BIOFEEDBACK AND RELAXATION: THE ROLE OF INDIVIDUAL DIFFERENCES

A Thesis

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ABSTRACT

BIOFEEDBACK AND RELAXATION: THE ROLE OF INDIVIDUAL DIFFERENCES. (February 1983)

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Biofeedback-assisted relaxation, while becoming widely used in the treatment of stress-related disorders, has yielded conflicting findings in the research setting. Procedural aspects have been explored, but these alone could not explain the variability in relaxation effectiveness. Individual differences have been studied in order to predict success in relaxation; it has appeared that interactions between procedural and personality factors might account for the variability in biofeedback/relaxation research.

This study investigated the role of two personality factors, level of anxiety and capacity for absorption, in the achievement of relaxation. Physiological measures of muscle activity, digital skin temperature, and pulse rate as well as ratings of subjective anxiety, change in locus of control, strategies of relaxation, and treatment preference served as the dependent variables. In this mixed factorial design, anxiety and absorption represented the between-subject variables and treatment served as the within-subject factor. Electromyographic (EMG) biofeedback, progressive muscle relaxation, autogenic training, and a self-relaxation control condition were presented to each subject.

Response to relaxation training was found to vary less with respect to personality and procedural factors than to the particular aspect of relaxation that was targeted by the treatment. There were no significant main effects of anxiety or absorption. EMG biofeedback was found to produce the greatest decrease in muscle activity for all subjects. While there was no main effect of treatment evidenced for skin temperature, an interaction of treatment X time blocks X absorption indicated that only high absorption subjects in the progressive muscle relaxation and self-relaxation conditions maintained the temperature increases made during the adaptation period. Pulse rate decreased significantly for all treatment conditions. While biofeedback resulted in the greatest muscular relaxation, it was rated the least cognitively relaxing technique; self-relaxation was the most preferred treatment. Relaxation strategies varied with the treatment conditions.

All subjects achieved some degree of relaxation; anxiety and absorption were not found to predict successful response to the training techniques. Each treatment, even self-relaxation, resulted in a decrease in arousal, yet no one treatment proved superior for generalized relaxation. Future research in this area might study these personality and procedural factors in terms of the specific response that is targeted for relaxation training.

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INTRODUCTION

In recent years, a variety of self-control techniques have been explored and applied in the clinical treatment of stress-related disorders. One of the primary adjuncts to relaxation training was biofeedback. However, even as biofeedback was gaining popularity and finding increasingly widespread application, the controversy concerning biofeedback's efficacy evolved. Before "biofeedback" as a unitary treatment method could be accepted or rejected, the various components and methodologies of the self-control technique had to be examined. After investigating the issues, the question remained: With which individuals are certain biofeedback and relaxation techniques most effective?

Development of Self-Control Techniques: The Emergence of Biofeedback

Interest in self-control techniques grew out of three lines of research. The first involved observation of Yogis and other Eastern mystics who, as a means of achieving spiritual enlightenment, learned to manipulate visceral events. Through retention of breath and increased muscle tension in the abdomen and thorax, Yogis learned to produce physiochemical changes which resulted in pleasant states of consciousness (Gatchell & Price, 1979).

A concomitant line of research focused on the area of learning. Much work was prompted by Kimble's assertion that autonomic events could not be instrumentally conditioned. Investigations of galvanic skin response, heart rate, urine formation, blood pressure, and vasoconstriction pointed to the operant conditioning of autonomic responses (Miller, 1969; Blanchard & Epstein, 1978).

This discovery had widespread implications for the third area of investigation, clinical application. A variety of self-control techniques including yoga, meditation, and verbal relaxation instructions were explored in the treatment of psychophysiological disorders. Once technology for the measurement of blood pressure, skin temperature, muscle activity, and other indicators of autonomic activity were refined, biofeedback could be applied in the treatment of stress-related disorders.

Biofeedback involved a learning process. It was defined as follows:

> Biofeedback training consists of detecting an electrical signal generated by some bodily tissue. This signal is amplified and then used to trigger a visual or auditory display, thus providing the subject with continuous information as to his progress in controlling the signal. In other words, the subject is connected in a feedback loop with some physiological response he himself is generating (Stoyva, 1976). (p. 375)

Biofeedback, originally employed in the muscle reeducation of stroke and accident victims, became a tool used to counter the stress response.

Stress and Biofeedback

The stress reaction is described as the "fight-or-flight" response, an autonomic nervous system function which serves to prepare the individual for action in the face of a stressor. A physical threat or a "social stressor" (Brown, 1977) stimulates an alert reaction.

A cluster of symptoms characterize the stress reaction. Once the autonomic nervous system is triggered, the ergotrophic response is carried out by the sympathetic portion of that system. The hypothalamus signals pituitary release of various hormones. Vasopressin constricts the arteries and raises blood pressure. Adrenocorticotrophic hormone stimulates adrenal release of epinephrine and norepinephrine. This results in the familiar "adrenalin rush" which includes increased heart rate, respiration, and body temperature, and the release of glycogen. The speed of coagulation, the immune response, and blood flow to the musculature are affected as well (Pelletier, 1977).

Normally, when the threat is gone, the body returns to its physiological equilibrium or low arousal. The parasympathetic branch of the autonomic nervous system produces a trophotrophic or relaxation response. However, when the individual continues to perceive danger, experiences repeated exposure to stressful stimuli, has no adequate release for the body's stress reaction, or responds with too strong a reaction, the body does not recover complete equilibrium. Increasing levels of arousal which the individual may come to accept as the norm are found to result in homeostatic failure or eventual destruction of vital tissues (Fuller, 1980; Stoyva, 1976). Cardiac arrhythmia, hypertension, strokes, diabetes, asthma, gastrointestinal disorders, low back pain, muscle tension and migraine headaches, and susceptibility to other conditions represent the stress-related disorders (Pelletier, 1977).

In the clinical setting, the individual's body systems are monitored, and internal signals are amplified. Feedback of these cues along with specific relaxation instruction are used to help the individual develop awareness and control of the stress response.

Procedural Variables in Biofeedback

Electromyographic (EMG), thermal, blood pressure, and EEG biofeedback techniques were applied to psychophysiological disorders (Brown, 1977). It appeared from the popularity of biofeedback that it verged on becoming a panacea. However, even as it was being applied clinically, biofeedback yielded mixed results in research.

Many EMG biofeedback studies indicated that people could learn to relax muscle activity with a feedback tone (Blanchard & Young, 1974). The research by Budzynski and Stoyva (1969) and Raskin, Johnson, and Rondestvedt (1973) demonstrated the efficacy of EMG biofeedback with the frontalis muscle for generalized relaxation. Contradicting these were the studies by Alexander (1975) and Siddle and Wood (1978) which yielded no generalized effect.

A particularly controversial area in biofeedback research concerned the use of the feedback tone alone or in combination with other relaxation techniques. Ability to control EMG, skin temperature, and heart rate differed with such treatments as progressive muscle relaxation, autogenic training, hypnosis, and EMG feedback (Canter, Kondo, & Knott, 1975; Keefe, Surwit, & Pilon, 1980; Reinking & Kohl, 1975; Roberts, Kewman, & Macdonald, 1973; Sime &

DeGood, 1977). However, even within a study of a given technique, it appeared that some individuals were more successful than others. Not all of the variability in biofeedback/relaxation research could be attributed to procedural variables.

Review of the Literature

The Role of Individual Differences

One major factor which contributed to the biofeedback controversy was found in the area of individual differences. In their reviews of the literature, Qualls and Sheehan (1981a) and Turk, Meichenbaum, and Berman (1979) pointed out that group studies often obscured important intersubject differences which may account for a portion of the variance in biofeedback and relaxation research. Plotkin (1979) and King and Montgomery (1980) noted that individuals of diverse traits and characteristics responded differentially to the biofeedback and relaxation procedures. In fact, subjects representing the opposite extremes of a trait may have served to cancel each other's responses and thus concealed differences in the analysis of group data. Individual variables even interacted with treatment procedures (Van Egeren, Headrick, & Hein, 1972). The task remained to identify the personality or other subject variables which were the most salient in describing these individual differences and which then could be employed as predictors of success in biofeedback/relaxation training.

Many individual variables have been suggested to account for subjects' dissimilar responses to biofeedback and relaxation procedures. Age (Haynes, Moseley, & McGowan, 1975) and sex differences

(O'Connell, Frerker, & Russ, 1979) were among the first to be tested with positive findings in both areas.

Several researchers have proposed still other subject characteristics which, at least at the theoretical level, seemed plausible sources of response disagreement: strategy (Plotkin & Cohen, 1976), motivation (Alexander, 1975), alertness, concentration, expectation, response to implicit or explicit suggestion, internal awareness, and perceived success (Plotkin, 1979) as well as such personality traits as level of anxiety, locus of control, degree of absorption, and presence and type of clinical disorder (Qualls & Sheehan, 1981a). Introversion/extraversion and field dependence (Matus, 1974), ego strength (Roessler, 1973), and even individual differences in autonomic biochemical and neural mediating events also have been considered (McCanne & Sandman, 1977). Chief among these individual variables appeared to be level of anxiety, degree of absorption, and locus of control. Only recently have these variables been addressed by means of specific experimentation.

Anxiety

Page and Schaub (1978) investigated the effects of anxiety in relation to subjects' response to EMG and progressive muscle relaxation training. They selected their 32 male alcoholic subjects on the basis of MMPI scores: one combined subgroup of neurotics (123' profile) who tended to somatize anxiety and of chronically anxious individuals (247' profile) and a second, more heterogeneous subgroup which represented profiles unlike those of the first group. Subjects were randomly assigned to the experimental progressive muscle relaxation/EMG biofeedback (PMR/EMG) group or to a music control group. Following 14 training days, the neurotic/anxious experimental group demonstrated significantly lower EMG levels than the other subjects. An interaction between anxiety and treatment condition emerged as anxious subjects performed better in the PMR/EMG treatment. While this gave some support to the role of anxiety in EMG research, its impact on generalization was clouded by the mixture of profiles in the "anxious" group as well as by the other clinical characteristics of the alcoholics.

An earlier study by Raskin, Johnson, and Rondestvedt (1973) examined the responses of 10 chronically anxious male and female patients who, for the previous two years, had been treated with medications and individual psychotherapy. With or without the feedback tone, all learned to decrease EMG levels, and some diminished their related symptoms of tension headaches and insomnia. There was no indication of the particular characteristics of successful patients; however, it was noted that for all subjects, no significant correlations were found between self-reported anxiety and baseline EMG levels nor between EMG and the use of medications.

Other studies have looked specifically at the roles of trait and state anxiety. Valle and DeGood (1977), using the Spielberger State Trait Anxiety Inventory (STAI), found a correlation between both trait and state anxiety and the ability to control EEG alpha density (EEG activity with a frequency ranging from 9-12 Hz); low anxious subjects were better able to suppress but not enhance alpha. In addition, no correlation between state or trait anxiety and baseline alpha density was demonstrated. The authors admitted that their results may have reflected a sampling bias. The median split of high and low STAI scores, while resulting in different groups, did not represent a wide range of anxiety.

The second phase of an experiment reported by Edelman (1970) addressed the state-trait anxiety variable, this time with no differences shown between high and low anxiety groups. Forty male undergraduates selected for their extreme scores on the STAI were assigned to one of four conditions: a procedure involving taped PMR instructions with relaxation suggestions, a control condition of taped relaxation suggestions, another control which employed taped PMR exercises without the relaxation suggestions, and a third control group exposed only to music. No main effects of treatment or of anxiety were found to influence the autonomic measures of heart rate or blood pressure. Again, no correlation was found between anxiety and the baseline autonomic levels.

Only one study regarding baseline physiological levels and anxiety was found which disagreed with these results. Smith (1973), using a sample of 20 normal male and female subjects of mixed ages, discovered a positive relationship between resting EMG level and trait anxiety as measured by the Cattell IPAT. No correlation was found between state anxiety, assessed by the Nowlis Adjective Checklist, and basal EMG. Again, the evidence was clouded by the possible effects of sex and age. Since subjects apparently were monitored rather than trained in EMG biofeedback, no data regarding learning ability and anxiety were available.

A different physiological measure was used to examine the role of anxiety when Bass, Mittenberg, and Petersen (1981) compared the differential ability of 42 undergraduates to increase digital skin temperature. High STAI-trait anxiety individuals showed a greater increase in temperature than did low trait anxiety subjects. No relationship was shown between temperature control and state anxiety.

Another study gave credence to the hypothesis that learned physiological control varied as a function of anxiety. Reinking (1976) exposed 120 subjects of either high or low STAI-trait anxiety to 10 30-minute EMG biofeedback training sessions and noted that both groups reduced EMG activity across sessions. However, the high anxiety subjects proved more successful in acquiring relaxation skills; a positive, linear relationship was found between trait score and EMG reduction.

Despite the widespread use of biofeedback and relaxation techniques in the treatment of anxiety, the question remained unresolved regarding the role of anxiety in biofeedback/relaxation research. Most studies (Bass, Mittenberg, & Petersen, 1981; Page & Schaub, 1978; Valle & DeGood, 1977) indicated that anxiety may have influenced subjects' responses; however, these results were contradicted (Edelman, 1970). The possibility of interactions between anxiety and procedural variables had to be considered. Finally, while Smith (1973) reported a correlation between baseline autonomic response and anxiety, none was reported in the other studies. Further work would be needed to demonstrate the impact of the anxiety variable and to discover the exact nature of the relationship between learned physiological control and state or trait anxiety.

Absorption

An individual variable which recently was examined in relation to biofeedback research was the characteristic of absorption. Absorption, as defined by Tellegen and Atkinson (1974) was the:

> disposition for having episodes of "total" attention that fully engage one's representational (i.e., perceptual, enactive, imaginative, and ideational) resources. This kind of attentional functioning is believed to result in a heightened sense of reality of the attentional object, imperviousness to distracting events, and an altered sense of reality in general, including an empathically altered sense of self. (p. 268)

It was this "capacity for absorbed and self-altering attention" (Tellegen & Atkinson, 1974) which was investigated in a series of experiments by Qualls and Sheehan (1979, 1981b, 1981c). In their first study (1979), 32 female undergraduates chosen for their extremely high or low score on a shortened version of the Tellegen Absorption Scale (Qualls, Note 1) were exposed to two counterbalanced EMG training sessions, one with a feedback tone and the other without. Following both sessions, the strategies used by the subjects during the session were assessed. All subjects demonstrated a decrease in EMG (frontalis) activity, but the two groups were found to respond differently to the training conditions. While low absorption subjects showed no difference in response within or across the feedback and no-feedback conditions, the high absorption group decreased EMG more during the no-feedback condition. Greater decreases were found during the second session for the high absorption individuals.

Further differences between the absorption groups were noted in their use of various strategies, and again there was an interaction with treatment condition. High absorption individuals reported the presence of a hypnagogic state involving the drifting in and out of images and thoughts, especially during the no-feedback condition. The low absorption group tended to report that their minds wandered and that their thoughts were stressful or active, particularly during the session which did not include the feedback tone. High absorption subjects expressed a preference for no-feedback and indicated that the tone was distracting. Low absorption subjects, on the other hand, preferred the feedback tone as an aid to focusing on relaxation.

Similar interactions between absorption and treatment method were found in subsequent studies. In the next experiment (1981c), Qualls and Sheehan tested the effect of external distractions through an attentional demand condition. Here, additional instructions with phrases that suggested relaxation without specifying a particular strategy were presented to the subjects. Forty-eight female undergraduates, again divided into high and low absorption, were exposed to this as well as to the two original conditions. As expected, low absorption subjects decreased EMG more successfully in the feedback and attentional demand conditions in which an external attentional focus was provided. The high absorption group showed greater EMG decreases in the no-feedback than in the feedback sessions; however, the results obtained in the no-feedback and attentional demand conditions were equivalent.

Questioning the power of this treatment, the attentional demand instructions were made more variable by changing the voices and the speed and volume of the relaxation patter. In this experiment, a new group of 18 high absorption subjects clearly reduced EMG more in the no-feedback than in the other two conditions. The high absorption group found the feedback and relaxation patter less useful than did the low absorption group.

Qualls and Sheehan (1981b) manipulated the aspect of imaginal strategy in their most recent study. This time, the 48 undergraduate females of high or low absorption were randomly assigned to feedback, no-feedback, or a third condition in which verbal instructions encouraging the use of imagery were given at the beginning of the feedback session. Two training sessions in the same technique were administered one week apart. In the first session, high absorption subjects performed better in the no-feedback and the imagery-encouraged biofeedback conditions; there was no difference between the two conditions. By the end of the second session, no differences between the three treatments were found. Low absorption subjects performed equally well in the two biofeedback conditions and showed greater EMG decreases there than in the no-feedback session. Qualls and Sheehan concluded that high absorption individuals relaxed best in an inner-directed, imaginal setting without external attentional demands. For them, the feedback tone proved a distraction which could be overcome spontaneously by providing initial no-feedback training or by encouraging imagery.

This series of experiments attested to the idea that some individuals are more responsive than others to biofeedback and relaxation procedures. However, given the interactions reported by Qualls and Sheehan (1981b, 1981c), it was difficult to isolate the effects of absorption alone. For this reason, it was important to consider the studies of other researchers who examined this and related variables.

Absorption has shown at least modest correlations with hypnotic susceptibility (Finke & Macdonald, 1978; Hilgard, Sheehan, Monteiro, & Macdonald, 1981; Tellegen & Atkinson, 1974). Both of these characteristics were used by Roberts, Schuler, Bacon, Zimmermann, and Patterson (1975) to select subjects for their study of differential control of skin temperature. Fourteen male and female subjects who ranged in age from 19 to 28 were chosen for their extremely high or low scores on both the Tellegen Absorption Scale and the Harvard Group Scale of Hypnotic Susceptibility. A feedback tone was provided during the 16 one-hour differential handwarming training sessions. Individual subjects demonstrated differences in their ability to increase temperature; however, no differences between the absorption/hypnotic susceptibility groups were noted. It must be pointed out that in each of the above studies, subjects were selected for extreme scores. As noted by the Roberts group, perhaps, in a curvilinear relationship, middle-range scores might have shown a difference between groups.

Dumas (1980) tested hypnotic susceptibility and its effects on EEG alpha enhancement. Eighteen subjects scoring high, medium, or low on the Harvard Group Scale completed four feedback sessions which included baseline, enhancement, and suppression components. Here, the high susceptibility group consistently showed poorer performance while the other subjects were able to control alpha suppression.

These two studies appeared to contradict the findings of Qualls and Sheehan. However, the limited number and varied other characteristics of the subjects made generalization difficult. The possibility of an interactional effect with procedure complicated the issue further.

One strategy-related study touched on the imagery variable and interaction discussed by Qualls and Sheehan. In their research on learned control of heart rate, Carroll, Baker, and Preston (1979) exposed 24 male and female subjects with different degrees of vividness of visual imagery to 40 bi-directional heart rate change trials. The first and last sets of eight trials were given without feedback while visual feedback was provided on the remaining trials. Following training, an interview revealed the strategies used by subjects during the session. Nonvisual imaging subjects demonstrated greater control than those who employed imagery, and their performance increased with the addition of feedback. On the other hand, visual imagers did not benefit from feedback, and some found it distracting. This, in part, seemed to parallel the responses of the absorption subjects described by Qualls and Sheehan.

Locus of Control

One of the most widely studied individual variables in the biofeedback/relaxation literature has been locus of control (LOC). This construct which originated from Rotter's work in social learning theory addresses individuals' beliefs about reinforcement: persons of internal LOC are thought to perceive reinforcement as contingent upon their own behavior while external LOC individuals see reinforcement as the result of chance, luck, fate, or powerful others (Rotter, 1966). The locus of control variable has been examined as a predictor of success with biofeedback; results have been mixed.

Ray and Lamb (1974) trained 15 male college students to increase and decrease heart rate and found significant differences between the LOC groups. With and without feedback, internals were better able to increase heart rate while externals were more successful at the decrease task.

Other studies also found differences attributable to LOC. Of the 38 male volunteers studied by Blankstein and Egner (1977), the internals were more successful in heart rate increase, but no differences were observed as internals and externals decreased heart rate.

An interaction between locus of control and method was reported by Ollendick and Murphy (1977). Thirty-six female undergraduates were randomly assigned to a progressive muscle relaxation, a cognitive relaxation, or a control group for five training sessions. Internals in the cognitive condition decreased heart rate to a greater extent while externals in the muscular relaxation sessions reduced heart rate more successfully.

Fotopolous and Binegar (1976) measured the effect of LOC on four physiological indices. Forty-eight internal or external subjects were instructed to both enhance then suppress EMG activity, EEG alpha and beta, and skin temperature. Internals were better able to control EMG and EEG alpha while externals demonstrated greater EEG beta control.

Carlson's (1977) study provided an interaction of LOC and treatment. Forty-eight college students took part either in EMG feedback or no-feedback sessions. Internals in the feedback condition reduced EMG more than did the externals receiving that treatment. While this finding seemed contradictory to that expected for a group which might find a feedback tone distracting, it was important to note that a constant tone, perhaps even more distracting, was given in the control session.

Another important finding of the Carlson study was the change in LOC following the eight training sessions. For externals who received EMG feedback, a shift towards internal control was exhibited. Stern and Berrenberg (1977), using the personal control subscale of the Rotter I/E, found a similar shift towards internality.

Generalization from locus of control research and use of the construct as a predictor of success has been hampered by several factors: differences in methodologies, interactions with other variables, and aspects of the LOC scale itself. However, it appears that another individual difference is having an impact on biofeedback and relaxation research.

Statement of the Problem

Inconsistent findings in biofeedback and relaxation research have led researchers to question which individuals respond most successfully to which procedures. The literature has indicated that individual differences may have a crucial influence on the response to biofeedback/relaxation training. While numerous studies have speculated upon individual differences, fewer have investigated specific effects. Individual variations in anxiety, absorption, and locus of control have been researched, but the argument over their contributions has not been resolved. More controlled investigations would be necessary to establish the impact of these variables and to allow further generalization to the clinical setting.

This aspect of the present collaborative study shared with Neerja S. Bhatnagar (Note 2) attempted to isolate two of these variables, high and low trait anxiety and high and low absorption, while monitoring a third, internal versus external locus of control. It departed from earlier research which has been clouded by other individual variables or small sample size, and, unlike previous absorption studies, main effects of that variable alone have been noted. These variables have been correlated with strategies used during training and examined for interactions with treatment procedures.

This study included several control procedures to avoid confounding. First, the within-subjects design allowed subjects to serve as their own controls. Age and sex differences were controlled by limiting subjects to female undergraduates, and demand characteristics were reduced by matching subjects' sex to that of the experimenters. Tape-recorded instructions were presented to avoid further demand characteristics.

Changes in EMG activity, digital skin temperature, and radial pulse rate served as the dependent physiological measures. Subjects' change in Subjective Anxiety Inventory and locus of control scores, strategies of relaxation, and preferred relaxation technique provided additional measures.

Several hypotheses were proposed: (a) individuals of high and low trait anxiety will reduce EMG, but there will be no differences between the groups; (b) individuals of high and low absorption will reduce EMG, but there will be no differences between the groups; (c) there will be an interaction between absorption and treatment indicating that high absorption subjects will reduce EMG more in the autogenic and self-relaxation procedures while the low absorption subjects will show greater EMG decreases in the EMG biofeedback and progressive muscle relaxation conditions.

METHOD

Subjects

Forty-eight females enrolled at Appalachian State University were selected from a subject pool of over 160 introductory psychology students who volunteered to be tested for extra credit. Selection was based on subjects' scores on two scales administered in the classroom: the Spielberger State Trait Anxiety Inventory A-trait scale (Spielberger, Gorsuch, & Lushene, 1970) and the Tellegen Absorption Scale (Tellegen, Note 3). In order to establish four separate subject groups, subjects scoring within the middle standard deviation of either of the two test distributions were eliminated from the sample. A median split of the distributions resulted in the four groups. The scores for the actual subject groups are reflected by the following means: low anxiety 30.9, high anxiety 51.5, low absorption 15.3, high absorption 26.8. Twelve subjects were included in each of the four personality groups: low anxiety, low absorption; low anxiety, high absorption; high anxiety, low absorption; high anxiety, high absorption. The mean age of the subjects was 19.1 years. Most had no previous experience in relaxation training and were taking no medications.

At the time of testing, subjects entered into an informal agreement to receive further class credit by participating in four relaxation training sessions. As volunteers were scheduled for the experiment, they were instructed to abstain for the two hours just prior to each session from alcohol, caffeine, nicotine, and drugs other than those prescribed by a physician.

Subjects were informed fully of their rights, including the right to withdraw at any time, and of any risks involved in the experiment. The ethical standards of the American Psychological Association were maintained in the treatment of all subjects.

Personality Scales

Spielberger State Trait Anxiety Inventory. The A-trait scale of the STAI is a 20-item, self-administered questionnaire which measures the way subjects feel generally as opposed to how they may feel at a given moment. As both a selection instrument and a clinical tool, the STAI A-trait scale measures fairly stable differences in degree of anxiety-proneness.

Tellegen Absorption Scale. (Appendix A.) The TAS, a subtest of the Differential Personality Questionnaire (Tellegen, Note 3), was developed through factor analytic studies in order to identify sources of individual difference in hypnotic susceptibility. Composed of 34 items which measure the individual's capacity for absorbed, self-altering attention, the TAS has been shown to have little correlation with the STAI (O'Grady, 1980).

Rotter Internal External Locus of Control Scale. The Rotter I/E (Rotter, 1966) is a 29-item scale which measures the degree to which the individual sees reinforcement as resulting from personal action (internal LOC) or as the result of chance, luck, fate, or powerful others (external LOC). Scores on this scale represent the number of external LOC responses.

Hopkins Symptom Checklist. (Appendix B.) The HSC (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974), a 58-item checklist of commonly experienced psychological symptoms, provides a 4-point scale which subjects use to note varying degrees of distress. Circled point responses are totaled, and higher scores represent greater and more severe anxiety symptoms.

Subjective Anxiety Inventory. (Appendix C.) The SAI (Goldfried & Davison, 1976) is a 0 to 100 scale ("complete relaxation" to "maximum tension") which allows the subject to rate very quickly her level of relaxation or tension at a given point in time.

Apparatus

Autogenic Systems biofeedback equipment was used to monitor physiological response and to provide a feedback tone for the experiment. Frontalis muscle activity was measured by an Autogen 1700 feedback myograph. Two standard silver chloride sensors were attached with electrode collars to the forehead approximately 1 inch to either side of the central inactive sensor. Settings for the 1700 unit were as follows: scale = x1, feedback = AN3, volume = 5, bandpass = 100-200 Hz., response = 2.5 seconds, average time = 20. An Autogen series 5100 pulse wave analyzer/digital integrator connected to the 1700 unit analyzed the signal and provided digital readings and feedback. The time interval scales were set for 1 minute compute and 5 seconds rest periods. An Autogen series 2000b feedback thermometer measured digital skin temperature from thermistors attached with surgical tape either to the first, third, and fifth or the first and third fingers of the dominant hand. Current to each of the biofeedback units was provided by an Autogen P-50 isolated power supply.

Experimental Setting

Subjects were seated in the biofeedback lab of the Appalachian State University Counseling and Psychological Services Center. The carpeted, 12 by 12.5 feet room was furnished with a reclining chair and was dimly lighted by a lamp placed above and behind the chair. A speaker for the feedback tone was placed behind the chair, and another speaker for the tape-recorded instructions was placed roughly five feet before the subject. The experimenter and the biofeedback equipment were located in one-half of the room behind a sound resistant screen. An audio cassette recorder, also placed behind the screen, provided instructions for the four treatment conditions.

Design

A 2 (high versus low trait anxiety) X 2 (high versus low absorption) X 4 (treatment) mixed factorial design was employed in this collaborative study. The two subject variables, anxiety and absorption, were the focus of this thesis which also considered four relaxation procedures, electromyographic biofeedback (EMGBF), progressive muscle relaxation (PMR) (Goldfried & Davison, 1976), autogenic training (AT) (Schultz & Luthe, 1969), and a self-relaxation control (SR). Other variables including locus of control, previous relaxation training experience, anxiety symptoms, and strategies of relaxation were noted. The dependent measures were EMG (frontalis) muscle activity, digital skin temperature, and radial pulse rate. Change in Rotter I/E, Subjective Anxiety Inventory scores, and preferred treatment technique also were assessed.

Procedure

The experiment was carried out from February through May, 1982. First, volunteers were tested in the classroom for selection purposes. Subjects then were telephoned and scheduled for four 1-hour relaxation sessions held, whenever possible, at approximately the same time on separate days within one week. As each subject arrived for the session, she signed an informed consent/contract to participate (Appendix D), completed the Rotter I/E and Hopkins Symptom Checklist, and provided her age, previous relaxation experience, current medications, and other demographic data. Upon completion of these tasks, the subject was taken to the biofeedback lab where, over the course of four days, she was trained in each of the four relaxation procedures. The order effect of treatment sequences was controlled by partial counterbalancing; 12 of the 24 possible sequences were selected so that each treatment was presented first, second, third, and fourth an equal number of times.

With the subject seated in a reclining chair, the experimenter measured radial pulse rate, cleansed the EMG sensor site with alcohol, then attached the sensors to the forehead and the thermistors to the dominant hand. A standard script was used to deliver the appropriate information (Appendix E). The experimenter then moved behind the sound resistant screen which divided the room, began monitoring the equipment, and started the tape-recorded instructions

(Appendix F). Sessions consisted of a 10-minute adaptation period, a 25-minute training period, and a 10-minute post-training interval.

Readings for EMG activity were averaged over 1-minute intervals by the pulse wave analyzer. At the end of each minute throughout the session, the "read" light signaled the appropriate time to note the EMG reading. Skin temperature was recorded concomitant with the EMG readings. Radial pulse rate was measured again at the end of the training session. When the EMG and temperature data were analyzed, blocks of 1-minute readings were averaged to reduce variability. All physiological data were recorded on standard data sheets (Appendix G).

Following each session, the subject completed the Subjective Anxiety Inventory, and the experimenter conducted a brief interview to assess particular strategies employed during the relaxation session. After the subject's last session, she was asked to rank order the relaxation techniques from most to least preferred and again to complete the Rotter I/E.

RESULTS

For each of the four personality groups, the effects of treatment are expressed through changes in the following dependent variables: frontalis EMG activity, digital skin temperature, radial pulse, ratings of subjective anxiety, and change in locus of control. In addition to these measures, subjects' relaxation strategies and overall treatment preference are assessed.

Physiological Variables

A 2 X 2 X 4 mixed analysis of variance involving two between-subject personality factors, anxiety (high and low) and absorption (high and low) plus one within-subject factor, treatment, is used to analyze this interval data.

EMG. Using the Pulse Wave Analyzer/Digital Integrator, frontalis EMG was averaged over 60-second intervals throughout the 10-minute adaptation, 25-minute treatment, and 10-minute post-treatment periods. This process yielded 45 EMG readings. Each series of five consecutive readings then was averaged to produce nine data points which describe EMG activity at successive intervals throughout the treatment process. These data points are expressed as time blocks one through nine.

To compare subjects' initial levels of EMG activity, the averaged readings from time blocks one and two which represent the adaptation period are used as the dependent variable in a

2 (anxiety) X 2 (absorption) X 4 (treatment) analysis of variance (Appendix H, Table 1). No significant differences are found as a function of personality groups or the treatment conditions. Subjects appear to start the treatment sessions at roughly the same EMG level regardless of their degree of anxiety or absorption type. The overall starting mean is 2.30 microvolts (μv).

The 2 X 2 X 4 X 9 mixed analysis of variance described in Table 2 (Appendix H) provides an overview of change in EMG activity throughout the experiment. The nine data points feature the averaged EMG readings for time blocks one through nine. Again, points one and two indicate the adaptation phase, while points three through seven mark the treatment interval, and points eight and nine denote the post-treatment session. Here the main effects of Anxiety and Absorption are not significant with EMG as the dependent variable. The main effect of Treatment (F (3,132) = 11.65, $p < .0001$) was significant. This finding primarily represents an artifact of one of the treatment procedures. As may be seen in Figures 1 and 2, the EMG curve peaks around time block four during the PMR condition while the other treatments follow roughly the same pattern of gradual EMG decline. The peak during PMR reflects the points in the taped instructions when the subject is told to tense her forehead, then her eyes, then her jaw; the tensing naturally inflates the EMG value. However, this tensing does not inhibit the achievement of relaxation later in the treatment session.

The significant main effect of the Time Blocks variable (F (8,352) = 19.38, $p < .0001$) shown in Figure 1 indicates a decrease

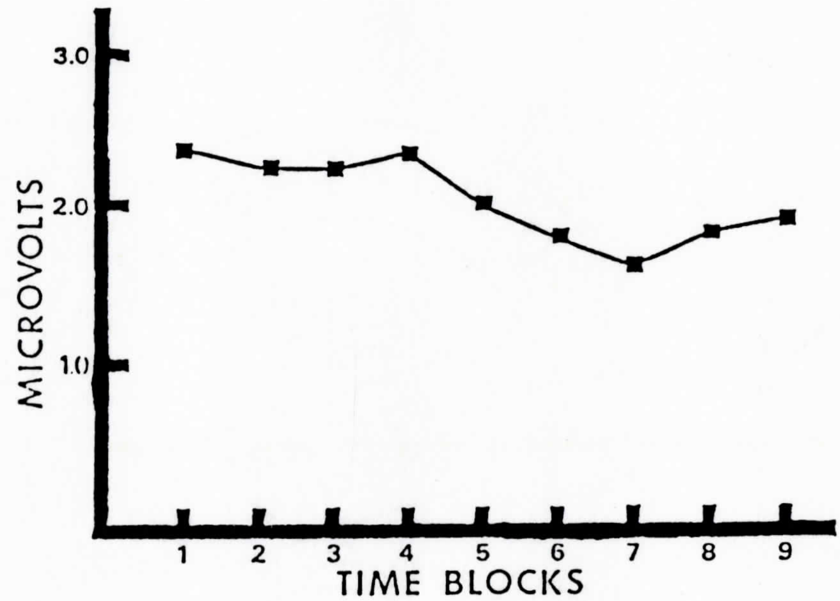

Figure 1. Average EMG Readings For All Subjects Across Nine Time Blocks

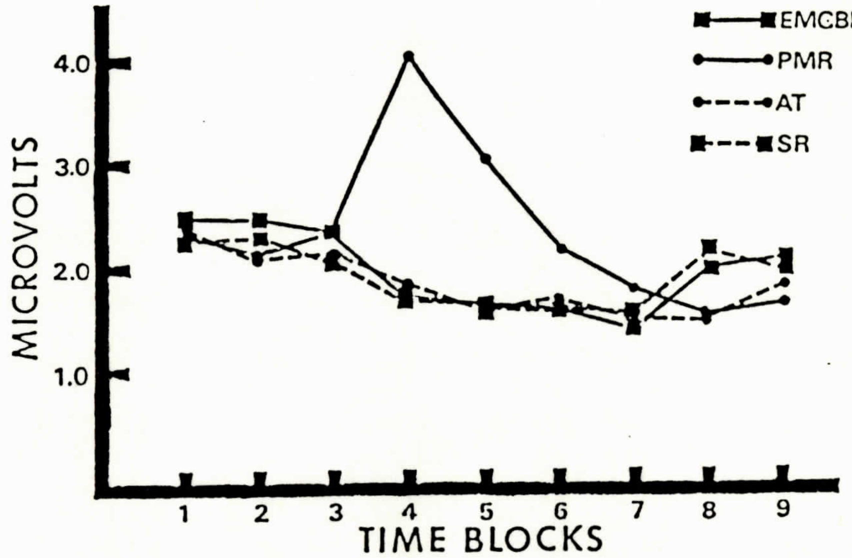

Figure 2. Average EMG Readings For All Subjects Across Nine Time Blocks as a Function of Treatment

in EMG activity across time. Each of the treatment conditions, including PMR and the self-relaxation control, produces the lessening of EMG activity which is associated with increased relaxation. This is particularly apparent at time block seven, the end of the treatment phase where subjects average 1.59 μν. It is interesting to observe that in the last 10 minutes, the post-treatment interval, the decline in EMG does not continue; all treatments evidence an increase in EMG activity. Rather than to progress into deeper levels of relaxation, subjects seem to view this as the end of the experiment and begin to move out of the relaxed state.

Two interactions emerge in this analysis. The first, Treatment X Time Blocks (F (24,1056) = 25.73, p < .0001), again reflects the PMR tensing (Figure 2). The second interaction involves all four factors: Treatment X Time Blocks X Anxiety X Absorption (F (24,1056) = 1.67, p = .0226). The EMG change across the time blocks for the high anxiety/high absorption group may be responsible for the interaction shown in Figure 3. For these subjects, greater relaxation, as evidenced by lower EMG levels at time blocks five and six, is achieved during EMG biofeedback and self-relaxation than in the other two conditions. This difference is not demonstrated by the other personality groups.

The artifact of tensing during PMR tends to overshadow other possible treatment effects. Furthermore, since subjects begin to anticipate the end of the experiment at time blocks eight and nine, the post-treatment interval does not reflect data that is representative of the treatment process. Although the previously described

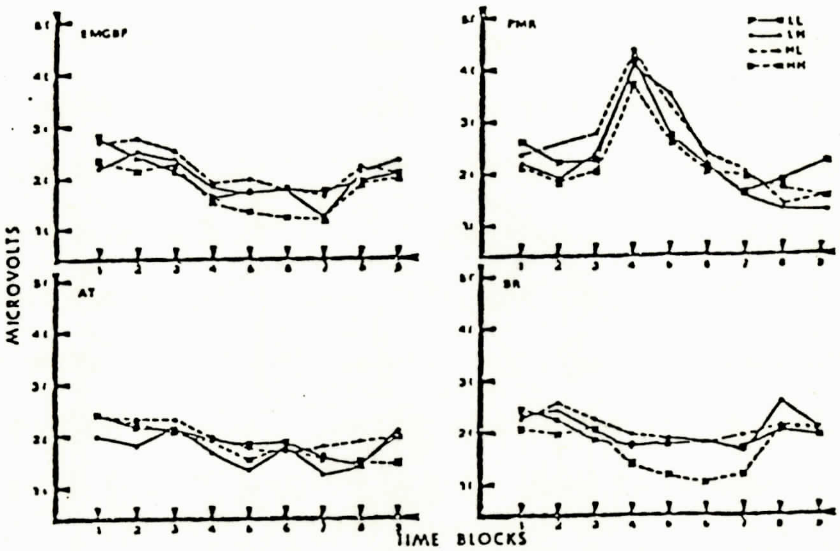

Figure 3. Average EMG Readings as a Function of Treatment, Time Blocks, Anxiety, and Absorption

(Low Anxiety, Low Absorption - LL
Low Anxiety, High Absorption - LH
High Anxiety, Low Absorption - HL
High Anxiety, High Absorption - HH)

nine-point change score analysis is useful in depicting overall patterns of the experiment, a single change score analysis provides a somewhat clearer picture of the impact of treatment on EMG.

To derive the change score used in the following analysis, averaged readings representing time blocks six and seven, the end of treatment, are subtracted from the average of time blocks one and two (adaptation level). These change scores are employed in a 2 X 2 X 4 mixed analysis of variance using the same factors as the previous analysis (Appendix H, Table 3). The main effect of treatment (F (3,132) = 7.29, p = .0001) was significant. A post-hoc Newman-Keuls F-test for simple effects (Bruning & Kintz, 1977) applied to the group means (Appendix H, Table 4) indicates that EMG biofeedback produces greater muscular relaxation than either PMR (F (132) = .40, $p < .05$) or AT (F (132) = .36, $p < .05$). Both SR (F (132) = .36, $p < .05$) and AT (F (132) = .30, $p < .05$) are more effective than PMR. It may be noted in Figure 4 that EMGBF yields more EMG change (.95 μv) than PMR or AT but does not differ significantly from the self-relaxation control.

Digital skin temperature. Forty-five digital skin temperature readings were taken from the feedback thermometer as each averaged EMG score was presented. These readings were averaged across 5-minute intervals (time blocks one through nine) which represent spot temperature readings that correspond to the 1-minute integrated (averaged) EMG readings. Adaptation readings (time blocks one and two) are averaged and employed in a 2 (anxiety) X 2 (absorption) X 4 (treatment) mixed analysis of variance (Appendix H, Table 5).

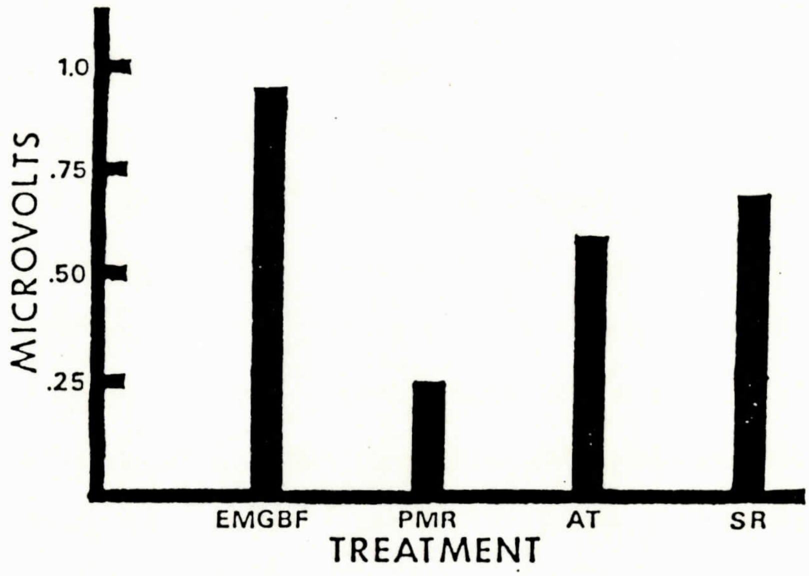

Figure 4. Average EMG Reduction as a Function of Treatment (Time Blocks 1 + 2 - Time Blocks 6 + 7)/2

None of the main effects or interactions are significant. Subjects do not differ widely in starting temperature; their mean adaptation reading is 89.0°F.

As in the case of the EMG data, a 2 X 2 X 4 X 9 mixed analysis of variance using the previous factors (Appendix H, Table 6) provides the best overview of treatment effect upon temperature. Again, the main effects of anxiety and absorption are not significant. No main effect of treatment is evidenced in this analysis. However, there is a highly significant effect of the Time Blocks variable (F (8,352) = 9.32, $p < .0001$). Figure 5 shows the pattern of temperature response across the experimental process. It may be seen that for each treatment, there is a notable increase in temperature during the adaptation period (time blocks one and two). This increase represents most of the relaxation achieved during the experiment; however, subjects are seen to start at an already high peripheral temperature which is indicative of relaxation. In the treatment phase, temperature eventually decreases. The decline generally continues through the posttreatment interval at time blocks eight and nine. As seen in the EMG analysis, the posttreatment interval does not represent a period of increased relaxation.

There are exceptions to this general pattern. The Treatment X Time Blocks interaction (F (24,1056) = 1.74, p .0150) shown in Figure 6 indicates now that, during the treatment interval (time blocks three through seven), the SR condition yields another increase in skin temperature. Further analysis reveals that self-relaxation is most effective in increasing temperature ($\overline{x}$ = 4.68°F)

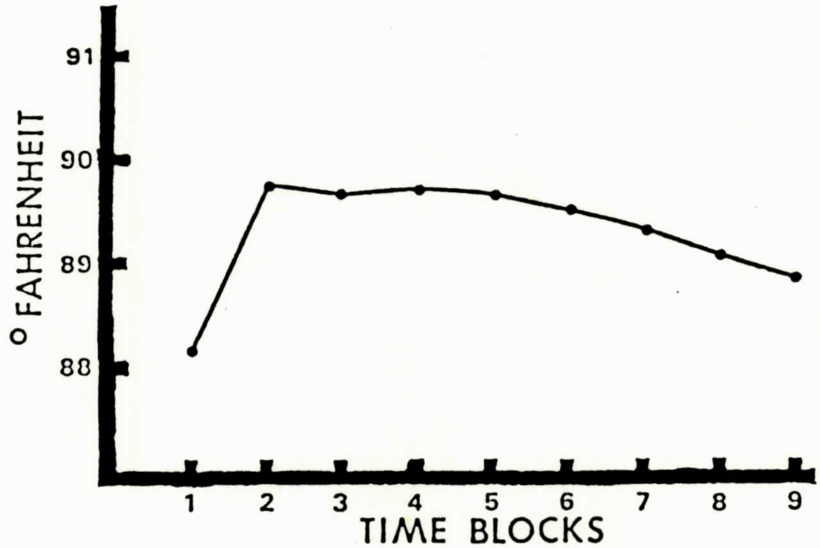

Figure 5. Average Skin Temperature Readings For All Subjects Across Nine Time Blocks

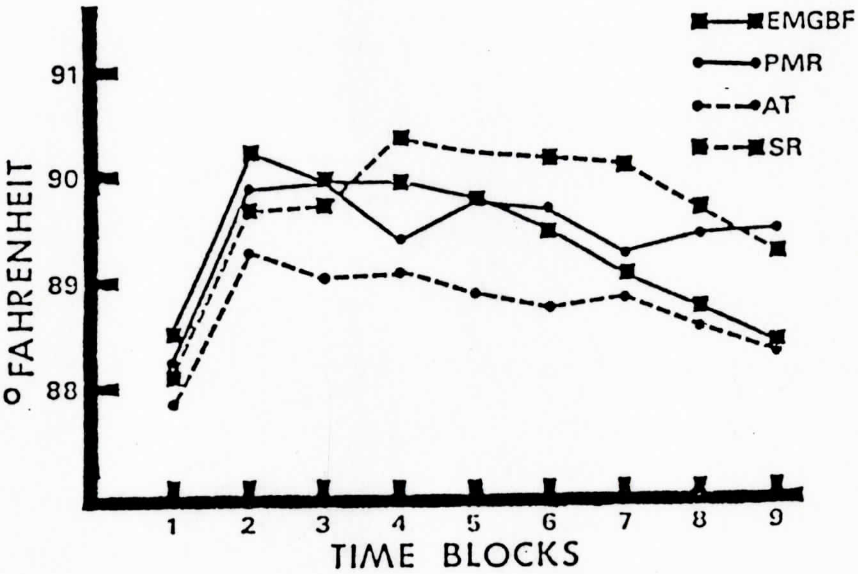

Figure 6. Average Skin Temperature Readings For All Subjects Across Nine Time Blocks as a Function of Treatment

when it is the first "treatment" presented to subjects. Without instruction, subjects are able to increase visceral relaxation. Even here there is a decline in the posttreatment session. Only in the SR and PMR treatments can subjects maintain most of the temperature gain made at any point during the course of the experiment.

The mediating role of the personality variables is seen in the Treatment X Time Blocks X Absorption interaction ($\underline{F}$ (24, 1056) = 1.93, $\underline{p}$ = .0047). Figure 7 shows that, during the treatment phase, the high absorption subjects in the EMGBF and AT conditions decrease temperature while low absorption individuals maintain their relaxation. In the two other treatments, there are no differences as a function of absorption level. Here, subjects increase or maintain their level of digital skin temperature. Apparently, the high absorption group finds it difficult to relax in the more ambiguous biofeedback and autogenic conditions.

Another interaction which approaches significance might be noted. In the Treatment X Time Blocks X Anxiety X Absorption interaction ($\underline{F}$ (24,1056) = 1.47, $\underline{p}$ = .0671), anxiety acts as a moderator variable which influences one subject group. In the PMR condition, high anxiety/low absorption subjects tend to gain and then reduce temperature rather than to maintain as reported above.

To provide another picture of treatment effect on temperature, a change score parallel to that used in the EMG analysis was calculated. Averaged temperature readings from time blocks six and seven were subtracted from the average of adaptation time blocks one and two. This 2 (anxiety) X 2 (absorption) X 4 (treatment) mixed

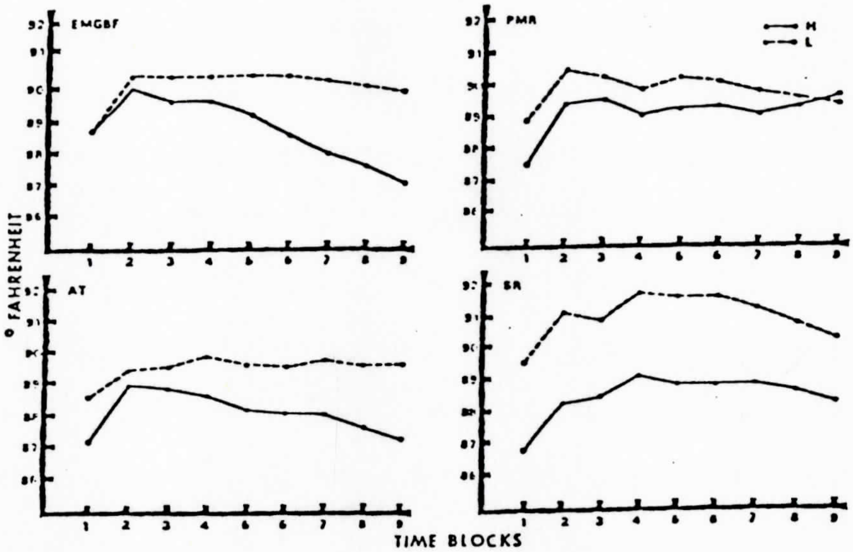

Figure 7. Average Skin Temperature Readings as a Function of Treatment, Time Blocks, and Absorption

(High Absorption - H
Low Absorption - L)

analysis of variance demonstrates no significant main effects or interactions (Appendix H, Table 7). Adaptation and late treatment values employed in the change score analysis are similar; the differential temperature elevation demonstrated in the previous analysis is seen only in the middle phase of treatment.

Pulse. Pre- and posttreatment radial pulse rate readings were taken manually during each treatment session. A 2 (anxiety) X 2 (absorption) X 4 (treatment) mixed analysis of variance considering initial pulse rate (Appendix H, Table 8) shows a trend towards significance in the Absorption variable with the low absorption subjects demonstrating slightly higher pulse (F (1,44) = 3.96, p = .0528). More importantly, as may be seen in Figure 8, there is a main effect of Treatment (F (3,132) = 3.04, p = .0315). The Newman-Keuls F-test (Appendix H, Table 9) shows that subjects in the EMGBF condition start at a higher pulse rate than those in PMR (F (132) = 4.43, p < .05), AT (F (132) = 4.97, p < .05), or SR (F (132) = 3.79, p < .05). This is assumed to be due to the failure of random assignment to produce completely equivalent groups. The mean pretreatment pulse rate in 73.4 beats per minute.

The comparison of pre- and postsession pulse rate in a 2 (anxiety) X 2 (absorption) X 4 (treatment) X 2 (time blocks) mixed analysis of variance (Appendix H, Table 10) indicates a main effect of Time Blocks (F (1,44) = 37.81, p < .0001). Showing a decrease in autonomic arousal, each personality group lowered pulse rate during all four treatments. The Treatment X Time Blocks interaction (F (3,132) = 3.72, p = .0132) reflects the regression towards the

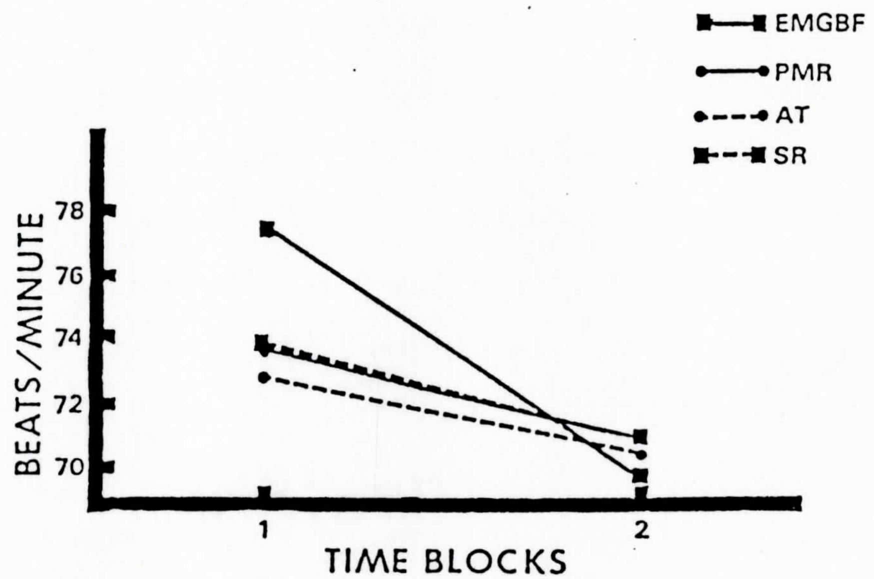

Figure 8. Average Pulse Readings For All Subjects Across Time Blocks as a Function of Treatment

mean of the subjects in the initially higher EMGBF condition. This is seen again in the post-hoc Newman-Keuls F-test (Appendix H, Table 11).

Personality Variables

Various other dependent measures are employed to measure treatment effects, to verify physiological data, and to describe further the differences among the four personality groups.

Subjective Anxiety Inventory. The SAI scores reported at the end of each treatment session provide a subjective measure of treatment impact. Rated on a scale from 0 to 100, lower SAI scores indicate greater relaxation. In the 2 (anxiety) X (absorption) X 4 (treatment) mixed analysis of variance shown in Figure 9 and in Appendix H, Table 12, a significant main effect of Treatment is evident (F (3,132) = 5.66, p = .0011). A post-hoc F-test for simple effects performed to explain this effect (Appendix H, Table 13) indicates that the means for EMG biofeedback-assisted relaxation are significantly different from those ratings given at the end of progressive muscle relaxation (F (132) = 6.65, $p < .05$) and autogenic training (F (132) = 7.30, $p < .05$). Subjects report lower SAI scores, or more relaxation, as a result of PMR and AT than EMGBF. It is interesting to note that this self-reported measure is just opposite the change in EMG score from adaptation to the end of the treatment interval which was described earlier. In that analysis, subjects achieve lower EMG levels with biofeedback. Here, subjects report less relaxation after EMGBF.

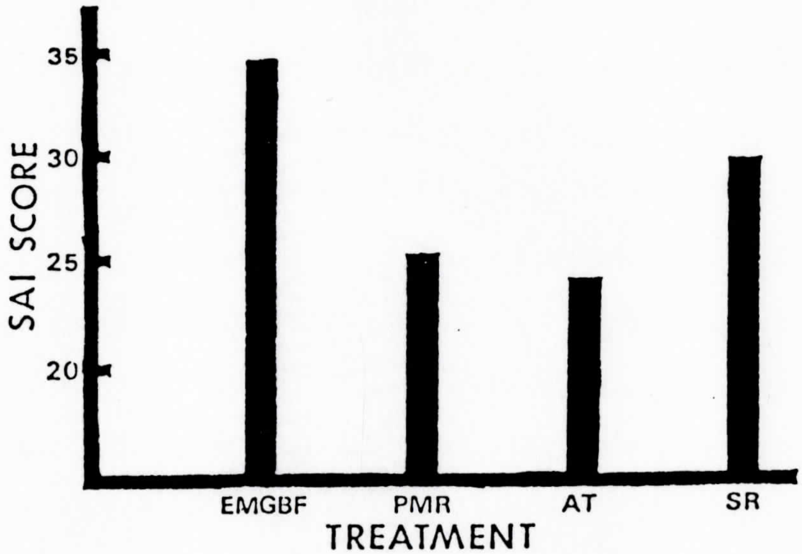

Figure 9. Average Subjective Anxiety Inventory Score For All Subjects as a Function of Treatment

Two other interesting findings emerge with further examination of Subjective Anxiety Inventory mean scores and the order of treatment. When subjects receive EMGBF as their fourth treatment, they rate it even less relaxing ($\overline{x}$ = 42.00) than when EMGBF is the first treatment encountered ($\overline{x}$ = 29.33). With the self-relaxation control condition, subjects respond with the reverse pattern: SR is rated progressively more relaxing when it is received in the last ($\overline{x}$ = 24.17) rather than in earlier positions ($\overline{x}$ = 27.25, 30.25, and 37.50 for third, second, and first treatment, respectively).

Strategies of relaxation. Following each training session, subjects reported the methods they used to achieve relaxation. These were classified into 22 categories. Those groupings which comprised less than 5% of the total response were eliminated from the analyses. Table 14 (Appendix H) illustrates the pattern of strategies most often employed by the subjects. Notice that while high absorption subjects gave somewhat more responses, the same response pattern is maintained by the two groups: during the structured PMR and AT conditions, most subjects simply followed the taped instructions to tense and relax muscle groups or to repeat certain phrases suggestive of warmth and heaviness. During EMG feedback, most subjects reported that they told their bodies to relax. Imagery was the strategy of choice in the self-relaxation condition. Images of a beach, river, or other scenes involving water often were reported. The imagery strategy was preferred by high as well as low absorption subjects. In the breakdown of strategies by anxiety, the low and high anxiety individuals reported the same pattern of strategy use as that presented for the absorption groups.

Some subjects reported that they found the taped instructions or the feedback tone a distraction. This report did not vary according to the absorption factor; an equal number of low and high absorption subjects reported the distraction.

Preference. At the end of the experiment, subjects were asked to rank the four treatments from most to least preferred. Overall, the self-relaxation control was the favorite "treatment" session; 25 subjects rated SR their first choice. Consistent with subjective anxiety ratings, EMG feedback generally rated as the second or third choice; only 10 subjects rated EMG first, yet only seven rated it last. Progressive muscle relaxation which received only seven votes as most preferred technique more often fell into the second or fourth slots. Autogenic training ratings were divided chiefly among the last three positions. The sequence SR, PMR, EMG, AT was the most common ranking of treatments with nine subjects offering this rating (Appendix H, Table 15).

Locus of control. The Rotter Internal/External Locus of Control scale, administered before the first and after the last treatment session, indicates subjects' beliefs about reinforcement. The mean locus of control score for all subjects is 11.3 external responses. The Rotter I/E exhibits a significant correlation with the STAI trait anxiety scale (r = .4984, p = .002). Subjects with higher trait anxiety tend to be more externally oriented and see reinforcement as a result of chance, luck, fate, or powerful others.

Low anxiety individuals exhibit a more internal locus of control and view reinforcement as contingent upon their own efforts. There also is a strong correlation between the Rotter I/E and the Hopkins Symptom Checklist (r = .4274, p < .001). Higher HSC scores tend to be related to greater externality in locus of control. There is no significant correlation between the Rotter I/E and absorption (r = .0738, p = .618).

Since the initial Rotter I/E score does not correlate with any of the dependent measures, the locus of control scale fails to predict success in relaxation training. As a dependent variable itself, the Rotter I/E shows no change as a result of anxiety, absorption, or treatment. The 2 X 2 X 4 mixed analysis of variance using these factors (Appendix H, Table 16) reveals no significant main effects or interactions.

Hopkins Symptom Checklist. This measure of anxiety-related symptoms, given before the first treatment, yields a mean score of 100.1 out of a possible 228 points. It is involved in a strong positive relationship with trait anxiety (r = .6164, p < .001); as STAI score increases to higher trait anxiety levels, there are more severe or a greater number of anxiety symptoms marked on the HSC.

Absorption. It is important to recall that the scale employed in the Qualls and Sheehan studies is a 21-item version of the Tellegen Absorption Scale which demonstrates a strong correlation (r = .92) with the original 34-item scale (Qualls, Note 1). Ratio comparisons of the absorption means demonstrated in this study with those reported by Qualls and Sheehan indicate that the present sample is less extreme by roughly four points each on the high and the low scores. In other words, the absorption subjects in this study represent a more middle-range group.

Trait anxiety and absorption. As has been noted in the literature, no significant relationship is found between STAI Trait Anxiety and the Tellegen Absorption Scale. This confirms that the two measures are tapping different personality characteristics and that these screening instruments have created four distinct personality groups.

DISCUSSION

Many factors have been explored to account for the variability in response to biofeedback-assisted relaxation. When it appeared that procedural variables alone could not explain conflicting results, the role of individual differences was considered. Interactions between personality characteristics and treatment techniques were noted. The current research investigated these factors by isolating two areas of individual difference, anxiety and absorption, and studying them in relation to four treatment conditions, EMG biofeedback (EMGBF), progressive muscle relaxation (PMR), autogenic training (AT), and a self-relaxation control (SR). Both the personality and procedural variables were found to contribute to subjects' ability to achieve and maintain relaxation through control of internal events. However, the role of these variables remains unresolved. A review of the findings indicates that success in relaxation is best understood in terms of the specific response which is targeted for training.

Physiological and Cognitive Measures

All subjects achieved some degree of relaxation during the treatment sessions. However, several aspects of relaxation were revealed: muscular relaxation, demonstrated through reduction of EMG activity, visceral relaxation, identified by an increase in digital skin temperature and a slowing of radial pulse rate, and cognitive relaxation, described as a subjective rating of anxiety. These dependent measures generally did not correlate; for example, subjects reduced EMG activity without producing a concomitant elevation in skin temperature. Thus there was not a particular treatment method which proved most successful in producing "generalized" relaxation, and personality factors did not predict overall treatment success. Response-specificity, rather than a comprehensive body/mind reaction, was evident.

EMG. As predicted, all subjects decreased EMG activity. While each technique produced muscular relaxation, it was EMGBF, the treatment which provided feedback specific to the muscle system, which proved most effective in reducing EMG activity. This superiority of EMGBF over PMR paralleled the earlier research of Canter, Kondo, and Knott (1975), Haynes, Moseley, and McGowan (1975), and Reinking and Kohl (1975). However, the effectiveness of self-relaxation noted in the current study contradicted the findings of the two latter groups of researchers whose control group subjects did not achieve muscle relaxation. One apparent difference in the studies was that the current research employed a within-subject design. Perhaps the repeated practice of relaxation and exposure to other techniques contributed to SR effectiveness; during the SR condition, subjects may have employed another of the relaxation strategies that they had been taught in the course of the experiment.

An important methodological issue was revealed by the significant main effect of Time Blocks and the Treatment X Time Blocks interaction. An artifact of PMR tensing was noted during those time blocks in which subjects tensed the muscles around the sensor site. This caused an inflation of EMG readings. Artifacts in EMG research have been dealt with by eliminating scores which differed considerably from the mean of the previous reading (Coursey, 1975) or by using a change score (Haynes, Moseley, & McGowan, 1975). For PMR, measuring EMG only at predetermined breaks in instruction (Edelman, 1970) or taking pre- and posttreatment readings (Sime & DeGood, 1977) might avoid this difficulty.

The role of anxiety and absorption, consistent with the findings of Reinking (1976) and Qualls and Sheehan (1979, 1981b, 1981c), was seen only in interaction with other variables; however, the interaction found in the current study was more complex than those reported previously. The predicted interaction of treatment with absorption was not demonstrated. Instead, an interaction of Treatment X Time Blocks X Anxiety X Absorption indicated that the subjects high in both trait anxiety and absorption (HH) were more successful in EMG reduction with EMGBF and SR than with the two other techniques. Interestingly, different strategies were employed by the HH group during EMGBF and SR. It is not known what made this group of anxious, inner-directed subjects respond more successfully to these techniques which focused attention on an external stimulus.

Consistent with Qualls and Sheehan studies (1979, 1981b, 1981c), there were no initial differences in EMG between high and low absorption subjects. The similarity in adaptation level EMG between subjects of high and low anxiety was unlike the earlier findings of Smith (1973) who found highly anxious male and female adults to have higher resting EMG levels but parallel to that of Raskin, Johnson, and Rondestvedt (1973). This divergence from Smith's findings might be attributed to his use of a clinical population and a different measure of anxiety.

Another issue in EMG research was raised when comparing baseline readings from studies which employed different types of biofeedback equipment. The adaptation mean of 2.30 μν found in the present study, while similar to the 2.16 μν found by Ohno, Tanaka, Takeya, and Matsubara (1978), was much less than the 8.32 μν found by Sime and DeGood (1977) and the 9.08 μν described by Qualls and Sheehan (1979). Such dissimilar adaptation levels could be attributed to sample differences, or, more likely, to the failure of EMG units to share universal calibration. The assurance that a change of two microvolts represented the same value on any type of EMG equipment would aid the evaluation of EMG research. In the meantime, the consideration of percentages of change rather than absolute values might facilitate comparison across studies.

Digital skin temperature. While increased muscle relaxation was achieved as a result of the four procedures, equivalent visceral relaxation did not occur in response to relaxation training. A significant increase in digital skin temperature occurred during the adaptation phase, but no significant gains were made during training. In fact, since the greatest gain in temperature was produced by subjects receiving SR as their first treatment, it might be speculated that short-term training with the other techniques actually interferes with natural relaxation strategies.

Again, the role of the SR procedure must not be overlooked. It may be noted that SR was the only condition which produced a small increase in temperature during the treatment phase. These normal subjects might have possessed skills in relaxation before receiving any instruction. It is not known whether a clinical population starting at much lower digital skin temperatures would respond with relaxation to this control procedure. However, it might be argued that expectancy plays a part in relaxation; volunteers who approach the experiment with the expectation of relaxation might respond to the SR "placebo."

The lack of a treatment effect contradicted the findings of Roberts, Kewman, and Macdonald (1973) and Bass, Mittenberg, and Petersen (1981). Several factors may have contributed to this divergence from previous research. First, subjects began at an already high digital skin temperature. Reaching even higher temperatures during adaptation, it may be that subjects were approaching the upper limit of this response and demonstrated a ceiling effect. Perhaps with these high temperature values, the regression phenomenon resulted in the pattern of readings demonstrated here.

Other factors also contributed to research differences. In the Roberts, Kewman, and Macdonald (1973) study cited above, characteristics of the small sample were unrepresentative of the general population. Most of those six subjects had experienced extensive training in hypnosis and meditation which might have improved their performance. Subjects in the Bass, Mittenberg, and Petersen (1981) study received feedback training specific to peripheral skin temperature rather than the EMG feedback employed here. Among those subjects, individuals high in trait anxiety were better able than less anxious subjects to increase skin temperature. Anxiety did not predict such success in the current study; however, the differences in treatment procedures made it difficult to compare the two findings.

Capacity for absorption has been tested less in relation to digital skin temperature than to EMG. As in one earlier study (Roberts, Schuler, Bacon, Zimmermann, & Patterson, 1975), absorption did not result in a significant main effect. Interestingly, it was involved in an interaction similar in some respects to that predicted for EMG. The Treatment X Time Blocks X Absorption interaction indicated that most subjects maintain or slightly raise temperature during treatment. However, subjects with a high capacity for absorption were found to decrease skin temperature during two treatments, EMGBF and AT. According to Qualls and Sheehan (1979, 1981b, 1981c), the feedback tone may have been a hindrance to the high absorption subjects who proved themselves able to increase temperature during the quiet adaptation phase; perhaps having to repeat phrases also interfered with their style of inner-directed absorbed attention.

One qualifier to the interaction described above was noted in the trend towards a significant interaction of Treatment X Time Blocks X Anxiety X Absorption. Here, among the low absorption subjects, anxiety served as a moderating variable: during PMR and AT, high anxiety subjects continued to increase temperature while less anxious subjects decreased temperature somewhat.

Pulse. A diminishing of autonomic arousal was demonstrated by a decrease in pulse rate. However, failure of the random assignment process to produce equivalent groups rendered this a less useful measure than those physiological variables already discussed.

Subjective anxiety inventory. The cognitive aspect of relaxation was represented by SAI values. The lower scores reported following PMR and AT indicated more relaxation. Electromyographic biofeedback (EMGBF), most effective in producing muscle relaxation, was subjectively experienced as the least cognitively relaxing treatment technique. This data contradicted that of Sime and DeGood (1977) which resulted in correspondence between these variables. This discrepancy could be attributed to subjects' lack of awareness of internal cues of relaxation and the body/mind link. On the other hand, the lack of correspondence between SAI ratings and the physiological measures again could denote response specificity. While producing muscular relaxation, EMG biofeedback presents an ambiguous cognitive task which is paradoxical in nature; to achieve relaxation the individual must learn to make a passive response. In training this response, the feedback tone acts as a negative reinforcer which helps the subject learn to achieve physiological relaxation. However, the presence of the feedback tone may result in confusion and cognitive tension.

It was interesting to note that ratings of relaxation following two of the techniques varied with the order in which the treatments were presented. It would appear that subjects found EMGBF more relaxing if they received it in their first rather than last experimental session where they may have compared it to the preceeding techniques. Since a tendency to give higher ratings over time was not seen for the other training procedures, this finding did not denote general impatience or anticipation of the experiment's end. In fact, subjective ratings of relaxation following SR actually improved successively for subjects receiving it as the second, third, or fourth treatment. This pattern was not shown for the other techniques, and it is doubtful that it represented an artifact of this within-subject design where dampening of anxiety might be explained as due to increased familiarity with the experiment itself. Subjects might report less anxiety with SR as their fourth session because they could employ another treatment technique to augment their own style of cognitive relaxation.

Relaxation strategies. Subjects were fairly consistent in their choice of strategies for achieving relaxation during the four treatment procedures. With PMR and AT, more structured than SR and less ambiguous than the biofeedback task, subjects followed the taped instructions. During EMGBF, the treatment which produced a physiological response, subjects passively told their bodies to relax. Finally, with instruction to relax on their own (SR), subjects most often used imagery to achieve relaxation. The content of the images frequently consisted of relaxing scenes.

Surprisingly, the pattern of these strategies was similar regardless of subjects' personality characteristics. Failure of differences in anxiety and absorption to result in significant main effects with regard to many of the dependent measures might have been a function of the range of test scores. For instance, since a volunteer who demonstrated an appropriate level of anxiety could not be selected unless her capacity for absorption was above or below the cut-off score for that variable, some potential subjects with more extreme scores could not be chosen for the experiment. While it was clear that the two personality measures were tapping different characteristics, it was possible that the high and low levels of those measures did not result in four clearly differentiated groups.

Treatment preference. Again, the impact of SR was seen as 25 of the subjects selected the control technique as their most preferred treatment. Self-relaxation was different from the other relaxation methods in that it was the only one not requiring cognitive performance; it also was the least intrusive of the methods. The subject was free to use her own style. Given these findings, SR might be an effective treatment approach in the clinical setting.

Personality Characteristics

Locus of control. Subjects were not selected on the basis of LOC scores; there was not enough diversity in scores to measure LOC as a predictor of success in relaxation or to correlate it with adaptation physiological measures. A strong correlation with anxiety was demonstrated here as in earlier research (Archer, 1979); it seems reasonable that individuals who feel less control over their environment would also express feelings of anxiety.

That the treatments did not result in a significant change towards internal locus of control was not surprising given the short-term nature of the relaxation training. Exhibiting only a trend towards internal LOC, the 12 subjects tested by Kappes and Michaud (1978) received a total of 10 training sessions. On the other hand, with only three frontalis EMG training sessions, subjects in another study (Stern & Berrenberg, 1977) demonstrated a significant shift towards increased internality. However, as pointed out by these experimenters, it is the personal control subscale of the Rotter LOC scale which is more appropriately used as a correlate of relaxation.

Hopkins Symptom Checklist. Demonstrating many of the symptoms that characterize the psychophysiological disorders described earlier as the stress response, subjects scoring high on the HSC also were found to rate high in trait anxiety and in external locus of control. This emphasizes the usefulness of the HSC as a clinical screening instrument, particularly with patients who are unaware of the source of their discomfort. The HSC could isolate symptoms and target patients for stress management treatment.

Future Considerations

The personality measures employed in this study were only a few which may be relevant to relaxation research. Other individual characteristics such as level of abstraction, intelligence, learning history, ways of organizing information and approaching tasks, and even the effect of the menstrual cycle also might contribute to response to relaxation training. Subject variables such as symptoms of physical or emotional distress should be considered.

Many other factors affect treatment outcome in biofeedback research. Among those may be the procedural variables which compare threshold training with the presentation of a continuous feedback tone, employ different relaxation instructions, and measure the impact of the therapist's presence in the room. It would be useful to compare the methodological differences involved in collecting and analyzing physiological data through continuous or averaged readings, training trials, and samples throughout the treatment process.

Factors contributing to generalization may be explored. In this study, it was apparent in the last 10 minutes of the procedure that instead of continuing to relax, subjects were cued to move around and to anticipate the end of the experiment. Perhaps more specific instruction to continue to relax would increase generalization. Increasing the number of treatment sessions also might prove effective as would the opportunity to practice relaxation outside of the treatment setting. In actual clinical practice, treatment often is tailored to the individual; there is more flexibility in procedure than in the more standardized experimental setting. The controls which serve to insure internal validity may interfere with generalization of treatment effect.

Summary

In the early days of physiological monitoring, Lacey (1950) reported:

> In the psychophysiological assay of individuals, patterning of somatic reaction is a variable as important as,

> possibly more important than, average reactivity itself. Both the degree to which two individuals are discriminated and the direction of that discrimination in terms of autonomic response, may depend strikingly upon the physiological variable used. (p. 349)

Later, Martin (1961) noted:

> Intercorrelations among physiological measures obtained under either resting states or under stress tend to be low and frequently insignificant. (p. 245)

Now that physiological monitoring and feedback training are employed in the treatment of a number of disorders, it is important to reconsider the impact of response-specificity.

In this study, the muscle activity aspect of relaxation was achieved by targeting that response for specific training. Visceral and cognitive relaxation might be achieved best by focusing treatment on those responses. Clinical treatment of the various stress disorders might consider this specificity of response. If the historical search has been to find the best technique for the achievement of generalized relaxation, the future task may be to tailor treatment to each response system. The question might then be asked: Which techniques targeting a specific relaxation response prove most effective for certain individuals?

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APPENDIX A

Tellegen Absorption Scale

TELLEGEN ABSORPTION SCALE

1. I keep close track of where my money goes. (a) True (b) False
2. Sometimes I feel and experience things as I did when I was a child. (a) True (b) False
3. I often stop in the middle of one activity to start something else. (a) True (b) False
4. I can be greatly moved by eloquent or poetic language. (a) True (b) False
5. I could be happy living all alone in a cabin in the woods or mountains. (a) True (b) False
6. While watching a movie, a T.V. show, or a play, I may become so involved that I forget about myself and my surroundings and experience the story as if it were real and as if I were taking part in it. (a) True (b) False
7. I frequently find myself worrying about something. (a) True (b) False
8. If I stare at a picture and then look away from it, I can sometimes "see" an image of the picture, almost as if I were still looking at it. (a) True (b) False
9. Sometimes I feel as if my mind could envelop the whole world. (a) True (b) False
10. I like to watch cloud shapes change in the sky. (a) True (b) False

11. When I have to stand in line, I never try to get ahead of other people. (a) True (b) False

12. If I wish, I can imagine (or daydream) some things so vividly that they hold my attention as a good movie or story does. (a) True (b) False

13. I often monopolize a conversation. (a) True (b) False

14. I think I really know what some people mean when they talk about mystical experiences. (a) True (b) False

15. I sometimes "step outside" my usual self and experience an entirely different state of being. (a) True (b) False

16. Textures--such as wool, sand, wood--sometimes remind me of colors or music. (a) True (b) False

17. I am very level-headed and always like to keep my feet on the ground. (a) True (b) False

18. Sometimes I experience things as if they were doubly real. (a) True (b) False

19. When I listen to music, I can get so caught up in it that I don't notice anything else. (a) True (b) False

20. If I wish, I can imagine that my body is so heavy that I could not move if I wanted to. (a) True (b) False

21. I can often somehow sense the presence of another person before I actually see or hear her/him. (a) True (b) False

22. It is very important to me that some people are concerned about me. (a) True (b) False

23. The crackle and flames of a wood fire stimulate my imagination. (a) True (b) False

24. It is sometimes possible for me to be completely immersed in nature or in art and to feel as if my whole state of consciousness has somehow been temporarily altered. (a) True (b) False

25. Different colors have distinctive and special meanings for me. (a) True (b) False

26. My parents' ideas of right and wrong have always proved to be best. (a) True (b) False

27. I am able to wander off into my own thoughts while doing a routine task and actually forget that I am doing the task, and then find a few minutes later that I have completed it. (a) True (b) False

28. I can sometimes recollect certain past experiences in my life with such clarity and vividness that it is like living them again or almost so. (a) True (b) False

29. Things that might seem meaningless to others often make sense to me. (a) True (b) False

30. While acting in a play, I think I could really feel the emotions of the character and "become" her/him for the time being, forgetting both myself and the audience. (a) True (b) False

31. Many people try to push me around. (a) True (b) False

32. My thoughts often don't occur as words but as visual images. (a) True (b) False

33. I am a better talker than a listener. (a) True (b) False

34. I often take delight in small things (like the five-pointed star shape that appears when you cut an apple across the core or the colors in soap bubbles). (a) True (b) False

35. When listening to organ music or other powerful music, I sometimes feel as if I am being lifted into the air.
(a) True (b) False

36. Sometimes I can change noise into music by the way I listen to it. (a) True (b) False

37. Some of my most vivid memories are called up by scents and smells. (a) True (b) False

38. I see no point in sticking with a problem if there is little chance of success. (a) True (b) False

39. Certain pieces of music remind me of pictures or moving patterns of color. (a) True (b) False

40. I often know what someone is going to say before he or she says it. (a) True (b) False

41. I often have "physical memories"; for example, after I've been swimming I may still feel as if I'm in the water.
(a) True (b) False

42. Whenever I go out to have fun, I like to have a pretty good idea of what I'm going to do. (a) True (b) False

43. The sound of a voice can be so fascinating to me that I can just go on listening to it. (a) True (b) False

44. People consider me a rather freewheeling and spontaneous person. (a) True (b) False

45. At times I somehow feel the presence of someone who is not physically there. (a) True (b) False

46. People seem naturally to turn to me when decisions have to be made. (a) True (b) False

47. Sometimes thoughts and images come to me without the slightest effort on my part. (a) True (b) False

48. I find that different odors have different colors. (a) True (b) False

49. I usually prefer to let someone else take the lead on social occasions. (a) True (b) False

50. I can be deeply moved by a sunset. (a) True (b) False

APPENDIX B

Hopkins Symptom Checklist

HOPKINS SYMPTOM CHECKLIST

Below is a list of 58 symptoms most commonly experienced. Across from each symptom is a four point scale representing various degrees of distress:

1 Not at all
2 A little bit
3 Quite a bit
4 Severe

In each of the following examples, circle the number that best approximates your level of distress.

1. Headaches 1 2 3 4
2. Nervousness or shakiness inside 1 2 3 4
3. Being unable to get rid of bad thoughts or ideas 1 2 3 4
4. Faintness or dizziness 1 2 3 4
5. Loss of sexual interest or pleasure 1 2 3 4
6. Feeling critical of others 1 2 3 4
7. Bad dreams 1 2 3 4
8. Difficulty in speaking when you are excited 1 2 3 4
9. Trouble remembering things 1 2 3 4
10. Worried about sloppiness or carelessness 1 2 3 4
11. Feeling easily annoyed or irritated 1 2 3 4
12. Pains in the heart or chest 1 2 3 4
13. Itching 1 2 3 4
14. Feeling low in energy or slowed down 1 2 3 4
15. Thoughts of ending your live 1 2 3 4

16. Sweating 1 2 3 4

17. Trembling 1 2 3 4

18. Feeling confused 1 2 3 4

19. Poor appetite 1 2 3 4

20. Crying easily 1 2 3 4

21. Feeling shy or uneasy with the opposite sex 1 2 3 4

22. A feeling of being trapped or caught 1 2 3 4

23. Suddenly scared for no reason 1 2 3 4

24. Temper outbursts you could not control 1 2 3 4

25. Constipation 1 2 3 4

26. Blaming yourself for things 1 2 3 4

27. Pains in the lower part of your back 1 2 3 4

28. Feeling blocked or stymied in getting things done 1 2 3 4

19. Feeling lonely 1 2 3 4

30. Feeling blue 1 2 3 4

31. Worried or stewing about things 1 2 3 4

32. Feeling no interest in things 1 2 3 4

33. Feeling fearful 1 2 3 4

34. Your feelings easily hurt 1 2 3 4

35. Having to ask others what you should do 1 2 3 4

36. Feeling others do not understand you or are unsympathetic 1 2 3 4

37. Feeling that people are unfriendly or dislike you 1 2 3 4

38. Having to do things very slowly in order to be sure you are doing them right 1 2 3 4

39. Heart pounding or racing 1 2 3 4

40. Nausea or upset stomach 1 2 3 4

41. Feeling inferior to others 1 2 3 4

42. Soreness of your muscles 1 2 3 4

43. Difficulty in falling asleep or staying asleep 1 2 3 4

44. Having to check and double check what you do 1 2 3 4

45. Difficulty making decisions 1 2 3 4

46. Wanting to be alone 1 2 3 4

47. Trouble getting your breath 1 2 3 4

48. Hot or cold spells 1 2 3 4

49. Having to avoid certain places or activities because they frighten you 1 2 3 4

50. Your mind going blank 1 2 3 4

51. Numbness or tingling in parts of your body 1 2 3 4

52. A lump in your throat 1 2 3 4

53. Feeling hopeless about the future 1 2 3 4

54. Trouble concentrating 1 2 3 4

55. Weakness in parts of your body 1 2 3 4

56. Feeling tense or keyed up 1 2 3 4

57. Heavy feelings in your arms or legs 1 2 3 4

58. Please comment on any special concern:

APPENDIX C

<u>Subjective Anxiety Inventory</u>

SUBJECTIVE ANXIETY INVENTORY

0	25	50	75	100
no tension completely relaxed	very relaxed		very tense	maximum tension

APPENDIX D

<u>Contract to Participate</u>

I, ______________________________, agree to participate in four sessions of the Relaxation Experiment. I understand that there is no risk involved in this procedure and that I may withdraw at any time.

Subject ______________________________

Experimenter _________________________

DEMOGRAPHIC INFORMATION

Age ________________

Handedness ________________

Medication ________________

Have you had any experience previously with any type of relaxation or meditation techniques?

__________ None

__________ Brief Exposure (1-3 sessions)

__________ Repeated Exposure (more than 3 sessions)

Note preference for techniques, rated from 1 to 4, when 1 represents best liked and 4 represents least liked:

__________ EMG

__________ PMR

__________ AT

__________ SR

APPENDIX E

Script for Pretreatment Interaction with Subjects

SCRIPT FOR PRETREATMENT INTERACTION WITH SUBJECTS

First, I am going to take your pulse.... Now I will wipe your forehead with alcohol, and I'm going to attach three sensors to your forehead. They're connected to some devices that monitor your muscle activity; no current passes through these, so you can't receive a shock. The sensors attached to your fingers will monitor your skin temperature. Lean back in the chair and sit quietly. In a few minutes a tape will give you further instructions.

APPENDIX F

Transcripts of Taped Relaxation Instructions
EMGBF, PMR, AT, SR

EMG BIOFEEDBACK

Please sit quietly for the next ten minutes and wait for further instructions. (10 minutes)...For the next 25 minutes, I would like for you to practice relaxation. Close your eyes, find a comfortable position in the chair, and listen carefully to the following instructions. For the next few minutes I would like for you to practice relaxation by listening to the tone...(tone begins)...As you become more relaxed, the tone will decrease in pitch and in volume. For example, wrinkle your forehead...Notice how the tone increases its pitch and becomes louder. Now smooth your forehead and relax...Notice the difference in the tone. Now continue to relax and make the tone go away. (25 minutes)...Now continue to sit quietly for the next ten minutes. (10 minutes)...Now I will count from one to four. On the count of one, move your hands and feet, two, stretch your hands and feet, three, move your head around, and four, open your eyes. One. Move your hands and feet. Two. Stretch your hands and feet. Three. Move your head around. Four. Open your eyes. Please remain seated until someone comes in and unhooks the sensors. Thank you for your participation.

PROGRESSIVE MUSCLE RELAXATION

Please sit quietly for the next ten minutes and wait for further instructions. (10 min.)...For the next 25 minutes, I would like for you to practice relaxation. Close your eyes, find a comfortable position in the chair, and listen carefully to the following instructions. Now settle back as comfortably as you can, close your eyes, and listen to what I'm going to tell you. I'm going to make you aware of certain sensations in your body and then show you how you can reduce these sensations. First, direct your attention to your left arm, your left hand in particular. Clench your left fist. Clench it tightly and study the tension in the hand and in the forearm. Study those sensations of tension...Now let go. Relax the left hand and let it rest on the arm of the chair. Note the difference between the tension and the relaxation...Once again now, clench your left hand into a fist tightly, noticing the tensions in the hand and in the forearm. Study those tensions, and now, let go. Let your fingers spread out relaxed and note the difference, once again, between muscular tension and muscular relaxation...Now let's do the same with the right hand. Clench the right fist. Study those tensions...And now relax. Relax the right fist. Note the difference once again between the tension and the relaxation, and enjoy the contrast...Once again now, clench the right fist. Clench it tight. Study the tensions. Study them. And now, relax the right fist. Let the fingers spread out comfortably. See if you can keep letting go a little bit more. Even though it seems as if you have let go as much as you possibly can, there always seems to be that extra bit of relaxation. Note the difference once again between the tension and the relaxation. Note the looseness beginning to develop in the left and right hands. Both your left and right arms and hands are a little bit more relaxed...Now bend both hands back at the wrist so that you tense the muscles in the back of the hand and in the forearm, fingers pointing towards the ceiling. And now relax. Let your hands return to their resting positions, and note the difference between tension and relaxation...Do that once again, fingers pointing to the ceiling, feeling that tension in the backs of the hands and in the forearms. And now relax...Let go further...Now clench both your hands into fists and bring them towards your shoulders so as to tighten your biceps muscles, the large muscles in the upper part of the arm. Feel the tension in the biceps muscles. And now relax. Let your arms drop down again to your sides, and note the difference between the tension that was in your biceps and the relative relaxation you feel now...Let's do that once again now. Clench both biceps muscles, bringing both arms up, trying to touch with your fists the respective shoulders. Study the tension. Hold it. Study it. And now relax. Once again, let the arms drop, and study the feelings of relaxation, the contrast between tension and relaxation. Just keep letting go of those muscles further and further...Now we can direct our attention to the shoulder area. Shrug your shoulders, bringing both shoulders up towards your ears as if you wanted to touch your ears with your shoulders, and note the tension in your shoulders and up in your neck. Study that tension. Hold it. And now relax. Let both shoulders return to a resting position. Just keep letting go further and further. Once again, note the contrast between the tension and the relaxation that is now spreading into your shoulder area...Do that once again. Bring both shoulders up as if to touch the ears. Feel the tension in the shoulders, in the upper back, and the neck. Study the tension in these muscles. And now relax. Loosen those muscles. Let your shoulders come down to a resting position, and study the contrast once again between the tension and the relaxation...You can also learn to relax more completely the various muscles of the face. So, what I want you to do now is to wrinkle up your forehead and brow. Wrinkle it until you feel all your forehead very much wrinkled, the muscles tense and the skin furrowed. And now relax. Smooth out the forehead. Let those muscles become loose...Do that once again. Wrinkle up the forehead. Study those tensions in the muscles above the eyes in the forehead region. And now smooth out your forehead. Relax those muscles. And once again, note the contrast between the tension and the relaxation...Now close your eyes very tightly. Close them tightly so that you can feel tension all around your eyes and the many muscles that control the movement of the eyes...And now, relax those muscles. Let them relax, noting the difference between the tension and the relaxation...Do that once again now, eyes tightly closed, and study the tension. Hold it. And relax. Let go, and let your eyes remain comfortably closed...

Now purse your lips. Press your lips together. That's right, press them together very tightly and feel the tension all around the mouth. Now relax. Relax those muscles around the mouth and just let your chin rest comfortably...Once again now, press your lips together, and study the tension around the mouth. Hold it. And now relax. Let go of those muscles more and more, further and further. Note how much more loose the various muscles perhaps have become in those parts of the body that we have successfully tensed and relaxed- your hands, forearms, upper arms, your shoulders, the various facial muscles. And now, we'll turn our attention to the neck. Press your head back against the surface on which it's resting. Press it back so that you can feel the tension primarily in the back of the neck and in the upper back. Hold it. Study it. Now let go. Let your head rest comfortably now. Enjoy the contrast between the tension you created before and the greater relaxation you feel now. Just keep letting go, further and further, more and more, to the best of your ability. Do that once again, head pressed back. Study the tension. Hold it. And now, let go. Just relax. Let go further and further...Now, I'd like you to bring your head forward and try to bury your chin into your chest. Feel the tension especially in the front of your neck. And now relax. Let go further and further. Do that once again now, chin buried in the chest. Hold it. And now relax. Just relax further and further...Now we can direct our attention to the muscles of the upper back. Arch your back, arch it, sticking out your chest and stomach so that you can feel tension in your back primarily in your upper back. Study that tension.

And now relax...Let the body once again rest against the back of the chair or the bed, and note the difference between the tension and the relaxation, letting those muscles get more and more loose... Once again, arch the back way up. Study the tensions. Hold it. Now relax. Relax the back once again, letting go of all the tensions in these muscles...And now, take a deep breath, filling your lungs, and hold it. Hold it and study the tension all through your chest and down into your stomach area. Study that tension, and now relax. Let go. Exhale and continue breathing as you were. Note once again the difference between the tension and the relaxation... Let's do that once again. Take a deep breath and hold it. Hold it. Study those tensions. Study them. Note the muscles tensing. Note the sensations. And now exhale and continue breathing as you were, very comfortably breathing, letting those muscles of the chest and some of the stomach muscles relax, getting more and more relaxed each time you exhale...And now, tighten up the muscles in your stomach. Tense those stomach muscles. Hold it. Make the stomach very hard. And now relax. Let those muscles become loose. Just let go and relax...Do that once again. Tighten those stomach muscles. Study the tension. And now relax. Let go further and further, more and more. Loosen the tensions. Get rid of the tensions, and note the contrast between tension and relaxation...I'd like you now to stretch both legs. Stretch them so that you can feel tension in the thighs. Stretch them way out. And now relax. Let them relax and note the differences once again between tension in the thigh muscles and the relative relaxation you can feel now...Do that once again, locking your knees, stretch out both legs so that you can feel the muscles. Let them get loose. Get rid of all tensions in the muscles of your thighs...Now tense both calf muscles by pointing your toes towards your head. If you point your toes upwards towards your head, you can feel the pulling, the tension, the contraction in your calf muscles and in your shins as well. Study that tension. And now relax. Let the legs relax and note once again the difference between tension and relaxation...Once again now, bend the feet back at the ankles, toes pointing towards your head, and study the tension. Hold it. Study it. And now let go. Relax those muscles further and further, more and more deeply relaxed...Just as you have been directing your muscles to tense you have also been directing them to relax or to loosen. You've noted the difference between tension and muscular relaxation. You can notice whether there is any tension in your muscles, and if there is, you can try to concentrate on that part, send messages to that muscle to loosen, to relax. If you think of loosening that muscle, you will, in fact, be able to do so, even if only a little. Now as you sit there in the chair, I'm going to review the various muscle groups that we've covered. As I name each group, try to notice if there is any tension in those muscles. If there is any, try to concentrate on those muscles and send messages to them to relax, to loosen...Relax the muscles in your feet, ankles, and calves...shins, knees, and thighs... buttocks and hips...loosen the muscles of your lower body...Relax your stomach, waist, lower back...upper back, chest, and shoulders... Relax your upper arms, forearms, and hands right to the tips of your fingers...Let the muscles of your throat and neck loosen...Relax your jaw and facial muscles...Let all the muscles of your body become loose...Now sit quietly with your eyes closed...Do nothing more than that. Just sit quietly with your eyes closed for a few minutes. (1 min). Now continue to sit quietly for the next ten minutes. (10 min.) Now I will count from one to four. On the count of one, move your hands and feet, two, stretch your hands and feet, three, move your head around, and four, open your eyes. One. Move your hands and feet. Two. Stretch your hands and feet. Three. Move your head around. Four. Open your eyes. Please remain seated until someone comes in and unhooks the sensors. Thank you for your participation.

AUTOGENIC TRAINING

Please sit quietly for the next few minutes and wait for further instructions. (10 minutes)...For the next 25 minutes, I would like for you to practice relaxation. Close your eyes, find a comfortable position in the chair, and listen carefully to the following instructions. You will be asked to repeat some phrases that will help in your achieving relaxation. Continue to repeat the phrases to yourself until a new phrase is presented. Now let's begin. I feel quite quiet...I am beginning to feel quite relaxed... My feet feel heavy and relaxed...My ankles, my knees and my hips feel heavy, relaxed and comfortable...My solar plexis and the whole central portion of my body feel relaxed and quiet...My hands, my arms and my shoulders feel heavy, relaxed and comfortable...My neck, my jaws and my forehead feel relaxed; they feel comfortable and smooth...My whole body feels quite heavy, comfortable, and relaxed...I am quite relaxed...My arms and hands are heavy and warm... I feel quite quiet...My whole body is relaxed and my hands are warm, relaxed, and heavy...My hands are warm...Warmth is flowing into my hands...They are warm, warm...I can feel the warmth flowing down my arms, into my hands...My hands are warm, relaxed and warm...My whole body feels quiet, comfortable, and relaxed...My mind is quiet...I withdraw my thoughts from the surroundings and I feel serene and still...My thoughts are turned inward and I am at ease...Deep within my mind, I can visualize and experience myself as relaxed, comfortable, and still...I am alert, but in an easy, quiet inward turned way...My mind is calm and quiet...I feel an inward quietness... Now continue to sit quietly for the next ten minutes. (10 minutes). Now I will count from one to four. On the count of one, move your hands and feet, two, stretch your hands and feet, three, move your head around, and four, open your eyes. One. Move your hands and feet. Two. Stretch your hands and feet. Three. Move your head around. Four. Open your eyes. Please remain seated until someone comes in and unhooks the sensors. Thank you for your participation.

SELF-RELAXATION

Please sit quietly for the next few minutes and wait for further instructions. (10 minutes)...For the next 25 minutes, I would like for you to practice relaxation. Close your eyes, find a comfortable position in the chair, and listen carefully to the following instructions. I would like for you to practice relaxation by any means that you wish. (25 minutes)...Now continue to sit quietly for the next ten minutes. (10 minutes)...Now I will count from one to four. On the count of one, move your hands and feet, two, stretch your hands and feet, three, move your head around, and four, open your eyes. One. Move your hands and feet. Two. Stretch your hands and feet. Three. Move your head around. Four. Open your eyes. Please remain seated until someone comes in and unhooks the sensors. Thank you for your participation.

APPENDIX G

Data Sheet

DATA SHEET

Subject ____________________ Experimenter ________________

Date ______________________ Treatment __________________

Anx/Abs Group _______________ Order ______________________

Adaption Phase, 10 minutes

EMG				TEMP			
1.____	4.____	7.____	10.____	1.____	4.____	7.____	10.____
2.____	5.____	8.____		2.____	5.____	8.____	
3.____	6.____	9.____		3.____	6.____	9.____	

Treatment Phase, 25 minutes

EMG				TEMP			
1.____	8.____	15.____	22.____	1.____	8.____	15.____	22.____
2.____	9.____	16.____	23.____	2.____	9.____	16.____	23.____
3.____	10.____	17.____	24.____	3.____	10.____	17.____	24.____
4.____	11.____	18.____	25.____	4.____	11.____	18.____	25.____
5.____	12.____	19.____		5.____	12.____	19.____	
6.____	13.____	20.____		6.____	13.____	20.____	
7.____	14.____	21.____		7.____	14.____	21.____	

Posttreatment Phase, 10 minutes

EMG				TEMP			
1.____	4.____	7.____	10.____	1.____	4.____	7.____	10.____
2.____	5.____	8.____		2.____	5.____	8.____	
3.____	6.____	9.____		3.____	6.____	9.____	

Strategy Employed:

APPENDIX H

Tables

TABLE 1

ANOVA SUMMARY TABLE FOR EMG

ADAPTATION PHASE

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	0.04	0.02	.8862
Absorption (B)	1	4.43	2.14	.1510
A X B	1	0.20	0.09	.7600
Error	4	2.07		
Treatment (T)	3	0.72	1.91	.1305
T X A	3	0.27	0.73	.5376
T X B	3	0.15	0.41	.7487
T X A X B	3	0.31	0.82	.4873
Error	132	0.38		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMGBF	2.48	1.02
2 - PMR	2.23	0.80
3 - AT	2.21	0.82
4 - SR	2.28	0.77

TABLE 2

ANOVA SUMMARY TABLE FOR EMG CHANGE

ACROSS NINE TIME BLOCKS

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	0.15	0.01	.9404
Absorption (B)	1	19.76	0.75	.3899
A X B	1	8.37	0.32	.5747
Error	44	26.20		
Treatment (T)	3	20.00	11.64	.0000
T X A	3	0.75	0.44	.7273
T X B	3	0.19	0.11	.9533
T X A X B	3	1.54	0.89	.4458
Error	132	1.72		
Time Blocks (S)	8	14.31	19.38	.0000
S X A	8	0.72	0.97	.4570
S X B	8	0.46	0.62	.7591
S X A X B	8	0.88	1.19	.3034
Error	132	0.74		
T X S	24	10.16	25.73	.0000
T X S X A	24	0.27	0.68	.8708
T X S X B	24	0.36	0.91	.5914
T X S X A X B	24	0.66	1.67	.0226
Error	1056	0.39		

TABLE 3

ANOVA SUMMARY TABLE FOR AVERAGE EMG CHANGE

(TIME BLOCKS 1+2-TIME BLOCKS 6+7)/2

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	0.23	0.15	.6991
Absorption (B)	1	0.05	0.03	.8591
A X B	1	0.29	0.19	.6649
Error	44	1.51		
Treatment (T)	3	4.02	7.29	.0001
T X A	3	0.42	0.76	.5163
T X B	3	0.49	0.89	.4481
T X A X B	3	0.06	0.10	.9585
Error	132	0.55		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMGBF	0.95	0.96
2 - PMR	0.25	0.63
3 - AT	0.58	1.06
4 - SR	0.68	0.76

TABLE 4

NEWMAN-KEULS MULTIPLE F-TEST FOR

EMG CHANGE SCORE

Group	EMGBF	PMR	AT	SR
1 - EMGBF 4	-----	.70*	.37*	.27
2 - PMR 1		---	.33*	.43*
3 - AT 2			---	.10
4 - SR 3				---

Critical Differences: Step 1 = .30
Step 2 = .36
Step 3 = .40

*Significant at $p < .05$

TABLE 5

ANOVA SUMMARY TABLE FOR TEMPERATURE

ADAPTATION PHASE

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	131.18	2.09	.1554
Absorption (B)	1	92.55	1.47	.2312
A X B	1	0.43	0.01	.9343
Error	44	62.78		
Treatment (T)	3	5.19	0.39	.7517
T X A	3	13.16	0.99	.3975
T X B	3	13.65	1.03	.3810
T X A X B	3	4.40	0.33	.7947
Error	132	13.29		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMGBF	89.39	4.78
2 - PMR	89.09	5.04
3 - AT	88.60	4.87
4 - SR	88.91	4.86

TABLE 6

ANOVA SUMMARY TABLE FOR TEMPERATURE CHANGE

ACROSS NINE TIME BLOCKS

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	830.00	1.87	.1786
Absorption (B)	1	1005.89	2.26	.1396
A X B	1	109.81	0.25	.6216
Error	44	444.50		
Treatment (T)	3	67.33	0.64	.5896
T X A	3	178.26	1.70	.1705
T X B	3	69.57	0.66	.5763
T X A X B	3	96.12	0.92	.4352
Error	132	104.95		
Time Blocks (S)	8	52.37	9.32	.0000
S X A	8	1.44	0.26	.9791
S X B	8	2.29	0.41	.9162
S X A X B	8	3.58	0.64	.7466
Error	352	5.62		
T X S	24	4.87	1.74	.0150
T X S X A	24	2.05	0.73	.8196
T X S X B	24	5.39	1.93	.0047
T X S X A X B	24	4.11	1.47	.0671
Error	1056	2.79		

TABLE 7

ANOVA SUMMARY TABLE FOR AVERAGE TEMPERATURE CHANGE

(TIME BLOCKS 1+2-TIME BLOCKS 6+7)/2

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	6.98	0.37	.5435
Absorption (B)	1	7.92	0.43	.5175
A X B	1	16.28	0.87	.3548
Error	44	18.61		
Treatment (T)	3	14.68	1.99	.1180
T X A	3	6.51	0.88	.4442
T X B	3	14.37	1.95	.1300
T X A X B	3	16.15	2.19	.0976
Error	132	7.36		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMGBF	0.03	3.38
2 - PMR	-0.43	2.96
3 - AT	-0.21	2.22
4 - SR	-1.24	3.52

TABLE 8

ANOVA SUMMARY TABLE FOR PRETREATMENT PULSE

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	178.26	0.72	.4020
Absorption (B)	1	985.55	3.96	.0528
A X B	1	109.51	0.44	.5106
Error	44	248.90		
Treatment (T)	3	215.41	3.04	.0315
T X A	3	127.56	1.80	.1506
T X B	3	52.21	0.74	.5323
T X A X B	3	27.56	0.39	.7614
Error	132	70.93		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMGBF	77.50	13.40
2 - PMR	73.65	10.03
3 - AT	72.71	12.87
4 - SR	73.75	10.90

TABLE 9

NEWMAN-KEULS MULTIPLE F-TEST FOR

PRETREATMENT PULSE

Group	EMGBF	PMR	AT	SR
1 - EMGBF 4	-----	3.85	4.79*	3.75*
2 - PMR 2		----	.94	.10
3 - AT 1			----	1.04
4 - SR 3				----

Critical Differences: Step 1 = 3.38
Step 2 = 4.04
Step 3 = 4.43

*Significant at p < .05

TABLE 10

ANOVA SUMMARY TABLE FOR PULSE CHANGE

PRE- AND POSTTREATMENT

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	137.76	0.33	.5712
Absorption (B)	1	1066.67	2.52	.1196
A X B	1	126.04	0.30	.5880
Error	44	423.26		
Treatment (T)	3	67.45	0.81	.4895
T X A	3	96.27	1.16	.3281
T X B	3	55.38	0.67	.5740
T X A X B	3	56.77	0.68	.5637
Error	132	83.08		
Time Blocks (S)	1	1504.17	37.81	.0000
S X A	1	51.04	1.28	.2635
S X B	1	137.76	3.46	.0695
S X A X B	1	12.76	0.32	.5740
Error	44	39.78		
T X S	3	167.88	3.72	.0132
T X S X A	3	38.02	0.84	.4732
T X S X B	3	41.75	0.92	.4308
T X S X A X B	3	13.63	0.30	.8240
Error	132	45.15		

Table 10 (continued)

MEANS AND STANDARD DEVIATIONS

Treatment	Mean		Standard Deviation	
Treatment	pre	post	pre	post
1 - EMGBF	77.50	69.58	12.16	9.03
2 - PMR	73.65	70.94	9.05	10.78
3 - AT	72.71	70.31	11.24	9.22
4 - SR	73.75	70.94	9.75	9.67

TABLE 11

NEWMAN-KEULS MULTIPLE F-TEST FOR

PULSE CHANGE

Group	EMGBF	PMR	AT	SR
1 - EMGBF 4	-----	5.21*	5.52*	5.11*
2 - PMR 2		----	.31	.10
3 - AT 1			----	.41
4 - SR 3				----

Critical Differences: Step 1 = 3.79
Step 2 = 4.53
Step 3 = 4.97

*Significant at $p < .05$

TABLE 12

ANOVA SUMMARY TABLE FOR SUBJECTIVE

ANXIETY INVENTORY (SAI) SCORE

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	96.33	0.16	.6877
Absorption (B)	1	1250.52	2.13	.1520
A X B	1	1160.33	1.97	.1673
Error	44	588.46		
Treatment (T)	3	1095.78	5.66	.0011
T X A	3	87.76	0.45	.7154
T X B	3	95.20	0.49	.6887
T X A X B	3	205.79	1.06	.3673
Error	132	193.64		

MEANS AND STANDARD DEVIATIONS

Treatment	Mean	Standard Deviation
1 - EMGBF	34.60	18.83
2 - PMR	25.27	15.50
3 - AT	24.12	15.94
4 - SR	29.79	16.32

TABLE 13

NEWMAN-KEULS MULTIPLE F-TEST FOR

SUBJECTIVE ANXIETY INVENTORY (SAI)

Group	EMGBF	PMR	AT	SR
1 - EMGBF 4	-----	9.33*	10.48*	4.81
2 - PMR 2		----	1.15	4.52
3 - AT 1			-----	5.67
4 - SR 3				----

Critical Differences: Step 1 = 5.57
Step 2 = 6.65
Step 3 = 7.30

*Significant at $p < .05$

TABLE 14

FREQUENCY OF STRATEGY USE AS A FUNCTION OF

ANXIETY, ABSORPTION, AND TREATMENT

Treatment	EMGBF				PMR				AT				SR			
Anxiety:	H	L			H	L			H	L			H	L		
Absorption:			H	L			H	L			H	L			H	L
<u>Strategy</u>																
Followed Instructions	2	5	4	3	13	17	13	17	18	17	16	19	0	1	0	1
Fell Asleep	0	3	2	1	3	2	4	2	3	3	3	3	4	2	3	3
Breathing	4	2	2	4	0	2	1	1	0	2	1	1	1	7	4	4
Imagery	6	2	6	2	4	1	4	1	3	3	3	3	6	10	10	6
Cleared Mind	2	1	3	1	0	2	1	0	4	0	4	2	6	2	2	4
Daydreamed/ Mind Wandered	2	4	2	2	1	0	1	1	3	3	3	3	2	3	4	2
Told Body to Relax	10	6	10	6	2	4	4	2	0	1	0	0	4	4	6	3

TABLE 15

FREQUENCY COUNT OF PREFERENCE FOR

TREATMENT TECHNIQUES

	Preference			
	1	2	3	4
Treatment				
EMGBF	10	14	17	7
PMR	7	16	11	14
AT	6	13	14	15
SR	25	5	6	12

TABLE 16

ANOVA SUMMARY TABLE FOR LOCUS OF CONTROL

Source	Df	Mean Square	F	Significance
Anxiety (A)	1	3.62	0.88	.3527
Absorption (B)	1	1.69	0.42	.5189
A X B	1	2.52	0.63	.4310
Error	44	3.99		

MEANS AND STANDARD DEVIATIONS

Personality Group	Mean	Standard Deviation
1 - Low A/Low B	0.42	2.23
2 - Low A/High B	0.50	2.19
3 - High A/Low B	0.33	1.67
4 - High A/High B	-0.50	1.83

VITA

Jane Carol Rawson was born December 2, 1952 in Brookhaven, Mississippi. She attended elementary schools in piedmont and western North Carolina, and in 1971 she graduated as an honor student from South Mecklenburg High School in Charlotte, North Carolina. Four years later, Jane received her Bachelor of Arts degree in psychology from the University of North Carolina at Chapel Hill.

From 1975 to 1980, Jane was employed at the Randolph Clinic, a private, outpatient alcoholism treatment center in Charlotte. There she received experience in individual and group therapy, training, and administration.

Since August, 1980, Jane has been living in Boone where she has been involved in the Appalachian State University Master of Arts program in clinical psychology. She has worked as a graduate assistant in the psychology department and as a part-time student employee at the Counseling and Psychological Services Center where she later completed her internship. Jane was the recipient of a Lovill Fellowship for the 1980-81 and 1981-82 academic years and was awarded a research grant by the Graduate Student Association Senate for her thesis study. She became a member of Phi Alpha Phi honor society, Psi Chi Psychology Honor Society, and the Southeastern Psychological Association.

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