A COMPARISON OF THE EFFECTS OF ELECTROMYOGRAPHIC BIOFEEDBACK ON MUSCULAR TENSION IN SELECTED PERSONALITY STATES FROM THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY

DISSERTATION

Presented to the Graduate Council of the North Texas State University in Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

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This investigation was concerned with the effects of electromyographic biofeedback on the muscular tension of patients diagnosed in a particular personality state. These personality states were manic, agitated, depressed, and a comparison group. Gilberstadt and Duker's criteria were used to assess the diagnoses from the Minnesota Multiphasic Personality Inventory. The effects of electromyographic biofeedback on muscular tension were investigated by comparing the EMG readings collected from fourteen sessions. Five different readings were taken for each session and an adjusted mean was computed by analysis of covariance. These EMG readings were compared by group totals at the end of the fourteen sessions, as well as by individual sessions.

Forty patients were picked from an in-patient population who could fit the criteria for the diagnosis of one of the four groups previously mentioned. After each group completed the biofeedback training, an analysis of covariance was used to assess the comparative effects of biofeedback on muscle tension in the respective groups, as well as when the greatest decrease of muscle tension took place during the fourteen sessions.

Results of the analysis of covariance revealed significant differences do exist for the four psychiatric groups. The most significant
reduction was found when the manic group was compared to the comparison group. The least significant difference was found when comparing the manic group to the depressed and agitated groups. There was no statistical significance when comparing group totals of the four groups.

During the development of the investigation, several problem areas were observed which lend themselves to further questioning. Specifically, experimental studies on the effects of psychopharmacology on the operant conditioning process of reducing muscular tension needs to be explored. The findings derived from this study led to the conclusion that there are significant individual differences in the previously named psychiatric groups in their ability to reduce muscle tension. Another significant finding was the reduction of EMG levels. This reduction was most significant during the middle sessions of the biofeedback training program.
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CHAPTER I

INTRODUCTION

Even after the severest critical scientific reviews, biofeedback still appears to be the closest thing to a panacea yet discovered (Brown, 1977).

...New equipment brings new possibilities for use and a new social readiness to use it, and the speed with which it gets advertised and talked about pushes advances in practice that no theory is likely to keep up with ... (London, 1972, p. 913).

Treat as many patients with the new remedies while they still have the power to heal (Historical medical admonition quoted in Shapiro, 1971, p. 442).

These two brief quotes are applicable to the area of biofeedback research and practice. The term "biofeedback" is relatively new, having been sanctioned in 1969 as a legitimate descriptive for a number of previously separate psychological and psychophysiological areas of investigation (Barber, 1971).

Barber described it in this manner:

The biofeedback technique is based on the fundamental learning principle that we learn to make a certain response when we receive information (feedback) stating we have made the correct response, or one that moves us closer to our goal (p. vii).

In a relatively short period, between 1969 and 1972, biofeedback attracted widespread attention in both scientific and public sectors. Schwartz (1973) reported that over 250 professional journal articles on biofeedback were published in that period and that nationwide publicity included articles in The Wall Street Journal, The New Yorker, Newsweek, Time, and Playboy.
The public responded enthusiastically. People were, perhaps, most caught up by the prospect of controlling their own brain waves and muscle tension levels. One aspect of biofeedback, EEG alpha training, received heaviest emphasis by the press. The actual parameters of these minute electronic signals were unknown to the public who had difficulty appreciating the technology involved in their use.\(^1\)

A large number of studies dealing with biofeedback have been accumulated. The use of biofeedback as a therapeutic technique seems to be mushrooming (Gaarder, 1971). In general, two uses for biofeedback have emerged. The first is to enhance the ability in controlling the voluntary muscles where that control has either not been developed (Scully and Busmajea, 1969) or where it has been diminished through dysfunction (Harrison and Mortensen, 1962). The second area in which biofeedback has been used is in achieving low levels of muscle tension (Green and Walter, 1969; Green and Murphy, 1969) for patients with chronic tension headaches (Budzynski, Stoyva and Adler, 1970; Wickramasekera, 1972) and chronic anxiety (Raskin, Johnson, Rondestvedt, 1973) and a vast number of other medical as well as psychological symptoms.

The wide variability of response to biofeedback procedures observed between subjects makes it clear that factors other than experimental

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\(^1\)EEG alpha activity in humans involves signals ranging from 5 - 100 microvolts in a sharply defined 8 - 13 Hz band (Kamiya, 1969). EMG measurements from the frontalis involve signal levels from 1 - 15 microvolts at resting potentials. The nominal bandwidth of this signal ranges from 85 Hz - 1.5 kHz (Budzynski and Stoyva, 1969). Actual EMG potentials extend from 10 Hz - 2 kHz, but upper and lower frequencies are filtered out to reduce internal amplifier noise and 60 Hz artifacts from the critical passband.
manipulations influence the outcome. Hume (1976) states that "with such a new area of research, it is not surprising that there has been little controlled instrumentation on those factors within the individual subject. The two major courses of variability are personality differences and physiological differences."

Statement of the Problem

The problem of this study was to analyze and compare the effects of biofeedback training on the muscle tension of specific personality states from the Minnesota Multiphasic Personality Inventory as measured by electromyographic activity in the frontalis muscle (located on the forehead).

Purpose of the Study

Specifically, the major focus of this study was to compare the effects of biofeedback on muscular tension in those who are initially diagnosed as "manic," "depressive," or "agitated" personality states, and those with no elevations on the MMPI.\(^2\)

Other purposes of this study were (1) to compare four different groups (classified by personality states) in their ability to decrease muscle tension, and (2) to examine the time period during which the greatest amount of decrease in muscle activity occurs. Because muscular tension differs for those who exhibit specific "personality states," if one knew the effects of biofeedback on muscular tension (when in a

\(^2\)See "Definition of Terms" for definition of above-named "states."
manic, depressive, or agitated state), then biofeedback programs could be modified to meet the needs of the individual.

Hypotheses

1. Subjects with a diagnosis of "depressive state" would be able to decrease EMG (electromyographic) readings significantly more than a comparison group (those profiles with no elevations over 70).

2. Subjects with a diagnosis of "agitated state" would be able to decrease EMG readings significantly more than those in the comparison group.

3. Subjects with a diagnosis of "manic state" would be able to decrease EMG readings significantly more than those in a comparison group.

4. Subjects with a diagnosis of "manic state" would be able to decrease EMG readings significantly more than those with a diagnosis of "depressive state."

5. Subjects with a diagnosis of "manic state" would be able to decrease EMG readings significantly more than those with a diagnosis of "agitated state."

6. Subjects with a diagnosis of "agitated state" would be able to decrease EMG readings significantly more than those with a diagnosis of "depressive state."

Each EMG reading was an average microamp reading for each
session per subject. The average microamp was computed from five readings taken at six-minute intervals.

Background and Significance

Because of the increasing trend towards the use of biofeedback for medical and psychological problems, it is important to know if individuals who come to the hospital in a certain personality state differ in their ability to lower muscle tension.

Most of the work on the relationship between the outcome of biofeedback training and personality has been concerned with an index of personality called the "locus of control." The two extremes of the locus of control are called internal and external. Those with an "external" locus of control feel that they have little personal control over personal events. "Externals" believe control comes from external sources such as an outrageous fortune. "Internals," on the other hand, believe that they themselves control their own destiny. It would only seem logical that in regard to biofeedback, which emphasizes self-control, the "internals" would do better than the "externals." This was confirmed in EEG alpha enhancement experiments (Johnson and Meyer, 1974; Goesling, May, Lavond, Barnes and Carreira, 1974). In regard to physiological control, Ray (1974) and Ray and Lamb (1974) have shown that externals are better than internals at decreasing heart rate levels, but that internals are more proficient at heart rate speeding. Gatchel (1975) showed that the relation between locus of control and directional heart rate was demonstrable early on in training. Unfortunately, there are relatively few studies on individual differences in regard
to biofeedback training. These studies on locus of control show that further investigation of specific individual differences and the effect that these differences have on biofeedback training are important.

Researchers have mentioned the need for such studies (Hume, 1976); however, little investigation has taken place in regard to personality and biofeedback. Brown, in *Stress and the Art of Biofeedback* (1977), states "personality structure appears to play a significant role in the success of EMG (and possibly all other biofeedback)." However, Brown does not expound on this concept but only comments on its importance.

The proposed study, therefore, followed from the suggestion by Brown and others that a variable such as personality would affect biofeedback training and that a fuller understanding of these variables was essential to further biofeedback research.

**Definition of Terms**

**Electromyographic biofeedback**—a process or technique for learning voluntary control over automatically regulated body functions. The term "biofeedback" is a shorthand expression to describe the process of "feeding back" physiological information to the individual generating the information (Brown, 1977). The term "electromyographic" indicates that muscular tension, rather than another physiological response is being measured. The frontalis muscle (located on the forehead) is the most common site at which feedback occurs.

**Substance abusers**—this refers to patients who have ingested substances considered either illegal or harmful when taken in large
dosages. All subjects used were classified as substance abusers by
the psychiatrist at East Dallas Hospital, and they either had been or
were to be admitted to the hospital because they were abusing drugs or
alcohol and had been unable to keep a job or function in everyday
life. All subjects were hospitalized at East Dallas Hospital.

Agitated state (diagnosis)--this was defined using the criteria
set by Gilberstadt and Duker (1965). The rules for defining an "agi-
tated state" were taken from the psychopathic scale and the paranoia
scale of the MMPI. Patients falling in this group had

1) a scaled T-score on the psychopathic deviate scale
greater than 65, and

2) a scaled T-score greater than 65 on the paranoia scale.

Manic state (diagnosis)--this was defined using the criteria
set by Gilberstadt and Duker (1965). The rules for defining a "manic
state" were taken from the mania and depressive scales of the MMPI.
Patients falling in this group had

1) a scaled T-score on the mania scale greater than 70, and

2) a scaled T-score of less than 55 on the depressive scale.

Depressive state (diagnosis)--this was defined using the cri-
teria set by Gilberstadt and Duker (1965). The rules for defining a
"depressive state" were taken from the depressive scale of the MMPI.
Patients falling in this group had

1) a depressive scaled T-score from 70 to 79, and a
   mania scaled T-score less than 40, or
2) a depressive scaled T-score from 80 to 99, and a
mania scaled T-score less than 50, or
3) a depressive scaled T-score of over 100, and a
mania scaled T-score less than 60.

Comparison group--these were patients with no elevations above
70 T-score on any of the ten scales, including the validity scales, on
the MMPI. However, all patients in the comparison group were in-patients
with drug or alcohol problems.

Limitations

One limitation was that the cassette tapes used in the bio-
feedback training program were of different time lengths. The differ-
ent time lengths proved a limitation because even though a subject may
have had a decrease in muscle tension by the end of a 44-minute tape,
the last reading was taken at 30 minutes. The specific population of
substance abusers limited the ability to generalize to other types of
populations. However, this population was readily accessible, as well
as being a population which could benefit from the effects of biofeed-
back. Only ten subjects were placed in each group due to the diffi-
culty of finding subjects who were admitted to the hospital in "person-
ality states" as defined by Gilberstadt.

Still another limitation lay in determining the effects of psy-
chotrophic drugs on a person's muscle tension. It would be virtually
impossible to discontinue the use of drugs due to legal and medical
implications. The exact drugs used and on which subjects each was
used is dealt with more extensively later in this study.
Perhaps one of the greatest limitations of this study was an inability to predict with validity the amount of time a subject remained in his initial "personality state." This problem is recognized in the literature. However, for the use of this study, personality states were concerned only as measures of classifications. It is this author's contention that a subject stays in a particular state until psychotherapy or another intervening treatment variable can alter this personality state. Any study which is looking at personality states recognizes this problem. Gilberstadt (1978) wrote, in a personal communication, "Behavioral terms to describe states probably will continue to be fuzzy conceptually until the biophysical and biochemical substrates as well as the psychophysiological correlates of these concepts are delineated."

Because biofeedback is an operant conditioning technique which must be learned, it is unlikely that personality states, psychotrophic drugs, or intervening variables such as group, individual, or family therapy could lower a physiological process. The only therapeutic treatment which would affect the experimental treatment of biofeedback would be relaxation therapy, in which the patient follows the therapist's instructions to relax specific muscle groups. No therapist utilized relaxation therapy with any subjects in this study.
Basic Assumptions

The investigation was based on the following assumptions.

1) The responses on the test items reflected the thinking of the respondents. The MMPI has a Lie scale to exclude those with a significant number of lies (over 70 T).

2) Respondents followed the directions on the cassette tape which teaches the subject to relax.

3) Electromyographic biofeedback is an operant conditioning process which measures muscle tension on the frontalis muscle (Brown, 1977).

Instrumentation

Minnesota Multiphasic Personality Inventory

The MMPI is one of the best-known personality tests used today. The MMPI does not attempt to measure the whole personality area in a systematic way, but rather attempts to predict currently accepted psychiatric categories. Adock (1965) states that the MMPI has empirical validity in that it is the basis for actual treatment in regard to psychiatric categories which are most meaningful from a diagnostic point of view. Ellis (1965) reviewed the MMPI in 1959 and found that out of 160 studies employing the MMPI, 102 (or 64%) showed significant discrimination. A well-publicized strength of the MMPI is its empirical derivation and norming.

Lingoes (1965) summarizes the diagnostic validity by saying that the "MMPI can differentiate quite well between those who do and
those who do not have emotional and adjustmental problems in a wide variety of settings, and can thus serve as an excellent screening device". There is little value in utilizing the MMPI to differentiate among individuals coming from normal and abnormal populations; however, neuroticism, character disorders, psychoticism and psychosomatic disorders can be reliably separated. Although most useful with an adult population, the MMPI has only slightly diminished utility with an adolescent population down to the age of 12 or 13 (Rodgers, 1972).

Test-retest stability coefficients reported range from 0.46 to 0.93 over a period of three days to one year, and cluster at about 0.76 (Adock, 1965).

The general consensus among experts is that the MMPI as a clinical instrument, especially when used in conjunction with other tests, is unequaled and has a definite contribution to make. For the purpose of this study, criteria definitions were set from the scales on the MMPI. Diagnostic criteria were specifically taken from Gilberstadt and Duker's *A Handbook for Clinical and Actuarial MMPI Interpretation* (p. 21).

**Procedure for Data Collection**

This experimental procedure consisted of four distinct phases: initial screening and division into groups, pre-treatment introductory biofeedback tape, the experimental treatment of electromyographic training taking place over fourteen days, and a comparison between these groups to determine which had the most significant decrease in EMG readings. Individuals who met Gilberstadt and Duker's criteria
for depressive states, agitated states, and manic states were used (see "Definition of Terms" for criteria of states). Also a comparison group was composed of ten subjects who had no elevations on their MMPI. All testing was done prior to admission to the hospital (within 48 hours prior to the beginning of biofeedback training) by biofeedback technicians. This was done to preclude investigator bias.

Initial Screening and Division into Groups

Within 48 hours prior to beginning the treatment program, all subjects were given the MMPI. This test was scored and charted and each subject was either (1) excluded due to inability to meet criteria, (2) included in a "manic state" group, (3) included in an "agitated state" group, (4) included in a "depressive state" group, or (5) included in a comparison group, indicating that this subject had no elevations on any scale of the MMPI. No subject was used in more than one group. For example, if a patient fit the criteria of "manic state," but also had an elevation on scale 7 (pt), he was not used in either group. Each group consisted of ten subjects.

No attempt was made to control for age, sex, or educational level, as it has not been determined that these variables have a substantial effect on the biofeedback treatment.

Pre-treatment Introduction

Each subject was given an introduction to biofeedback. This introduction was given by the biofeedback technician. It included an explanation of what biofeedback is, a demonstration of the apparatus
to be used and where it was to be placed on the subject, and the length of each session. This introduction by the technician was given ten to fifteen minutes prior to the first session. At this time, the technician told each subject to listen to the instructions on each cassette tape, and to follow the directions of the speaker.

**Experimental Treatment**

The treatment phase lasted fourteen days (with 24 hours between each session), and was composed of six tapes. Each subject was given a schedule which designated at what time he was to have biofeedback training. After the explanation of biofeedback, the first tape was played ten to fifteen minutes after the introduction had been given by the technician.

These tapes were created by Stat Clinics, Incorporated, of Houston, Texas. The tapes are part of the standard treatment for use with biofeedback. Use of these tapes with the EMG biofeedback treatment has resulted in a treatment "success rate" of 75 per cent with alcoholics (Brown, 1977). However, Brown does not define what is meant by "success rate." EMG equipment is produced by Biofeedback Systems, Boulder, Colorado, and is accepted as valid equipment in the use of biofeedback programs.

Session 1, Tape 1--This tape is an introduction to biofeedback, and a description of what the treatment process entails. (Time of tape: 30 minutes).
Session 2, Tape 2--This tape is a presentation of tensing/relaxing different muscle areas. The patient is instructed to tense and release a specific set of muscles. Also, suggestions that tension is "floating away" and the body is becoming more and more relaxed are given. (Time of tape: 30 minutes).

Session 3, Tape 2--Repeat of Session 2.

Session 4, Practice Tape--This tape is a presentation of soft music along with some verbalization to the patients that they should practice what they have learned on the tape which was heard in the last session of biofeedback (Tape 2). During all practice tapes, the individual is instructed to practice the exercises he has learned the previous day.

Session 5, Tape 3--This tape is a replication of Jacobson's progressive muscle relaxation technique. This technique was first created in 1908 by Edmund Jacobson. It is a procedure whereby the subject relaxes each part of the body progressively and learns to become internally aware of this feeling of relaxation (Brown, 1977). This tape differs from Tape 2 in that there is no tensing of the muscle areas. The speaker starts with the patient's head and instructs him to relax every part of the body, down to the feet. (Time of tape: 35 minutes).

Session 6, Tape 3--Repeat of Session 5.
Session 7, Practice Tape--This is a practice tape with background music and instructions to practice what was learned in the preceding session (Tape 3). (Time of tape: 30 minutes).

Session 8, Tape 4--This tape contains basically the techniques of "autogenic training." Autogenic training (A.T.) was borrowed from hypnotic techniques and is a combination of self-suggestion about relaxation and more advanced self-suggestion phrases for learning to control consciousness, as in meditation (Brown, 1977). The speaker gives instructions that the patient should be passive and "let something happen--not try to make something happen." Included in this tape is the introduction to visual imagery, whereby the patient imagines, for example, ocean waves and feels the relaxation that this scene creates. Visual imagery is a technique by which the subject visualizes a pleasant relaxing image. Jacobson was able to demonstrate that there is an energy expenditure during imagination (Brown, 1977). (Time of tape: 35 minutes).

Session 9, Tape 4--This is a repeat of Session 8.

Session 10, Practice Tape--This is a practice session of Tape 4.

Session 11, Tape 5--This tape is labeled "visual imagery training" and has the patient imagine an island as the speaker takes him through scenes on this island in his imagination. Such images as "visualize yourself on a cloud as the relaxation sets in" are presented. Many other relaxing images are presented, and suggestions of relaxation are also combined with the technique of visual imagery. The subject is also instructed to visualize an actual situation which evokes anxiety and to practice relaxation in this circumstance. (Time of tape: 44 minutes).
Session 12, Tape 5—Repeat of Session 11.

Session 13, Practice Tape—This session entails practice of what was learned on the preceding tape (Tape 5).

Session 14, Tape 6—This is a combination of all techniques presented on Tapes 2 through 5. These techniques are progressive muscle relaxation, tensing/relaxing muscle groups, autogenic training and visual imagery. (Time of tape: 35 minutes).

Recording and Monitoring

There were three phases in recording a subject's EMG reading.

1) Each subject had three electrodes placed on the frontalis muscle and headphones placed on the ears.

2) The cassette tape was started and auditory clicks were heard through a set of headphones, with the instructions that each subject should try to decrease the number of clicks.

3) EMG readings were taken at six-minute intervals by the biofeedback technician, using a clock with a second hand. Five readings were recorded for each session. EMG readings were recorded by the biofeedback technician to prevent investigator bias. Even though some tapes were longer, all readings were taken at six-minute intervals, in order to equalize time intervals for all tapes.

Procedure for Analysis of Data

All EMG readings were expressed in microamps for each session. An adjusted mean was computed for each session through analysis of
covariance. These daily session means were computed into an adjusted group mean for each group and the resultant means were compared between groups. In this way, it was easy to determine where EMG decreases took place for each group. At the end of the experimental treatment, all group means were compared to examine the general differences between groups. These hypotheses were tested by the analysis of covariance using a Randomized Block Design. The Tukey's Range Statistic was used for making multiple comparisons among means. The four different analyses of covariance were used to compare the adjusted groups means on the dependent measure. This study followed Rosco's ex post facto design, since sampling was based on an established population.
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Electromyography and Muscular Tension

Electromyography is used to study muscular function, muscular tension specifically. The electrical energy derived from the muscle signal is amplified to achieve recording potentiation. "Muscle tension" differs according to which field (physiology or psychology) is using the term. Jacobson's (1938) reference to muscle tension defines it as "a state of nervous hypertension or hyperexcitability with definite pathological connotations." Some writers identify tension with "tonus" (Goldstein, 1972), while others distinguish between the two, confining the term tonus to mean sustained contraction caused by a continuous barrage of nerve impulses. In psychological research, muscle tension is taken to mean the state of contraction of the muscle. When complete relaxation occurs, there is no muscular contraction and consequently no tension (Broman, 1949). Stimulation of the muscle leads to contraction and simultaneous electrical, chemical, structural and thermal changes that result in what is known as muscle action potentiation (MAP). The recording of electrical events of the MAP makes up the EMG.

The electrochemistry of the MAP is important in understanding the rationale for the use of the EMG apparatus. A typical muscle is an elongated mass of tissue consisting of millions of separate muscle fibers, bound together by a sheet of connective tissue. If two or more
electrodes are on the skin, or inserted (in a hypodermic form) into the muscle, and the muscle is stimulated, an electrical current flows, and this is recorded as the EMG. Each time an action potential passes along a muscle fiber, a small portion of electrical activity spreads from the muscle to the skin. During the resting state, each fiber within the muscle maintains a negative intracellular potential of 50 - 100 mV (microvolts).

Basic to an understanding of the MAP is the concept of the motor unit, for muscle fibers in normal skeletal muscles do not contract individually, but function as a group. This group of fibers is innervated by a single nerve fiber. Just before reaching the muscle fibers, axons of the nerve fiber divide into small branches called axon fibrils. Each axon fibril ends upon a muscle fiber so that there is usually a one-to-one relationship between muscle fiber and axon fibril. The complete motor unit consists of the nerve cell body, its axon, the axon fibrils, and all of the muscle fibers innervated by these fibrils. Most EMG studies in psychology are concerned with the activity of the whole muscle, rather than discrete motor units. This is the reason why the psychologist uses surface electrodes that record the coarse pattern of rapidly occurring spikes over many units. The magnitude of contraction, as measured by surface EMG, varies as a function of motor units participating. At low contraction there are only a few discrete motor units active at a low discharge rate. A slight increase in effort increases the contraction rate of these units up to 40 discharges per second. With greater tension, additional motor units are activated (Bigland and

Electromyographic Studies Relating to Personality Theory

Since the early part of the twentieth century, various writers have suggested a relationship between muscle tension and certain aspects of personality (Goldstein, 1972). In general, the individual with low muscle tension has been found to approach situations in a very calm, deliberate manner. In contrast, the highly tense person is characterized by more hyperactive, excitable behavior (Goldstein, 1964). For the most part, these results have come from observations of indirect and unreliable means of recording muscle tension. Using a factor estimate of general muscle tension obtained from MAPs of 16 different muscle groups, Balshan (1962) showed that tension during an auditory stimulus was negatively correlated with the Guilford-Zimmerman trait of restraint and positively correlated with general activity. This would seem to indicate that the person with the heightened muscle tension is somewhat impulsive and happy-go-lucky, with a rather high energy level. There was no relationship found between muscle tension and any other of the Guilford-Zimmerman temperaments. Using an index of general muscle tension based on the sum of standard scores for seven widely separated muscles (frontalis, trapezius, neck, extensors, biceps, forearm flexors, quadriceps, and gastrocnemius), Shipman, Oken, Goldstein, Grinker and Heath (1964) found an unexpected relationship between MAPs and personality. They found that subjects whose EMGs during rest and stressful interviews were
elevated tended to be emotionally stable and free from anxiety, with a clear sense of personal limits and good self control. These results, which are contrary to most theoretical thinking and earlier investigation, probably result from the selection of subjects who were from a psychiatric population in which intense depression and acute illness were major factors. Among these highly depressed patients, the individuals who were in better control of their emotions were more tense than patients with low emotional stability. The authors suggested that the element of control was expressed through skeletal muscles. This study helps to support the contention that persons with internal locus of control are more successful at reducing muscle level tension. Martin (1956, 1958) divided four groups of college students into introverted neurotics, extroverted neurotics, introverted normal and extroverted normal subjects. She found that none of the categories were significantly related to MAPs obtained from the frontalis muscle. Goldstein (1972) suggested that Martin's study was deficient in the range of the college population and was not extreme enough to show differences. Since that time, LeBoeuf (1977) has found that anxious extroverts react far less favorably to frontalis training than do anxious introverts. This study confirms the theory of Eysenck (1953) that introverts learn more easily than do extroverts due to inhibition factors rather than excitation factors. All studies related to EMG training and introvert/extrovert factors in personality suggest that other techniques for inhibiting anxiety might be used for the anxious extrovert.
Kempe (1956) reported that personality types differentiated on the basis of their primary response in one of the physiological systems. This supports the contention that a given individual has a characteristic pattern of muscle reaction and will respond to a variety of conditions with a maximal level of response in the same muscle (response specificity). He will also maintain a constant hierarchy of tension levels in different muscle groups (response stereotype). Patterns of response are maintained fairly well by seven different muscle groups during conditions of affect arousal, attempts at self-control, a non-stressful interview, and rest. Kempe (1956) recorded the GSR (galvanic skin response), heart rate, respiration rate, and MAPs from a masseter sternocleidomastoid, and forearm extensors taken during sensory stimulation in response to pictures which were similar on the Thematic Apperception Test. On the basis of intercorrelations obtained from 12 physiological measures and 26 personality test items, Kempe extracted clusters of significant intercorrelations. He found that skeletal muscular responders were ones who remained aloof from others, denied emotions, and approached life in an intellectual, unfeeling manner. In contrast, he found that the autonomic responder was prone to worry a great deal, was emotionally sensitive, and was highly concerned with acceptance by others.

Experimental studies support the hypothesis that there are distinct differences in muscle tension among individuals, and that these differences tend to be maintained under varied conditions (Goldstein, 1972). Furthermore, Goldstein states that although the results are not clear
cut, certain traits have been associated with high muscle tension. For the most part, it appears to be that excessive MAP activity has been found in the subject who is extremely responsive to a variety of stimuli. This individual is able to express his emotions freely and to act out his feelings.

Among psychologically maladjusted groups, frequent reports have been made of exaggerated skeletal muscular responses (Goldstein, 1972). These individuals have stated that they feel "fidgety," "uncomfortable," and "tense." Reusch, Cobb, and Finesinger (1941) and Reusch and Finesinger (1943) observed that subjects with reported feelings of body tension had difficulty relaxing. This was indicated by elevated MAPs of the forearm flexors and extensors during the intervals between a simple hand exercise. In addition, while typewriting, those subjects who had been judged as tense used more muscles to perform the activity, yet used them in a less efficient manner (Lundervold, 1951). These findings have been challenged since EMG recordings were used originally to make judgments of the subjects' tension level.

Jacobson (1934, 1938), the father of "progressive relaxation," believes that the inability to relax is responsible for the persistence of the mental state, and the excessive imagination and emotions of many neurotic and hypertensive subjects. Jacobson trained subjects to relax by contracting and relaxing various muscle groups. By engaging in this practice, Jacobson found he could reduce the subjects' MAPs and accompanying mental symptoms. In addition to an inability to relax, many neurotics are characterized by persistent conflicts. Hoshiko and
Grandstaff (1967) provided evidence of some trends in the MAPs of conflict situations. They found that accompanying frequent conflicts is a tendency to respond to stress with extreme skeletal muscular reactions. This picture is further complicated by the neurotic's tendency to perceive a number of situations as potentially stressful. Davidowitz, Brown-Meyers, Kohn, Welch, and Hayes (1955) found MAPs greater in the neurotic than in the control group when asked to perform a simple voluntary motor task. This was found to be true whether the stress was real or imagined; the physiological responses of the neurotic are the same. Research shows that the neurotic, with his imagined fears and pain, are in a constant state of heightened muscle tension (Grossberg and Wilson, 1968).

Malmo, Shagass, Belanger, and Smith (1951) concluded that psychoneurotics can be characterized by some disturbance in motor function, perhaps as a result of a defect in the motor mechanism. They hypothesize that this defect would become apparent in any type of stress. In response to three stressors (mirror drawing, speeded size discrimination, and pain stimulation), psychotic and neurotic patients showed higher EMG reactions in the forearm flexors and the neck than a comparable group of non-patients. Evidence for an exaggerated muscle response was also found in other measures of motor activity (Malmo, Shagass, Belanger, and Smith, 1951). Malmo believes that the large amount of energy that the psychoneurotic expends may offer an explanation for the clinical complaints of fatigue and tension. Martin (1956) recorded MAPs of the frontalis and forearm extensors and found no difference between neurotics and normals at rest.
In a study which looked at personality factors and psychophphysiology, some interesting conclusions were reached. Goldstein (1964) cites evidence indicating that temporary emotional states of anxiety raise muscle tension. However, this evidence was refuted by Davis (1938) who found that muscle tension levels tend to be a rather stable, enduring characteristic of the individual. The question presented as it relates to psychophyysiology and muscle tension, appears to be what enduring personality characteristics tend to go along with high, medium or low muscle tension levels (Shipman, Oken, Goldstein, Grinker, and Heath, 1964). Wenger (1938) indicated that chronically high muscle tension appears in energetic, restless, distractible, impulsive, emotional children. Variability of this muscle tension was found related to excitability (McKinley and Berkowitz, 1928 and Duffy, 1932). Kempe (1956) found more muscle variability in those who denied their emotions.

Experimental literature has emphasized the relationship between anxiety states and muscle tension while the psychiatric literature has focused on muscle tension as an element in the impulse control system. Shipman, Oken, Balshan, Goldstein, Grinker and Heath (1962) note in their study that these issues of psychophysiology and muscle tension raise the question as to how each aspect of emotion, alone or in combination, is related to muscle tension. Their research specifically predicted that muscle tension would be greatest in the presence of anxiety, lower with anger (anger also found in "agitated states") and lowest with depression. They also predicted that muscle tension would not rise with unconscious defensive behavior, while it would be
considerably elevated by conscious efforts at control. Another prediction was that the resting levels of muscle tension would be high in people with "personality rigidity" and that the greatest increases above basal levels would be found in anxious, highly emotional, poorly emotionally controlled, hysterical people. Paradoxically, they found that the depressive state was related to low biceps tension levels while high anxiety states were associated with a minimal use in frontalis and quadriceps tension over basal levels. The suggested relationship between depressed states and reduced biceps tension was not anticipated. The authors suggest that one might interpret this finding as depressed patients having "lost the will to fight." When the individual muscles were considered, four of them had significant correlations with personality. It was found that persons scoring high on Emotional Stability, Rorschach Movement, and Rorschach Barriers (E-M-B), tended to have high trapezius tension. Low E-M-B people had the greatest increase in trapezius tension during the experiment. People low in unconscious hostility had the greatest muscle activity in the quadriceps, while those with much unconscious hostility had the greatest level of tension in the quadriceps at rest. People with hysterical tendencies had the lowest frontalis tension. Frontalis increase was related to the ego strength score on the Minnesota Multiphasic Personality Inventory (MMPI). Also found was that consciously angry persons had the most variable quadriceps functioning and the least variable frontalis functioning. Martin (1956) found that hysterics had lower muscle tension than did dysthymics. The suggested reasoning for this is that hysterics make such extensive
use of repression that at rest they can become the most calm and relaxed. In general, Martin concluded that dysthymics (anxious, depressed, or obsessional patients) were more tense than hysterics, while psychotics (schizophrenics in the early stages) showed higher EMG responses than normals. Martin's study supports the findings of Acker (1963) who concluded that there is a sympathetic imbalance in people compensating for unstable or weakening ego defenses. It appears that muscle tension is also related to this autonomic balance level.

Henley (1935) looked at tension scores in a psychiatric population and found that tension scores were distributed in the following manner from greatest to least: manic-manic, psychoneurotic, dementia praecox, and manic depressives. However, the results of this study are dubious since muscle tension was defined by outmoded diagnostic categories. Goldstein (1964) remarks in his article that it has been shown that psychiatric patients exhibit increases in muscle tension under most conditions. Although it is natural for stress to bring about marked increments in tension, it is probable that to some individuals most situations are perceived as stressful.

There are distinct differences between well-adjusted and emotionally unstable children in physiological measures taken during rest, attention, learning, frustration, recall, and sensory stimulation. While some differences were found to exist during both rest and attention, they were prevalent during frustration. In the emotionally unstable group an exaggerated reaction was found in skin resistance, heart rate, blood pressure and suppression of alpha rhythm. Whereas pre-psychotic and
neurotic individuals presented unstable patterns and reacted most violently to frustration, adjusted persons showed patterns of greater stability (Jost, 1941; Sherman and Jost, 1942). In comparisons of manic depressives, schizophrenics, psychoneurotics, and normal adults during motor tasks (in contrast to Sherman and Jost, 1942), it was the schizophrenics who showed the greatest increases in muscle tension (Wulfeck, 1941). These contradictory results could be due to several factors. To begin with, Sherman and Jost had only three schizophrenics in their population. Also, the only measure of muscle tension was the amount of tremor present. Moreover, the amount of physiological reactivity may be related to the chronicity of the psychosis. In a study which compared normals and schizophrenics, it was found that schizophrenics have higher muscle action potential levels in the forehead, jaw, forearm, and leg (Whatmore and Ellis, 1958). These results were confirmed by another study reported by Petursson (1962).

During agitated states, neurotic patients evaluated by Jacobson (1952) exhibited increases in muscle tension in all four regions from which he recorded muscle action potentials: brachial biceps, quadriceps femoris, eyebrow and jaw.

Due to the presence of muscular tension in "nervous individuals," there is difficulty relaxing. Lundervold (1957) has shown that individuals who are not so tense can relax in many positions and sit comfortably over long periods of time. More tense persons, on the other hand, are unable to relax in many positions and can only change with a marked increase in muscle strain. Although the results show an inability
to relax among psychiatric populations, Jacobson (1934) has found such a phenomenon to be characteristic of a group of college students. After a period of training the group of neurotic individuals could be taught to relax to a greater extent than the untrained college students (Jacobson, 1938). This may suggest that muscle tension may not be related to the ability to relax. In comparison, the reaction to a pain stimulus in anxiety neurotics, schizophrenics, and normals, the degree of physiological reaction was related to the amount of anxiety present (Malmo, 1957).

While many investigators have shown that the neurotic, rather than the psychotic, is the most physiologically reactive, this has been assumed to be due to the anxiety level of the neurotic. In a study by Goldstein (1965), the anxiety of the neurotic and psychotic groups were matched in advance on the basis of anxiety test scores. Individuals with character disorders responded at MAP levels which were equivalent to those of normal subjects. This was found to conflict with the belief that schizophrenics are unreactive as shown by Malmo and Shagass (1949) who reported that schizophrenics had exaggerated EMG neck reactions to pain. The investigators hypothesized that disturbances in thinking and emotion, which are typical of schizophrenia, might stem from a hyperactive motor system. Because the degree of retardation is so great in chronic schizophrenics, there is reason to believe that their psychophysiological reactivity is correspondingly low. The research of Malmo, Shagass, and Davis (1951) seems to indicate that this is not true. When the necessary muscular response was a purposive act such as pressing a
button in response to pain, the schizophrenic found it difficult to react adequately. Presumably, while his emotional physiological responses were intact, voluntary reactions were subject to some loss. In another study of chronic schizophrenics, 10 out of 13 showed failure to suppress muscle tension during REM sleep, either in terms of very frequent bursts of EMG or sustained EMG activity during REM periods. This raises the question of some disturbance of the motor inhibitory components of REM sleep in schizophrenics (Gulevich, Dement, and Zarcone, 1967).

Fenz and Velner (1970) classified their patients as either acute or chronic schizophrenics based on their premorbid level of development. EMG MAPs were recorded at rest and in response to intense audio and visual stimuli. In general, the two schizophrenic groups did not differ with regard to muscle tension, but they did exhibit higher EMG responses than a normal control group. The patient groups also showed greater muscle potential increases from rest to the stress situation.

Probably the most work related to muscle activity and personality has been done on depression. In depression, there is usually a decline in overt responsiveness. Whatmore and Ellis (1959) chose a group of depressed patients who were retarded to the point of being mute, and found their EMG responses during relaxation were higher than a control group. A second group of depressed patients with less visible signs of retardation was also characterized by exaggerated EMG activity, although the MAPs in this group were not as high as in the mute depressive group.
During psychiatric treatment with five of these patients, muscular activity was found to drop. Some time after treatment, during a period of health, prior to relapse, significant increases in MAP levels occurred in the retarded patients, suggesting that this is a general characteristic of the depressed person (Whatmore and Ellis, 1962).

Rimon, Stenback, and Hahmar (1966) used Beck's Depression Inventory to assess depression. They recorded resting levels of muscle tension in the frontalis, masseter, forearm, and leg, and found differences among various muscle groups as well as sex differences. They also found slightly depressed women exhibited higher muscle tension levels than the more depressed women, however this result was felt to be due to the psychological tension produced in women by a male physician. Among the male patients, greater EMG activity was more characteristic of severely depressed patients. In contrast, the authors found the masseter muscle was more active among slightly depressed patients of both sexes.

Many times depression is accompanied by symptoms of anxiety. Goldstein (1965) compared depressed neurotic patients with a group of non-depressed neurotics of equivalent tested anxiety levels as well as with a non-patient population. He found that the depressed patients were differentiated by their autonomic responses as well as by heightened MAPs in response to a white noise. The non-depressed neurotics and normals had similar physiological reactions and were less responsive than the depressed patients. It was concluded from this study that the presence of a neurosis, alone or with some anxiety, is not enough to account for the exaggerated physiological responses accompanying depression.
Whatmore and Ellis (1959) noted higher muscle tension in elderly depressed patients than in normals of the same age, and also found that within the depressed group those who were extremely mute deviated more from normal controls, especially on the jaw-tongue muscles. Whatmore and Ellis (1962) also reported a reduction of muscle tension during the treatment of five depressed patients who had experienced several episodes of a depressive illness. However, when treatment terminated, muscle tension became elevated once again. Heath (1966) reached several conclusions regarding depression and muscle activity. He found that relative to frontalis and trapezius areas, bicep and quadricep tension are lower for depressed than for non-depressed patients. Within the depressed group, higher bicep readings are related to better emotional adjustment. This is not true for the non-depressed patient who, relative to frontalis and trapezius tension, already has higher bicep tension than the depressed patient. McCarron (1973) looked at other physiological responses besides muscle tension in depressed patients, and found that the depressed group was differentiated from the control group by a decreased skin resistance response, a rapid heart rate, increased respiration rate, and greater activation-complexity of EEG. A Russian study by Volynkina (1974) found increased electrical activity of the articulation muscles in subjects in the emotional states of psychosis and depression. Noble and Lader's study (1971) found that prior to ECT (electroconvulsive shock), high basal EMG levels were diminished. Muscle reactivity was correlated with the severity of the depression and with high scores for anxiety, gastrointestinal somatic symptoms,
loss of libido, and weight loss. This study suggests that depressive illness is associated with raised forearm extensor EMG activity.

High muscle tension has been found to be prevalent among psychiatric patients who not only react to stress with tension, but perceive many situations as stressful. Gilberstadt (1965) looked at galvanic skin response in relation to psychiatric diagnosis, and found that the presence of depression is associated with lower levels of activity. Among those patients for whom there is evidence of particularly extreme muscle activity are those with symptoms of anxiety.

There are suggestions that muscle tension relates to a variety of traits although the relationship is not clear cut. There have been a number of conflicting studies as to the relationship of muscle tension and personality. Balshan (1962) found that there was no significant correlation between resting muscle tension and personality traits. This confirms the fact that there is little agreement in the literature as to which of the psychological disorders is accompanied by the greatest amount of muscle disturbance (Goldstein, 1965). There are several hypotheses as to why this is so. The conflict of findings could be due to the noncomparability of the experimental situations. In addition, there is tremendous variation in the methodology of assessing muscle tension, as well as in the decision regarding which muscle responses to measure. Another problem arises because of the unreliability of the diagnostic categories. Also, the chronicity of the psychosis and neurosis may have an important bearing on the magnitude of muscle tension. The only generalized conclusion reached is that muscle tension and
personality factors are very complex. Thus, a finding concerning depressed patients as well as other psychiatric categories with regard to muscle tension cannot be generalized.

The only definite conclusion derived from the literature is that subjects with emotional problems have different muscle tension levels than those who are classified as belonging to a non-psychiatric patient population or "normal" group. The relevancy that muscle tensions do differ for various psychiatric groups is essential for a study which is concerned with the reduction of muscle tension. One question which has not been addressed is whether one's level of muscular tension is an important factor influencing the ability to decrease muscle tension.
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CHAPTER III

METHODS AND PROCEDURES

Subjects

The population of potential subjects from which the ultimate selection was made were persons referred to the Program for Alcoholism, Addiction, Stress and Anxiety from community resources for the treatment of alcoholism, drug addiction, and anxiety. This treatment program is based upon a holistic approach to the treatment of addictions viewed as primarily stress-related problems and includes all the major elements of psychotherapy, such as videotape training, family therapy, occupational and attitudinal therapy, group and individual counseling, and biofeedback training.

After patients were admitted to the hospital, each was assigned to one of six different schedules: A, B, C, D, E, or F. Each schedule designated the time at which each participant was to be engaged in a specific activity. For example, a patient on schedule A was in individual therapy at 10:00 a.m.; a person on Schedule B was in step counseling at 10:00 a.m. A person on schedule C was in diversional therapy at 10:00 a.m. Appendix A contains a copy of this schedule and provides a definition of the various activities. The number of subjects on a particular schedule was important because of the impact an activity preceding the biofeedback training may have had on the subject's muscle tension.
In addition to the printed schedule in Appendix A, the general program outline included family therapy if the individual therapist deemed this to be necessary for a particular patient. Each patient was also given the opportunity to leave on the weekends, either to go out with an assigned person (a non-substance abuser) confirmed by the staff, or given a pass to go home, again providing this was approved by the staff. Weekend passes ranged from twelve-hour passes to thirty-six hour passes and the individual was required to check back into the hospital no later than the specified time limit of his pass. A patient who "acted out" delinquent behavior was secluded within the confines of his hospital room until the professional staff felt that the person was ready to change his "acting out" behavior.

Because this program advocates a "chemical-free life," pharmacology was used as little as possible. However, if a patient entered the hospital in an intoxicated or drugged state, then medication was used to help minimize withdrawal effects from alcohol or drugs. No subject was "heavily drugged" due to medication. All subjects were functional, meaning that they could complete a full day of activities even though they were on medication. The implication that medication has for biofeedback training is that if a person were medicated before treatment began, then muscle tension would be relaxed. However, because biofeedback is an operant conditioning process, it would be virtually impossible for medication to affect this process of teaching an individual how to reduce his EMG readings.
In the agitated group, twenty per cent of the subjects were on an A schedule, thirty per cent were on a B schedule, twenty per cent on a C schedule, zero per cent on a D schedule, thirty per cent on an E schedule, and zero per cent on an F schedule. For the manic group, thirty per cent were on an A schedule, twenty per cent were on a B schedule, ten per cent were on a C schedule, zero per cent were on Schedule D, twenty per cent on an E schedule and twenty per cent were on an F schedule. For the depressed group, twenty per cent were on an A schedule, twenty per cent on a B schedule, ten per cent on a C schedule, twenty per cent were on a D schedule, ten per cent were on an E schedule, and twenty per cent were on an F schedule. For the comparison group, thirty per cent were on an A schedule, twenty per cent were on a B schedule, zero per cent on a C schedule, ten per cent were on a D schedule, ten per cent were on an E schedule, and thirty per cent were on an F schedule.

With regard to pharmacology, major and minor tranquilizers were prescribed for the appropriate patients by a psychiatrist. In the agitated group, two subjects required psychotrophic agents. One patient required 300 mg of lithium carbonate to be dispensed every forty-eight hours. The other patient in the agitated group was given 5 mg of valium every twenty-four hours. In the manic group, one patient required psychotrophic medication. For this patient, 75 mg of Tofranil was given every twenty-four hours. The depressed group had the greatest amount of psychotrophic medication dispensed. Five patients within the depressed group were on psychotrophic medication during the experimental treatment. One depressed subject was put on a "detoxification program,"
which included 150 mg of Tofranil and 30 mg of Dalmane; however this medication was given prior to the experimental treatment. The "detoxification program" was indicated in any instance where a patient was intoxicated with drugs or alcohol when admitted to the hospital. One depressed patient was maintained on 150 mg of Tofranil and 300 mg of lithium carbonate during the experimental treatment. Another subject in the depressed group was diagnosed as epileptic and was maintained on 200 mg of dilantin as well as 25 mg of elavil during the experimental treatment. Two of the depressed subjects were maintained on 300 mg of lithium carbonate every twenty-four hours, and in addition, were given 5 mg of valium every twenty-four hours. The last patient in the depressed group on medication was maintained on 400 mg of meprobamate and 125 mg of Tofranil every twenty-four hours. In the comparison group, two patients required psychotrophic medication. One patient required 300 mg of lithium carbonate every twenty-four hours, while the other required 25 mg of librium and 2 mg of hadol per twenty-four hours.

Although medication was utilized most heavily in the depressed group, medication could not be circumvented due to legal and medical implications. All forty subjects were given multi-vitamins as part of the treatment program.

In the manic group, forty per cent were males, sixty per cent were females. All subjects in this group were Caucasian. Ten per cent of the subjects were Catholic, fifty per cent were Christian, and forty per cent classified themselves as having no religion. All ten subjects within
the manic group were single. Twenty per cent of the subjects were in grades 7 to 9, and eighty per cent were in grades 10 to 12. Seventy per cent were between the ages of 14 to 16, and thirty per cent were between the ages of 17 to 19.

Within the agitated group, sixty per cent were male, forty per cent were female. All subjects in this group were Caucasian. Fifty per cent classified themselves as Christian, ten per cent Baptist, ten per cent Catholic, and thirty per cent were classified as having no religion. Ninety per cent were single and ten per cent of these subjects were separated. Thirty per cent were in grades 7 to 9, sixty per cent in grades 10 to 12, and ten per cent were college graduates or had some college credits. Thirty per cent were from ages 14 to 16, forty per cent were from ages 17 to 19, and twenty per cent were from ages 20 to 22. Ten per cent of the subjects ranged from ages 35 to 37.

Within the depressed group, ninety per cent were male, ten per cent were female. All subjects within this group were white. Seventy per cent were classified as Christian, ten per cent were Baptist and twenty per cent had no religion. Fifty per cent of the subjects within the group were single, twenty per cent were married, ten per cent separated, and twenty per cent were divorced. Thirty per cent of the patients were in grades 7 to 9, ten per cent had college credits, and ten per cent had professional occupations. Thirty per cent were blue-collar workers, and twenty per cent were unemployed. Within age ranges, ten per cent were ages 11 to 13, twenty per cent were 17 to 19, twenty per cent were 23 to 25, ten per cent were 29 to 31, ten per cent were from 32 to 34, ten
per cent were from 41 to 43, ten per cent were from 44 to 46, and ten per cent were from 50 to 52 years old.

Within the comparison group, ninety per cent were male, ten per cent were female. All subjects within this group were white. Sixty per cent were classified as Christian, ten per cent were Baptist, twenty per cent were of no denomination, and ten per cent were Catholic. Twenty per cent were single, forty per cent were married, ten per cent were separated, and thirty per cent were divorced. Ten per cent were from grades 7 to 9, twenty per cent were from grades 10 to 12, ten per cent had college credits, ten per cent were unemployed, ten per cent were white-collar, forty per cent were blue-collar. Twenty per cent were from ages 14 to 16, twenty per cent were from 20 to 22, 10 per cent were from 29 to 31, ten per cent were from 38 to 40, ten per cent were from 44 to 46, twenty per cent were from 50 to 52, and ten per cent were above the age of 55.

The nature of this study was made known to the Program Director and approved by the main organization in Houston, Texas. No attempt was made to control for age, sex, or educational status, as these were not believed to be crucial to an ability to decrease muscle tension (Brown, 1977). Subjects were not made aware of the nature of the study as this would have contaminated the results. A recent study has shown that placebo effects greatly influence the outcome of biofeedback (Andrews, 1975). All potential subjects were given the MMPI within 48 hours of the beginning of the biofeedback treatment program. Selection criteria were based on whether the subjects could meet Gilberstadt and Duker's
(1965) criteria for the three diagnostic categories, or no elevation on any of the ten scales of the MMPI.

All subjects were tested in a hospital room at East Dallas Hospital. All tests were given by the biofeedback technician and scored immediately afterwards. Biofeedback training was then initiated within 48 hours after testing and each patient was assigned to a specific schedule.

Instrumentation

The MMPI has been repeatedly reviewed in Burrows as a valid and clinically effective instrument. Rodgers (1972) states, "The MMPI is almost certainly the psychological instrument of choice for the routine assessment of nature and degree of emotional upset in adult patients seeking help from psychological, medical, or related professions."

The MMPI scales used in this research were Scale 4, the psychopathic deviate scale, and Scale 6, the paranoia scale for the agitated states. Scale 9, the mania scale, and Scale 2, the depressive scale, were used for the manic diagnosis. Scales 2 and 9 were also used for the depressive diagnosis but with diametrically opposed elevations.

To examine the scales more specifically, Scale 2, depression, was utilized in identifying both those in a "manic state" as well as those in a "depressive state." This scale contains items which were selected by contrasting depressed psychiatric patients mainly diagnosed manic-depressive depressed with a general sample (Hathaway and McKinley, 1942).

In general, Scale 2 measures a state characterized by poor morale, moodiness, and feelings of hopelessness and sorrow. Although this scale was constructed from a largely psychotic sample, these items reflect
variations in mood regardless of underlying character structure or
general adjustment. Scale 2 items deal with a lack of interest in
things, apathy, denial of happiness or personal worth, inability to
work, and physical symptoms. Scale 2 is a sensitive index of current
mood; it characteristically reflects temporal variation in depressive
symptoms. Though the interpretation of Scale 2 elevation varies de-
pending on the rest of the profile, it is an efficient index of im-
mediate satisfaction and comfort in living.

Scale 2 is most frequently the highest scale in profiles obtained
from psychiatric patients (Meehl, 1946). These patients readily recog-
nize their own self-depreciation, moodiness and disposition to worry
over even small matters. Here Scale 2 elevation generally reflects
discomfort over failure to achieve life's satisfactions and acceptable
adjustment. Scale 2 is often interpreted as a prognostic index. A
moderate elevation suggests awareness of personal problems and motiva-
tion to change this state of affairs. Low elevation suggests that this
individual's problems have been recognized only by others. Extreme
Scale 2 elevations may reflect a severe lack of psychic energy or with-
drawal which would make traditional talk psychotherapy inappropriate
prior to chemotherapy or ECT. Scale 2 elevation tends to increase with
age and likely reflects increasing responsibilities and worries and
decreasing energy and assets.

A careful and complicated process was conducted in the item
analyses to make this scale more sensitive to minor fluctuations in
mood within the normal range (see Appendix  C ).
The Ma/Hypomania (Scale 9) is a 46-item scale which reflects what is known as hypomania, mild or acute mania, which includes overactivity, elated but unstable mood, and flight of ideas. Some "manic" patients are difficult to distinguish from ambitious and energetic normals. Scale 9 items are quite heterogeneous, reflecting expansiveness, activity level, and excitement (Appendix D). Other less face-valid items describe moral attitudes and family relations as well as somatic concerns.

Scale 9 elevation among a normal male population suggests sociable, energetic, open and forward individuals who are often described as expressive, individualistic, adventurous, enthusiastic, impulsive and curious. They are often noted to enjoy alcohol, have interests in national and political matters, and are often seen as generous and affectionate. High Scale 9 females are described as frank, courageous, and idealistic. Descriptors generally formed a picture of high energy: talkative, enthusiastic and versatile.

Scale 9 is often interpreted as a measure of general energy level at the time of testing. This scale reflects a continuum ranging from low energy and inertia through a range of optimism and energy. Higher elevations suggest hyperactivity while extreme elevations suggest manic excitement and agitation. T scores of 60-70 usually suggest a pleasant, outgoing, enthusiastic individual. They may be seen as restless and uninhibited and perhaps tense and hyperactive. Scores above 70 T in a psychiatric population suggest, with increasing elevation, problems of poor control, narcissism, distractability, and superficiality.
Difficulties in interpersonal relations and aggressive impulses as well as amoral behavior have been noted. Low scorers in this population are often seen as listless, apathetic and lacking in drive. They often lack both self-confidence and optimism. A very low elevation may suggest a significant depression even when Scale 2 is not markedly elevated.

The paranoia scale, Scale 6, contains forty items which characterized a heterogeneous group of psychiatric patients with prominent paranoid features (Appendix E). The expressed purpose of Scale 6 was to evaluate the clinical picture of paranoia, which includes delusional beliefs, ideas of reference, feelings of persecution, influence and grandeur, pervasive suspiciousness, interpersonal sensitivity and rigidity (Hathaway, 1956).

Scale 6 appears fairly stable in a normal population, but is sensitive to fluctuations in paranoid characteristics in individuals within a psychiatric population. Scale 6 is a good example of an actuarial scale; its items correlate moderately to strongly with the clinical syndrome but very little with each other. This scale represents a rather heterogeneous group of items which range from frankly psychotic content to the denial of ulterior motives in others.

This scale, in general, taps the dynamics of the defense mechanism of projection. Moderate elevations suggest excessive interpersonal sensitivity, secretiveness, and a tendency to blame others for one's difficulties. Distrust, brooding, resentment, and indirect hostility may be present. Those who obtain Scale 6 elevations are often seen as
sensitive and prone to worry. Scale 6 suggest suspiciousness, fixed beliefs, and perhaps delusional content and other paranoid signs. These patients characteristically have poor rapport in therapy. They are seen in this context as rigid and intellectually argumentative.

The last scale, the psychopathic deviate scale (Scale 4), contains fifty items ranging from constricted conformity to the anti-social acting out of impulses (Appendix F). The criteria groups used in research often consist of patients hospitalized at the request of the courts due to a long history of delinquent behavior. Scale 4 was developed as an index to measure the predisposition to display characterological features such as impulsivity, low frustration tolerance, and poor social adjustment, and is a fairly stable trait scale.

When prominent Scale 4 elevations are obtained in a psychiatric patient population, several characteristics may be indicated:

1) An inability to express anger in a modulated fashion,
2) Impulsive behavior and limited inner controls,
3) Nonconforming, rebellious, dissatisfied individuals, who may engage in antisocial and self-defeating behavior in spite of adequate intelligence and opportunity,
4) Inability to anticipate the consequences of one's behavior or profit from experience (including punishment and psychotherapy),
5) Interpersonal relations which are quickly formed but shallow and lacking in true intimacy,
6) General problems with authority,
7) A tendency to project blame for current difficulties which may take on a paranoid tinge,
8) Acting-out tendencies which may be evidenced by alcoholism, sexual promiscuity, marital difficulties and conflict with the law.
When Scale 4 is elevated, pathology is likely to be more visible. This scale is a common high-point among a normal male population. These elevations are higher for adolescents which reflects age-appropriate parental or societal conflict and still growing inner controls. High Scale 4 in adolescence may well, however, reflect delinquent trends. High Scale 4 elevation in normals usually reflects a sociable, adventurous, individualistic, assertive, and active orientation which makes for high social visibility. High Scale 4 women are often seen as tense, striving, active, and lacking in internal control (Lachar, 1977).

A low elevation on Scale 4, in contrast, suggests males with low drive and narrow interests who are seen as conforming, conservative, and dependable. Women who obtain similar low elevations may also be seen as balanced, good-tempered and as having home and family interests. Some suggest (Carson, 1969) these elevations reflect low levels of heterosexual aggressiveness, rigidity, and overidentification with social status.

It is important to note that when examining "states," it was the combination of scales, rather than solely the elevations of specific scales that determined diagnosis. The examination of specific scales was incorporated only to identify behavioral characteristics of subjects utilized in this study.

Procedure for Collecting and Processing the Data

A standard procedure for biofeedback training was implemented and was conducted in two phases following the procedure for the selection of subjects. There was no differential treatment for the comparison
and experimental groups. All subjects received identical instructions prior to the actual treatment phase.

Pre-treatment Introduction—The subjects were brought into the biofeedback room between the hours of 10:00 a.m. and 5:00 p.m., depending on each patient's individualized schedule. Each patient was taken to a large room for biofeedback training. Instructions were then given for the biofeedback training (see Appendix A).

Experimental Treatment—Preceding the instructions, each subject was seated in a large recliner chair in a dark room which was temperature-controlled. The electrodes were attached to the subject's frontalis muscle, located on the forehead. The headband consisted of a long rubber strip with three surface electrodes approximately one inch apart. Electrogel cream was inserted between the forehead and the electrodes to facilitate the recording of the electrical muscle activity as projected by the EMG machine. The machines used are created by Bio-Feedback Systems, Boulder, Colorado. EMG readings were recorded as D.C. microamps. These microamps range from zero (resting level) to fifty (highest level of muscle activity). The EMG machines have three levels of sensitivity: low, medium, and high. All recordings were made on low sensitivity. The volume of auditory "feedback clicks" was set on a volume most comfortable for each individual subject. Volumes ranged from zero to ten, with normal volume range set between eight and ten. Five subjects received biofeedback training simultaneously since there were five portable EMG machines in the room where the treatment took place.
There was a 24-hour time lapse between each session for each individual subject.

Six different cassette tapes were used in the treatment program. The tapes consisted of recordings of various relaxation methods and were heard through individual sets of headphones. The headphones used were Sonic A, 8 ohm. The biofeedback technician assisted each subject to adjust the headset to the most comfortable position and volume level. A baseline reading was taken when the electrodes were first placed on the subject. Subsequent to the first reading, four more readings were taken during each 30-minute session. Readings were taken at 6-minute intervals, which were timed by a stopwatch. There was a total of fourteen sessions, 30- to 40-minutes per session.

After the speaker on the tape was finished, the biofeedback technician removed the subject's headgear and handed each one a kleenex to remove the electrogel cream. Each subject was asked to sit quietly until all other subjects had finished. When the session was over, all patients were taken back to the hospital ward.

Procedure for Analysis of Data

The tenability of the hypotheses of this study was determined by parametric statistical analyses for both group data and individual subject comparisons.

Analysis of Group Data--The analysis of group data involved the average of the adjusted means for each group. Specifically, an average of the adjusted means was used to compare with a group mean for each specific classified group. These subject means would have already been adjusted
by analysis of covariance. The covariant for the individual subject was the first EMG reading which was taken. The rationale for the use of the covariant was that all subjects differed in their initial EMG readings. The hypotheses were tested by the analysis of covariance using a Randomized Block Design. This design chose a single measurement design which was used as the blocking factor. Each subject was assigned to a block based on his psychiatric diagnosis. Blocking is an effective means of increasing design power only if the block variable correlates with the criterion, that is, if mean scores differ among blocks (Lee, 1975). Blocking of subjects along a quantitative block variable increases design power (Lee, 1975). Lee (1975) also states that it is best to use only one blocking variable which, in this study, was the psychiatric diagnostic category. The Tukey's Range Statistic was used for making multiple comparisons among total group means because this is on the computer program with analyses of covariance at North Texas State University.

Analysis of Individual Session Data--Lastly, an analysis of covariance was used to adjust the mean for each session of each individual subject. This resulted in fourteen adjusted means per subject because there were fourteen sessions for each subject. Session-adjusted means were computed into a group mean and compared among all other groups by each session. The analysis of covariance was used to compare these group means for each session. In this way the statistical tool became more powerful because it could be determined during which session the greatest decrease took place for which groups. This statistical
analysis would help to determine if one group could significantly decrease the EMG reading more rapidly than the other groups.

Summary—All hypotheses were tested by analyses of covariance using the Randomized Block Design. The Tukey's Range Statistic was employed to test the significance of these hypotheses. Four different analyses of covariance were used to detect for significant decreases when looking at both the total group means and the adjusted means per session.
CHAPTER BIBLIOGRAPHY


Henschel, E. O. "Effects of Electrosleep on Gastric Acid Secretion in Man." In IESA Information, 1974.


CHAPTER IV

ANALYSIS OF RESULTS AND DISCUSSION

Analysis of Data

The purpose of this chapter is to present and analyze the statistical and non-statistical results based on the data collected in this study. This investigation was concerned with a person's ability to decrease muscular tension while in a particular personality state by using electromyographic biofeedback training. Furthermore, the four groups, depressive, agitated, comparison, and manic, were compared as to when the greatest amount of decrease occurred. It is known that in a study of this nature no absolute cause and effect relationship can be determined. Yet, it is hoped that studying a variable such as personality and its effect on biofeedback training, would enrich the understanding of biofeedback research (Brown, 1977; Hume, 1976).

The four groups involved consisted of ten subjects each. These four groups will, at times, be referred to by numbers as well as names. Specifically, Group I is "depressive state", Group II is "agitated state", Group III is comparison group, Group IV is "manic state". Specific scores used to describe and diagnose the subjects were explained in Chapter I. First, the comparison group was compared to each of the other three to see if the effects of biofeedback differed significantly. Next, the manic group was compared to the depressive group, the manic group was compared to the agitated group, and the agitated group was compared to the depressive group.
Each subject proceeded through fourteen sessions of biofeedback training. EMG readings were recorded during each of the fourteen sessions; when two groups were compared, the groups were compared session by session, as well as by the total for each group. This amounted to fourteen comparisons for each of the six times two groups were compared. Part of the investigation was concerned with the total scores for each group: testing to see if significant differences occurred in the way they reacted to biofeedback training; and part of the investigation was concerned with when, if ever, did these differences occur. The fourteen sessions were compared to determine the time element involved.

Analysis of covariance was used in this experiment because the investigator needed to control for one variable which would influence the criterion. The four groups, by their very definitions, would have differing beginning EMG readings. What was of interest, however, was the ability to lower these EMG readings regardless of the starting point. Thus, the starting level itself was considered the covariate. This method of statistical control permitted the criterion to be adjusted accordingly. The criterion in this experiment was the average of the last four readings in each session. The major advantage of using analysis of covariance was that it enabled the experimenter to remove a source of possible bias--the starting EMG level--by statistical control.

All data were computed and analyzed on the North Texas State University computer which is an IBM 360, Model 50. The printouts gave all results and significances rounded to four decimal places. As is customary, however, most of the tables included in this chapter are rounded to two places.
As protocol dictates, the statistical hypotheses were accepted or rejected according to whether or not the probability of occurrence was as small as 0.05 or less. However, Skipper, Guenther, and Nass (1967) state that "The level of significance used should be determined by the nature of the experiment, and the consequences of the result. One comes to internalize the difference between 0.05 and 0.06 as 'right' versus 'wrong,' 'credible' versus 'embarrassing,' 'success' versus 'failure.' Tradition notwithstanding, there seems to be little justifiable reason for such a state of affairs. We find it hard to believe that social scientists simply wish to avoid the inconvenience of selecting significance levels as one of the parameters of the problem under investigation."

Winer (1964) agrees to some extent stating, "The frequent use of the 0.05 and 0.01 levels of significance is a matter of convention having little scientific or logical basis."

Because of the nature of this experiment, the significance levels described were up to the 0.25 level. While the 0.05 was used as the basis for retaining or rejecting the hypotheses, the 0.06 through the 0.25 levels were used for descriptive purposes. Trends could be seen in certain sessions where most significant and descriptive differences occurred. There is no supportable evidence that 0.25 is suitable for any specific study, however the 0.25 level was considered to be acceptable for this experimenter's confidence level. The 0.25 confidence level may not be suitable for those who prefer the traditional 0.01 or 0.05; however 0.25 was considered an arbitrary level for descriptive purposes.
Hypotheses

Hypothesis I--Hypothesis I was a directional hypothesis stating that subjects with a diagnosis of "depressive state" would be able to decrease EMG readings significantly more than a comparison group. This particular pairing yielded the fewest number of descriptive differences and no significant differences in the subjects' abilities to decrease their EMG readings. The sessions which showed some descriptive differences were Session six and Session nine. Results are presented in Table I and Table II, respectively.

### TABLE I
(Session six)

#### COMPARISON OF GROUP I AND GROUP III ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>963.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>877.58</td>
<td>51.62</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>86.41</td>
<td>86.41</td>
<td>1.67d</td>
</tr>
</tbody>
</table>

\[d\] This number is significant at the 0.2130 level, thus will be used only for descriptive purposes.
TABLE II
(Session nine)
COMPARISON OF GROUP I AND GROUP III ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>1,229.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>1,013.38</td>
<td>59.61</td>
<td></td>
</tr>
</tbody>
</table>

This number is significant at the 0.07 level, thus will be used only for descriptive purposes.

Because the data obtained in testing Hypothesis I resulted in no significant mean differences, the hypothesis was rejected. However, the data were examined in further hypotheses and must be considered in light of the entire investigation.

Hypothesis II--Hypothesis II was a directional hypothesis stating that subjects with a diagnosis of "agitated state" would be able to decrease EMG readings significantly more than those in the comparison group. In the seventh session a very significant difference was seen in the adjusted means of the two groups. These results are presented in Table III.

TABLE III
(Session seven)
COMPARISON OF GROUP II AND GROUP III ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>717.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>530.20</td>
<td>31.19</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>187.52</td>
<td>187.52</td>
<td>6.01*</td>
</tr>
</tbody>
</table>

* This number is significant at the 0.02 level.
Further, descriptive differences were seen in Sessions five, six, and fourteen. The results are given in Tables IV, V, and VI.

**TABLE IV**  
(Session five)  
COMPARISON OF GROUP II AND GROUP III ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>1,155.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>1,068.76</td>
<td>62.87</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>86.79</td>
<td>86.79</td>
<td>1.38d</td>
</tr>
</tbody>
</table>

*d* This number is significant at the 0.25 level, thus will only be used for descriptive purposes.

**TABLE V**  
(Session six)  
COMPARISON OF GROUP II AND GROUP III ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>910.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>829.19</td>
<td>48.78</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>80.90</td>
<td>80.90</td>
<td>1.66dd</td>
</tr>
</tbody>
</table>

**dd** This number is significant at the 0.22 level, thus will be used for descriptive purposes only.
TABLE VI
(Session fourteen)
COMPARISON OF GROUP II AND GROUP III ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>939.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>788.98</td>
<td>46.41</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>150.05</td>
<td>150.05</td>
<td>3.23^d</td>
</tr>
</tbody>
</table>

^dThis number is significant at the 0.09 level, thus will be used for descriptive purposes only.

Observation of the results of this comparison shows that in session seven the group diagnosed as "agitated state" did decrease EMG readings significantly more than did the comparison group. For this session, the hypothesis was retained. For the others, it was rejected.

Hypothesis III--Hypothesis III was a directional hypothesis stating that subjects with a diagnosis of "manic state" would be able to decrease EMG readings significantly more than those in a comparison group. Results of this comparison yielded more significant differences than any of the others. The greatest significance was in session six (0.009 level); the next most significant was in session fourteen (0.01 level); and the third most significant was in session twelve (0.02 level). The tables displaying these results are Tables VII, VIII, and IX. Even the descriptive results were exceptionally high in significance (0.07 level). This is shown in Table X.
**TABLE VII**  
*(Session six)*

**COMPARISON OF GROUP IV AND GROUP III ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>877.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>584.68</td>
<td>34.39</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>292.80</td>
<td>292.80</td>
<td>8.51*</td>
</tr>
</tbody>
</table>

*This number is significant at the 0.009 level.

**TABLE VIII**  
*(Session fourteen)*

**COMPARISON OF GROUP IV AND GROUP III ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>796.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>557.08</td>
<td>32.77</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>239.08</td>
<td>239.08</td>
<td>7.29**</td>
</tr>
</tbody>
</table>

**This is significant at the 0.0151 level.**
### TABLE IX
(Session twelve)

**COMPARISON OF GROUP IV AND GROUP III ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>769.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>569.82</td>
<td>33.52</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>199.41</td>
<td>199.41</td>
<td>5.95*</td>
</tr>
</tbody>
</table>

*This is significant at the 0.026 level.

### TABLE X
(Session nine)

**COMPARISON OF GROUP IV AND GROUP III ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>904.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>749.23</td>
<td>44.07</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>155.10</td>
<td>155.10</td>
<td>3.52d</td>
</tr>
</tbody>
</table>

*dThis is significant at the 0.0779 level, thus will be used only for descriptive purposes.*
The results in sessions six, twelve, and fourteen were significantly different and Hypothesis III was retained for each of those sessions. Session nine produced nearly significant results (0.07 level) but the hypothesis was rejected in all other sessions.

Hypothesis IV--Hypothesis IV was a directional hypothesis stating that subjects with a diagnosis of "manic state" would be able to decrease EMG readings significantly more than those with a diagnosis of "depressive state". There were no significant differences, yet in three sessions the mean differences were great enough to be classified as descriptive. These were sessions two, twelve, and fourteen. Results are shown in Table XI, Table XII, and Table XIII.

### TABLE XI
(Session two)

COMPARISON OF GROUP IV AND GROUP I ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>1,057.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>945.33</td>
<td>55.61</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>112.06</td>
<td>112.06</td>
<td>2.01^d</td>
</tr>
</tbody>
</table>

^dThis is significant at the 0.17 level, thus will be used only for descriptive purposes.
### TABLE XII
(Session twelve)

**COMPARISON OF GROUP IV AND GROUP I ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>1,081.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>953.82</td>
<td>56.11</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>127.95</td>
<td>127.95</td>
<td>2.28d</td>
</tr>
</tbody>
</table>

\[d\]This is significant at the 0.14 level, thus will be used only for descriptive purposes.

### TABLE XIII
(Session fourteen)

**COMPARISON OF GROUP IV AND GROUP I ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>669.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>618.67</td>
<td>36.39</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>51.28</td>
<td>51.28</td>
<td>1.41dd</td>
</tr>
</tbody>
</table>

\[dd\]This is significant at the 0.25 level, thus will be used only for descriptive purposes.
According to the results of comparing these two groups, the probability of the F ratio's occurring never reached the 0.05 level. Therefore, the hypothesis was rejected in each of the fourteen sessions involved.

Hypothesis V--Hypothesis V was a directional hypothesis stating that subjects with a diagnosis of "manic state" would be able to decrease EMG readings significantly more than those with a diagnosis of "agitated state." As in Hypothesis IV, there were no significant differences. However, session seven yielded an F ratio significant at 0.06 level, and session fourteen yielded an F ratio significant at the 0.09 level. Other probabilities which were close enough to be used as descriptive were: 0.11 in session nine; 0.12 in session six; and 0.18 in session twelve. Results of these sessions can be seen in Tables XIV, XV, XVI, XVII, and XVIII.

TABLE XIV
(Session seven)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>784.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>635.51</td>
<td>37.38</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>149.30</td>
<td>149.30</td>
<td>3.99d</td>
</tr>
</tbody>
</table>

\(d\) This is significant at the 0.06 level, thus will be used only for descriptive purposes.
### TABLE XV
**(Session fourteen)**

**COMPARISON OF GROUP IV AND GROUP II ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>453.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>381.44</td>
<td>22.44</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>72.08</td>
<td>72.08</td>
<td>3.21d</td>
</tr>
</tbody>
</table>

*d*This is significant at the 0.09 level, thus will be used for descriptive purposes only.

### TABLE XVI
**(Session nine)**

**COMPARISON OF GROUP IV AND GROUP II ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>654.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>564.67</td>
<td>33.21</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>90.28</td>
<td>90.28</td>
<td>2.718dd</td>
</tr>
</tbody>
</table>

**dd**This is significant at the 0.1176 level, thus will be used only for descriptive purposes.
TABLE XVII
(Session six)

COMPARISON OF GROUP IV AND GROUP II ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>596.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>493.11</td>
<td>29.01</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>76.00</td>
<td>76.00</td>
<td>2.62d</td>
</tr>
</tbody>
</table>

d This is significant at the 0.1239 level, thus will be used for descriptive purposes only.

TABLE XVIII
(Session twelve)

COMPARISON OF GROUP IV AND GROUP II ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>603.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>543.49</td>
<td>31.97</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>59.84</td>
<td>59.84</td>
<td>1.87dd</td>
</tr>
</tbody>
</table>

dd This is significant at the 0.1891 level, thus will be used for descriptive purposes only.
However, as close as some of the probability levels may have been, none reached the prescribed level of 0.05. Therefore, this hypothesis was rejected in each session.

Hypothesis VI--Hypothesis VI was a directional hypothesis stating that subjects with a diagnosis of "agitated state" would be able to decrease EMG readings significantly more than those with a diagnosis of "depressive state." Session seven yielded an F ratio probable at the 0.04 level of significance, while no other session showed significant results. Session nine had a probability level of 0.09, and session fifteen had a probability level of 0.14. Tables XIX, XX, and XXI display these results.

TABLE XIX
(Session seven)
COMPARISON OF GROUP II AND GROUP I ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>1,070.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>842.26</td>
<td>49.54</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>228.12</td>
<td>228.12</td>
<td>4.60*</td>
</tr>
</tbody>
</table>

*This is significant at the 0.0466 level.
TABLE XX
(Session nine)

COMPARISON OF GROUP II AND GROUP I ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>887.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>750.60</td>
<td>44.15</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>137.18</td>
<td>137.18</td>
<td>3.11d</td>
</tr>
</tbody>
</table>

*d* This is significant at the 0.0959 level, thus will be used for descriptive purposes only.

---

TABLE XXI
(Session fourteen)

COMPARISON OF GROUP II AND GROUP I ADJUSTED GROUP MEANS USING ANALYSIS OF COVARIANCE

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18</td>
<td>855.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>17</td>
<td>750.48</td>
<td>44.15</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>105.38</td>
<td>105.38</td>
<td>2.39dd</td>
</tr>
</tbody>
</table>

**dd** This is significant at the 0.14 level, thus will be used only for descriptive purposes.
When using the data from the seventh session, the hypothesis was retained. When using the data from all of the other sessions, the hypothesis was rejected.

Group Totals

The comparisons described for testing each hypothesis were also run on group totals, averaging all fourteen sessions. Although no significant F ratios were forthcoming, two of the comparisons were fairly close to the 0.05 level. The comparison of Group IV, "manic state," and Group I, "depressive state," produced an F ratio significant at the 0.08 level. The comparison of Group IV, "manic state," and Group III, comparison group, yielded an overall F ratio probable at the 0.12 level. The rest of the comparisons produced even smaller F ratios. Consequently, by looking only at group totals rather than individual sessions, each of the hypotheses was rejected. Table XXII gives the exact probabilities of the F ratios derived by comparing adjusted means.

| TABLE XXII |
| PROBABILITIES AT WHICH F RATIOS WERE SIGNIFICANT COMPARISONS OF GROUP TOTALS USING ANALYSIS OF COVARIANCE |

<table>
<thead>
<tr>
<th></th>
<th>Depressive State</th>
<th>Agitated State</th>
<th>Comparison Group</th>
<th>Manic State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressive State</td>
<td></td>
<td>0.44</td>
<td>0.89</td>
<td>0.08</td>
</tr>
<tr>
<td>Agitated State</td>
<td>0.44</td>
<td></td>
<td>0.53</td>
<td>0.78</td>
</tr>
<tr>
<td>Comparison Group</td>
<td>0.89</td>
<td>0.53</td>
<td></td>
<td>0.12</td>
</tr>
<tr>
<td>Manic State</td>
<td>0.08</td>
<td>0.78</td>
<td>0.12</td>
<td></td>
</tr>
</tbody>
</table>
There remains, however, a great deal of information available through studying the data in this experiment. One of the purposes listed in Chapter I was to examine the time period during which the greatest decrease in EMG readings occurs. Another was to compare the four groups as to likenesses and differences between the four personalities diagnosed. The following discussion points to the similarities and differences of the four groups.

Discussion

Of all the instances where a comparison yielded a significant difference or a descriptive difference, fifty-two per cent were in the middle sessions. Specifically, they were in sessions six, seven, and nine. With a few exceptions, the remainder of those differences appeared in either session twelve or session fourteen. This was true in the testing of all six hypotheses. Over eighty-one per cent of the descriptive or significant differences were found in some combination of the above listed sessions. It is interesting to see how these hypotheses repeatedly measured differences in the same sessions. One good way to delineate the manner in which the results occurred was by means of a matrix display of the significance levels produced by the F ratios during the analysis of covariance. Session six saw four of the twenty-one total ratios involved. The significance levels are given in Table XXIII.
TABLE XXIII
(Session six)

MATRIX DISPLAY OF SIGNIFICANCE LEVELS: ALL POSSIBLE COMPARISONS

<table>
<thead>
<tr>
<th></th>
<th>Depressive State</th>
<th>Agitated State</th>
<th>Comparison Group</th>
<th>Manic State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressive State</td>
<td></td>
<td></td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>Agitated State</td>
<td></td>
<td>0.21</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>Comparison Group</td>
<td>0.21</td>
<td>0.21</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>Manic State</td>
<td>0.12</td>
<td>0.009</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Session seven showed two significant and one descriptive result. Table XXIV shows these results.

TABLE XXIV
(Session seven)

MATRIX DISPLAY OF SIGNIFICANCE LEVELS: ALL POSSIBLE COMPARISONS

<table>
<thead>
<tr>
<th></th>
<th>Depressive State</th>
<th>Agitated State</th>
<th>Comparison Group</th>
<th>Manic State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressive State</td>
<td></td>
<td>0.04</td>
<td></td>
<td>0.06</td>
</tr>
<tr>
<td>Agitated State</td>
<td>0.04</td>
<td></td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Comparison Group</td>
<td></td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manic State</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The ninth session produced four descriptive significances. Table XXV indicates the comparison which yielded the numbers.

**TABLE XXV**  
(Session nine)  
**MATRIX DISPLAY OF SIGNIFICANCE LEVELS: ALL POSSIBLE COMPARISONS**

<table>
<thead>
<tr>
<th></th>
<th>Depressive State</th>
<th>Agitated State</th>
<th>Comparison Group</th>
<th>Manic State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressive State</td>
<td></td>
<td>0.09</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Agitated State</td>
<td>0.09</td>
<td></td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>Comparison Group</td>
<td>0.07</td>
<td>0.11</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Manic State</td>
<td></td>
<td>0.07</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The twelfth session yielded significant differences in each comparison to the manic group. Table XXVI shows these results. In comparing the manic and comparison groups, a significant difference was yielded at the 0.02 level.
TABLE XXVI  
(Session twelve)  

MATRIX DISPLAY OF SIGNIFICANCE LEVELS: ALL POSSIBLE COMPARISONS

<table>
<thead>
<tr>
<th></th>
<th>Depressive State</th>
<th>Agitated State</th>
<th>Comparison Group</th>
<th>Manic State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressive State</td>
<td></td>
<td></td>
<td></td>
<td>0.14</td>
</tr>
<tr>
<td>Agitated State</td>
<td></td>
<td></td>
<td></td>
<td>0.18</td>
</tr>
<tr>
<td>Comparison Group</td>
<td></td>
<td></td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td>Manic State</td>
<td>0.14</td>
<td>0.18</td>
<td>0.02</td>
<td></td>
</tr>
</tbody>
</table>

The only other session which produced several differences was session fourteen. It looked the same as session twelve where every comparison with the manic group was worth noting. Again, a very significant difference was noted between the comparison group and the manic group, at the 0.01 level. Table XXVII shows the results. In Table XXVII, a descriptive difference was seen at the 0.25 level when comparing the manic to the depressive group. The manic group also showed a descriptive difference when compared to the agitated group at the 0.09 level. Although the only true statistical significance was seen when comparing the manic to the comparison group, all other comparisons were significant at a descriptive level. Also, no descriptive difference was seen beyond the 0.25 level.
TABLE XXVII  
(Session fourteen)  

MATRIX DISPLAY OF SIGNIFICANCE LEVELS: ALL POSSIBLE COMPARISONS

<table>
<thead>
<tr>
<th></th>
<th>Depressive State</th>
<th>Agitated State</th>
<th>Comparison Group</th>
<th>Manic State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressive State</td>
<td></td>
<td></td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>Agitated State</td>
<td></td>
<td></td>
<td></td>
<td>0.09</td>
</tr>
<tr>
<td>Comparison Group</td>
<td></td>
<td></td>
<td></td>
<td>0.01</td>
</tr>
<tr>
<td>Manic State</td>
<td>0.25</td>
<td>0.09</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>

Summary

The cumulative effect of electromyographic biofeedback was found to be effective in reducing muscular tension in all four groups. The most significant decrease of muscular tension was found in the middle of the fourteen biofeedback training sessions. Significance for all groups, when looking at reduction of muscle tension, was more significant when using the descriptive statistics. There was a significant difference in the ability of the agitated group to reduce muscular tension when compared to the comparison group, especially in the middle of the training program (session seven). The most significant difference came when comparing the manic group and the comparison group, especially in the sixth and fourteenth session. There was no difference in the
manic group when compared to the depressive and agitated groups in their ability to decrease EMG levels. The agitated group were able to decrease their EMG levels significantly more than the depressive group in the middle of the biofeedback training program (session seven). For the group totals, there was no significant difference in any of the four groups in their ability to decrease EMG levels.

Surely, from the evidence of how the results tended to group themselves, some conclusions can be drawn. The analyses of the experimental data and the statistical findings have been presented and discussed in this chapter.

Some factors are discussed to explain the lack of significance at the 0.05 level between group totals. However, it is suggested that the findings of the present study may be interpreted as evidence supporting the view that psychiatric groups do differ in their ability to decrease muscle tension. This adds to the importance of individual differences when considering the use of biofeedback training as an adjunct to psychotherapy.

Several factors involved in the design of the experiment were presented as possible causes of the failure of the study to derive clearly distinct differential effects between groups. There was a discussion of uncontrolled factors which may have influenced a patient's ability to decrease his EMG readings.

Hence, statistical analysis of the experimental data led to the rejection of three hypotheses for statistical significance at the 0.05 level, and the acceptance of three hypotheses at the 0.05 level.
Specifically accepted for a statistical significance were Hypothesis II during session seven, Hypothesis III during sessions six, fourteen, and twelve, and Hypothesis VI during session seven. Hypotheses which were descriptively significant were Hypothesis II for sessions five, six, and fourteen, Hypothesis III during session nine, Hypothesis IV for sessions two, twelve, and fourteen, Hypothesis V for sessions seven, nine, six and twelve, and Hypothesis VI during session seven. No hypothesis was rejected for all fourteen sessions. In order to review the differences between groups, the adjusted group means for all tables listed are included in Appendix H.
CHAPTER BIBLIOGRAPHY


CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

This research was undertaken to investigate the differential effects that biofeedback training would have on muscular tensions exhibited by patients in a specific personality state. A review of the literature disclosed that there is no conclusive evidence as to which types of psychiatric patients have the most muscle tension. Further, the literature is inconclusive as to which personality state will respond to such training with a decrease in muscle tension. This study was designed, therefore, to look at muscle tension as exhibited by specific personality states and how these personality groups compared in their ability to reduce muscle tension. Questions specifically addressed in this research were as follows:

1) Was there any difference in a person's ability to decrease muscle tension when diagnosed in a specific personality state?

2) Where would the greatest decrease take place within the training program?

3) Would there be any group which would experience an increase in muscle tension as a result of the biofeedback training program?

4) When comparing all four groups by their total group EMG readings, would there be any difference in their ability to decrease their muscle tension when compared to all other groups?
Six hypotheses were developed to postulate the outcome of the four groups and their comparative ability to decrease muscle tension. Investigation of these six hypotheses was carried out by a standardized biofeedback program.

As a sample test population, forty subjects were selected from the total in-patient population. The subjects used in the study were limited to patients who were substance abusers and were admitted to East Dallas Hospital for treatment. Subjects who met Gilberstadt and Duker's (1965) criteria for specific personality states were assigned to their respective groups. The four groups were the manic state group, the depressive state group, the agitated state group, and a comparison group. These four groups were given the standardized biofeedback treatment produced from STAT Clinics, of Houston, Texas. There were fourteen sessions of biofeedback training which took place over a period of fourteen days, each session being given at the same time each day approximately twenty-four hours apart. Each session lasted between 30 - 40 minutes during which time five EMG readings were taken, recorded, and an adjusted mean for each session was computed on a biofeedback record (See Appendix G ). An analysis of covariance was used to assess (1) if there was any difference between the four groups in their ability to decrease their muscle tension by EMG biofeedback training as analyzed within each session; (2) if there was any difference in the total group's ability to lower muscle tension when compared against all other groups and (3) where the greatest decrease came for each group. The level of significance was established only for the rejection of the
six hypotheses at the 0.05 level. However, statistical as well as descriptive differences are discussed. The statistical level of 0.05 was used when explaining the research data.

The findings were significant enough to show that individual differences do exist in regard to one's ability to lower EMG levels. Specifically, there was no significant difference in the depressive group's ability to lower muscle tension when compared to the comparison group. However, a descriptive difference was seen in sessions six and nine respectively. These sessions showed a significant difference at the 0.07 level. The agitated group was able to decrease EMG readings significantly more than the comparison group in the seventh session. A descriptive difference was seen in sessions five, six, and fourteen. The greatest significance was seen when comparing the manic group to the comparison group in sessions six (0.009), fourteen (0.01), and twelve (0.02) respectively. The descriptive differences between the two groups were significant at the 0.07 level for session nine, but the hypothesis was rejected for all other sessions. When comparing the ability to decrease EMG readings of the manic group to the depressive group, no statistical significance was observed. However, in sessions two (0.17), twelve (0.14), and fourteen (0.25), a descriptive difference was found. There was no difference found in the manic group's ability to decrease EMG readings when compared to the agitated patients. Session seven showed a descriptive difference at the 0.06 level, and session fourteen was descriptively significant at the 0.09 level. Other sessions for these two groups which did not show as much descriptive significance were
sessions nine (0.1176 level), session six (0.1239 level), and session twelve (0.1891 level). The agitated group were able to decrease their EMG readings more significantly than the depressive group in session seven (0.04 level). Those sessions which showed a descriptive difference were sessions nine (0.09 level), and session fifteen (0.14 level).

Group totals were not statistically significant for any of the four groups; however two of the comparisons were close to the 0.05 level. The manic group's ability to decrease EMG levels when compared to the depressive group was descriptively significant at the 0.08 level. The manic group's total EMG readings were descriptively significant when compared to the comparison group's total at the 0.12 level. All other total group comparisons produced even smaller F ratios. In general, the greatest decrement for all groups took place in the middle of the biofeedback training program. Specifically, fifty-two per cent of the decrease in EMG levels took place in the middle sessions (sessions six, seven, and nine, respectively).

Conclusions

Based upon the procedures utilized for the data collection and the statistical treatment of the data, the following conclusions were drawn from this investigation. These conclusions were formulated from results which were both statistically significant (0.01 and 0.05) and descriptively significant (0.25); however, only individual session results which were statistically significant were presented in the conclusions numbered 4, 5, and 6.
(1) There exists a descriptive difference between the four groups (depressive, manic, agitated, and comparison) in their ability to decrease muscular tension when using EMG biofeedback.

(2) Biofeedback was found to be an effective treatment in reducing muscular tension for all groups.

(3) The most significant decrease in muscle tension took place in the middle sessions (middle session refers to sessions 6 or 7) of the biofeedback treatment.

(4) The agitated patients could decrease their muscle tension significantly more during a middle session when compared to a comparison group. This finding was statistically significant in session seven.

(5) The manic patients could decrease their muscle tension significantly more during a middle session when compared to the comparison group. This was found to be statistically significant in sessions six, fourteen, and twelve.

(6) The agitated group could decrease their muscle tension significantly more during a middle session when compared to the depressive group. This was found to be statistically significant during session seven.

Implications

This study is only a beginning when looking at the implications that individual differences hold for biofeedback training. Several statistically significant differences and descriptive differences were derived from this investigation which showed that individual differences do play a part in one's ability to lower EMG levels. If one knew
definitely that certain psychiatrically diagnosed groups differed in their ability to decrease their EMG levels, then these biofeedback programs could be structured to meet the individual needs of the patient.

Another implication formulated from this study is the effectiveness biofeedback has for certain in-patient populations who wish to lower their EMG levels.

Several speculations could be discussed in regard to the clinical implications that this study has purported to show. Again, one should be reminded that implications were drawn from results which were mostly "descriptively" significant (at the 0.25 confidence level or better). Because this study suggests that manics are generally most appropriate for biofeedback training, one could speculate on the use of biofeedback as an essential part of a psychotherapeutic treatment program for all patients classified as "manic." The implications biofeedback has for a manic patient population suggest that biofeedback should be an integral part of their treatment plan.

Another implication can be inferred from the findings of the depressed patient population. Because the depressed group was found to be the "least" successful, one might suggest that this group's treatment plan might emphasize other types of psychotherapeutic modalities rather than biofeedback training. An important part of biofeedback training is that the individual be able to generalize what he has learned on the EMG machine to "daily outside life activities." Since the term "manic" is usually associated with high energy levels, it seems appropriate that a patient in a manic phase could appreciate the results of
biofeedback training, whereas the depressed patient may feel "listless and apathetic" so that the relevance of a relaxation technique may be more difficult for the depressed patient to internalize.

This study implies that biofeedback may be more applicable for someone with a psychiatric diagnosis (as determined by the MMPI) rather than for a person who has no elevations on the MMPI.

Further implications of this study suggest that there remains a need to investigate individual differences when utilizing biofeedback as a therapeutic treatment technique in psychotherapy.

Recommendations

In view of the findings of the present study, several recommendations are offered which take into consideration future research as well as problems encountered while undertaking this study.

(1) It is recommended that a repeated study be done with the four previously-listed groups which would be free from all medication (if legal and medical requirements would allow for such a study).

(2) It is recommended that the block design be based on the psychiatrist's diagnosis rather than on Gilberstadt and Duker's criteria. In this way, a "behavioral, observational" diagnosis rather than a "paper and pencil test" diagnosis would be used for grouping.

(3) That when considering an experimental design in biofeedback research, comparison of groups by sessions appears to be the design of choice rather than a design which only takes group EMG totals into consideration.
(4) It is recommended that this study be used with out-patients in order to control for possible contaminating factors such as family therapy, neurotone therapy, et cetera.

(5) It is recommended that the institution's policy for daily biofeedback treatment be tailored more to meet the individual's need.

(6) It is recommended that a follow-up study be done to see if any particular group was better able to generalize the biofeedback training to everyday life.

(7) It is recommended that a correlational study be done to assess if there is any correlation between initial muscle tension and psychiatric diagnosis as determined by the Minnesota Multiphasic Personality Inventory.

(8) It is recommended that a study be done to assess the effects that neurotone therapy might play in a person's muscular tension and his ability to decrease his muscle tension by biofeedback training.

(9) It is recommended that a study be done in which several MMPIs are given during the course of the experimental treatment to assess how long a patient remains in his particular state.

(10) It is recommended that a controlled study be done using only biofeedback to look at the possibilities that biofeedback has for lowering MMPI profiles which indicate a patient's psychiatric "state."

(11) It is recommended that EEGs (electroencephalographs) be done both as pre- and post-testing to indicate a change in brain waves as a result of biofeedback training.
(12) It is recommended that a site different from the frontalis muscle be used to assess whether muscle tension in different parts of the body is the same as the muscle tension in the frontalis muscles for the previously-described psychiatric groups.

(13) It is recommended that the same study be done, but with another form of biofeedback (i.e., temperature control), to assess if the respective groups can decrease their finger temperature in the same way they are able to decrease frontalis muscle tension.
PLEASE NOTE:

This page not included in material received from the Graduate School. Filmed as received.

UNIVERSITY MICROFILMS
APPENDIX A

SCHEDULE OF ACTIVITIES AND
DEFINITION OF ACTIVITIES
DEFINITION OF LISTED ACTIVITIES

Recreation Therapy--Patients engage in physical activity which takes place outdoors when the weather permits. Softball, volley ball, kick ball and other activities are commonly played.

Diversional Therapy--This is where the patient works on an art project. Macramé, paintings, needlepoint, rugs and other crafts are common art projects.

Individual Therapy--The patient spends this time talking with his primary therapist who conducts the therapy session according to the therapist's theoretical orientation.

Neurotone Therapy--Also called cerebral electrotherapy (CET) and electrosleep. This is a treatment modality for anxiety, reactive depression and sleep problems. It applies a series of low intensity electrical pulses to the nervous system as an alternative to drug medication. Treatment is a 30- to 40-minute session whereby position electrodes located on a headband are placed on the mastoids (under the ear). Patients are usually able to feel a mild electrical sensation. Neurotone therapy is a prescription device prescribed only by a medical doctor. This treatment was discovered in the Soviet Union in 1949 by Liventsev. The research in this country on neurotone is scanty (Cox and Heath, 1975), however success in treating depression, anxiety, and insomnia, as well as reduction of gastric acid has been reported (Rosenthal, 1972; Henschel, 1974).
Step Counseling--The patient spends this session with a Palmer Drug Abuse Program counselor. These counselors are para-professionals who are rehabilitated drug addicts. The twelve steps are discussed (a copy of these twelve steps is included in this appendix).

Quiet Time--No structured activity is planned. This time is arranged for the patient to rest.

Unit Activities--No structured activity is planned. Patients usually spend time talking with other patients.

Group Therapy--There are two groups planned. One group therapy is for adults and one group therapy is for adolescents. Problems, feelings, and concerns are discussed during this time.
PALMER DRUG ABUSE PROGRAM

TWELVE STEPS TO LIFE, LOVE AND HAPPINESS

We at PDAP have developed a way of life without the use of chemicals. By taking certain steps, not one of us has failed to find Love and Happiness in this Way of Life. If you want what we have and are willing to go to any lengths to get it, you are ready to follow these Steps.

1. We admitted that mind-changing chemicals had caused at least part of our lives to become unmanageable.

2. We found it necessary to "Stick with Winners" in order to grow.

3. We realized that a Higher Power, expressed through our love for each other, can help restore us to sanity.

4. We made a decision to turn our will and our lives over to the care of God, as we understand Him.

5. We made a searching and fearless moral inventory of ourselves.

6. We admitted to God, to ourselves, and to another human being the exact nature of our wrongs.

7. We became willing to allow our Higher Power, through the love of the group, to help change our way of life and humbly asked Him to help us change.

8. We made a list of all persons we had harmed and became willing to make amends to them all.

9. We became willing to make direct amends to such people, whenever possible; except when to do so would injure them, others or ourselves.

10. We have continued to look at ourselves and when wrong, promptly admitted it.

11. We have sought through prayer and meditation to improve our conscious contact with our Higher Power, that we have chosen to call God, praying only for knowledge of His will for us and courage to carry that out.

12. We, having had a spiritual awakening as a result of these Steps, tried to carry our love and understanding to others and to practice these principles in our daily lives.

These Steps are not easy, but they are simple and they do work. If you follow these Steps, we guarantee that you will find a Way of Life that is full of Love and Happiness and you will be armed with a way to cope with life's problems. The key of Love and Happiness will open many doors.

HONESTY....is the freedom from self-deception; the willingness to admit wrong; fairness in our dealings with others....with Honesty we will develop FAITH....belief that we can change, with the help of God, as we understand Him.
## Adolescent Schedule

**Program for Alcoholism, Addictions, Stress and Anxiety**

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<th>C</th>
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APPENDIX B

INSTRUCTIONS FOR BIOFEEDBACK TRAINING
INSTRUCTIONS FOR BIOFEEDBACK TRAINING

Following is a sample of the explanation given to the patients by the biofeedback technician at the beginning of the first training session:

"This machine will not hurt you in any way. It measures muscle tension and will give off a clicking sound to let you know how tense you are. What you will do is listen to a series of six tapes. Please stay awake while the tapes are being played. You will be able to hear a number of clicks through your headphones. The faster the clicks go, the more tense you are. You are to try and slow these clicks down. The slower the clicks go, the more relaxed you are. Now I will start the tape. Don't try to make your body do anything. Just follow the directions on the tape and let the relaxation happen to you."
APPENDIX C

EXAMPLE OF SCALE 2 (DEPRESSION) ITEMS ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY (Wiener, 1948)
EXAMPLES OF SCALE 2 (DEPRESSION) ITEMS ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY (Wiener, 1948)

Examples of depression (40 items):

I wish I could be as happy as others seem to be (T)
I certainly feel useless at times (T)
I cry easily. (T)
I seem to be about as capable and smart as most others around me. (F)
At times I am all full of energy. (F)

Examples of subtle items (20 items):

I am easily awakened by noise. (T)
It takes a lot of argument to convince most people of the truth. (F)
I am neither gaining nor losing weight. (F)
I like to flirt. (F)
I dream frequently about things that are best kept to myself. (F)
I sweat very easily even on a cool day. (F)

Examples of physical malfunctioning (11 items):

I have a good appetite. (F)
I feel weak all over much of the time. (T)

Examples of mental dullness (15 items):

My judgment is better than it ever was. (F)
I find it hard to keep my mind on a task or job. (T)

Examples of brooding (10 items):

I usually feel that life is worthwhile. (F)
I certainly feel useless at times. (T)

Examples of subjective depression (32 items):

I have never felt better in my life than I do now. (F)
My sleep is fitful and disturbed. (T)
I don't seem to care what happens to me. (T)
I am happy most of the time. (F)
Examples of Psychomotor retardation (15 items):

I have difficulty in starting to do things. (T)
At times I feel like smashing things. (F)
APPENDIX D

EXAMPLE OF SCALE 9 (MANIA) ITEMS ON THE
MINNESOTA MULTIPHASIC PERSONALITY INVENTORY
(Harris and Lingoes, 1955)
EXAMPLE OF SCALE 9 (MANIA) ITEMS ON THE
MINNESOTA MULTIPHASIC PERSONALITY INVENTORY
(Harris and Lingoes, 1955)

Example of amorality (6 items):

I don't blame anyone for trying to grab everything he can get in this world. (T)
I do not blame a person for taking advantage of someone who lays himself open to it. (T)

Example of psychomotor acceleration (11 items):

When I get bored, I like to stir up some excitement. (T)
At times I feel that I can make up my mind with unusually great ease. (T)
At times my thoughts have raced ahead faster than I could speak them. (T)

Example of imperturbability (8 items):

I never worry about my looks. (T)
It is not hard for me to ask for help from my friends even though I cannot return the favor. (T)

Example of ego inflation (9 items):

I am an important person. (T)
I have been inspired to a program of life based on duty which I have since carefully followed. (T)
I have at times stood in the way of people who were trying to do something, not because it amounted to much, but because of the principle of the thing. (T)

Wiener (1948) divided this scale equally into obvious and subtle components as follows:

Examples of obvious components (23 items):

At times I have fits of laughing and crying that I cannot control. (T)
I have met problems so full of possibilities that I have been unable to make up my mind about them. (T)
I have never done anything dangerous for the thrill of it. (F)
I have often had to take orders from someone who did not know as much as I did. (T)
Once a week or more often, I become very excited. (T)

Examples of subtle components (23 items):

A person should try to understand his dreams and be guided by or take warning from them. (T)
I sometimes keep on at a thing until others lose their patience with me. (T)
I believe women ought to have as much sexual freedom as men. (F)
I am afraid when I look down from a high place. (F)
When in a group of people, I have trouble thinking of the right things to talk about. (F)
APPENDIX E

EXAMPLE OF SCALE 6 (PARANOIA) ITEMS ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY (Harris and Lingoes, 1955)
EXAMPLES OF SCALE 6 (PARANOIA) ITEMS ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY

(Harris and Lingoes, 1955)

Examples of persecutory ideas (17 items):

Someone has been trying to poison me. (T)
I am sure I am being talked about. (T)
I have no enemies who really wish to harm me. (F)
Someone has control over my mind. (T)
I believe I am being followed. (T)

Examples of poignancy (9 items):

I feel uneasy indoors. (T)
Even when I am with people I feel lonely much of the time. (T)
At times I hear so well it bothers me. (T)

Examples of naivete (9 items):

Most people inwardly dislike putting themselves out to help other people. (F)
Most people are honest chiefly through fear of being caught. (F)
I tend to be on my guard with people who are somewhat more friendly than I had expected. (F)

Examples of obvious components (23 items):

I believe I am being plotted against. (T)
People say insulting and vulgar things about me. (T)
I have certainly had more than my share of things to worry about. (T)
Someone has been trying to influence my mind. (T)

Examples of subtle components (17 items):

My mother or father often made me obey when I thought it was unreasonable. (F)
The man who provides temptation by leaving valuable property unprotected is about as much to blame for its theft as the one who steals it. (F)
Something exciting will almost always pull me out of it when I am feeling low. (F)
APPENDIX F

EXAMPLE OF SCALE 4 (PSYCHOPATH) ITEMS ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY

(Harris and Lingoes, 1955)
EXAMPLES OF SCALE 4 (PSYCHOPATH) ITEMS ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY

(Harris and Lingoes, 1955)

Scale 4 content ranges widely. Harris and Lingoes (1955) sub-
custers provide a good indication of scale content:

Examples of familial discord (11 items):

At times I have very much wanted to leave home. (T)
I have very few quarrels with members of my family. (F)
My parents and family find more fault with me than they should. (T)

Examples of authority problems (11 items):

I have never been in trouble with the law. (F)
In school I sometimes was sent to the principal for cutting up. (T)
I have never been in trouble because of my sex behavior. (F)

Examples of social imperturbability (12 items):

I find it hard to make talk when I meet new people. (F)
I wish I were not so shy. (F)

Examples of social alienation (18 items):

My hardest battles are with myself. (T)
I have not lived the right kind of life. (T)
Much of the time I feel as if I have done something wrong or evil. (T)

Wiener (1948) identified a subset of subtle items in Scale 4.

Examples of these 22 items include:

I have been disappointed in love. (T)
At times my thoughts have raced ahead faster than I could speak them. (F)
I am neither gaining nor losing weight. (F)
I liked school. (F)
I am against giving money to beggars. (F)
APPENDIX G

BIOFEEDBACK RECORD FORMS
### Biofeedback Treatment Record

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APPENDIX H

ADJUSTED GROUP MEANS BY SESSIONS

and

ADJUSTED TOTAL GROUP MEANS
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