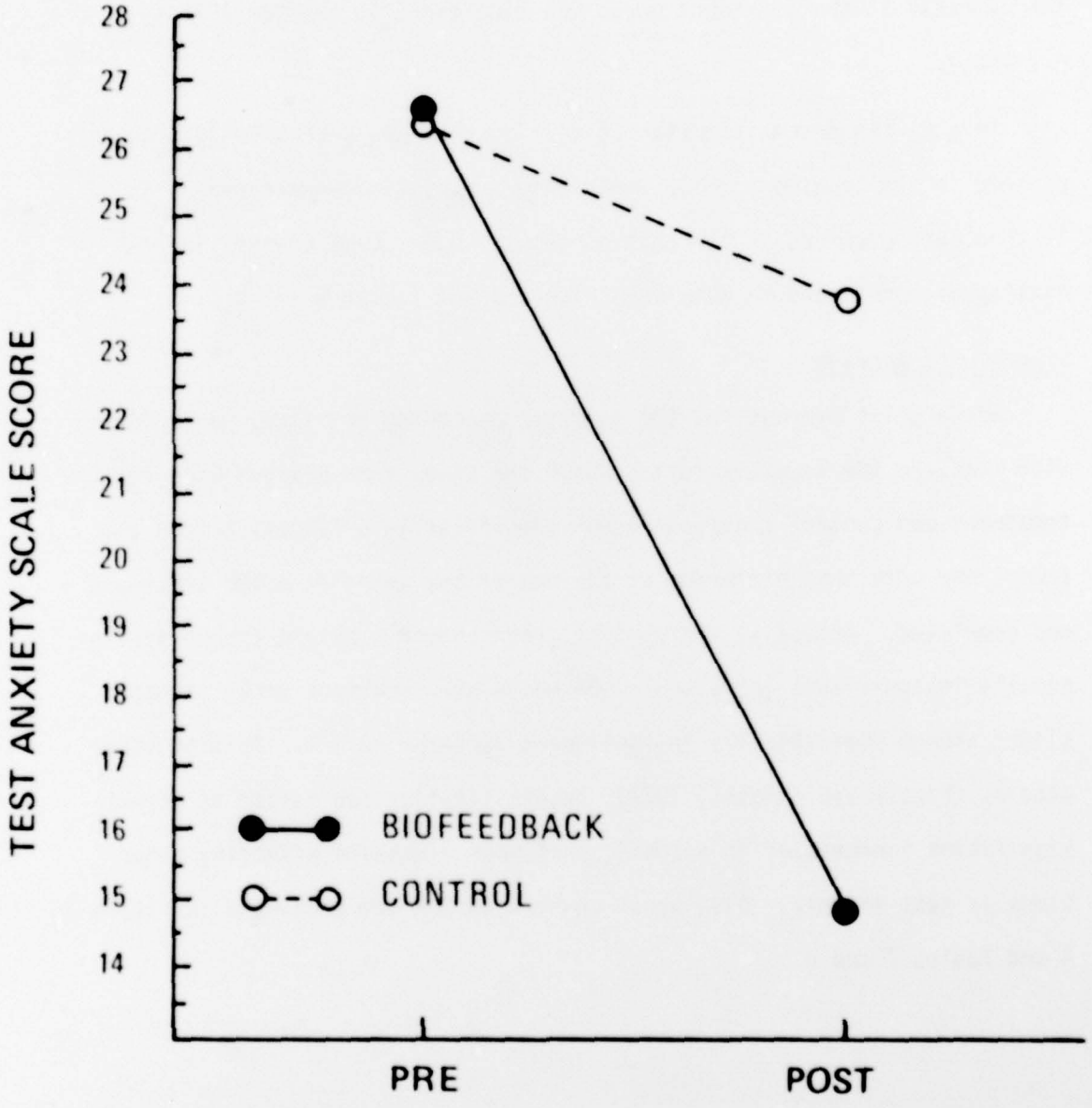

FIGURE 3. Test Anxiety Scale Scores For The Treatment And Control Groups Before And After Treatment

ACADEMIC PERFORMANCE

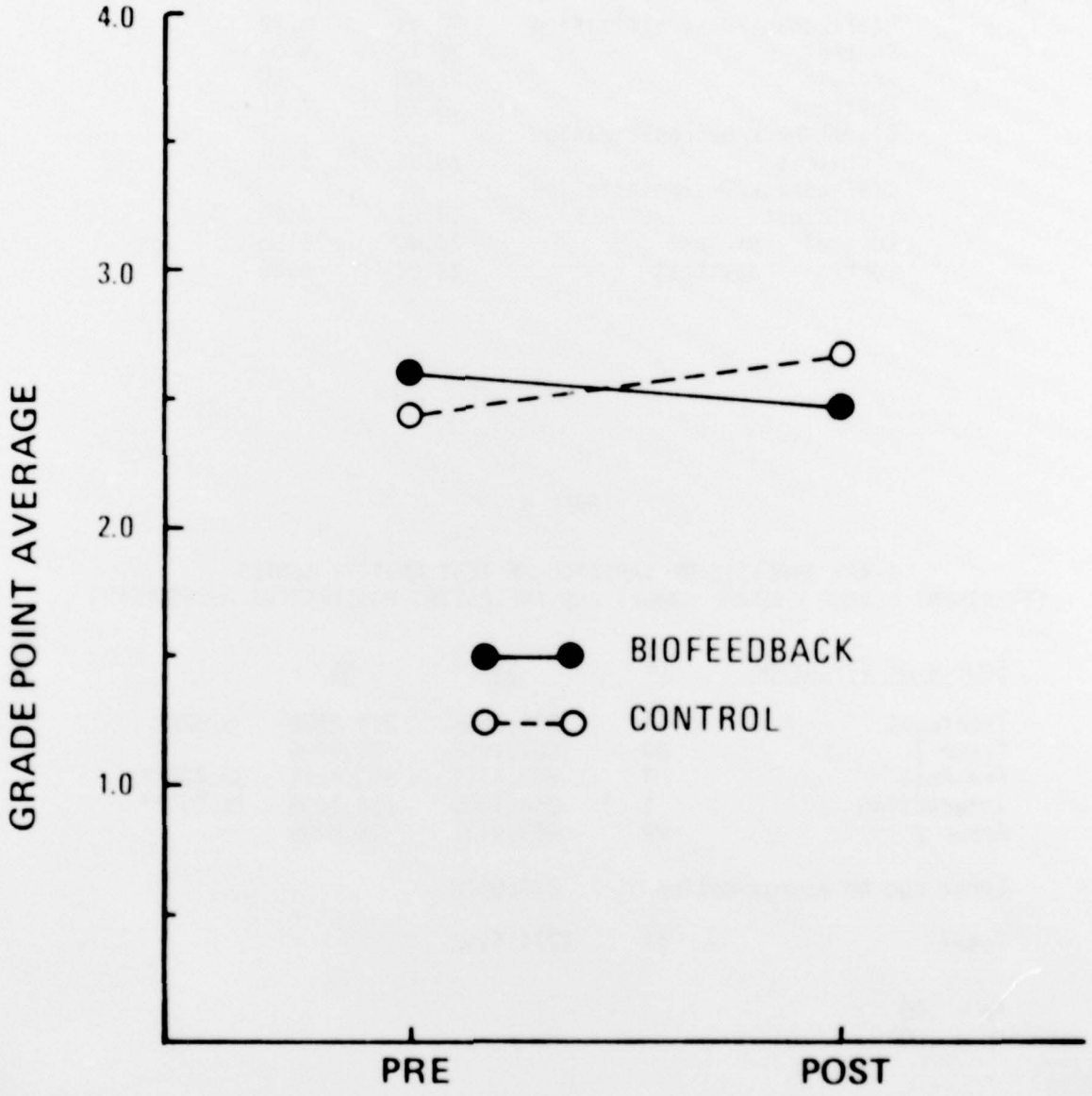

FIGURE 4. Grade Point Avergae For The Treatment And Control Groups Before And After Treatment.

TABLE 5

MEANS AND STANDARD DEVIATIONS OF TEST ANXIETY SCORES FOR DIFFERENT EXPERIMENTAL GROUPS

Group	$\bar{X}$	S.D.
Biofeedback/Desensitization	20.71	8.12
Control	25.10	5.09
Pretest	26.50	3.66
Posttest	18.30	7.91
Biofeedback/Desensitization pretest	26.56	3.20
Biofeedback/Desensitization posttest	14.87	7.29
Control - pretest	26.40	4.50
Control - posttest	23.80	5.55

TABLE 6

2-WAY ANALYSIS OF VARIANCE OF TEST ANXIETY SCORES (TREATMENT VERSUS CONTROL GROUPS AND PRETESTING/POSTTESTING ASSESSMENT)

Source of Variation	DF	SS	MS	F
Treatment	1	236.2505	236.2505	5.626*
Error 1	24	1007.7688	41.9904	
Pre-Post	1	663.4311	663.4311	39.420**
Interaction	1	254.1005	254.1005	15.098**
Error 2	24	403.9187	16.8299	
Error due to approximation		209.0496		
Total	51	2774.5192		

*$p < .05$
**$p < .001$

TABLE 7

MEANS AND STANDARD DEVIATIONS OF GPAs
FOR DIFFERENT EXPERIMENTAL GROUPS

Group	$\bar{X}$	S.D.
Biofeedback/Desensitization	2.50	.58
Control	2.57	.36
Pretest	2.50	.60
Posttest	2.55	.40
Biofeedback/Desensitization pretest	2.53	.70
Biofeedback/Desensitization posttest	2.48	.44
Control - pretest	2.46	.41
Control - posttest	2.68	.28

TABLE 8

2-WAY ANALYSIS OF VARIANCE OF GPA
(TREATMENT VERSUS CONTROL GROUPS AND PRETESTING/POSTTESTING ASSESSMENT)

Source of Variation	DF	SS	MS	F
Treatment	1	0.0685	0.0685	0.171
Error 1	24	9.5950	0.3998	
Pre-Post	1	0.1109	0.1109	0.860
Interaction	1	0.2365	0.2365	1.834
Error 2	24	3.0946	0.1289	
Error due to approximation		-0.0635		
Total	51	13.0421		

Other Performance Measures

As noted above, there was a significant difference between the biofeedback/desensitization and control groups on some measures before any treatment began. On the BEAST and on the comprehension portion of the Nelson-Denny Reading Test the control group scored significantly higher both before and after treatment. Both groups demonstrated improved performance on both measures at posttesting but the improvements were not statistically significant. Since the control group maintained its relative superior performance on these measures at posttesting, despite having had no treatment at all, the improvements which did occur should be attributed to practice.

As with grade point average, these measures reflect no improvement in the performance of test anxious Ss who have completed a desensitization program despite the fact that the Ss' test anxiety itself was markedly reduced by the desensitization. Data pertaining to the BEAST are presented in Figure 5 and Tables 9 and 10; that for the reading comprehension test are presented in Figure 6 and Tables 11 and 12.

DISCUSSION

One interesting finding of this study was that reductions in test anxiety occurred despite relatively insignificant changes in muscle tension between pre and posttesting. A statistically significant decrease in mean EMG level did occur in the biofeedback/desensitization group following treatment, but an equivalent change also occurred in the control

NELSON-DENNY READING TEST COMPREHENSION

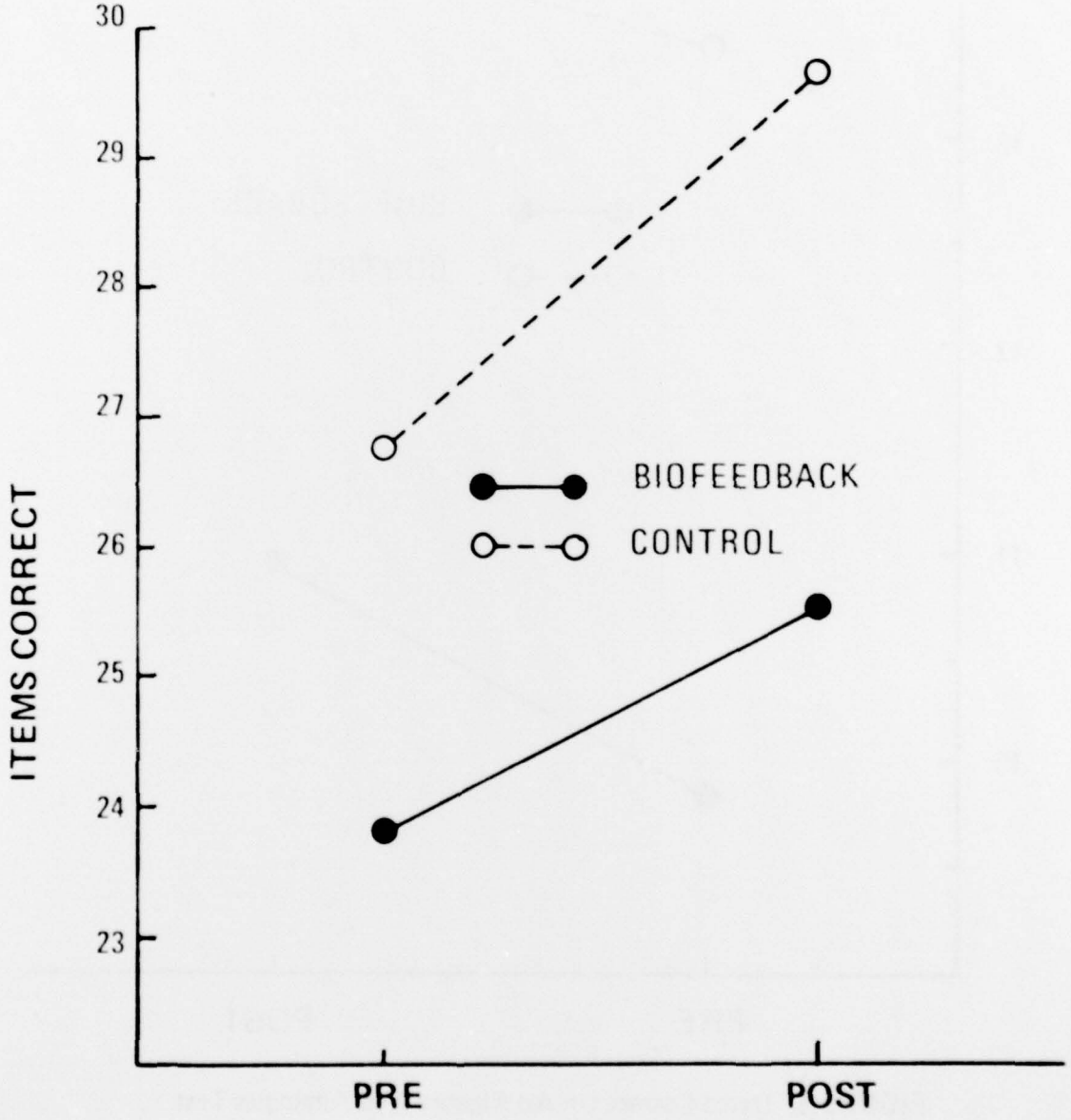

FIGURE 5. Reading Comprehension Scores For The Treatment And Control Groups Before And After Treatment.

BEAST

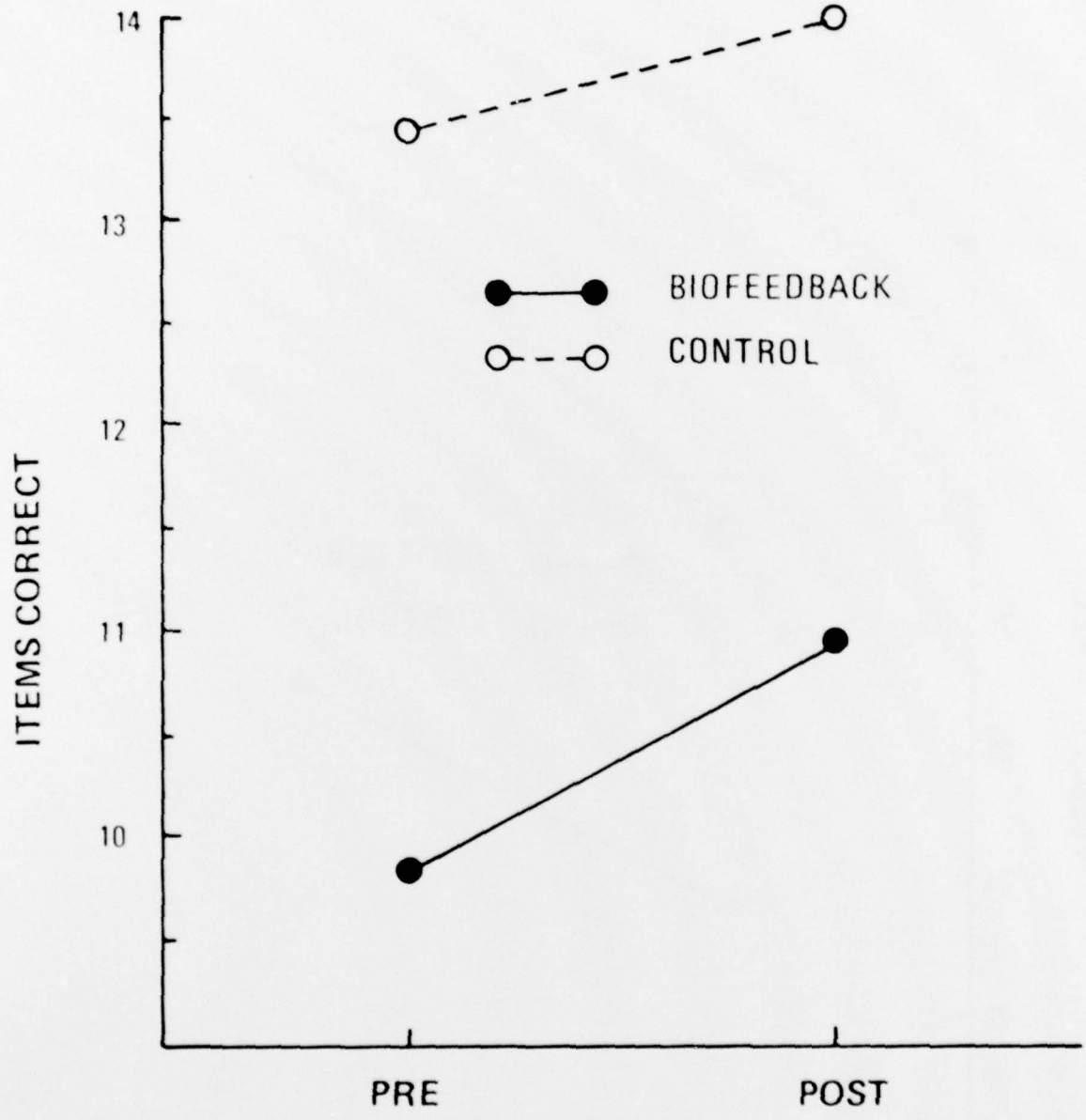

FIGURE 6. Items Correct On An Algebra And Analogies Test For The Treatment And Control Groups Before And After Treatment.

TABLE 9

MEANS AND STANDARD DEVIATIONS OF BEAST SCORES FOR DIFFERENT EXPERIMENTAL GROUPS

Group	$\bar{X}$	S.D.
Biofeedback/Desensitization	10.37	2.92
Control	13.70	2.69
Pretest	11.19	3.37
Posttest	12.11	3.12
Biofeedback/Desensitization pretest	9.81	3.05
Biofeedback/Desensitization posttest	10.93	2.76
Control - pretest	13.40	2.67
Control - posttest	14.00	2.82

TABLE 10

2-WAY ANALYSIS OF VARIANCE OF PERFORMANCE ON THE BEAST (TREATMENT VERSUS CONTROL GROUPS AND PRETREATMENT/POSTTREATMENT ASSESSMENT)

Source of Variation	DF	SS	MS	F
Treatment	1	136.0692	136.0692	11.888*
Error 1	24	274.7000	11.4458	
Pre-Post	1	9.6708	9.6708	1.982
Interaction	1	0.8481	0.8481	0.174
Error 2	24	117.0750	4.8781	
Error due to approximation		1.4061		
Total	51	539.7692		

*$p < .005$

TABLE 11

MEANS AND STANDARD DEVIATIONS OF READING COMPREHENSION SCORES FOR DIFFERENT EXPERIMENTAL GROUPS

Group	$\bar{X}$	S.D.
Biofeedback/Desensitization	24.68	4.91
Control	28.10	2.80
Pretest	24.88	3.59
Posttest	27.11	5.11
Biofeedback/Desensitization pretest	23.87	4.06
Biofeedback/Desensitization posttest	25.50	5.65
Control - pretest	26.50	1.90
Control - posttest	29.70	2.70

TABLE 12

2-WAY ANALYSIS OF VARIANCE OF READING COMPREHENSION SCORES (TREATMENT VERSUS CONTROL GROUPS AND PRETESTING/POSTTESTING ASSESSMENT)

Source of Variation	DF	SS	MS	F
Treatment	1	143.3250	143.3250	4.734*
Error 1	24	726.6750	30.2781	
Pre-Post	1	75.6620	75.6620	18.218
Interaction	1	7.6327	7.6327	1.838
Error 2	24	99.6750	4.1531	
Error due to approximation		-10.9697		
Total	51	1042.0000		

*$p < .05$

group. Furthermore, the clinical significance of these changes is marginal given the relatively low initial EMG levels. The changes, while statistically significant, do not signify change from a muscularly tense state to a muscularly relaxed state. In fact, the muscular tension levels in the test-anxious subjects were never (on the average) particularly high. For practical purposes, then, the treatment had more effect upon verbal reports of test anxiety than upon levels of muscular tension.

It is possible that this inconsistency is due to the fact that the muscle tension data was obtained during periods of imaginal visualization of test-taking. Perhaps test-anxious Ss really are tense during actual examinations (i.e., do not simply report being more tense then) but not during imagined examinations. Unfortunately, this question cannot easily be answered simply by assessing frontalis EMG levels during actual examinations because academic tests typically involve significant motor components which would lead to spurious readings. Even the act of visually focusing on a printed page might involve sufficient contraction of certain facial muscles as to produce significantly elevated EMG levels which are unrelated to anxiety. Therefore, it seemed necessary to assess muscle tension levels while Ss imagined themselves in difficult testing situations. Such use of visualization is widespread clinically, of course, and it typically does produce anxiety. In retrospect, however, there are grounds for questioning whether visualizing these scenes was stressful to the Ss after all. Since their reported tension decreased following the

visualization, it would appear that the activity was somewhat relaxing rather than stressful. The relatively low levels of muscular tension observed among the test-anxious Ss in this study are consistent with this self-report data. Still, it is curious that imaginally visualizing what appeared to be stressful testing situations was no more stressful than it appeared to be for these test-anxious Ss; imagining anxiety-producing situations typically is stressful for other kinds of phobic clients, at least so it would appear from clinical observations.

In light of this unexpected effect it may be worthwhile to remember that there are no conceptual reasons why desensitization could not be successful even when the visualized scenes are not experienced by clients as stressful. Intense anxiety during desensitization is not only unnecessary, it is undesirable since it interferes with counterconditioning relaxation to the anxiety-producing stimuli. A client's anxiety during desensitization mostly seems to serve as a guide to the therapist that the scenarios do, in fact, involve psychologically significant themes. It is tactically helpful, not conceptually essential. Thus, the relatively relaxed self-reports of test-anxious Ss following the visualization of academic testing scenes does not imply that desensitization could not have taken place.

This point is important, since it is obvious from the data that something therapeutic did occur as a result of treatment. Ss in the biofeedback/desensitization group reported dramatically reduced test anxiety after treatment. There was minimal change among Ss in the control group.

The desensitization was successful, despite the apparent and somewhat surprising comfort of Ss throughout the treatment. This finding is critical to the purpose of this study, which was to evaluate performance effects following desensitization. Obviously, desensitization itself must be accomplished if performance effects are to be evaluated, and the test anxiety decrements observed in this study compare favorably with those reported elsewhere from desensitization (Spielberger, et al).

Several different performance measures were observed in the present study. These included grade point average, reading comprehension, and accuracy on a stressful, timed test of analogies and algebra problems. The conclusion to be drawn from the results is very clear: there were no performance effects attributable to the treatment. The improvements which did occur in the two standardized tasks can be attributed to practice effects, and there was no significant change whatsoever in grade point average. The absence of performance improvement attributable to desensitization is noteworthy in that the test-anxious Ss clearly were able to relax physically to a significant degree. Thus, desensitization may not be effective in affecting anything other than verbal self-reports even when deep muscle relaxation is achieved.

As a final note, one of the most intriguing findings of this study was the relatively relaxed musculature of test-anxious Ss even before treatment. This is certainly not consistent with the image of the physiologically tense individual for whom relaxation-based treatments are

presumably directed. However, this finding suggests an interesting possibility: that test-anxious individuals are not, after all, so physically tense as they describe themselves as being. This possibility needs to be more seriously explored.

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