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EXPLORATION OF A COMBINED PROGRAM OF ELECTROMYOGRAPHIC BIOFEEDBACK AND PROGRESSIVE RELAXATION AS A TREATMENT APPROACH WITH SCHIZOPHRENICS

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EXPLORATION OF A COMBINED PROGRAM OF ELECTROMYOGRAPHIC BIOFEEDBACK AND PROGRESSIVE RELAXATION AS A TREATMENT APPROACH WITH SCHIZOPHRENICS

By

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ABSTRACT

EXPLORATION OF A COMBINED PROGRAM OF ELECTROMYOGRAPHIC BIOFEEDBACK AND PROGRESSIVE RELAXATION AS A TREATMENT APPROACH WITH SCHIZOPHRENICS

By

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Persons diagnosed as schizophrenic have been shown to be aroused on skeletal-muscle measures. Researchers have suggested that such physiologic arousal is reflective of responses occurring in other systems where cognition and emotional behaviors are represented. It has also been hypothesized that schizophrenics are in a state of chronic physiological disequilibrium which impacts on their ability to modulate or change levels of responsivity to correspond to variations in internal and external events. The physiological arousal, then, has been viewed as an important contributing factor to the emotional and cognitive instability of the schizophrenic.

Electromyographic biofeedback relaxation training has been used with highly anxious individuals who, like schizophrenics, experience muscular tension. The technique focuses on muscular relaxation, which in turn has been demonstrated to effect consequent improvements in emotional functioning. The purpose of the present study was to develop and examine the effectiveness of a combined treatment program of electromyographic biofeedback and modified progressive relaxation exercises in alleviating select symptoms with schizophrenics.

One male and three females were accepted for the study based on three criteria which included (a) diagnosis of schizophrenia without paranoid ideation, (b) functional stability, and (c) experiences of physical tension. All subjects were required to have the consent of their psychiatrists in order to participate. Each subject had a history of at least three psychiatric hospitalizations and was being maintained on an antipsychotic medication.

A single case study was used with an A-B time series research design. Observations were made for each subject across 22 sessions which included a pre- and post-treatment interview, 7 baseline and 13 EMG biofeedback relaxation training sessions. The continuous dependent variables which were compared across baseline and treatment sessions included: EMG values during biofeedback training and during cognitive test performance, scores on each of five cognitive tests known as the Repetitive Psychometric Measures, and scores on three self-rating scales of tension. The Taylor Manifest Anxiety Scale was administered pre- and post-treatment.

The split-middle method of analysis was used to assess linear trends in the data, and binomial tests were applied to determine the significance of differences for the continuous measures.

The major results of the study were:

1. All subjects significantly decreased EMG values during biofeedback training compared to baseline resting levels.

2. Subject D significantly decreased EMG values during cognitive test performance following treatment intervention.

3. Subject A significantly increased scores on three out of four cognitive tests and Subject D significantly increased scores on one out of five cognitive tests following treatment intervention.

4. Subjects B and C significantly decreased ratings of general levels of tension following treatment intervention.

5. All subjects significantly increased ratings of their ability to modify levels of tension following treatment intervention.

6. Subjects did not improve in their ability to detect changes in levels of tension following treatment intervention.

7. Only Subject D did not decrease scores on the Taylor Manifest Anxiety Scale at the end of treatment.

The treatment was found to be clinically significant in view of the changes which occurred in physiological, cognitive, and emotional behaviors. The treatment process was particularly beneficial in helping individuals identify and modify ideation which inhibited successful relaxation. Further studies are needed which test the clinical significance of the treatment with a wider variety of subjects, specifically those who are psychologically less stable. In addition, it would be important to establish the long-term benefits of continued practice with these techniques.

To my mother, Maude Pelak, for her unconditional support and much-appreciated wisdom.

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CHAPTER I

THE PROBLEM

Introduction

Schizophrenia is a complex mental illness which can best be understood from a multidimensional perspective. Research and theory which emphasize genetics, predisposition and learning, environment, family relationships, and errors in metabolism are illustrations of the many ways in which this mental illness has been studied (Freedman, Sadock, & Kaplan, 1976). Likewise, therapeutic interventions such as drug therapy and various forms of psychotherapy reflect treatment approaches which derive from the various hypotheses put forth concerning the etiology of schizophrenia.

One approach to studying schizophrenia lies in the field of psychophysiology. Researchers in this field such as Malmo, Whatmore and Kohli, and Goldstein and the theories of Mednick (1958), Broen (1968), and Tecce and Cole (1972) focus on characteristics of physiological arousal and behavioral response tendencies to stress in schizophrenics.

Psychophysiological research has shown that schizophrenics are abnormally aroused on skeletal-muscle measures and that this arousal is manifested during rest and in response to stressors. Theories have examined this arousal and explore the possible explanations for the individual's apparent inability to modulate response tendencies.

They attempt also to explain how arousal in the skeletal-muscle system is linked to the symptomatology of delusions, emotional blunting, hallucinations, and disordered thought processes observed in schizophrenia. This particular aspect of research forms the basis for the present study, which proposes a treatment program aimed at teaching persons diagnosed as schizophrenic to more effectively modulate responses in the skeletal-muscle system.

Research in psychophysiology indicates that abnormal physiological arousal is a contributing factor in behavioral responses and in the maintenance or production of symptoms in schizophrenics. For example, Malmo and Shagass (1949) examined the relationship of anxiety to physiological arousal. They found that the closest correspondence between degree of anxiety and degree of physiologic disturbance was reflected in measurements of striate muscle activity. On these measures, schizophrenics most resembled a comparison group of nonschizophrenics whose predominant symptom was anxiety. Malmo, Shagass, and Davis (1951) and Malmo, Shagass, and Smith (1951) also observed that during cognitive and performance tasks schizophrenics evidenced significantly greater levels of muscular activity than nonschizophrenic controls. They hypothesized that their experimental findings reflected the types of reactions one might observe in everyday stress situations among psychiatric patients.

The relationship between skeletal-muscle activity and degree of psychological disturbance was the focus of another study by Goldstein (1965). She compared schizophrenics with other groups of psychiatric inpatients and normal controls on a number of physiological

variables which included measures of muscle tension. Schizophrenics showed the highest degree of physiologic disturbance reflected in the skeletal muscles, and they also manifested the highest degree of psychologic disturbance.

Additional studies focused on the direct relationship of skeletal-muscle activity to schizophrenic symptomatology and behavior. Whatmore and Ellis (1958) and Whatmore (1966) concluded that hyperactivity of the motor system of schizophrenics was intimately tied with states of emotion and cognition. They observed that schizophrenics in remission exhibited labile skeletal-muscle measures, with tension levels varying greatly from day to day. An increase in lability was observed to precede acute schizophrenic episodes, while a reduction in skeletal-muscle tension was followed by clinical improvement.

Fenz and Felner (1970) hypothesized that the hyperactivity noted in the motor systems of schizophrenics was indicative of a common basic deficit in these individuals in their inability to modulate or change levels of responsivity to correspond to variations in internal and external stimulation. They felt that the ineffective modulation was characteristic of responses occurring in the cognitive and behavioral as well as in the physiological domains. Others, including Whatmore and Malmo, have incorporated this notion into their theories of mechanisms involved in schizophrenic symptomatology.

Schizophrenics were compared with highly anxious subjects in several of the studies cited. The excessive muscle tension in anxious persons is believed to be a manifestation of emotions which

evoke defensive behavior, particularly the activation of muscles in preparation to defend against threats to one's well-being (Brown, 1978). Others, including Whatmore and Kohli, theorized that the excessive muscle tension in schizophrenics is also part of an emotional response. While the total symptom picture of these two populations is quite dissimilar, skeletal-muscle activity as well as degree of anxiety which is experienced often appears similar between these two groups.

Electromyographic (EMG) biofeedback relaxation training is a form of treatment which has been utilized with anxious individuals who manifest abnormal levels of skeletal-muscle tension. Most EMG biofeedback programs combine this technique with relaxation exercises for home practice (Brown, 1978). The focus of EMG biofeedback and relaxation exercises is the modification of a physiological response in the form of decreased muscle tension. The rationale is that the newly acquired response pattern, decreased muscle tension, is antagonistic to that observed in stress reactions or anxiety states (Schwartz & Beatty, 1977). Generalizing to other systems, Gaardner and Montgomery (1977) believed that an alteration in one response system, in this case a physiological one, can interact and impact on the autonomic and central nervous systems as well where cognitive, behavioral, and emotional reactions are also represented. They used the term "psychophysiological feedback" to illustrate this interaction between systems, and they viewed the skeletal-muscle system as a main vehicle for communication between the brain and the environment.

Studies of therapeutic outcomes of EMG biofeedback relaxation training provide illustrations of the interactive effects of decreased skeletal-muscle arousal. For example, Raskin and her colleagues (1973) found that chronically anxious individuals could better manage situational anxiety in their daily lives following training. Townsend, House, and Addario (1975) also treated chronically anxious patients and found changes in mood disturbance and in trait and state anxiety measures. In a more recent study, Quieting Response Training, which combines various relaxation techniques including EMG biofeedback and Progressive Relaxation, was used with psychiatric inpatients (Ford, Strong, Stroebel, & Szarek, 1981). A significant finding was that these techniques could be successfully used with various psychiatric populations, regardless of diagnosis. Until recently, the use of this type of treatment with psychiatric inpatients was not recommended because of the possibility of increasing pathological symptoms.

This study explores the possible benefits of using EMG biofeedback training with persons diagnosed as schizophrenic. The foundations for this work are based on aspects of research and theory in the psychophysiology of schizophrenia and work which has been performed in the area of biofeedback training with patient populations who share some of the same characteristics in terms of anxiety and skeletal-muscle responses.

Specifically, a treatment program was developed which combines EMG biofeedback training with home exercises in the form of modified Progressive Relaxation. To date, few researchers have explored the

use of these techniques with such a population. The aim of the program was to observe first the changes which occurred in skeletal-muscle tension levels and to assess consequent changes in formal cognitive functions and subjective feelings of tension and anxiety. Measures were selected which would sample behaviors in the physiological, cognitive, and behavioral/emotional domains.

Need

Evidence indicates that muscle tension, primarily the ability to effectively modulate arousal response tendencies, is a significant component of the total symptom picture of schizophrenics. The significance lies in the belief that physiological tension does not exist independently of emotional and cognitive responses. To date, antipsychotic medications have produced the most profound changes in schizophrenic symptomatology with one of the benefits being a decrease in general levels of arousal (Freedman, Sadock, & Kaplan, 1976). Tecce and Cole (1972) found, however, that this only pertained to certain autonomic measures and not to somatic or skeletal-muscle arousal. The question arises as to the significance of this finding. It seems highly probable that even though "arousal" is decreased with medications and some symptoms are alleviated, that the schizophrenic individual remains quite tense and that this is part of an emotional or anxiety response.

If, even with highly effective medications, the schizophrenic continues to experience emotional or physical difficulties, then it is apparent that the need exists for additional therapeutic

interventions. This may, in part, be provided by the more conventional modes of psychotherapy, but may be addressed in yet another way.

The notion of teaching schizophrenics to become cognizant of their physiological reactions as they relate to other behaviors, such as emotion and thinking, has only begun to be explored. While the therapeutic effectiveness of antipsychotic medications cannot be disputed, they do not enhance the individual's self-awareness, nor do they teach the patient how to deal with stressful events in their daily lives. This researcher believes that therapeutic interventions which are based on existing data regarding the nature of schizoprenia should be explored. The need is not to dispute the effectiveness of contemporary treatments already in use. Rather, the need lies in exploring additional interventions to be used in conjunction with accepted practices.

Purpose

There is considerable support for the theory that the abnormally high skeletal-muscle tension of schizophrenics is indicative of the difficulties experienced by them in dealing with internal and external stressors. Research findings suggest that a relationship exists between these motor irregularities and in the production and maintenance of symptoms of schizophrenics. While these issues have already been touched upon, a more extensive review will follow.

Other persons diagnosed as being chronically anxious and who also manifest unusually high skeletal-muscle tension have been helped

to alleviate their feelings of tension through EMG biofeedback relaxation training. While these two populations are different in many ways, certain similarities do exist, specifically in anxiety and tension represented in the skeletal-muscle system. It has been recently suggested that similar techniques can be used successfully with various psychiatric populations. Therefore, it was the purpose of this investigation to explore the effectiveness of EMG biofeedback techniques in alleviating select symptoms in persons diagnosed as schizophrenic.

General Hypotheses

Hypotheses for the study were divided into three parts, each part pertaining to a different type of dependent variable. The variables were: (a) electromyographic levels, (b) scores on five cognitive tests, and (c) scores on three self-rating scales.

EMG Levels

1. The EMG levels (measured in microvolts) will be lower following the point of biofeedback training than prior to treatment.
2. The EMG levels (measured in microvolts) will be lower during the administration of cognitive tests following the point of biofeedback training than prior to treatment.

Cognitive Tests

3. Scores on each of five cognitive tests will increase following the point of biofeedback training than prior to treatment.

Self-Rating Scales

4. Scores on general level of tension will decrease following the point of biofeedback training than prior to treatment.

5. Scores of the ability to modify levels of tension will increase following the point of biofeedback training than prior to treatment.

6. Scores of the ability to detect change in levels of tension will increase following the point of biofeedback training than prior to treatment.

Definition of Terms

The following definitions are listed to clarify terms used in this study:

Peripheral nervous system. The peripheral nervous system consists of nerves entering and leaving the brain and spinal cord and is subdivided into two other systems: (a) The Somatic Nervous System or skeletal-muscle system, consists of motor nerves emerging from the spinal cord in the ventral roots and sensory nerves entering the dorsal roots. These receptors carry information to nerve impulses which innervate the Central Nervous System. These sensory and motor systems are integrated at several points in the nervous system, including the spinal cord, cerebellum, and cerebral cortex. (b) The Autonomic Nervous System consists of sensory and motor nerves serving the heart, glands, and smooth muscle of the viscera. These structures maintain homeostasis of internal mechanisms (Tuttle & Schottelius, 1969).

Antipsychotic medications. These drugs are known as major tranquilizers or neuroleptics and are often the drugs of choice used in the treatment of schizophrenia. Subclassifications of these drugs are penothiazine derivatives, thioxanthene derivatives, and butyrophenone derivatives (Freedman, Sadock, & Kaplan, 1976).

Schizophrenia. Schizophrenia is a mental disorder of psychotic level characterized by disturbances in thinking, mood, and behavior. The causes of schizophrenia remain unknown. The disorder consists of the following subclassifications: hebephrenic, catatonic, paranoid, schizoaffective, childhood, residual, latent, chronic undifferentiated, and acute schizophrenia (Freedman, Sadock, & Kaplan, 1976). This study used the Taylor and Abrams (1975) modification of the Feighner et al. (1972) criteria for schizophrenia. The following are suggested criteria for use in research:

1. Duration of episode greater than six months.

2. Clear consciousness.

3. Presence of either delusions, hallucinations, or formal thought disorder. Thought disorders include the following: (a) verbigeration (meaningless repetition of words or phrases), (b) nonsequiturs (illogical thought whereby an inference or conclusion does not follow from established evidence), (c) word approximation, (d) neologisms (a new word or condensation of several words which are formed in order to express a complex idea), (e) blocking (thought deprivation or involuntary cessation of thought or speech), (f) derailment (many incomprehensible and disconnected utterances). These six criteria refer to the lack of understandable speech.

4. Absence of broad affect.

5. Absence of signs and symptoms sufficient to make a diagnosis of affective disease.

6. Absence of alcoholism or drug abuse within one year of admission.

7. Absence of clinical signs and symptoms of coarse brain disease or major medical illness known to produce significant behavioral changes.

Biofeedback. Biofeedback is the use of instrumentation to reflect physiological processes of which the individual is not normally aware. A person receives immediate information about a biological process, such as muscle tension, skin-surface temperature, brain-wave activity, heart rate, blood pressure, and galvanic skin response (Fuller, 1977).

Electromyogram (EMG). The EMG is a recording of electrical responses from muscles which detects levels and changes in muscle contractions (Schwartz & Beatty, 1977).

Electromyographic feedback. This process relays information through visual or auditory amplification of levels and changes in the contraction of muscles (Schwartz & Beatty, 1977).

Progressive relaxation. Progressive Relaxation is a technique developed by E. Jacobson in 1938 which emphasizes the relaxation of voluntary skeletal muscles (Benson, 1975). Sets of muscles are alternately tensed and relaxed. The exercises emphasize discrimination of tension versus relaxation.

Overview

In Chapter II, literature relevant to the theory and research focusing on skeletal-muscle responses and physiological arousal in schizophrenics is reviewed. Literature is also reviewed which relates to studies in the field of electromyographic biofeedback and Progressive Relaxation techniques. In addition, this chapter contains general reviews of the possible relationship which exists between the skeletal-muscle systems and other variables and the effects of antipsychotic medications on skeletal-muscle measures. In Chapter III the design and analysis are presented, including a description of the sample, methodology, and instrumentation. The formal research hypotheses are also presented in this chapter. An analysis of the data is presented in Chapter IV with an interpretation of the results for each hypothesis. Included in Chapter V are a summary of this investigation, a discussion of the findings, and implications for further research in the area of EMG biofeedback training for schizophrenics.

CHAPTER II

RELATED RESEARCH

The literature reviewed in this chapter is divided into seven sections. The first is a review of the hypothesized relationship between the skeletal-muscle system to other variables. It provides background information for the next two sections, which are reviews of research and theory focusing on skeletal-muscle responses and physiological arousal in schizophrenics. The fourth and fifth sections pertain to electromyographic biofeedback and Progressive Relaxation, techniques which have been used to decrease skeletal-muscle tension in various patient populations. The following section reviews the effects of neuroleptic medications on skeletal-muscle measures. (These medications are the preferred drugs used in persons diagnosed as schizophrenic.) The last section is a summary of the implications of the research for the present study.

Relationship of Skeletal-Muscle System to Other Variables

In order to understand the significance of some of the studies presented in this chapter, it is important to understand the hypothesized relationship which exists between the skeletal-muscle system and other variables involving cognition and behavior. The symptoms of schizophrenia permeate all three areas of functioning.

Figure 2.1 is a schematic representation of brain structures which serve as a relay system for excitatory and inhibitory impulses going to and coming from other parts of the body, including the skeletal-musculature. In essence, the process which will be described is an elaborate feedback loop where impulses originating at one site can impact on and affect other sites.

It is generally agreed that the hypothalamus and portions of the brain stem form the Reticular Activating System (RAS), believed to be that part of the brain which mediates inhibitory and excitatory impulses. Neuronal pathways form connections with the RAS and structures such as the limbic system, the cortex, and the skeletal-musculature. The limbic system is believed to contribute to the subjective experience of emotions, while the cortex is that part of the brain where cognition or thinking is represented (Lezak, 1976).

Gellhorn (1964) reviewed experimental evidence which examined the interactive effects between the somatic (skeletal-muscle) system and structures within the brain. It was observed that an increase in proprioceptive discharges in the skeletal-musculature was correlated with states of mental alertness and cortical excitation. Conversely, a decrease or inhibition of proprioceptive discharges was correlated with a diminished state of cortical excitation. Utilizing the figure and descriptions of structures within the brain, it can be seen how states of excitation or inhibition might also be occurring simultaneously at other sites.

Whatmore and Kohli (1974) focused on the skeletal-muscle system as being most important in the maintenance of fear and symptoms of

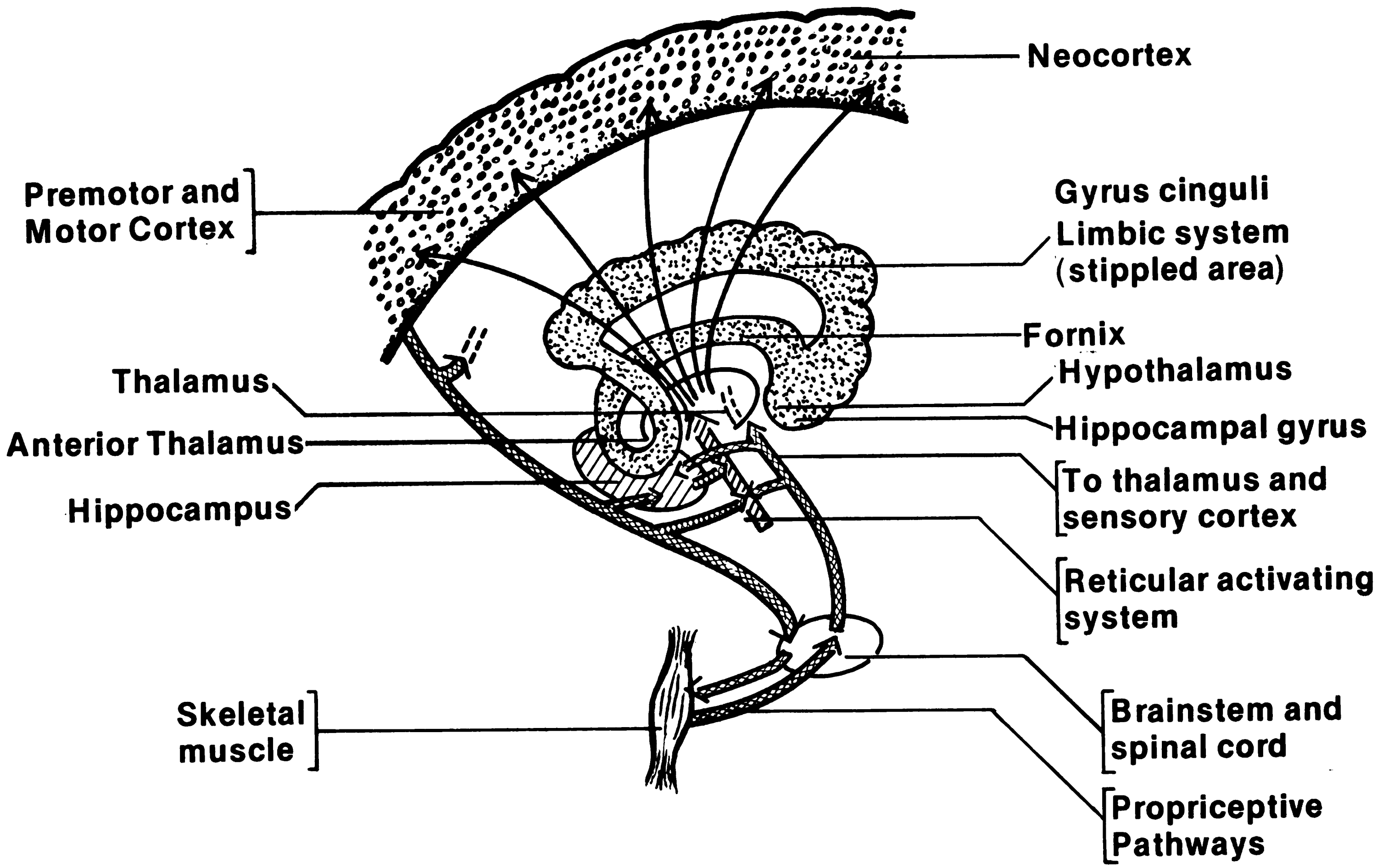


Figure 2.1: Pathways from skeletal muscle to neocortex. (From Whatmore & Kohli, 1974.)

anxiety. They hypothesized that excessive skeletal-muscle activity observed in these emotional states resulted in excitatory signaling to the Reticular Activating System, which in turn affected states of emotion through effects on the limbic system as well as on ideation through effects at the cortical level.

Psychophysiological research in the field of schizophrenia attempts to find physiological correlates of emotion and cognition. Lang, Rice, and Sternbach (in Greenfield & Sternbach, 1972) emphasized that an understanding of the interrelation of response systems is fundamental to the psychology of emotion and to the development of the effective treatment of emotional disorders. The literature reviewed in this chapter examines data which integrate physiological arousal and skeletal-muscle response tendencies in schizophrenics as they relate to other response systems.

The Relationship of Skeletal-Muscle Response Tendencies to Other Variables in Schizophrenia

Studies in the field of schizophrenia are often confusing because of the heterogeneous nature of this diagnostic group. There are numerous ways of subclassifying schizophrenics to create more homogeneous samples for study. Three of the most common classificatory systems found in the literature include: (a) process/reactive, (b) chronic/acute, and (c) paranoid/nonparanoid. The criteria for these groups are based on duration of illness, history of the development of the illness, and type and severity of symptomatology. An attempt will be made to clarify the nature of samples used in the studies reviewed.

The results of years of investigation can be summarized as follows. Among schizophrenics, (a) skeletal-muscle measures differentiate among the subject groups more clearly than other measures, such as heart rate or brain wave activity; (b) a high degree of consistency exists among individuals in measures of muscular tension from one stress situation to another; (c) disturbances in striate muscle activity correspond to degree of anxiety; (d) skeletal-muscle tension bears a relationship to symptom production; (e) skeletal-muscle activity is believed to be representative of stress reactions experienced in everyday life situations; and finally, (f) observed emotional withdrawal and emotional blunting in schizophrenics are not indicative of general diminished physiological responsiveness to stimuli.

Malmo and his co-workers generated considerable interest in the role of muscle tension in symptom production and its relationship to emotional states. They looked at changes in physiological variables during the presentation of experimental stressors in psychiatric patients. In 1949, Malmo and Shagass studied reactions to thermal pain stimulation in an attempt to investigate the relationship of physiologic disturbance to anxiety. They made comparisons among "early" schizophrenics (mean duration of illness was 1.5 years), psychiatric patients with anxiety as the predominant symptom, a mixed group of psychiatric patients, and a nonpatient control group. They found that the greatest degree of physiological disturbance occurred among the most anxious and early schizophrenic groups. This occurred during a seven-minute prestimulus period as well as during pain

stimulation. In addition, the clearest correspondence between degree of anxiety and degree of physiologic disturbance was found in measures of striate muscle activity which were similar among anxious and early schizophrenic groups. Overreaction to pain stimulation, as reflected in the signaling of pain experience with stimuli of low intensity, occurred more frequently among both groups (anxious and schizophrenic), with the least amount of discrimination occurring among early schizophrenics. They concluded that this heightened state of expectation also appeared to be characteristic of degree of anxiety. These findings provided the groundwork for the following investigations.

Malmo, Shagass, and Davis (1951) expanded on the 1949 study with the addition of a group of chronic schizophrenic patients. (Mean duration of illness was 4.5 years, and all had been committed to an institution for an average of three years.) Two more stressors, rapid discrimination and mirror drawing tasks, were presented to the subjects. In general, they found that muscular tension tended to be abnormally high in psychiatric patients. During the preparation (instruction) period of the tests, while marked elevations were observed on some autonomic measures in all groups, only skeletal-muscle tension was considerably greater in the patients. These considerations added further weight to the issue that the skeletal-motor aspect of emotional states is an important one. Muscular tension was also observed to be a highly consistent measure within individuals from one stress situation to another. Finally, levels of muscle tension under stress were as high in chronic schizophrenics as in other psychiatric patients, with the exception that they were hyporeactive to

pain stimulation. The authors concluded that excessive muscular tension was probably of considerable importance in the production of symptoms.

Using data from the Malmo, Shagass, and Davis study, Malmo, Shagass, and Smith (1951) addressed an additional issue of observed behavioral withdrawal and affective dulling in chronic schizophrenics. Such symptoms had been tentatively explained by others in terms of low physiological reactivity. Malmo, Shagass, and Smith summarized that chronics, while being equally reactive on skeletal-muscle measures in anticipation of a stressor, were less reactive on presentation of the stressor. In other words, tension levels remained high, but showed little fluctuation in reaction to the stressors. Chronics also executed fewer button presses, an indication of the experience of pain, than did the other patients. The authors concluded that the withdrawal and affective dulling observed in schizophrenics were the result of a diminished ability to execute purposeful behavior in response to environmental cues, rather than being due to diminished Central Nervous System activity.

Goldstein (1965) also investigated the relationship between anxiety, overt emotionality, and physiologic responsiveness. She compared groups of subjects with diagnoses of psychosis (10 of 15 of these patients were schizophrenic and none were chronic), neurosis, and character disorder with normal controls. All subjects were rated for degree of anxiety on the Taylor Manifest Anxiety Scale and the Freeman Manifest Anxiety Scale. Results showed that psychotics exhibited the highest levels of response on skeletal-muscle measures

during the presentation of a stressor (an auditory stimulus), and they were significantly more reactive, with greater variability from baseline to stress situations, on skeletal-muscle measures. She concluded that degree of physiologic disturbance was related to degree of psychological maladjustment despite observations of diminished emotional responsivity among psychotics.

Whatmore and Ellis (1958) observed levels of skeletal-muscle tension in schizophrenics during a 30-minute rest period and found exaggerated motor activity compared to a group of normal controls. Although it was not stated, the schizophrenics in this study appeared to resemble Malmo's early or acute schizophrenics. Whatmore continued observations of skeletal-muscle activity among various patient populations and found that schizophrenics who were in remission exhibited labile EMGs, with day-to-day readings alternating from being markedly elevated to falling within the range of the nonpatient control subjects (Whatmore, 1966). Important here is that EMGs were abnormally variable when compared to a group of depressed controls, even though the patients were in excellent clinical condition. He observed that an increase in lability and an elevation of baseline measures preceded acute psychotic episodes, with the episodes occurring at high points in the EMG curve. Conversely, a sustained reduction in electromyographic levels was followed by improvement in clinical condition. His findings, that there was a relationship between manifest symptomatology and skeletal-muscle tension, led to the conclusion that there was an important connection between such tension and the variables of emotion and cognition. He hypothesized that hyperactivity in the

skeletal-musculature was characteristic of levels of arousal or excitation also occurring within the limbic system, Reticular Activating System, and cortical sites within the brain.

Later studies confirmed that schizophrenics, with labels of acute and chronic, and process and reactive, were overaroused on measures of skeletal-muscle tension. This was consistent during rest, and during the presentation of stressors. This was not true for paranoid subjects, which is why individuals falling within this subgroup were excluded from the present study. Fenz and Velner (1970) concluded that a common basic deficit in schizophrenics lies in their inability to modulate or change levels of responsiveness to correspond to variations in internal and external stimulation. In behavioral terms, the deficit seems to indicate that the schizophrenic individual is unable to evaluate the emotional demands of a situation and to respond to it appropriately. Issues of overarousal at the physiological level and the effects upon behavior and cognition are central to psychophysiological theories of schizophrenia, which are reviewed in the next section.

Theories of Psychophysiological Arousal in Schizophrenia

The theories of Mednick, Broen, and Tecce and Cole are reviewed in this section. They are exemplary of theories which focus on disturbances in psychological functions, such as attention and learning, and the relationship of these functions to physiological variables. A common theme of these three theories is that in schizophrenia, a state of physiological disequilibrium exists, whereby chronic states

of arousal impact on the individual's ability to process and filter information. The behavioral results are seen as disorganization at the cortical level, producing such symptoms as the inability to focus thoughts, increased attention to irrelevant stimuli, and delusional thinking. The theories do not explain etiology, but attempt to describe psychophysiological interactions.

Mednick (1958) suggested that there must be a predisposition for schizophrenia, possibly genetic in nature, which results in limitations in terms of the individual's ability to adapt adequately to events in his environment. The characteristics of this predisposition involve excessively strong physiological reactions to mild stress and excessively slow recovery rates of physiological arousal. Mednick hypothesized that this arousal may have a role in the development of certain learned defensive cognitive styles which characterize the thought disorder of schizophrenia. One of the key factors of this theory is that the individual learns to focus on nonstressful stimuli.

Physiological arousal was viewed by Mednick as a variable which contributes to the strength of the individual's drives, where increasing arousal is accompanied by increased drive levels. The preschizophrenic, experiencing excessive arousal, would be in a heightened state of drive according to this theory. Mednick further predicted that increasing drive states resulted in increased response strength of any habit tendencies. Consequently, the highly aroused preschizophrenic individual responds to a wider range of stimuli more quickly and with greater intensity. In terms of the learning theory on which

Mednick based his theory, conditioned responses are acquired more rapidly and excessive stimulus generalization occurs.

Following is a brief description of the progression of the schizophrenic psychosis. The preschizophrenic was described by Mednick as being an extremely anxious individual, fearful of many situations. New stimulus events and experiences which appear similar to those the individual has already learned to fear tend also to elicit anxiety responses. There appears to be an almost circular chain of events: increased arousal, increased drive levels, excessive stimulus generalization, and further heightened arousal. The individual, seeking to reduce levels of anxiety, learns to avoid the feared events, but since the original fears never extinguish, this does not represent a successful adaptation. The psychosis develops out of these learned defensive habits and usually is precipitated by an event or crisis which interfered with the anxiety-avoidant responses. This event serves to exacerbate the individual's already high levels of anxiety. (Anxiety and arousal appear to be used interchangeably in Mednick's theory.) The conditions which have been described continue to escalate: drive levels become unusually high and generalization to stimuli is increased, whereby an even greater number of events provoke fear responses. Finally, an upper limit or "threshold" of psychological and physiological arousal and stimulus generalization is reached. The individual can no longer control the number and quality of thoughts. The ability to discriminate relevant from irrelevant stimuli is diminished and increased generalization results in remote associations gaining in response strength. Thoughts

speed, associations are not logical, and the individual attempts to reach a rational solution to these fearful events in the form of delusions.

Mednick explained the cognitive process of schizophrenia primarily as a learned problem, and he cited important research in conditioning and generalization which supported such an interpretation. Broen's theory, which is reviewed next, postulates that set patterns of physiological responding are causally related to schizophrenic symptomatology. His idea about the developing cognitive style of the schizophrenic appears quite similar to Mednick's, even though the emphasis is on physiological rather than learning factors.

Broen (1968) agreed with Mednick that the schizophrenic is highly anxiety-prone, with slow rates of recovery from high levels of physiological arousal. He cited research which demonstrated that skeletal-muscle tension is a consistent and predominant indication of this arousal. He also hypothesized that changes in cognition were a direct result of this chronic arousal. Two factors, physiological arousal and "response strength ceiling," are central to Broen's theory of schizophrenia.

He explained response strength ceiling in this way. In normals, when a stimulus evokes more than one response tendency, the appropriate response tendency is much stronger than competing response tendencies and, therefore, will usually occur. These response tendencies are hierarchically ordered in accordance with their appropriateness. In schizophrenics, this hierarchy seems to be partially collapsed, where the strengths of dominant and competing responses

are more nearly equal. The collapse in the hierarchy of responses is also viewed as being a predispositional factor. The interaction of arousal and collapsed response strength ceilings results in cognitive disorientation.

The theory states that since the recovery from arousal in schizophrenics is retarded, new situations tend to have an additive effect on tension which has not yet abated. As with Mednick, Broen postulated that physiological arousal increases attentiveness to remote associations and stimuli. When arousal is initially high and the strongest response in a response hierarchy is restricted at ceiling strength, an increase in arousal can only facilitate the competing responses, and the result is a sensory overload on a cognitive system which is capable of processing a limited amount of information. This hypothesis parallels the upper threshold of stimulation which Mednick referred to.

Broen cited the research of Malmo, which indicated that as levels of physiological activation increase in the schizophrenic, responsivity to stimuli decreases. He hypothesized that a physiological inhibitory set occurs with thoughts directed toward nonstress ideation. This represents an effort to decrease arousal and restabilize or reach some form of homeostasis.

> The result of inhibitory feedback is not always simply to control the overactive system. . . . Inhibitory processes stimulated by the activation of a physiological system can have fairly important effects on other systems. . . . For example, it seems that a spurt in cardiovascular functioning activates an inhibitory process that not only provides homeostatic feedback to the heart, but also tends to counteract the activation of processes involved with sensory receptivity (Broen, 1968, p. 216).

Broen's statement suggests that tension and physiological arousal are causally related to behavioral changes in schizophrenics, specifically, attention to remote stimuli and decreased utilization of cues in the environment.

Tecce and Cole (in Mostofsky, 1976) presented a theory of schizophrenia which incorporated other theories and empirical findings already reviewed. The theory attempts to define the relationship which exists between physiological arousal and cognitive behaviors of attention and distraction. These two concepts are similar to the concepts of excessive stimulus generalization of Mednick's theory and the disturbances of associative processes due to irrelevant responses of Broen's theory. Tecce and Cole considered the relationship between arousal, represented in the Reticular Activating System, and in changes of skeletal-muscle tension, as being a complex interaction between states of excitation and inhibition which impact on cognitive interference. Like Broen and Mednick, they did not attempt to resolve the cause-effect issue in terms of the etiology of schizophrenia.

Tecce and Cole hypothesized a two-process theoretical model, based in part on the earlier works of a theory by Hebb. The two hypotheses, schematicized in Figures 2.2 and 2.3, are:

1. Performance of schizophrenics is positively and monotonically related to attention.

2. Performance of schizophrenics is nonmonotonically (an inverted U) related to levels of arousal.

Stated differently, performance increases with increasing attention, whereas performance increases with increasing arousal only to a

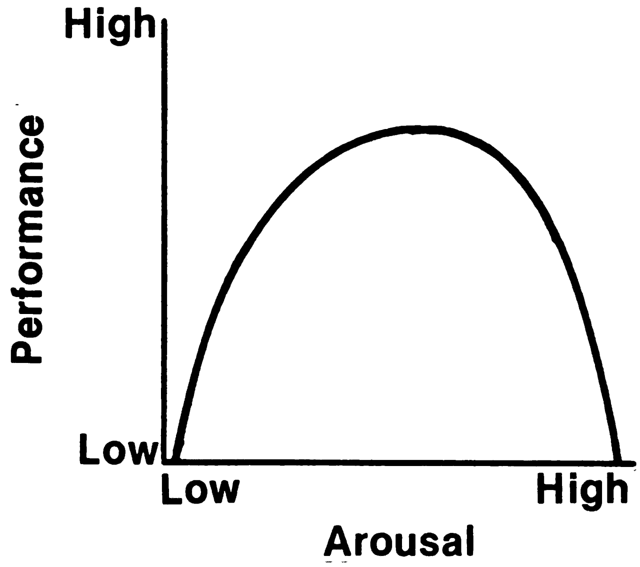


Figure 2.2: Nonmonotonic relationship between Arousal and Performance

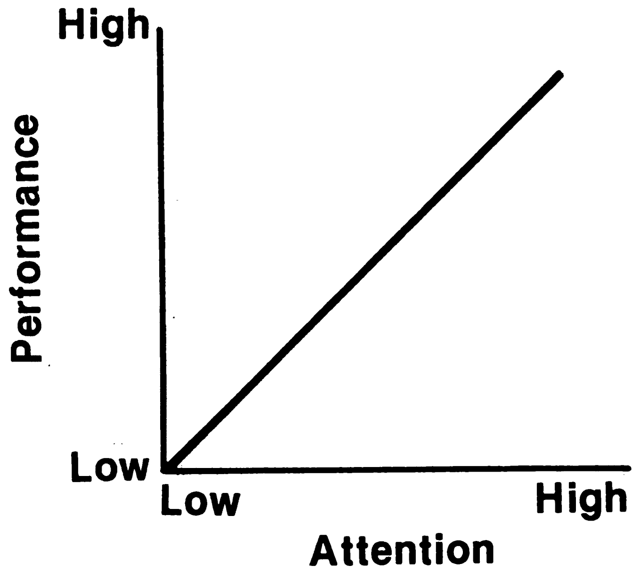


Figure 2.3: Monotonic relationship between Attention and Performance.

maximum level. As arousal increases above maximum level, a decrement in performance occurs. This decrement in performance occurs because excessively high levels of arousal produce behavioral impairment by distraction. Conversely, Tecce and Cole stated that distraction can also produce elevations in arousal.

The interaction between arousal, attention, and distraction has its basis in the excitatory and inhibitory regulation of the Reticular Activating System according to this theory. Tecce and Cole concluded:

> The direct exclusion of extraneous stimuli (including irrelevant thoughts) by focused and narrowed attention processes appears to occupy a central role in psychotherapeutic and drug treatment methods. Transcendental meditation appears to be an especially effective technique in altering states of consciousness by producing a decrease in distraction and a lowering of physiological functions (Mostofsky, 1976, p. 208).

The following sections reviewed in this chapter deal with elements of biofeedback and progressive relaxation which can also be instrumental in decreasing levels of physiological arousal.

Electromyographic Biofeedback as a Method of Relaxation Training

Biofeedback involves the use of instrumentation to reflect psychophysiological processes of which the individual is not normally aware and which may be brought under voluntary control. It is the integration of bodily functions and cognition, or the mind-body relationship, which is central to the concepts of biofeedback. A person is given information about his or her biological conditions such as muscle tension, skin-surface temperature, or brain wave activity, and the cognitive awareness or understanding of a

physiological activity enables the individual to alter the physiological response (Fuller, 1977). EMG biofeedback is used in relaxation training to effect a decrease in muscle-contraction activity. Electrodes attached on the surface of the skin over a particular muscle measure electrical discharges from the muscle fibers. The electrical activity comprises the EMG recording. As the muscle becomes more tense, indicating increased contraction, the auditory signal heard by the subject increases in pitch. This feedback provides immediate information to the subject of the state of muscle tension (Olton & Noonberg, 1980). As Green and Green (1977) point out, in learning to voluntarily control normally unconscious processes, one does not become aware of the biological activity in neuronal pathways, but one increases awareness of the mental-emotional factors which influence physiological states.

Brown (1978) summarized the concepts involved in the biofeedback process. First, conditioning results from rewarding biological activities for performance, where the biofeedback monitor is used as the reward in shaping the desired activity. Second, EMG biofeedback is used as a stress-reduction technique, where a developing awareness of the feeling of relaxation occurs, allowing the discrimination of differences between tension and relaxation. Finally, biofeedback involves cognitive mechanisms. She emphasized this concept of higher mental activity as being an important factor involved in the control of physiological functions.

Brown believed that in complex emotional problems, where muscle relaxation was achieved, it seemed that the patient's attention

shifted to insights related to the problem as the individual became aware of the subjective mechanisms which maintained stress. Stress is maintained by: (a) excessive rumination and preoccupation which focus on the stressors, and (b) internal feedback of information about the status of physiological reactions to stress, where states of tension are interpreted as emotional stress reactions which become reinforcing. Brown stated:

> Between the information input and the resulting learned physiological control, extraordinarily complex information processing must occur, where appropriate information to the brain is associated, integrated, evaluated, put into memory, and the product of this brain activity is used to activate patterns of neural activity that result in discreet, channelled directions to control the selected physiologic activity (p. 22).

Brown believed that in biofeedback, attention is redirected from fixed, self-reinforcing, circular mental activities by supplying information about the physiological mechanisms involved in maintaining such mental activity. This idea seems to be compatible with the theories of arousal in schizophrenia which emphasized that thoughts of the schizophrenic are redirected to inappropriate ideation in an effort to reduce stress. Clearly, this type of thought distraction contributes to the maladaptive behavior of the schizophrenic.

Gaardner and Montgomery (1977) provided a model, illustrated in Figure 2.4, which describes how EMG biofeedback relates to other variables. The figure illustrates the interaction between external stimuli, muscular tension, and cortical activation. They endorsed what others, including Jacobson (1938) and Benson (1975), have also emphasized: that anxiety cannot exist in the presence of deep muscle

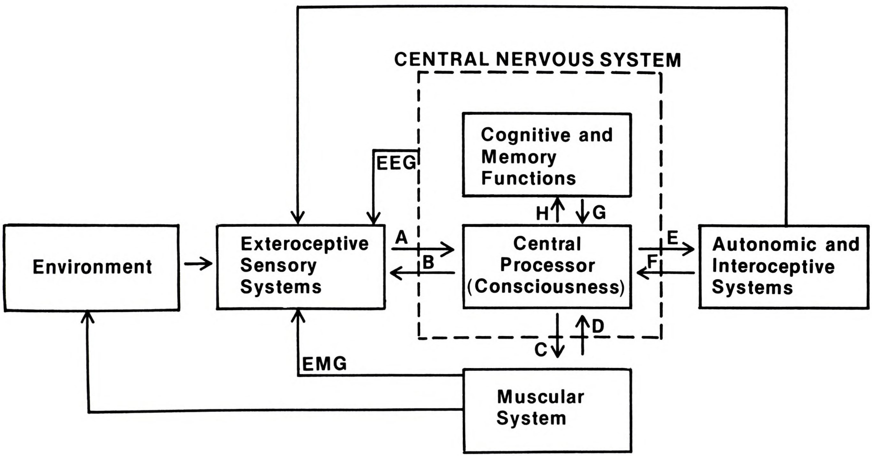


Figure 2.4: Psychophysiological feedback loop. (From Gaardner & Montgomery, 1977.)

relaxation. Using the diagram, minimizing activity of the muscular system (Channel C) and consequent focusing of conscious awareness (Channel D) prohibits the existence of physiological stress. According to this hypothesis, cognitive functions are, in part, dependent on the state of the muscular and sensory systems.

The effects of muscle relaxation on other bodily systems were also reviewed by Basmajian (1979). He observed that with the achievement of states of muscle relaxation, heart rate and cortical arousal are decreased. He discussed the probability that in learned muscle relaxation, brainstem inhibitory mechanisms were activated. The relationship of skeletal-muscle responses to brain structures was discussed in conjunction with Figure 2.1.

Schwartz and Beatty (1977) emphasized, as well, that EMG biofeedback training deals with somatic reactions which are part of a broader set of issues relating to stress and adaptation to stress. These stress reactions and emotional processes are the result of an individual's cognitive appraisals of the significance of an event. The control of such somatic reactions is seen as an important aspect of the emotions and self-regulation. They believed that it is the self-regulation which provides the link between biofeedback and the emotions.

Clinical studies have shown that EMG relaxation training has been used successfully for chronic anxiety with beneficial changes in muscular tension and other anxiety symptoms. Some of these studies are cited in the following section, which provides the rationale for combining relaxation techniques. Several other researchers have

examined the efficacy of using EMG biofeedback as relaxation training with various psychiatric populations.

Jessup and Neufeld (in Stoyva, Kamiya, Barber, Miller, & Shapiro, 1979) made comparisons between four relaxation techniques, including EMG biofeedback, with hospitalized psychiatric patients. Fifteen out of the 20 subjects had some form of depression as their major diagnosis. The diagnoses of the other five were not given, although none of the subjects were psychotic. Subjects in the EMG biofeedback group were given brief instructions over an intercom in which they were asked to use a tone to help them relax. They were given four sessions on consecutive days of training. The treatment did not significantly affect EMG measures, and insignificant changes on a mood checklist were found from pre to post testings. The authors concluded that there was no support for using EMG biofeedback treatment for inducing relaxation in the samples studied.

A second study by Ford, Stroebel, Strong, and Szarek (1981) provided data suggesting that Quieting Response Training, which combines EMG biofeedback with thermal feedback, deep breathing, progressive relaxation, and autogenic techniques, is a useful technique for use with psychiatric inpatients. Although the study assessed a combination of techniques which were different from those used in the present study, the findings suggested that patients with various diagnoses could benefit from techniques which emphasize self-regulation. Thirty-seven inpatients participated in the study with diagnoses which included psychotic, neurotic, personality disorders, and "special" disorders. It is probable that some of the 15 psychotics were

schizophrenic, even though this was not specified. Outcome measures which included changes in the frequency, severity, and duration of symptoms as well as changes in medication indicated that success of treatment was unrelated to diagnosis or presenting complaint. There were no differences in the percentage of subjects who experienced success when comparisons were made between the inpatients and a general clinic population. In addition, there were no problems for patients in terms of increases in pathological symptoms or motivation.

Studies support that the techniques outlined in the present study would be beneficial for persons diagnosed as schizophrenic. These individuals are known to be psychotic from time to time and manifest some symptoms which are similar to individuals who are chronically anxious.

The idea of self-regulation in biofeedback training seems particularly appealing in working with schizophrenics, who, because of the nature of their illness, often become dependent on others to provide continuous reassurance and support in treatment. To date, psychotherapy, institutionalization, and antipsychotic medications have been the means by which this support has been provided (Freedman, Sadock, & Kaplan, 1976).

Progressive Relaxation

Progressive Relaxation is a set of exercises that emphasize the relaxation of skeletal muscles. The technique seeks to achieve increased control over the skeletal muscles until the individual is able to produce very low levels of tension in major muscle groups (Benson,

1975). The technique was originally developed by E. Jacobson, whose major thesis was that anxiety and relaxation are mutually exclusive. Since individuals generally have little awareness of the sensation of relaxation, the technique requires that the individual tense a set of muscles as hard as he can until real tension is experienced. The muscles are then relaxed and the individual tries to focus on the difference between tension and relaxation. As practice continues, the individual begins to discriminate more finely the different degrees of tension and relaxation (Brown, 1978). Jacobson's Progressive Relaxation requires extensive amounts of time for practice. Therefore, abbreviated instructions such as those provided by Basmajian (1979) have been recommended for home practice. Modified instructions were also used in this study.

The primary reason for combining EMG biofeedback with relaxation techniques is that they are complimentary and result in the added efficiency and effectiveness of muscle relaxation. The following studies indicate why this is the case.

Researchers have demonstrated that while self-report measures of relaxation may be equal to, or higher, in groups of subjects training in Progressive Relaxation, EMG measures are significantly lower in groups training with EMG biofeedback. Canter, Kondo, and Knott (1975) made comparisons between two groups of chronically anxious patients. One group received EMG biofeedback training and the other was taught progressive muscle relaxation. Patients given feedback training learned to decrease EMG levels to a greater degree than patients who learned Progressive Relaxation. Results from symptom checklists

revealed, however, that the latter group may have obtained greater relief from anxiety. Reinking and Kohl (1975) also examined the effectiveness of EMG relaxation training with other relaxation therapies. While all groups in the study reported increased relaxation on self-report measures, measures of EMG activity showed that the speed of learning and depth of relaxation were superior with EMG biofeedback.

While improvements in symptoms of anxiety have been found in patient populations trained with EMG biofeedback, the question arises as to the generalization of physiological relaxation to untrained muscle sites. Alexander (1975) tested this hypothesis in groups of normal adults trained on the frontalis muscle located on the forehead. No generalization of relaxation occurred. While reductions in frontalis EMGs occurred, subjects showed increases for arm EMGs, while values for a leg muscle remained at low levels throughout sessions. Alexander also found no reliable correlation between subjective feelings of relaxation and levels of frontalis muscle tension. His use of normal samples with initially low EMG levels limits these findings but raises important issues for combining techniques.

Coursey (1975) also investigated the problem of generalization of relaxation. He concluded that EMG feedback was more effective in lowering tension in a specific muscle than simple verbal instructions to relax. The muscle site used for EMG training in this study was also the frontalis. Results from a questionnaire showed that only the upper parts of the body (face, forehead, upper arms, and hands) correlated with the subjective sense of relaxation.

Several final points have been made which provide information as to the effectiveness of combining EMG feedback with relaxation instructions such as Progressive Relaxation. Lader and Matthews (1971) emphasized that the neuroleptics seem to reduce subjective feelings of arousal but do not actually affect EMG levels. The physiological feedback of muscle tension allows one to observe the unfelt tension. In addition, individuals prominent in the field of biofeedback techniques, such as Gaardner and Montgomery, and Brown, emphasized that home practice of relaxation is extremely important since the major objective of the biofeedback treatment is to teach the patient voluntary control of tension without the use of instrumentation. They generally suggest tape recordings of instructions for relaxation, which the patient can use in the home between feedback sessions.

The Effects of Neuroleptics on Skeletal-Muscle Measurement and Cognition

The widely accepted use of neuroleptics in the treatment of schizophrenia necessitates a brief review of some of the changes in symptomatology produced by these drugs.

Spohn, Lacoursiere, Thompson, and Coyne (1977) reported changes toward normalization in the variables of attention and perception along with a reduction in the severity of manifest symptomatology following the administration of a neuroleptic. These changes were attributed to the reductions in autonomic hyper-arousal in chronic schizophrenics being treated with neuroleptics. There were no reported changes observed on cognitive tests, which included a

shortened version of the Wechsler Adult Intelligence Scale and tests of memory.

In a review of the effects of drugs on physiological activity, Tecce and Cole (1972) summarized that the neuroleptics reduced generally elevated basal levels of autonomic physiological activity (except for heart rate), as well as reactivity to stimuli. Such changes were often observed to be accompanied by behavioral improvement. However, they were unable to find consistent evidence for similar changes in EMG measures. The Spohn et al. study did not include measures of EMG responses.

Lehman (1975) explained that neuroleptic drugs diminish arousal of the Central Nervous System without inhibiting the higher cortical centers at any dose level. He hypothesized that the result of the administration of the drugs was to effect a decrease of excessive perceptual input through inhibition at the reticular formation. This may be one reason why changes in formal cognitive functioning are not observed to occur with these drugs. Lader and Matthews (1971) noted the drugs which act on the Central Nervous System may reduce subjective tension without accompanying reductions in EMG levels.

In some of the studies cited in this chapter, subjects were receiving doses of a neuroleptic medication. The results indicated that the ability to modulate skeletal-muscle tension during rest and in response to stressors continued to be problematic.

Neuroleptics appear to normalize autonomic activity and reactivity, to improve attentional-perceptual deficits, and to reduce subjective anxiety. It should be expected, then, that in the

population under study, one would find a low correlation between subjective tension and EMG levels. The therapeutic effectiveness of normalizing EMG levels remains open to question, particularly as it might affect cognitive performance and the individual's perceived ability to modify stress reactions.

Summary and Implications of Related Research

The review of psychophysiological research in schizophrenia has shown that schizophrenics are abnormally aroused on skeletal-muscle measures. It is believed that this tension is representative of anxiety experienced by the schizophrenic and that a relationship exists between such tension and the maladaptive behaviors observed in schizophrenia. Specifically, an increase in tension has been observed to occur prior to the appearance of symptoms, and a decrease in tension accompanies clinical improvement. To date, neuroleptic medications have been one of the most effective means of treatment for the schizophrenic, resulting in improvements of attention and perception as well as decreasing autonomic arousal. These medications do not appear to impact, however, on skeletal-muscle tension, which remains elevated.

Combined techniques of electromyographic biofeedback and Progressive Relaxation have been effective in reducing skeletal-muscle tension and in decreasing subjective feelings of tension in various patient populations, including chronically anxious and psychotic individuals. In addition, it is emphasized in the literature that one of the primary aims of these techniques is to help the individual

become more aware of stress reactions represented in the skeletal-muscle system by (a) focusing on minute-to-minute alterations in tension and (b) becoming more aware of factors, internal and external, which serve to maintain or increase tension.

In this study, persons diagnosed as schizophrenic were taught to alter skeletal-muscle tension, utilizing a combined program of EMG biofeedback and modified Progressive Relaxation exercises. Changes in performance on cognitive tasks, subjective feelings of tension, anxiety, and EMG levels were measured to examine the effectiveness of the treatment program.

CHAPTER III

DESIGN OF THE STUDY

The design of the study involved recording EMG averages and administering the Repetitive Psychometric Measures and Self-Rating Scales of tension during Baseline and Treatment phases to subjects on an individual basis. An additional measure, the Taylor Manifest Anxiety Scale, was administered pre-Baseline and post-Treatment. These results were included in the Clinical Observations of Chapter IV but were not included in hypothesis testing. A description of the sample, design, methodology, and analysis are presented in this chapter. A description of the split-middle technique is also included.

Sample

Following is a description of the four subjects selected for the study:

Subject 1 was a 20-year-old, single male who lived at home with his divorced mother and younger brother. He graduated from high school and was enrolled in a vocational rehabilitation program during the study. He had a history of three psychiatric hospitalizations, each lasting about four weeks. He was being maintained on 400 mg of Thorazine per day for six months prior to the study. This was changed to 50 mg of Loxitane per day by the end of the study. Both medications are antipsychotic agents.

Subject 2 was a 37-year-old, married woman with one teenage daughter. The subject was the elder of two children. At the time of the study, she was enrolled in graduate-level courses and had earned one masters-level degree. She had a history of six previous psychiatric hospitalizations, the first occurring after the birth of her daughter. Length of stays in the hospital varied in duration, and none was less than several weeks. Her medications included 3-5 mg of Prolixin, 900 mg of Lithium, and 100 mg of Seconol per day. Only the Prolixin is an antipsychotic medication. The Lithium was used in combination with the Prolixin, and the Seconol is a sedative used for sleep.

Subject 3 was a 24-year-old woman who was single and lived at home with her mother and father. She had one older brother who lived away from home. She completed 11 grades of school and did not have a high school diploma. She was attending a day program at a community mental health center and was enrolled in two high school equivalent classes at the time of the study. Her first psychiatric hospitalization occurred when she was 11 years old, and she had subsequently been admitted to psychiatric hospitals at least eight times. One of the hospitalizations, at age 16, lasted for three years. Throughout the study, she was taking 100 mg of Serental per day, which is an antipsychotic medication.

Subject 4 was a 28-year-old, divorced woman with one child, whom she gave up for adoption. She lived with her older brother but frequently spent evenings at her parents' home. At the time of the study, she had an associate degree and was attending day care at a

community mental health center. She was also enrolled in two college courses at a junior college. She had three psychiatric hospitalizations with stays from one to two months in duration. At the time of the study, she had been maintained on 20 mg of Navane for one year. This antipsychotic medication was discontinued on the ninth training session of the study.

Initially, the study was presented to psychiatrists in the East Lansing and Lansing areas as a research project designed to investigate the effects of an electromyographic biofeedback treatment program on EMG levels, subjective experiences of tension, and on cognitive performance in persons diagnosed as schizophrenic. A request was made that psychiatrists recommend clients for the study who they felt were not classified as paranoid schizophrenic and who (a) fit the research criteria, (b) were stable enough to participate, and (c) experienced some difficulty with tension. In turn, clients who agreed to participate with the consent of their psychiatrist were asked to contact the experimenter. This arrangement insured that issues of client/physician confidentiality were honored.

Each potential subject was given an introductory session in which the purpose and procedures of the study were reviewed. They were informed that three to four hour-long sessions per week were required, and they were shown examples of questions and tests which would be administered during the study. In addition, clients were told that they would be asked to practice relaxation at home with the use of tape-recorded instructions provided by the experimenter. This session

was also used to demonstrate the biofeedback equipment, with an explanation of the measurement of muscle tension.

Four out of five individuals interviewed were selected for the study. One male was excluded because of his evident paranoid delusions, which might have prevented him from understanding and using the instructions in a straightforward manner without incorporating them into his delusions.

Instrumentation

Three types of measures were used in order to test the major hypotheses. They included (a) three Self-Report Rating Scales, (b) frontalis EMG values, and (c) five cognitive/perceptual measures known as the Repetitive Psychometric Measures. In addition, the Taylor Manifest Anxiety Scale was used to compare pre- and post-measures of anxiety for individuals. Test scores from the TMAS could not be statistically analyzed because they were not a continuous measure, which is a requirement of the research design. Results from this measure were included in the Clinical Observations of Chapter IV.

Self-Report Rating Scales

Three scales were developed by the experimenter in order to provide quantitative measurements of subjective changes in tension experienced throughout the treatment program. In addition to the quantitative data, another purpose for utilizing these measures was to enhance the subject's awareness of variations in states of tension. Subjects rated themselves on a scale of 1-5 or 1-10, depending on

the scale, for: general level of tension (Scale 1), ability to decrease tension at will (Scale 2), and awareness of changes in tension throughout the day (Scale 3). (See Appendix A.)

Biofeedback Equipment

Information about the feedback myograph and digital integrator was obtained from the instruction manuals for the Autogen 1500c and HT-10 by Autogenic Systems, Inc., of Berkeley, California. The feedback myograph used was the 1500c model by Autogenics Systems. This model detects signals as low as 0.1 microvolts (Mv) and has six audio feedback modes. The EMG amplitude is an integral averaged measure rather than a peak-to-peak measure. The unit is equipped with a standard bandpass of 100-200 Hz (cycles per second). Visual feedback is presented on a logarithmically scaled amplitude meter. There are three silver/silver chloride surface electrodes provided which are attached to the skin by adhesive discs. The digital integrator, the Autogen HT-10 model, is an instrument which provides average EMG values during data collection. It can be calibrated to average values from one second to 20 minutes.

Repetitive Psychometric Measures

These five tests by Moran and Mefferd (1959) were developed for study of physiological and biochemical correlates of human behavior. They were adapted from tests already known to represent distinct factors of mental abilities through factor-analytic studies. The measures may be repeated often because of the 20 alternate, equated

forms for each test. They are timed, paper-and-pencil tests, requiring a total time of about 15 minutes to administer. (See Appendix B for examples.) Following is a description of each test.

1. Flexibility of Closure (FC). The task of FC is to retain the image of a given configuration despite the influence of other distracting configurations. The subject copies specified geometric figures onto matrices of dots. The score is the number of figures correctly copied in 3 minutes.

2. Number Facility (NF). This test requires the addition of one- or two-digit numbers in sets of three. The score is the number of correct answers obtained in 3 minutes.

3. Perceptual Speed (PS). This test measures the speed with which an individual crosses out every digit in rows of random digits, which is like the one indicated for that particular row. The score is the number of digits correctly marked in 2.5 minutes.

4. Speed of Closure (SC). This test measures the ability to unify a disparate perceptual field into a single percept. The task is to circle all four-letter words in rows of random letters. The score is the number of correctly circled words in 2.5 minutes.

5. Visualization (V). This test is associated with the ability to visualize the outcome of objects in space. The subject's task is to visually follow the path of a line embedded in a set of tangled lines, from left to right, and to place the number of the line in the appropriate cell. The score is the number of cells correctly numbered in 3 minutes.

Standardization of the measures was obtained initially by constructing 30 alternate forms of each test through random assignment of items from a large pool of items. All 30 forms of each test were administered twice to subjects in random order. Paired scores were plotted and items were exchanged between forms in which disparate levels of difficulty were observed. The procedure, using the new forms, was repeated on new subjects. Each form of the test was adjusted toward the mean performance. All forms which varied more

than 0.5 SD from the subject's own means were discarded. The 20 forms of the test which varied least from the subject's means were selected.

Intercorrelations between the tests were established by administering Form 1 to 164 subjects. The correlations ranged from .09 to .44. Test-retest correlations between Form 1 and Form 2 ranged from .72 to .94.

In a second study, Moran and Kimble, Jr. (1964) equated the 20 alternate forms for level of difficulty. They administered the forms to samples of 544 and 508 college students. All alternate forms were found to be reliably different in difficulty level for all but the Number Facility Test. Correction factors were provided in order to decrease this variability.

Moran and Mefferd claimed that the tests were appropriate for use with psychiatric populations in terms of their ability to sustain levels of motivation. They found that such individuals were able to perform satisfactorily for as many as 246 consecutive days.

Taylor Manifest Anxiety Scale (TMAS)

This true-false test was devised by Janet Taylor (1953) to measure manifest symptoms of anxiety. Five clinicians rated 200 items from the Minnesota Multiphasic Personality Inventory (MMPI) for their descriptions of manifest anxiety. Sixty-five items were retained with 80% agreement. These items plus 135 buffer items were given to a normative sample of 352 students. Several modifications retained 50 of the original 65 items through an analysis of internal consistency.

The buffer items were changed so that the total test has 225 items. This latter form is referred to as the Biographical Inventory. Many studies have been carried out on the 50-item test, which was revised in terms of wording to increase its applicability to various populations. This 50-item test (see Appendix C) is known as the At scale in Dahlstrom et al. (1975). The following data refer to the At scale, which was used in this study.

A test of clinical validity reported a correlation of .44 (significant beyond the .01 level) between psychologists' ratings and scores on the At scale. Mean scores of 233 normals and 51 neurotic patients were reliably different at the .001 level. Other studies show mixed results with respect to clinical ratings and scores on the scale. Apparently, the At scale doesn't consistently agree with observers' ratings of anxiety. It does, however, discriminate between various psychiatric populations and normals with differences in scores being statistically significant beyond the .01 level. The scale has a correlation of .92 with the Pt scale of the MMPI, which measures such things as anxiety and dread, low self-confidence, doubts, sensitivity, and moodiness.

Research Design

This study employed a single case study with an A-B time series research design. The notation for this design according to Kratochwill (1978), where repeated interventions are presented in the B Phase, is: $0_1 0_2 0_3 0_4 0_5 0_6 0_7 I_1 0_8 I_2 0_9 \ldots\ldots I_9 0_{12}$. Observations across Baseline and Treatment are represented by 0. I signifies the

introduction of treatment. The dependent variables measured on a repeated or continued basis over time included: electromyogram values (EMGs), three Self-Report Rating Scales, and five cognitive tests (Repetitive Psychometric Measures). The treatment effects of electromyographic biofeedback training, combined with relaxation exercises, were contrasted against the dependent variables across four individuals at the same relative points in time of the treatment.

Methodology

All sessions presented during the study were given on an individual basis and averaged 60 minutes for each session. Subjects participated in four sessions per week for a total of 22 sessions per subject. With the exception of the first and final sessions (the Pre- and Post-Treatment Interviews), only the subject and experimenter were present in the room. Subjects were seated on a comfortable chair or sofa, depending on preference. Sessions were divided into the following phases: (a) Pre-Treatment Interview, (b) Baseline, (c) Treatment, and (d) Post-Treatment Interview. The design of phases is represented in Table 3.1. All EMG values recorded during these sessions represented one-minute averages and were taken from the frontalis muscle. The two active electrodes were placed approximately one inch above the eyebrows and two inches from the upper midpoint of the nasal bones (equidistant from the nasion). The ground electrode was placed between the active electrodes. Note that at the end of each session an additional 10 minutes of resting EMGs were recorded. These values were included to determine the nature of

Table 3.1: Treatment Schedule and Phases

PHASE I Pre-Treatment Interview (1 session)	Administer Self-Rating Scales	Record Resting EMGs (10 min.)	Administer TMAS Record EMGs	Record Resting EMGs (10 min.)	SESSION 1
PHASE II Baseline (7 sessions)	Administer Self-Rating Scales [a]	Record Resting EMGs (20 min.) [a]	Administer RPMs Record EMGs [a]	Record Resting EMGs (10 min.)	SESSION 2-8
PHASE IIIa Treatment (9 sessions)	Administer Self-Rating Scales [a]	Biofeedback Training (30 min.) [a]	Administer RPMs Record EMGs [a]	Record Resting EMGs (10 min.)	SESSION 9-17
PHASE IIIb Treatment (4 sessions)	Administer Self-Rating Scales	Biofeedback Training (30 min.)		Record Resting EMGs (10 min.)	SESSION 18-21
PHASE IV Post-Treatment Interview (1 session)	Administer Self-Rating Scales	Record Resting EMGs (10 min.)	Administer TMAS Record EMGs	Record Resting EMGs (10 min.)	SESSION 22

[a]These measures are those included in hypothesis testing. Other measures are for purposes of discussion.

change in EMG values following a task. Results were not included in hypotheses testing but were included in the Clinical Observations of Chapter IV.

Pre- and Post-Treatment Interviews

During the Pre-Treatment Interview, subjects were asked to fill out a Subject Consent Form (Appendix D) and a Subject Information Form (Appendix E). Subjects were instructed that they could discontinue participation at any time during the course of the study, and they were also informed that the treatment administered in the study did not guarantee any beneficial results. Prior to beginning the Baseline sessions, the subjects' physicians were also asked to fill out a Physician's Consent Form (Appendix F).

The format for the Pre- and Post-Interview Sessions continued in the following manner. Subjects were first asked to respond to the three Self-Rating Scales. Next, surface electrodes from the biofeedback equipment were attached, and the subject was asked to sit quietly for 10 minutes while EMGs were recorded. Following this, the Taylor Manifest Anxiety Scale was administered by a third person while EMG averages were recorded by the experimenter. At the end of the session, the interviewer left the room, and 10 additional minutes of resting EMG averages were recorded. The information gained from these two pre- and post-sessions was for purposes of discussion, and data were not included in statistical tests of significance.

Baseline

Baselines were established in the first seven sessions following the Pre-Treatment Interview. Each session began with subjects' ratings on the three Self-Rating Scales, at which point electrodes were attached and subjects were asked to sit quietly for 20 minutes while resting EMGs were recorded. Next, the five Repetitive Psychometric Measures were administered while EMGs were recorded. The final part of the session consisted of recording 10 additional minutes of resting EMGs.

Treatment

The Treatment phase consisted of the next 13 sessions. During the first nine sessions, the format was identical to the Baseline sessions with the exception of the 20-minute resting EMGs. Instead, following the administration of the Self-Rating Scales, biofeedback training was given for 30 minutes while EMGs were recorded. In addition, the subject was given a tape with relaxation instructions following the format of Progressive Relaxation exercises. They were instructed to use the tape once each day.

The tenth through thirteenth sessions measured only the Self-Rating Scales and 30-minute training EMG levels. As nine data points were sufficient for the data analysis, these last sessions were included to provide more time to assess whether or not the maximum level of muscle relaxation was attained for each subject.

Hypotheses

The following research hypotheses were developed to test for changes in EMG levels, scores on the Repetitive Psychometric Measures, and for scores on Self-Rating Scales of tension.

Differences in EMG Levels

I. Null Hypothesis: There will be no difference in the linear trend for EMG levels between 20 minutes of rest during Baseline and 30 minutes of biofeedback training during Treatment.

Alternative Hypothesis: There will be a reduction in the linear trend for EMG levels between 20 minutes of rest during Baseline and 30 minutes of biofeedback training following the point of treatment intervention.

II. Null Hypothesis: There will be no difference in the linear trend for EMG levels during cognitive tests between Baseline and Treatment phases.

Alternative Hypothesis: There will be a reduction in the linear trend for EMG levels during cognitive tests following the point of treatment intervention during the Treatment phase.

Differences in Test Scores of Cognitive Abilities

III. Null Hypothesis: There will be no difference in the linear trend for scores on Flexibility of Closure between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for scores on Flexibility of Closure following the point of treatment intervention during the Treatment phase.

IV. Null Hypothesis: There will be no difference in the linear trend for scores on Number Facility between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for scores on Number Facility following the treatment intervention during the Treatment phase.

V. Null Hypothesis: There will be no difference in the linear trend for scores on Perceptual Speed between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for scores on Perceptual Speed following the point of treatment intervention during the Treatment phase.

VI. Null Hypothesis: There will be no difference in the linear trend for scores on Speed of Closure between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for scores on Speed of Closure following the point of treatment intervention during the Treatment phase.

VII. Null Hypothesis: There will be no difference in the linear trend for scores on Visualization between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for scores on Visualization following the point of treatment intervention during the Treatment phase.

Differences in Self-Ratings of Tension

VIII. Null Hypothesis: There will be no difference in the linear trend for ratings of general level of tension on Self-Report Rating Scale 1 between Baseline and Treatment phases.

Alternative Hypothesis: There will be a decrease in the linear trend for ratings of general level of tension on Self-Report Rating Scale 1 following the point of treatment intervention during the Treatment phase.

IX. Null Hypothesis: There will be no difference in the linear trend for ratings of the ability to modify levels of tension on Self-Report Rating Scale 2 between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for ratings of the ability to modify levels of tension on Self-Report Rating Scale 2 following the point of treatment intervention during the Treatment phase.

X. Null Hypothesis: There will be no difference in the linear trend for ratings of the ability to detect changes in levels of tension on Self-Report Rating Scale 3 between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for ratings of the ability to detect changes in levels of tension on Self-Report Rating Scale 3 following the point of treatment intervention during the Treatment phase.

Analysis

The split-middle method of analysis was used in this study to test for the effects of a combined treatment program of electromyographic biofeedback and modified Progressive Relaxation exercises. This analysis was applied to an A-B time series design for single subjects. The purpose of this analysis was to determine if data during Phase B were significantly different from the data during Phase A on measures of: (a) EMG levels, (b) scores on five tests of cognitive abilities, and (c) scale values for three rating scales of tension. One-tailed tests of significance were used with an $\alpha = .05$ level to determine if there was a significant difference in the trend of the data curves from A to B. Graphic data curves for dependent measures were presented for visual inspection of trends.

Split-Middle Method

The split-middle technique (White, 1974) is a method of describing behavior change over time which can be applied to single-subject and group designs. The primary purpose of the technique is to characterize linear trends in the data and to predict future performance based on the trend estimation. In addition, a binomial test can be applied to the projected A slope in order to assess the statistical significance of the changes in behavior which occurred during the intervention, or B phase (Hersen & Barlow, 1976).

In applying the split-middle technique, a separate slope or "celeration" line is estimated from the plotted data for each phase. Median data points from phases A and B are used to determine these lines, so that 50% of the data fall above the slope and 50% fall below. The statistical significance of change across phases is evaluated once these lines are determined. The null hypothesis upon which the test is made is that there is no change in performance across A and B phases. In other words, the celeration line of the A phase should be a valid estimate of the celeration line of the B phase. The binomial test determines the probability of attaining x number of data points on Phase B which fall above or below the projected A slope.

Data Graphs

Thoresen (1974) and White (1972) recommended transforming data for the split-middle analysis onto a semilog scale. They reported that this type of scale reduces variability and makes the trend more

suitable for linear expression. The slope which is generated from the transformed data is comparable to a least squares regression line and is less influenced by extreme data points.

The graphs presented in this study followed these recommendations. The *y* axes, which represent values of the dependent variables, were expressed on a log to the base 10 scale. A true value of 10 is therefore transformed to a value of 1 on the graphs. The *x* axes, representing days, were not transformed to log units.

Summary

Four subjects from the Lansing and East Lansing areas were selected for the study. They were selected on the basis of a diagnosis of schizophrenia based on defined criteria and with their physician's consent that they were stable enough to participate. In addition, all subjects had experienced at least three major psychotic episodes with hospitalization, and all were being maintained on antipsychotic medication. They varied in terms of marital status and level of education obtained, and all were nonpaid volunteers.

Subjects participated in a combined treatment program of EMG biofeedback training and Progressive Relaxation while EMG levels, the Repetitive Psychometric Measures tests, and Self-Rating Scales of tension were administered on a repeated basis over time. These measures were representative of changes which might occur in the physiological, cognitive, and behavioral domains. Data regarding levels of anxiety were also obtained using the Taylor Manifest Anxiety Scale.

An A-B single case time series design was used with the split-middle method trend analysis. Binomial tests of significance were applied to test the main hypotheses. Scores on EMG levels, five psychometric measures, and three Self-Rating scales were the dependent variables. The purpose of using the split-middle technique with significance testing was to analyze intraindividual changes occurring over repeated measures of the dependent variables from Baseline to Treatment phases. Data from the Taylor Manifest Anxiety Scale were included for purposes of discussion and were not included in hypothesis testing.

The results of the hypotheses tests and an interpretation of these results are presented in Chapter IV.

CHAPTER IV

ANALYSIS OF RESULTS

The statistical hypotheses and an analysis of the data are presented in Chapter IV. All hypotheses relate to comparisons made between events in the seven baseline and first nine treatment sessions of the research schedule. The hypotheses were tested using the split-middle method of trend analysis with binomial tests of significance. One-tailed tests of significance were determined for each dependent variable for each subject at the α = .05 level. An analysis of the data from clinical observations is also presented. Following is a summary of the results.

Hypotheses I and II: Differences in EMG Levels

I. Null Hypothesis: There will be no difference in the linear trend for EMG levels between 20 minutes of rest during Baseline and 30 minutes of biofeedback training during Treatment.

Alternative Hypothesis: There will be a reduction in the linear trend for EMG levels between 20 minutes of rest during Baseline and 30 minutes of biofeedback training during Treatment, following the point of treatment intervention.

The plotted daily EMG levels and celeration lines for 20 minutes of rest during Baseline sessions and 30 minutes of biofeedback training during Treatment sessions are presented for all subjects in Figure 4.1. Median EMG levels obtained during the two phases and

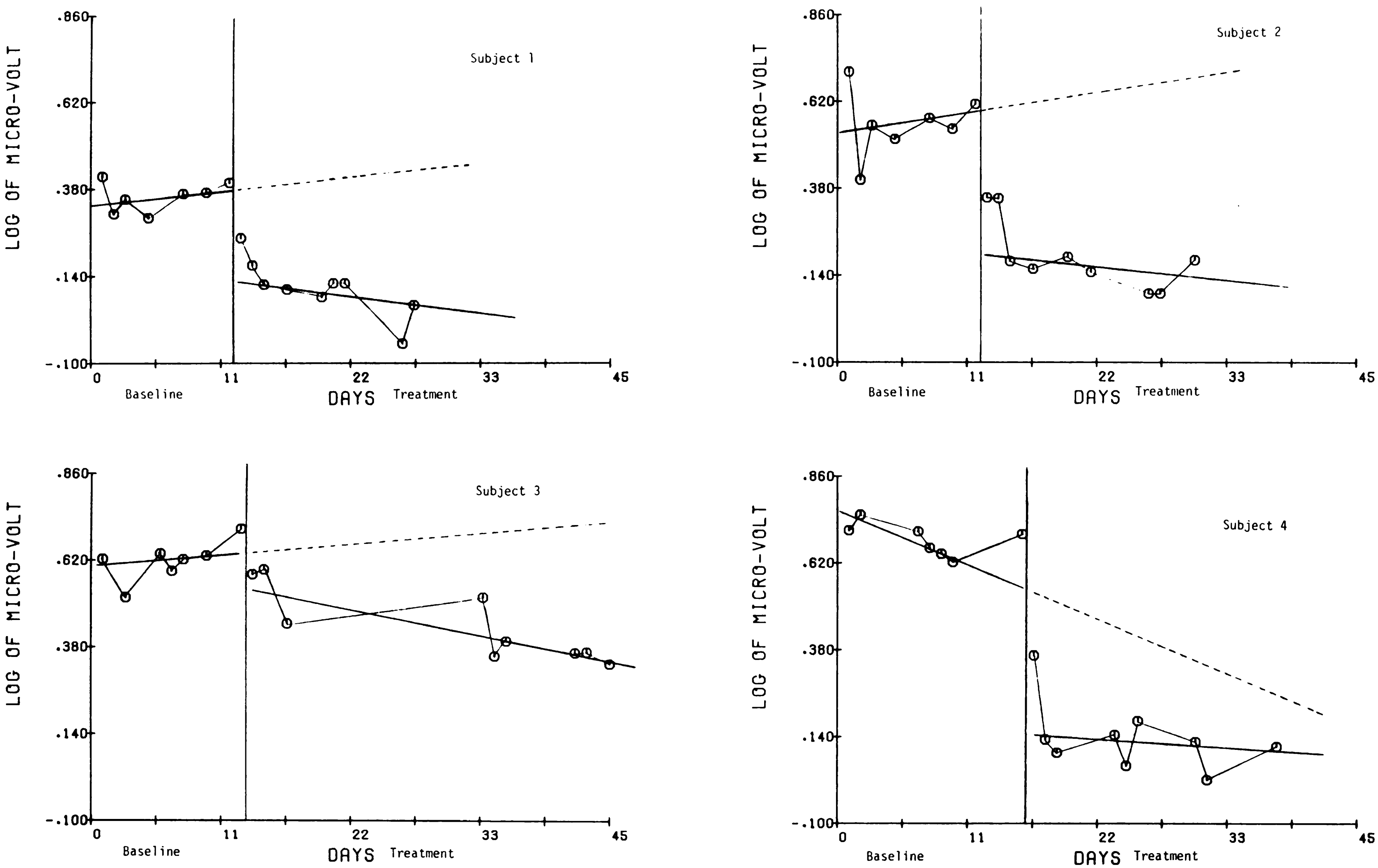


Figure 4.1: Daily EMG levels for 20 min. rest to 30 min. biofeedback training.

the percentage of change across phases are shown in Table 4.1. EMG levels were decreased from Baseline to Treatment by 43% for Subject 1, 58% for Subject 2, 40% for Subject 3, and 73% for Subject 4. The results of the statistical analysis were significant for all subjects at the $\underline{p} = .002$ level. These are shown in Table 4.2. The null hypothesis for no differences between Baseline and Treatment phases for EMG levels was rejected in favor of the alternative hypothesis in four out of four cases. Subjects decreased EMG levels during 30 minutes of biofeedback training compared to resting baseline measures.

Table 4.1: Percentage of Change for Median EMG Levels From 20 Minutes Rest During Baseline to 30 Minutes of Biofeedback Training During Treatment

Subject	Baseline (20 min. Resting EMG)	Treatment (30 min. Biofeed-back Training)	Percent of Change
1	2.33 Mv	1.32 Mv	-43%
2	3.58 Mv	1.51 Mv	-58%
3	4.20 Mv	2.50 Mv	-40%
4	5.02 Mv	1.34 Mv	-73%

- indicates a decrease from Baseline to Treatment.

Mv = microvolts.

Table 4.2: Binomial Tests of Phase Changes for Research Hypotheses Involving EMG Levels

Subject	Baseline-Treatment (H_1)	Baseline-Treatment (H_2)
1	.002*	.253
2	.002*	1.0
3	.002*	1.0
4	.002*	.002*
Across all subjects	4 of 4 significant	1 of 4 significant

*Significant at .05 level.

II. Null Hypothesis: There will be no difference in the linear trend for EMG levels during cognitive tests between Baseline and Treatment phases.

Alternative Hypothesis: There will be a reduction in the linear trend for EMG levels during cognitive tests following the point of treatment intervention during the Treatment phase.

The difference in daily EMG levels during cognitive tests between Baseline and Treatment phases is shown in the plotted data in Figure 4.2. The percentage of change from Baseline to Treatment for median EMG levels obtained during cognitive tests is shown in Table 4.3. After treatment, EMG levels increased by 26% and 6% for Subjects 1 and 3 during the administration of cognitive tests. A decrease of 11% and 12% occurred for Subjects 2 and 4. Binomial test results (Table 4.2) show that EMG changes from Baseline to Treatment were not significant for Subjects 1, 2, and 3 and that the decrease

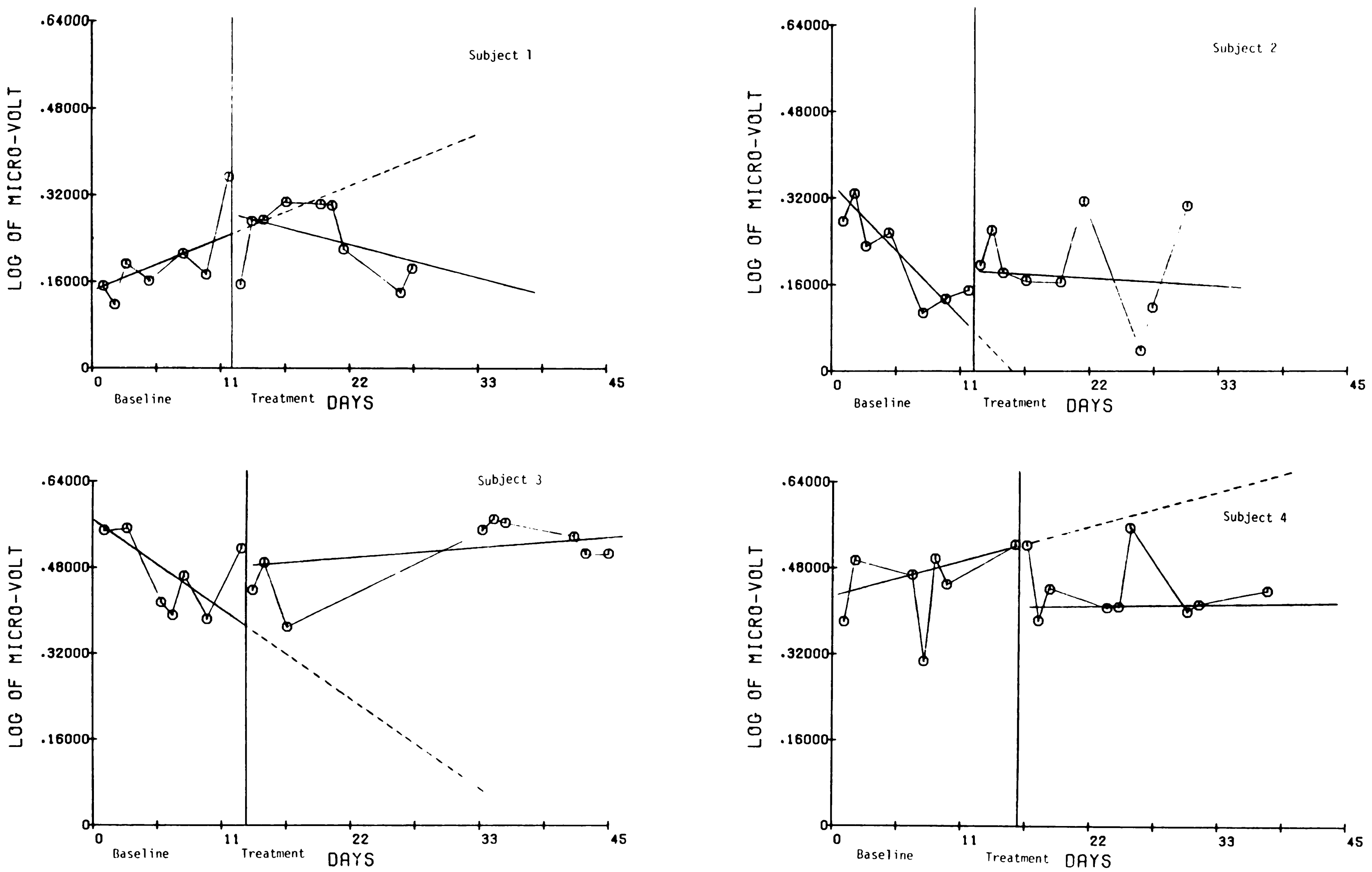


Figure 4.2: Daily EMG levels during cognitive tests.

in EMG levels was significant for Subject 4 at the $p = .002$ level. The null hypothesis was rejected in favor of the alternative in one out of four cases. Only Subject 4 decreased EMG levels during cognitive test task performance following treatment intervention.

Table 4.3: Percentage of Change for Median EMG Levels From Baseline to Treatment During Cognitive Tests

Subject	Baseline	Treatment	Percent of Change
1	1.49 Mv	1.87 Mv	+26%
2	1.70 Mv	1.52 Mv	-11%
3	2.91 Mv	3.08 Mv	+ 6%
4	2.94 Mv	2.60 Mv	-12%

Mv = microvolts.

+ indicates an increase from Baseline to Treatment.

- indicates a decrease from Baseline to Treatment.

Hypotheses III, IV, V, VI, and VII: Differences in Scores on Repetitive Psychometric Measures

III. Null Hypothesis: There will be no difference in the linear trend for scores on Flexibility of Closure between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for scores on Flexibility of Closure following the point of treatment intervention during the Treatment phase.

Plotted scores and celeration lines for the Repetitive Psychometric Measures test of Flexibility of Closure are shown in Figure 4.3.

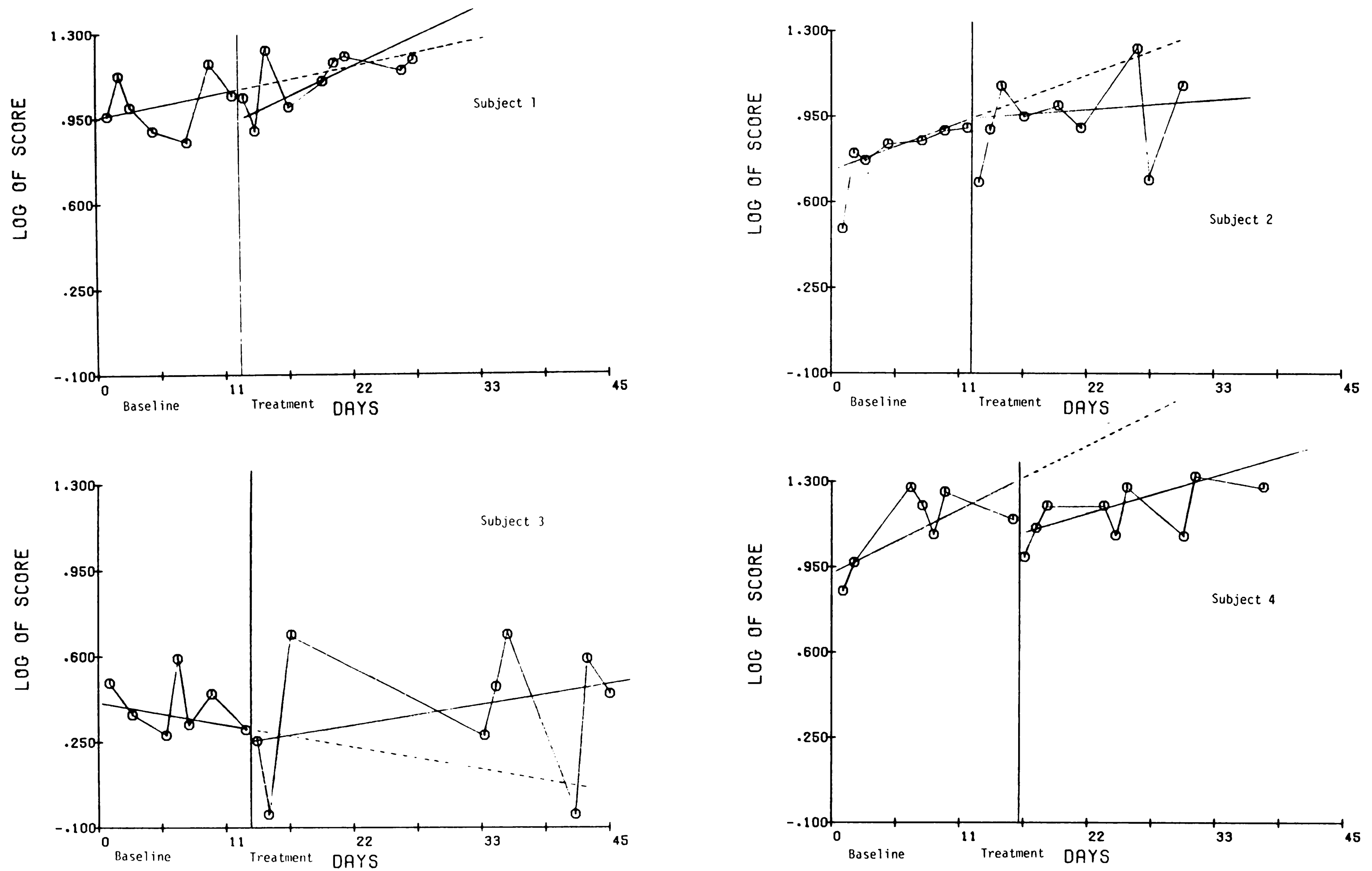


Figure 4.3: Daily scores on Flexibility of Closure.

The median scores obtained during Baseline and Treatment phases are given in Table 4.4. There were increases across phases in median scores for the number of items correctly completed for all subjects. The increase was 4 points for Subject 1, 3 points for Subject 2, .5 points for Subject 3, and 1.9 points for Subject 4. Results from the binomial tests shown in Table 4.5 indicate that overall increases were not statistically significant at the $\alpha = .05$ level. The null hypothesis for no differences in linear trend between Baseline and Treatment phases was therefore not rejected in favor of the alternative in any of the four cases. There were no significant improvements in subjects' ability to correctly copy geometric figures onto matrices of dots following treatment intervention.

IV. Null Hypothesis: There will be no difference in the linear trend for scores on Number Facility between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for scores on Number Facility following the treatment intervention during the Treatment phase.

The daily plotted scores for the Repetitive Psychometric Measures test of Number Facility for subjects are shown in Figure 4.4. Results from Table 4.4 indicate that Subjects 1, 3, and 4 increased their median scores for number of items correctly completed from Baseline to Treatment by 1, 9, and 6 points, respectively. There was a decrease of 1 point for Subject 2. The statistical analysis (Table 4.5) showed that the overall increase in scores was significant for Subject 1 at the $\underline{p} = .019$ level and for Subject 4 at the $\underline{p} = .002$ level. The null hypothesis for no differences was rejected in two out of four cases,

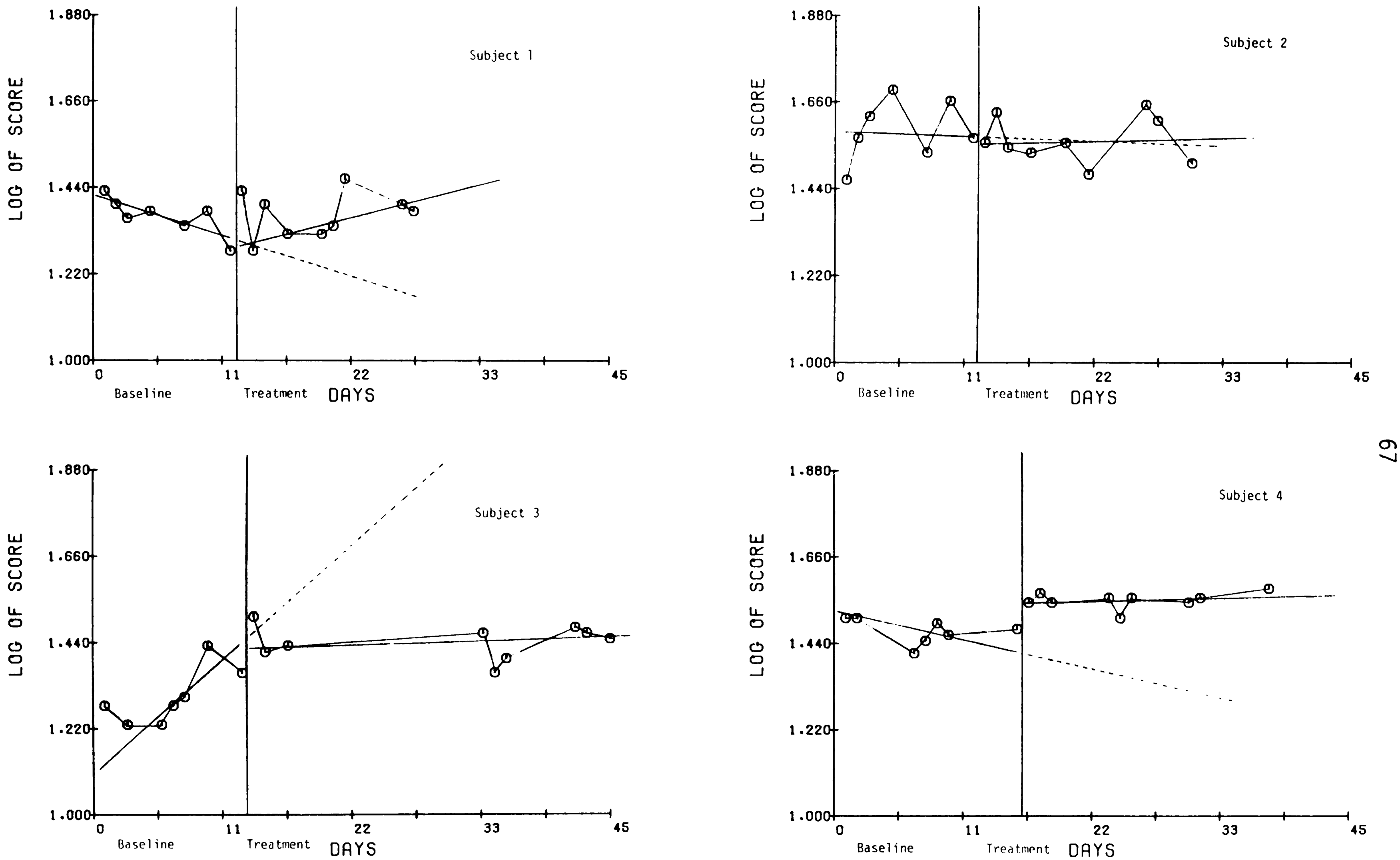


Figure 4.4: Daily scores on Number Facility.

Table 4.4: Median Scores for Repetitive Psychometric Measures Tests During Baseline and Treatment Phases

Subject	Flexibility of Closure (H_3)		Number Facility (H_4)		Perceptual Speed (H_5)		Speed of Closure (H_6)		Visualization (H_7)	
	B	T	B	T	B	T	B	T	B	T
1	9.9	13.9	24.0	25.0	64.9	75.2	37.0	36.2	27.1	29.9
2	6.9	9.9	37.0	36.0	79.9	89.0	28.0	31.3	25.0	24.0
3	2.3	2.8	19.0	28.0	76.9	88.2	21.9	27.3	13.9	26.0
4	14.0	15.9	30.0	36.0	101.1	92.9	31.1	33.9	35.9	37.9

Scores represent the median number of items scored correctly, adjusted for level of difficulty.

Table 4.5: Binomial Tests of Phase Changes for Research Hypotheses Involving Repetitive Psychometric Measures

Subject	Baseline-Treatment (H_3)	Baseline-Treatment (H_4)	Baseline-Treatment (H_5)	Baseline-Treatment (H_6)	Baseline-Treatment (H_7)
1	.910	.019*	.002*	1.0	.002*
2	.980	.746	1.000	1.0	.253
3	.253	.998	.998	1.0	1.000
4	1.000	.002*	1.000	1.0	1.000
Across all subjects	0 of 4 significant	2 of 4 significant	1 of 4 significant	0 of 4 significant	1 of 4 significant

*Significant at .05 level.

indicating that two subjects improved in their ability to correctly add sets of numbers following treatment intervention.

V. Null Hypothesis: There will be no difference in the linear trend for scores on Perceptual Speed between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for scores on Perceptual Speed following the point of treatment intervention during the Treatment phase.

Figure 4.5 shows the daily plotted scores for the Repetitive Psychometric Measures test of Perceptual Speed from Baseline to Treatment phases. Changes in the median scores obtained during both phases shown in Table 4.4 indicate that during Treatment, Subject 1 increased median scores by 10.3 points, Subject 2 showed an increase of 9.1 points, and Subject 3 increased scores by 11.3 points. There was a decrease during Treatment in median scores for Subject 4 of 8.2 points. Results from the binomial tests (Table 4.2) show that the overall score increase was statistically significant for Subject 1 at the $\underline{p} = .002$ level. The improvements noted in scores for Subjects 2 and 3 were not significant. Therefore, the null hypothesis for no difference in linear trend from Baseline to Treatment was rejected in favor of the alternative in one out of four cases. These results indicate that one subject improved in the ability to correctly identify given digits from rows of random digits following treatment intervention.

VI. Null Hypothesis: There will be no difference in the linear trend for scores on Speed of Closure between Baseline and Treatment phases.

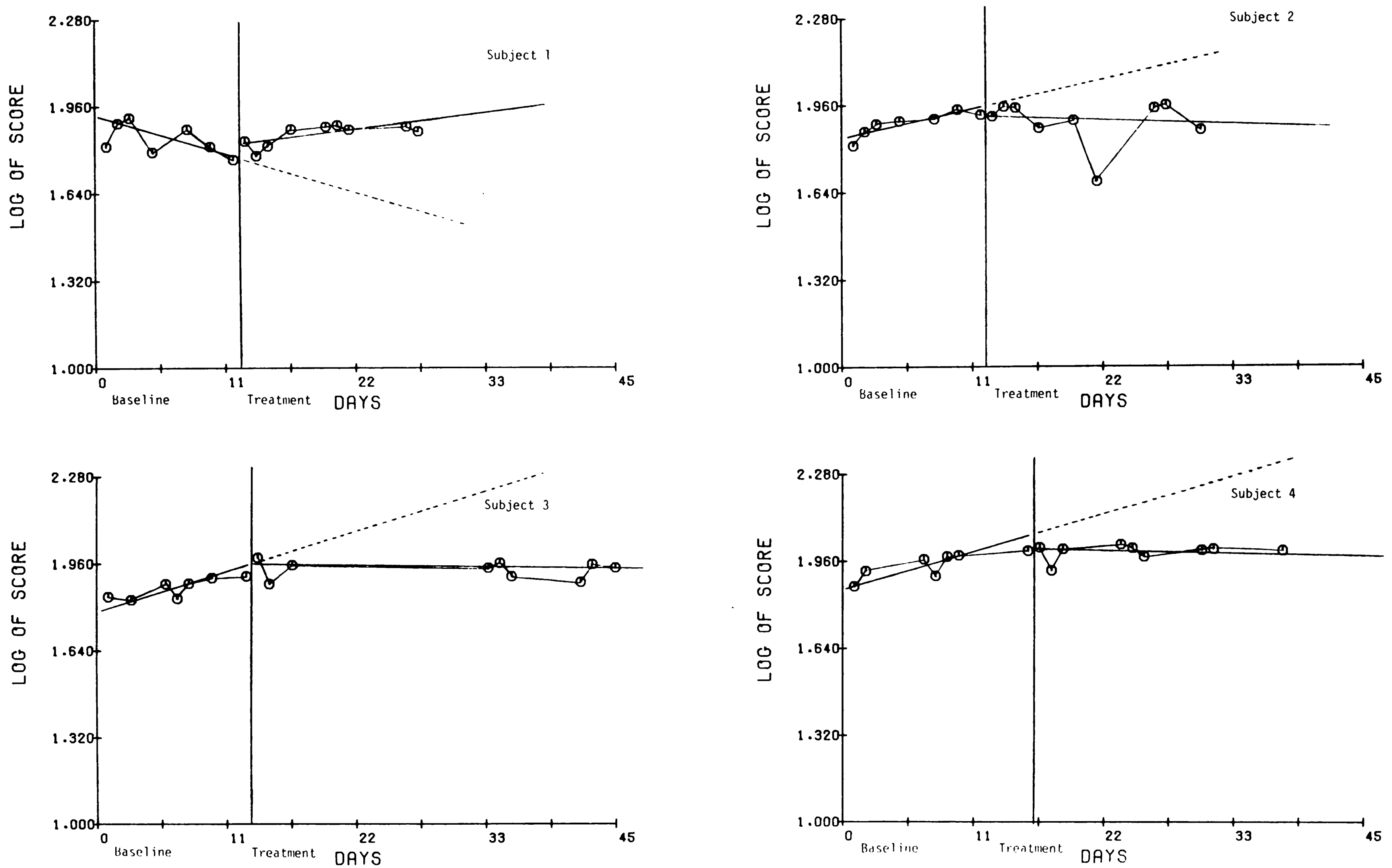


Figure 4.5: Daily scores on Perceptual Speed.

Alternative Hypothesis: There will be an increase in the linear trend for scores on Speed of Closure following the point of treatment intervention during the Treatment phase.

The daily plotted scores for the Repetitive Psychometric Measures test for Speed of Closure for all subjects are presented in Figure 4.6. The median scores obtained during Baseline and Treatment phases are given in Table 4.4. There was an increase in number of items scored correctly across phases for Subject 2 of 3.3 points, for Subject 3 of 5.4 points, and for Subject 4 of 2.8 points. The median score decreased by .8 points for Subject 1. Binomial tests (Table 4.5) indicated that none of the overall increases in scores were significant at the α = .05 level. Therefore, the null hypothesis for no differences in the linear trend was not rejected in favor of the alternative in any of the four cases. There were no improvements in subjects' ability to correctly identify four-letter words in rows of random letters following the treatment intervention.

VII. Null Hypothesis: There will be no difference in the linear trend for scores on Visualization between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for scores on Visualization following the point of treatment intervention during the Treatment phase.

Daily plotted scores on the Repetitive Psychometric Measures test for Visualization are shown in Figure 4.7. Results from Table 4.4 indicate increases in the median scores for number of items scored correctly from Baseline to Treatment for Subjects 1, 3, and 4 of 2.8, 12.2, and 2 points, respectively. There was a decrease of 1 point for Subject 2. Probabilities from the binomial tests (Table 4.5) show

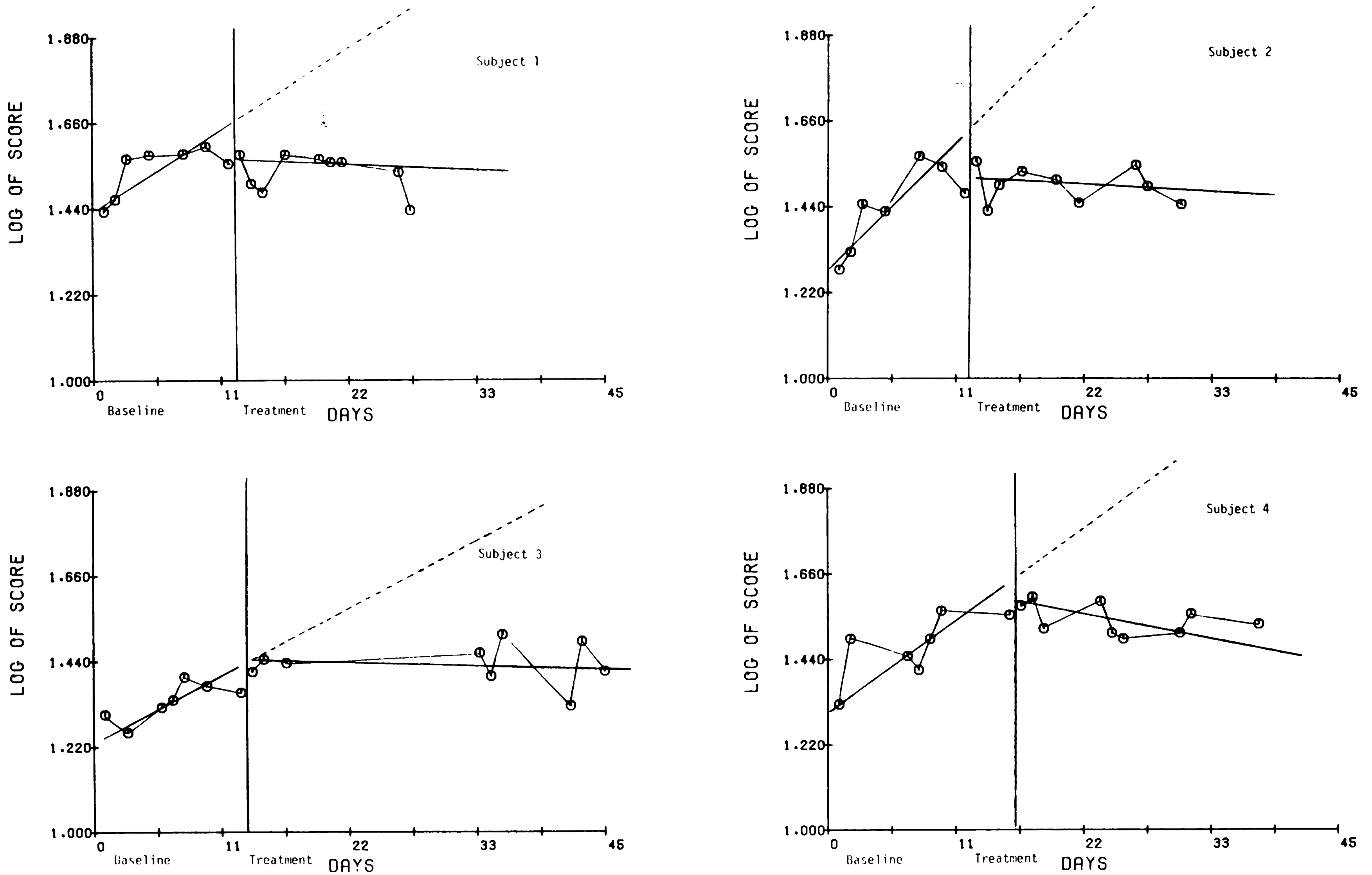


Figure 4.6: Daily scores on Speed of Closure.

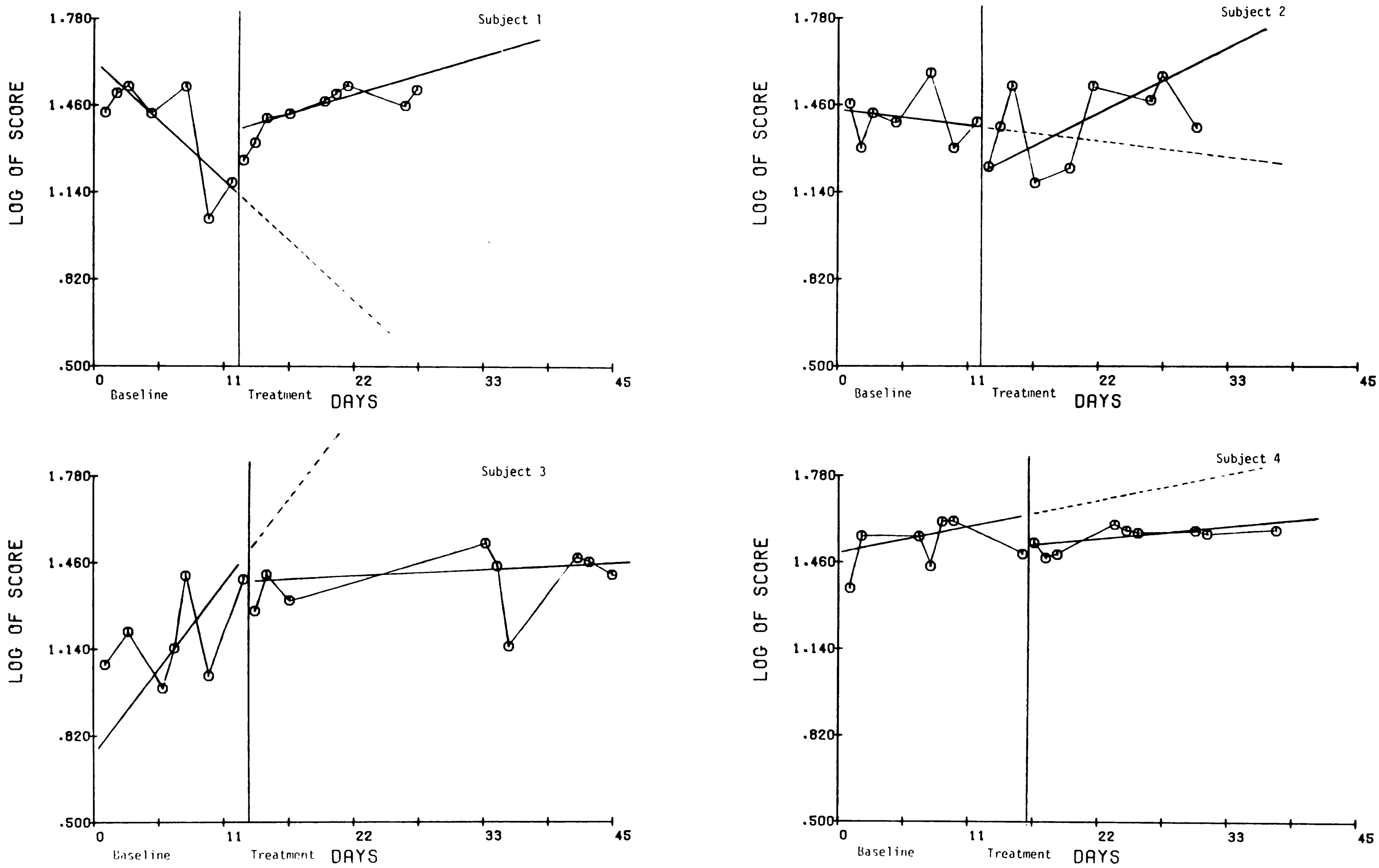


Figure 4.7: Daily scores on Visualization.

that the overall increase in scores was statistically significant for Subject 1 at the p = .002 level. The increases for Subjects 3 and 4 were not significant. Therefore, the null hypothesis for no difference in linear trend was rejected in favor of the alternative in one out of four cases. One subject improved in the ability to correctly visually track the path of a line embedded in a set of tangled lines following treatment intervention.

Hypotheses VIII, IX, and X: Differences in Scores on Self-Rating Scales of Tension

VIII. Null Hypothesis: There will be no difference in the linear trend for ratings of general level of tension on Self-Report Rating Scale 1 between Baseline and Treatment phases.

Alternative Hypothesis: There will be a decrease in the linear trend for ratings of general level of tension on Self-Report Rating Scale 1 following the point of treatment intervention during the Treatment phase.

The plotted daily scores and celeration lines for Self-Report Rating Scale 1 for Baseline and Treatment phases are presented in Figure 4.8. The results from the binomial tests, summarized in Table 4.6, show that ratings on Scale 1 decreased significantly for Subjects 2 and 3. These changes were significant at the p = .002 level. Even though the linear trends for Subjects 1 and 4 showed a decelerating pattern, overall ratings during Treatment did not decrease below the extended linear trend of Baseline. Therefore, the null hypothesis for no differences in the linear trend for ratings of tension was rejected in favor of the alternative in two of four cases. The results indicate that two subjects rated themselves lower on

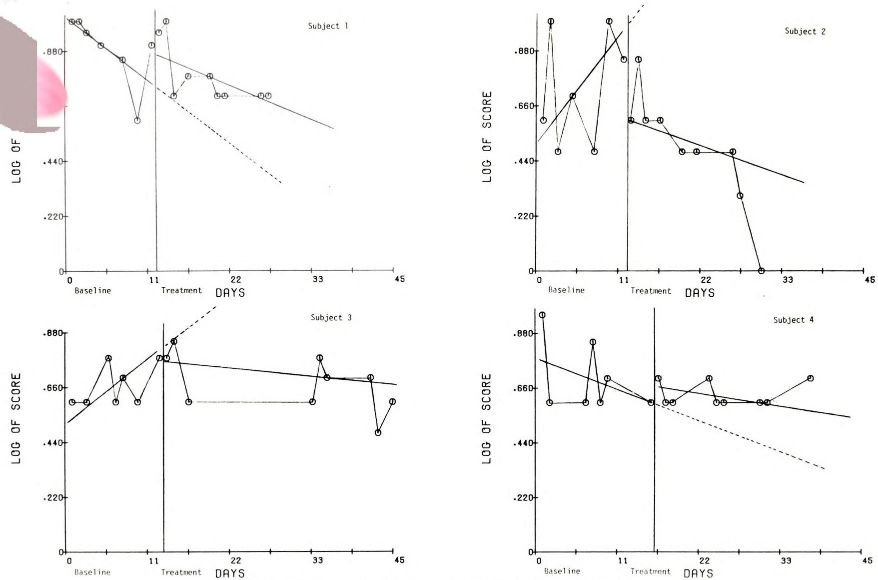


Figure 4.8: Daily scores on Self-Rating Scale #1.

subjective levels of tension following the point of treatment intervention.

Table 4.6: Binomial Tests of Phase Changes for Research Hypotheses Involving Self-Report Rating Scales

Subject	Baseline-Treatment (H_8)	Baseline-Treatment (H_9)	Baseline-Treatment (H_{10})
1	1.000	.019*	1.0
2	.002*	.002*	1.0
3	.002*	.002*	1.0
4	1.000	.002*	1.0
Across all subjects	2 of 4 significant	4 of 4 significant	0 of 4 significant

*Significant at .05 level.

IX. Null Hypothesis: There will be no difference in the linear trend for ratings of the ability to modify levels of tension on Self-Report Rating Scale 2 between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for ratings of the ability to modify levels of tension on Self-Report Rating Scale 2 following the point of treatment intervention during the Treatment phase.

The plotted daily scores on Self-Report Rating Scale 2, indicating the ability to modify levels of tension, are shown in Figure 4.9. Statistical tests shown in Table 4.6 indicate that ratings on Scale 2 significantly increased for all subjects from Baseline to Treatment phases. Therefore, the null hypothesis for no differences was

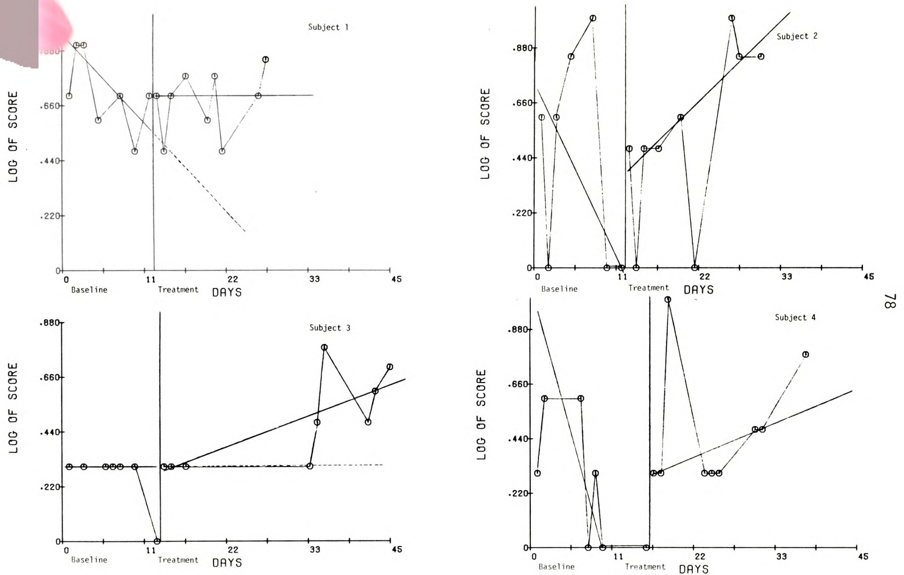


Figure 4.9: Daily scores on Self-Rating Scale #2.

rejected in favor of the alternative in four out of four cases. All subjects consistently rated themselves higher in their ability to modify their tension levels following the point of treatment intervention.

X. Null Hypothesis: There will be no difference in the linear trend for ratings of the ability to detect changes in levels of tension on Self-Report Rating Scale 3 between Baseline and Treatment phases.

Alternative Hypothesis: There will be an increase in the linear trend for ratings of the ability to detect changes in levels of tension on Self-Report Rating Scale 3 following the point of treatment intervention during the Treatment phase.

Plotted scores on Self-Report Rating Scale 3 for Baseline and Treatment phases are shown in Figure 4.10. Even though celeration lines during Treatment showed an increasing trend for Subjects 1 and 2, results from the binomial tests (Table 4.6) indicated that changes in ratings from Baseline to Treatment were not statistically significant for any of the four subjects. Therefore, the null hypothesis for no differences was not rejected in favor of the alternative. None of the subjects increased their ratings, indicating that they did not improve in their ability to detect changes in levels of tension following treatment intervention.

Clinical Observations

End of Session Resting EMGs

During Baseline and Treatment phases, at the end of every session, 10 minutes of resting EMG levels were recorded. It was expected that EMGs would decrease from Baseline to Treatment phases as subjects

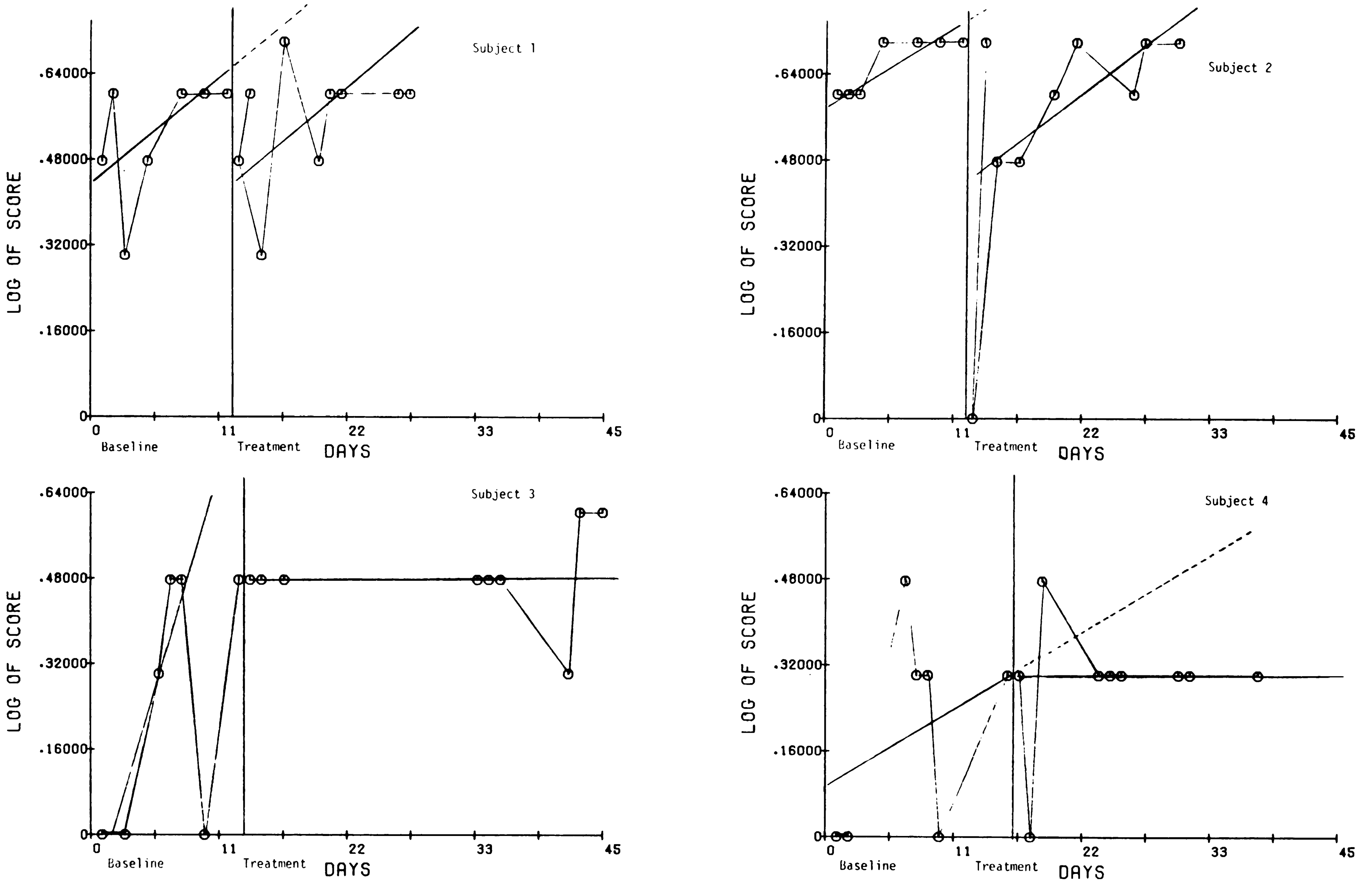


Figure 4.10: Daily scores on Self-Rating Scale #3.

learned to lower EMGs during biofeedback training. Figure 4.11 shows the daily EMG levels and celeration lines for the 10-minute resting EMGs across Baseline and Treatment phases. The split-middle method of trend analysis with binomial tests of significance ($\alpha = .05$) indicated that there were statistically significant decreases in EMG levels for Subject 3 with $\underline{p} = .019$ and Subject 4 with $\underline{p} = .002$. The probabilities are shown in Table 4.7. The Treatment phase linear trend shows slight increases in EMG levels for Subjects 1 and 2. Therefore, in two out of four cases, subjects were able to maintain significantly lower EMGs for 10 minutes at the end of the training sessions which occurred during the Treatment intervention phase.

Table 4.7: Binomial Tests of Phase Changes for End of Session 10-Minute Resting EMGs

Subject	Baseline-Treatment
1	.910
2	.998
3	.019*
4	.002*
Across all subjects	2 of 4 significant

*Significant at .05 level.

Final Four Biofeedback Training Sessions

A comparison was made between EMG levels in the first nine and final four biofeedback training sessions. The median EMG value for

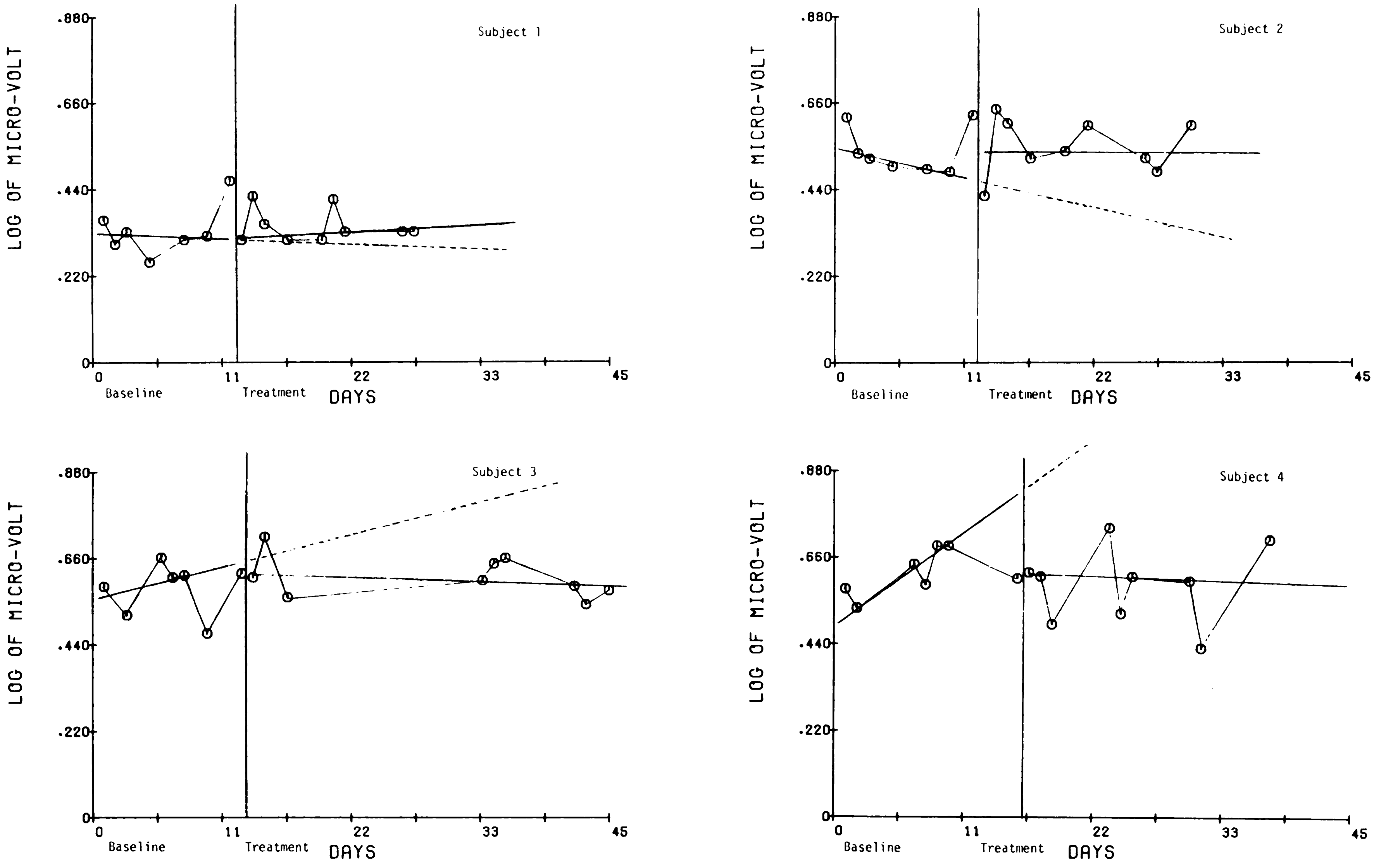


Figure 4.11: Daily EMG levels for 10 min. at end of session.

each of these phases was used in order to determine the differences. The maximum reduction from the first nine to the last four sessions for any subject was 0.2 Mv, or two-tenths of a microvolt. Since this represented such a small change, it was concluded that there were no differences in EMG levels between these two phases.

EMG Changes During the Pre- and Post-Treatment Interviews

EMGs were recorded during three events (rest, TMAS administration, rest) for the Pre- and Post-Treatment Interviews. In examining the fluctuation in the median values across these events, it was observed that these fluctuations were variable for subjects and seemed to follow no predictable pattern. The averages are shown in Table 4.8. For example, it was expected that during the Pre-Treatment Interview, there would be an increase in EMG levels from the first event (rest) to the administration of the TMAS. This only occurred for Subject 2. During the Post-Treatment Interview which was given at the end of Treatment, it was expected that EMGs would remain low from the first event of rest to the test administration. Instead, there were increases for Subjects 1, 2, and 4. The change for Subject 4 was small enough, however (from 4.2 Mv to 4.9 Mv), that it was considered insignificant.

Taylor Manifest Anxiety Scale

Comparisons were made for scores on the Taylor Manifest Anxiety Scale between the Pre- and Post-Treatment Interviews. The test score indicated the number of items marked positive for anxiety out of a

Table 4.8: Median EMG Values for Subjects During Pre- and Post-Treatment Interviews

	Subject	10 Min. Resting EMG	Administration of TMAS	10 Min. Resting EMG
Pre-Treatment Interview (1 session)	1	5.07 Mv	2.65 Mv	3.01 Mv
	2	4.73 Mv	5.50 Mv	4.38 Mv
	3	4.70 Mv	3.70 Mv	3.40 Mv
	4	4.30 Mv	3.47 Mv	4.40 Mv
Post-Treatment Interview (1 session)	1	2.25 Mv	3.61 Mv	2.52 Mv
	2	1.70 Mv	6.60 Mv	4.70 Mv
	3	5.20 Mv	2.30 Mv	3.70 Mv
	4	4.20 Mv	4.90 Mv	4.70 Mv

Mv = microvolts.

total of 50. These scores, as well as the percentage of change from the Pre to Post sessions are shown in Table 4.9. Results show that Subjects 1, 2, and 3 decreased the number of items scored positive for anxiety from the Pre to Post sessions by 26%, 50%, and 38%, respectively. There was an increase for Subject 4 of 6%. Thus, in three out of four cases, scores for anxiety improved after biofeedback training.

Table 4.9: Percentage of Change for Subjects' TMAS Test Scores

Subject	Test Scores[a]		Percent of Change
	Pre-Treatment	Post-Treatment	
1	31	18	-26%
2	38	10	-56%
3	41	22	-38%
4	13	16	+ 6%

[a]Test score indicates the number of items scored positive for anxiety out of a total of 50.

Progressive Relaxation

Subjects were asked to use cassette tapes of modified Progressive Relaxation exercises in daily practice at home. They were asked about their experiences with the exercises and the consistency of practice. Their reports indicated that Subject 1 practiced approximately 80% of the time; Subject 2, 78% of the time; Subject 3, 58% of the time; and Subject 4, 75% of the time.

Subjects' Experiences During Biofeedback Training

During the biofeedback training sessions, subjects reported on techniques which they found helpful in terms of producing relaxing feelings and decreasing EMGs. Redirecting and focusing of thoughts to nonstressful ideation seemed to be critical for all subjects. For example, one subject was able to relax when thinking of a very small circle or a straight line, while another thought of playing tennis. A third subject thought of being "dark, empty, and soft inside." No matter what images helped subjects to relax, they all found it difficult to maintain low EMG levels when certain perseverative thoughts came into focus. For one subject these were self-punishing statements; for another they were thoughts of failure. Training sessions were frequently interrupted when subjects felt they could no longer maintain relaxation because of threatening ideation. By the end of training, subjects were able to maintain relaxation without interruption for at least 15 consecutive minutes.

All subjects reported at various times throughout the training sessions that they had experienced being able to alter feelings of physical tension at different times in the day using techniques learned in treatment. At these times, they were able to identify situations outside of treatment which seemed to produce tense feelings.

Subject 2 reported being able to sleep without her usual sedative after the eighth biofeedback training session. She continued to sleep without medication periodically and stated that this was the first time in six years that she was able to do so. This was verified

with her physician. Subjects 1 and 4 also had antipsychotic medications altered or discontinued during treatment after at least six months of continuous usage.

Summary

Ten hypotheses were tested to examine changes in repeated measures of EMG values, changes in scores on cognitive tests, and changes in self-ratings of various aspects of tension. The split-middle method of trend analysis with one-tailed tests of significance at the $\alpha = .05$ level was applied to an A-B, single-subject time series research design to test for Baseline-Treatment phase differences. The treatment under consideration was a combined program of electromyographic biofeedback with home practice of modified Progressive Relaxation exercises.

The following is a summary of the results for each hypothesis test:

1. Hypothesis I predicted a decrease in EMG levels following the point of treatment intervention with comparisons made between 20 minutes of rest during Baseline and 30 minutes of biofeedback training during Treatment. The null hypothesis was rejected in four of the four cases.

2. Hypothesis II predicted a decrease in EMG levels during the administration of cognitive tests following the point of treatment intervention. Comparisons were made for subjects between the administration of tests during Baseline and test administration during Treatment. The null hypothesis was rejected for one of the four subjects.

3. Hypotheses III through VII predicted that scores on each of five Repetitive Psychometric Measures tests would increase following the point of treatment intervention. Comparisons were made for subjects between scores obtained during Baseline and Treatment phases.

Hypothesis III: The null hypothesis was not rejected for any of the four subjects for scores on Flexibility of Closure.

Hypothesis IV: The null hypothesis was rejected in favor of the alternative hypothesis in two of four cases for scores on Number Facility.

Hypothesis V: The null hypothesis was rejected in favor of the alternative hypothesis in one of four cases for scores on Perceptual Speed.

Hypothesis VI: The null hypothesis was not rejected in favor of the alternative hypothesis in any of four cases for scores on Speed of Closure.

Hypothesis VII: The null hypothesis was rejected in favor of the alternative hypothesis for one of four subjects for scores on Visualization.

4. Hypothesis VIII predicted that scores on Self-Report Rating Scale 1, indicating general level of tension, would decrease following the point of treatment intervention. Comparisons were made for subjects between scores obtained during Baseline and Treatment phases. The null hypothesis was rejected in four out of four cases.

5. Hypothesis IX predicted that scores on Self-Report Rating Scale 2, indicating the ability to modify levels of tension, would increase following treatment intervention. Comparisons were made for subjects between scores obtained during Baseline and Treatment sessions. The null hypothesis was rejected in favor of the alternative hypothesis in four of four cases.

6. Hypothesis X predicted that scores on Self-Report Rating Scale 3, indicating the ability to detect changes in levels of tension, would increase following the point of treatment intervention. Comparisons were made for subjects between scores obtained during Baseline and Treatment sessions. The null hypothesis was not rejected in favor of the alternative hypothesis in any of the four cases.

In Chapter V a summary of the study is presented. The findings of the study are discussed and conclusions presented. Limitations of the study and implications for future research are also discussed.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of the study was to evaluate the effectiveness of a combined treatment program of electromyographic biofeedback and modified Progressive Relaxation exercises upon specific behaviors of persons diagnosed as schizophrenic. The treatment intervention was assessed using EMG measures, scores on a series of cognitive tests, subject self-rated scales of tension, and scores on a test of anxiety. In this chapter a summary of the study will be presented. Conclusions based on the results of the analysis of the data will be included along with a discussion of the results of the study. Limitations of the present study and implications for future research will be given.

Summary

The study was based on several areas of theory and research. The first of these was the study of abnormal skeletal-muscle response tendencies in schizophrenics. Related to this were theoretical formulations concerning the psychophysiology of schizophrenia, which attempted to integrate abnormal physiological arousal with the production and maintenance of symptoms of schizophrenia. A third area involved the use of electromyographic biofeedback and Progressive Relaxation as a clinical intervention technique.

A common theme which was stressed in all three areas of research was that physiological responses represented in the skeletal-muscle system were reflective of responses occurring in other systems involving cognitive and emotional behaviors.

A review of the literature was presented in which this theme was evident. For example, in previous research it was revealed that schizophrenics were abnormally reactive on skeletal-muscle measures during the experimental events of rest, the presentation of stressors, and during task performance. Authors concluded that a clear correspondence existed between degree of physiologic disturbance and the variables of anxiety and psychological maladjustment. In addition, it was observed that skeletal-muscle tension increased for schizophrenics prior to psychotic episodes and that when clinical condition improved, arousal decreased but continued to be abnormally variable from day to day. These findings were related to psychological variables involving cognition and emotions. The theories which were reviewed summarized that chronic states of physiological disequilibrium, evident in the skeletal-muscle system, impacted on the schizophrenic's ability to process and filter information. It was hypothesized that the results were seen as the inability to focus thoughts, increased attention to irrelevant stimuli, and cognitive disorganization.

Finally, literature reviewed in the areas of electromyographic biofeedback and Progressive Relaxation revealed that skeletal-muscle arousal was maintained, in part, through subjective experiences represented in cognition. These combined techniques were shown to

effect positive changes in emotional symptoms related to stress and anxiety in highly anxious individuals by teaching them to modify the stress-related symptoms of excessive muscle tension. One study indicated that other combinations of relaxation therapy, specifically Quieting Response Training, resulted in positive outcomes for psychiatric inpatients. The literature reviewed provided the rationale for the present study, which proposed that relaxation therapy techniques be explored with persons who were diagnosed as schizophrenic. It was felt that this specific population could benefit from learning to modify excessive skeletal-muscle tension and, in turn, might experience some of the same improvements in areas of emotional and cognitive functioning noted for other patient populations.

One male and three females were accepted for the study based on screening criteria which included clinical signs of schizophrenia without paranoid ideation; functional stability; and the experience of physical tension. The experimenter required that individuals have the consent of their psychiatrists in order to participate in the study. Each subject had a history of at least three psychiatric hospitalizations and was being maintained on an antipsychotic medication. They varied in terms of educational and marital experiences and in terms of their daily routines.

Prior to acceptance into the study, potential subjects were interviewed. During the interview, the biofeedback equipment was demonstrated, and the purpose and conditions of the study were introduced. Four out of five individuals interviewed were selected to participate.

The following session, the Pre-Treatment Interview, was the first phase of the experiment. Subjects were asked to respond to a Subject Information Form which elicited summary information concerning social, educational, psychiatric, and medical history. Additional information obtained from this session was repeated on the last session of the study following biofeedback training and was referred to as the Post-Treatment Interview. Data obtained in these two interviews included, in the order presented, scores on three Self-Report Rating Scales of tension, 10 minutes of resting EMG, scores on the Taylor Manifest Anxiety Scale, and a final 10-minute resting EMG. Items from the TMAS were read to the subjects by a third party while EMGs were recorded by the investigator. The rationale for using an interview format for this test was that subjects might experience some tension, reflected in EMG measures, in having to respond to questions about themselves to a stranger.

Findings from these two sessions were included in a discussion of clinical observations and were not part of the hypotheses tests. The results were not statistically analyzed because the TMAS was not constructed for use as a continuous measure, which was one of the requirements for the research design. Observations were made in the fluctuations of EMG levels across the events in each session. Scores on the Taylor Manifest Anxiety Scale were compared from the pre to post interviews.

The next seven sessions following the Pre-Treatment Interview were for purposes of establishing a baseline. After the administration of the three tension rating scales, EMG levels were recorded for the

remainder of the sessions during (a) 20 minutes of rest, (b) the administration of five cognitive tests known as the Repetitive Psychometric Measures, and (c) 10 additional minutes of rest.

The treatment intervention began after baselining and continued for 13 sessions. Only information from the first nine of these sessions was included in statistical analysis and hypothesis testing. The final four sessions were offered because it could not be determined at the outset of the study, the number of sessions which might be needed for the subjects to feel that they had obtained maximum benefits from relaxation training. While nine sessions were adequate for the actual data collection, there was a concern that maximum gains be experienced by the subjects.

During the first nine Treatment sessions, the format was identical to Baseline, with the exception of the first 20 minutes of resting EMG levels. In place of this, 30 minutes of EMG biofeedback training was given while EMG levels were recorded. Subjects were also given cassette tapes of a shortened version of Progressive Relaxation exercises for daily use at home. During these sessions, EMGs were recorded during (a) 30 minutes of biofeedback training, (b) the administration of the RPMs, and (c) 10 minutes of rest.

Research hypotheses were formulated based on information obtained from the Baseline and first nine Treatment sessions. Comparisons were made between EMG values during the first 20 minutes of rest from Baseline and 30 minutes of biofeedback training during Treatment; between EMG values during the administration of cognitive tests from Baseline to Treatment; between scores on each of five cognitive tests

from Baseline to Treatment; and between scores on the three rating scales of tension from Baseline to Treatment.

The tenth through thirteenth Treatment sessions involved administration of the Self-Report Rating Scales, 30 minutes of biofeedback training, and 10 minutes of rest. Differences in the median EMGs obtained during the 30 minutes of biofeedback training from the first nine and last four Treatment sessions were computed in order to determine if EMG levels continued to decline. These results were discussed in the Clinical Observations section.

The Post-Treatment Interview was given following the last Treatment session. The format and information obtained were identical to those of the Pre-Treatment Interview which was discussed.

Ten research hypotheses were formulated for the seven Baseline and first nine Treatment sessions. The first two hypotheses were based on previous findings of chronic overarousal expressed in the skeletal-muscle system of schizophrenics. It was hypothesized that during the Treatment phase, EMG levels would decrease. This would occur during 30 minutes of biofeedback training and during the administration of cognitive tests. Positive results would indicate that schizophrenics could learn to modify skeletal-muscle tension during biofeedback training and during task performance.

Five hypotheses were formulated based on theory which predicted that abnormal physiological arousal, observed as excessive skeletal-muscle tension, contributed to the schizophrenic's behavioral responses of increased distraction, excessive stimulus generalization, and disorganization at the cortical level. It was hypothesized that during

the Treatment phase, subjects' scores on five cognitive measures would increase. It was believed that improved performance on these measures would be indicative of decreased distraction and increased ability to focus at the cognitive level.

The final three hypotheses related to research in EMG biofeedback techniques which emphasized the importance of combining relaxation exercises with EMG biofeedback training in order to produce generalization of results outside of the training sessions. It was therefore hypothesized that during Treatment, subjective ratings of general levels of tension would decrease and that ratings of the ability to modify levels of tension and of the ability to detect changes in levels of tension during the day would increase. Changes in these scores would indicate that the treatment had an effect on subjects' increased awareness and control over aspects of tension.

An A-B single-subject time series research design was employed in the study. Recordings were charted daily during Baseline and Treatment on the following measures: (a) EMG levels during rest and biofeedback training; (b) EMG levels during the administration of the five Repetitive Psychometric Measures of Flexibility of Closure, Number Facility, Perceptual Speed, Speed of Closure, and Visualization; and (c) scores on three Self-Report Rating scales of tension. The treatment effects were contrasted against the 10 dependent variables for four individuals at the same relative points in the treatment schedule. Analysis of the data from the continuous measures was performed using the split-middle technique of trend analysis with binomial tests to determine the significance of Baseline-Treatment phase

changes. One-tailed tests of significance were conducted at the $\alpha = .05$ level. Following is a summary of the results of the hypothesis tests:

1. Significant differences were found between phases for EMG values during 30 minutes of biofeedback training for all subjects ($p \geq .002$).

2. There was a significant difference between phases for EMG values during the administration of the Repetitive Psychometric Measures for Subject 4 at the $p \geq .002$ level. No differences were found for Subjects 1, 2, and 3.

3. There were no significant differences between phases for scores on the RPM test for Flexibility of Closure for any of the four subjects.

4. Significant differences were found between phases for scores on the RPM test for Number Facility for Subjects 1 and 4 ($p \geq .019$ and $p \geq .002$). No differences were found for Subjects 2 and 3.

5. A significant difference was found between phases for scores on the RPM test for Perceptual Speed for Subject 1 ($p \geq .002$). No differences were found for Subjects 2, 3, and 4.

6. There were no significant differences between phases for scores on the RPM test for Speed of Closure for any of the subjects.

7. There was a significant difference between phases for scores on the RPM test for Visualization for Subject 1 ($p \geq .002$ level). There were no differences for Subjects 2, 3, and 4.

8. There were significant differences between phases for scores on Self-Rating Scale #1 for Subject 2 ($p \geq .002$) and Subject 3

($p \geq .002$). No differences were found for Subjects 1 and 4. The scale indicated overall general levels of tension.

9. Significant differences were found for all subjects between phases for scores on Self-Rating Scale #2. Significance levels ranged from $p \geq .002$ to $p \geq .019$. This scale indicated the ability to modify levels of tension during the day.

10. There were no significant differences between phases for scores on Self-Rating Scale #3, indicating the ability to detect changes in levels of tension throughout the day.

The following clinical observations were reported:

1. The trend analysis was used to determine the significance of differences of 10 minutes of resting EMGs recorded at the end of Baseline and Treatment sessions. Although this was not part of the hypotheses tests, it was found that Subjects 3 and 4 decreased EMGs during Treatment ($p \geq .019$, $p \geq .002$) for the end-of-session EMGs.

2. Fluctuations in EMG levels during the Pre- and Post-Treatment Interviews were observed. It was expected that across the pre-session, the median EMG would increase from the first 10 minutes of rest to the administration of the TMAS. This was true for Subject 2. It was also expected that median EMGs during the post-session would remain low from the first 10 minutes of test to the test administration. There were, however, increases observed for Subjects 1, 2, and 4.

3. A comparison of the first nine and final four treatment sessions, using median EMG values, revealed that subjects did not continue to decrease EMG levels after the first nine sessions.

4. Scores from the Taylor Manifest Anxiety Scale indicated that the percentage of items scored positive for anxiety decreased for Subjects 1, 2, and 3 from the first to second testings following biofeedback training. There was a slight increase in items scored positive for Subject 4.

5. Further clinical observations indicated that subjects found it difficult during biofeedback sessions to focus thinking away from stressful or threatening ideation. It was observed that they could not maintain low EMG levels with the intrusion of such thoughts. As a consequence, subjects learned to identify thoughts which seemed to be compatible with relaxation. By the end of treatment, each subject was able to maintain consistently low EMGs for at least 15 minutes.

6. Following treatment, Subject 2 could periodically fall asleep at night without her usual sedative, Subject 1 was prescribed a different antipsychotic medication, and Subject 4 discontinued medication altogether.

7. Subjects' reports of the frequency of assigned daily home practice of relaxation exercises during the Treatment phase indicated that Subject 1 practiced approximately 80% of the time, Subject 2 practiced 78%, Subject 3 practiced 58%, and Subject 4 practiced 75% of the time.

Conclusions

The outcome data, which included physiologic, cognitive, and self-report measures as well as various clinical observations, indicated in which ways the treatment intervention was clinically

beneficial. In the following discussion, conclusions regarding the impact of treatment are drawn based on changes which occurred (or did not occur) in each of the different types of variables. Together, the results were supportive of the use of combined EMG biofeedback and relaxation exercises for persons who are diagnosed as schizophrenic and who are in stable clinical condition.

Electromyographic Levels

Findings which were related to the changes in EMG levels throughout various phases of the study indicated in which ways subjects were able to modify physiological tension, represented in the skeletal-muscle system, as a result of the treatment intervention. Research findings repeatedly emphasized that schizophrenics were chronically over-aroused and that this was consistently observable in skeletal-muscle measures. In addition, hypotheses put forth in the psychophysiological theories of schizophrenia suggested that physiologic over-arousal was predispositional in nature. Implied in these statements is the notion that muscular tension in schizophrenics is relatively refractory to change. It was evident from the present findings that subjects experienced considerable success during the feedback sessions in modifying levels of skeletal-muscle arousal. From 20-minute resting baseline measures to 30-minute recordings during biofeedback training, subjects decreased skeletal-muscle tension across phases by not less than 40% and in one case of up to 73%. In addition, they were able to achieve significant decreases within nine treatment sessions, and by the end of treatment were able to

maintain consistently low EMGs for at least 15-minutes duration. These data are noteworthy, given that the individuals being treated had experienced long-term difficulty with tension levels. It was demonstrated that some schizophrenics can begin to learn to alter chronic arousal within a period of time which does not exceed practical limits. A description of EMG changes during other events in the research schedule is important in that there were some unpredictable trends which related to the clinical significance of the treatment intervention and raised questions as to general statements which have been made about schizophrenics by other researchers.

EMG levels recorded during Baseline and Treatment phases while cognitive tests were administered showed two distinct patterns of change. For Subjects 1 and 4, there was an expected increase in the linear trend during Baseline and a decreasing linear trend during Treatment. The change across phases was significant in the case of Subject 4. The reverse pattern was observed, however, for Subjects 2 and 3. In these cases, there was a decreasing linear trend during Baseline which increased at the beginning of Treatment and then began to decline again. Clearly, the treatment did not have the desired effect on skeletal-muscle measures during task performance in these two cases. The fact that EMGs actually declined during baselining does not follow from studies by Malmo and his co-workers and Goldstein, who found that during the presentation of stressors and during task performance, EMG levels in schizophrenics increased or remained elevated from those recorded immediately prior to a task. Not only did EMG levels decline during baseline sessions in two cases, they were

lower than the 20-minute resting measures taken prior to the task in all four cases. This observation, then, contradicts those made by other researchers. Subjects were not highly aroused during task performance, and the conclusion reached given this information needs to be qualified. It can be stated that even though EMGs were relatively low during task performance, one of the subjects sustained even lower EMGs following treatment intervention.

There are several explanations which might account for these patterns. First, recall that in the clinical observations, subjects were able to effect a decrease in muscular tension only when thoughts were directed to nonstressful ideation. The Repetitive Psychometric Measures are relatively concrete, simple tasks which require some concentration but probably present little personal threat to the individual. Therefore, during Baseline and Treatment sessions, with attention focused to a nonthreatening task, a decrease rather than an increase in muscle tension naturally occurred.

A second explanation, which is not necessarily inconsistent with the first, is that predictions for the present study were based on data from group studies of inpatient and outpatient samples. Individuals in the present study could have been quite different from other randomly selected groups of schizophrenics both in their clinical condition and in the criterion used for diagnosis. Most of the studies which focus on the psychophysiologic responses of schizophrenics and which are frequently quoted in the literature were performed in the 1950s and 1960s. Perhaps it is time to reexamine certain data on schizophrenia within the context of current therapeutic

environments. With the introduction and refinement of the use of antipsychotic medications in the late 1950s, changing attitudes about mental illness, and improved treatment milieus, the variables which could profoundly affect the progression of any mental illness have changed dramatically. Findings from the present study indicated that the diagnosis of schizophrenia alone is not sufficient information from which to make global statements about arousal response tendencies. In this respect, physiologic arousal most likely follows on a continuum which at times more resembles normal populations, and it is possible that this might not have been the case 20 years ago.

There was a discrepancy between the EMG patterns observed during rest in the present study and resting EMGs reported by Whatmore. The schizophrenics in his study, who were reported to be in excellent clinical condition, exhibited EMG patterns which varied widely from day to day. While subjects in both studies were clinically similar, those in the present study had EMG patterns during baselining which were relatively stable, with daily fluctuations which did not exceed 1.8 Mv across days for any one subject. This phenomenon was shown in the plotted data for 20-minute resting baseline measures. Clearly, patterns of responding in the skeletal-muscle system are not the same for all persons who have been diagnosed as schizophrenic, and caution should be used when generalizing the results from one study to populations in general.

EMG measures taken during 10 minutes of rest at the end of each session and during the administration of the TMAS at the end of Treatment indicated that some of the subjects were able to maintain

lower EMGs during other events presented in the research schedule as a result of relaxation training. Subject 3 had lower EMGs during the 10 minutes of rest and during the test administration while this was true for Subject 4 during the 10 minutes of rest only. The findings indicated that subjects were beginning to generalize relaxation from the 30 minutes of biofeedback training. It also could be suggestive that generalization of relaxation was occurring at other times during the day as well.

In summary, although EMG measures did not always follow predictable trends, the treatment intervention was clinically significant with respect to decreasing skeletal-muscle tension in the following ways: (a) All subjects were able to effect a decrease in tension during biofeedback training, and they were able to sustain decreased EMGs for at least 15 minutes duration within nine treatment sessions; (b) One subject significantly decreased EMGs during task performance; and (c) Generalization of relaxation to other events in the research schedule occurred during the Treatment sessions for two subjects and continued to occur for one subject at the end of the study.

Repetitive Psychometric Measures

The psychophysiological theories of schizophrenia hypothesized that disturbances in attention and learning were related to physiologic over-arousal. Mednick proposed that as physiological arousal increased, the schizophrenic experienced a diminished capacity at the cognitive level to discriminate relevant from irrelevant stimuli. Broen hypothesized that increasing arousal resulted in sensory

overload at the cognitive level with a diminished ability to utilize relevant environmental cues. Tecce and Cole also theorized that as arousal increased, a decrement in cognitive performance occurred. It was expected that cognition, as measured by test performance, would be one of the variables affected by changing EMG levels. There was no apparent relationship, however, between EMG levels at the time of testing and improved performance on tests for subjects in the present study.

During treatment, Subject 1 did not decrease EMGs during testing, but he did improve scores on three of the five tests presented, while Subject 4 decreased EMGs but improved scores on only one of the tests. Although it could not have been predicted, the finding that there was no apparent relationship between cognitive performance and EMGs was not surprising in view of the fact that EMGs were relatively low during the test administration across Baseline and Treatment sessions. Integrating these data with the theoretical formulations, it could be that at lower levels of arousal, disturbances in cognition are not evident in test performance. Although data provided in the present study do not necessarily negate the theories, they point to a weakness of the theories to take into account the fluctuating clinical condition of the schizophrenic, specifically, when symptoms improve. While theorists emphasized the effects of increasing arousal on behaviors, they did not discuss the nature of the interaction of variables at what appears to be the opposite end of a continuum of behaviors. It was assumed in the theories that the schizophrenic was chronically over-aroused, and therefore, it would be expected that even at lower

levels of arousal there would continue to be an interactive effect with cognition which is measurable. A more accurate statement might be that schizophrenics are prone to excessive physiological arousal which can result in changes at the cognitive level, but in the absence of symptoms, they resemble normals on formal cognitive functioning. If this is the case, then relaxation training could be effectively used as a preventative measure, teaching the schizophrenic to become more aware of changing states of tension and to become cognizant of the internal and external events which affect tension levels so that when tension began to increase, individuals would be familiar with techniques to minimize its effects.

Even though there was no discernible relationship between arousal and test performance, there could be a relationship between elements of the treatment intervention and improved scores having to do with thought control. During biofeedback training, subjects became aware that it was necessary to focus attention in order to decrease arousal. Even though they were in excellent clinical condition, they still experienced difficulty with perseverative, stressful ideation. Improvements in the ability to exclude extraneous stimuli by focused and narrowed attention resulted in an increased ability to focus during tests. It is possible that techniques learned in the treatment intervention were used by two of the four subjects, evidenced by the improved ability to perform on cognitive tests as a result of learning to focus attention on the task.

The test construction itself guards against improvements in scores occurring because of repeated testings. The 20 forms of each

test were equated in terms of level of difficulty and had adequate test/retest reliabilities, so changes could not be attributed to factors of instability or nonequivalence of the tests themselves. It was unclear as to why there were improvements on some tests and not on others. The authors reported that each test represented a different factor of cognitive abilities, but they did not elaborate on this information in stating which factors might be more sensitive to changes.

Self-Report Rating Scales

Because the biofeedback and relaxation exercises were combined as a treatment intervention, it was not possible to determine the separate effects each might have had on the dependent variables. Research indicated, however, that individuals experienced more positive changes in subjective ratings of tension with relaxation exercises than with biofeedback. It was therefore expected that daily home practice of relaxation exercises would enhance awareness of tension and would contribute to increased control over tension outside of the biofeedback sessions.

Subjects 1, 2, and 3 showed improvements on two out of three of the rating scales while practicing 80%, 78%, and 58% of the time. Subject 4 practiced 75% of the time and improved on one of the scales. If subjects had practiced more consistently, they might have experienced a greater degree of awareness and control over levels of tension.

Examination of the linear trends for daily ratings of tension (Scale #1) indicated that for Subjects 2 and 3, whose ratings of

tension decreased significantly across phases, the linear trend increased during Baseline and decreased during Treatment, as expected. In the case of Subjects 1 and 4, the linear trend began to decrease during Baseline sessions, which indicated that before Treatment they began to experience less tension. It is possible that their Baseline ratings were reflecting an increasing degree of comfort with the experimental situation itself. These ratings increased at the beginning of biofeedback training and then decreased as the sessions progressed. The fluctuating linear trend could again have been an indication that during Treatment, subjects felt some initial discomfort when feedback about tension levels was introduced, and over time, adjustments were made to the experimental conditions, resulting in lower ratings. On the other hand, this might have indicated that subjects rated themselves more realistically on tension as they began to discriminate tension from relaxation during Treatment. Unfortunately, it is not possible to determine which interpretation best described these trends. In all cases, as treatment progressed, subjects' ratings of tension decreased and followed a pattern which was consistent with their decreasing EMG levels. In two of these cases, the treatment intervention resulted in a significant positive change in subjective feelings of tension.

Positive changes occurred for each subject in their perceived ability to decrease tension when they were aware of being tense. This finding was consistent with the fact that with feedback during training, they were able to significantly decrease EMGs. Clearly,

the treatment intervention resulted in subjects feeling that they had more control over tension.

There were no changes in subjects' ratings of their awareness of changes in levels of tension during the day (Scale #3). Since daily EMG levels were relatively stable, subjects probably did not experience the dramatic changes in tension which were expected, and therefore, they found it difficult to report on any minor fluctuations which might have occurred. Scale #3 is probably the most difficult of the scales in that it requires that a person be sensitive to fluctuating degrees of tension during various activities when attention is not necessarily focused on physical sensations. This degree of sensitivity may require more extensive training in discriminating degrees of tension and relaxation so that the process becomes internalized. Consistency and duration of the practice of relaxation exercises might not have been sufficient in order for improvements to occur on this scale.

It was stated that subjective feelings of tension might not be consistent with skeletal-muscle arousal because of the effects of anti-psychotic medications. Lader and Matthews pointed out that these drugs decreased autonomic arousal and therefore, individuals may feel that tension is lower, even though the drugs have no effect in reducing somatic or skeletal-muscle arousal. Results from the first two rating scales indicated that as treatment progressed, subjects felt consistently less tense as EMG levels decreased and they were aware of their increased ability to control tension. The combined treatments

were effective in that subjects seemed to be able to realistically assess changes in muscular tension and were aware of their increased ability to alter tension levels.

Clinical Observations

At the end of treatment, Subjects 1, 2, and 3 reported fewer symptoms of anxiety indicated by scores on the TMAS. Prior to treatment, the number of items they scored positive for anxiety ranged from 31 to 41 out of a total of 50. Their scores decreased from 26% to 56% at the end of treatment. In contrast, Subject 4 scored 13 items positive for anxiety prior to testing and increased her score by three items at the end of treatment. Subject 4, then, had a relatively low level of anxiety at the beginning of the study and experienced a relatively small change in symptoms compared to the others. The slight increase is inconsistent in view of the progress she made during treatment. She decreased EMGs by 73%, maintained consistently lower EMGs during the end-of-session resting measures and during task performance, improved scores on one test, and reported an increased ability to modify tension levels. A critical factor during Treatment which could have effected the increase in scores was that Subject 4 was the only individual in the study who discontinued antipsychotic medications. She was also one of two subjects who did not report feeling less tense by the end of treatment. The change in medication could have been followed by increased levels of autonomic arousal, thereby increasing her experiences of tension and symptoms of anxiety.

Because subjects continued to attend scheduled therapy sessions during the study, it cannot be ruled out that changes in test scores were a result of extraneous variables. However, since decreased anxiety occurred in three out of four cases, and the slight increase for Subject 4 was likely due to medication effects, it is more probable that the treatment intervention contributed to the improvements in anxiety.

The importance of cognitions, particularly excessive rumination and preoccupation, in the maintenance of tension was stressed in the biofeedback literature. It was stated that in the process of reducing the physiological symptoms of stress through biofeedback, the individual's attention shifted to the subjective mechanisms which maintained stress. In addition, it was pointed out that during the biofeedback process, individuals become aware of the importance of self-control, which gives them the capacity to alleviate their own symptoms.

The process by which subjects learned to modify tension clearly involved becoming aware of and learning to control throughts. As subjects became aware of fluctuations in their EMG levels during biofeedback training, they began to identify persistent thoughts which prevented them from relaxing. They discovered that a conscious effort was required in order to persist in controlling stressful ideation, and consequently, in order to maintain lowered tension. It was a major accomplishment that, by the end of treatment, they could maintain a mind set free from these preoccupations for a minimum of 15 minutes. Certainly, these discoveries were a significant gain

for all subjects, and the treatment process allowed significant insights regarding the impact of cognitions on functioning.

Since medications were not controlled for in the study, it cannot be established that there was a relationship between the intervention and the medical decision to discontinue Subject 4's antipsychotic medication. Each subject, at various times in the study, expressed a desire to stop taking medications. This "goal" seemed to be present prior to the study, and therefore, it was noteworthy that this subject had been maintained on the same type and dosage of medication for one year prior to the study. Perhaps the insights related to cognitions and stress and an increased sense of self-control contributed to the decision to discontinue medications.

Subject 2, who stopped taking her nightly sedative, stated that she could relax and focus thoughts to nonstressful ideation. Her psychiatrist confirmed that for six years prior to the study she had been unable to sleep without medication. The issue of whether or not the treatment intervention contributed to the decreased need for antipsychotic medications in clinically stable schizophrenics is one which cannot be answered within the present study. It was established, however, that elements of the intervention were directly related to one subject's decreased reliance on sedatives.

Researchers provided evidence that Quieting Response Training was successful for use with a mixed group of psychiatric inpatients in alleviating somatic complaints. Most importantly, they found that relaxation techniques did not increase emotional instability as others had predicted. The results of the present study provided evidence

that another form of relaxation training can also be used without producing negative emotional reactions in schizophrenic outpatients who are in stable clinical condition. In fact, the treatment intervention was clinically beneficial in that subjects were able to modify skeletal-muscle tension which was believed to be chronic and predispositional in nature. In addition, there was some evidence that the ability to decrease skeletal-muscle tension was generalized to other situations in the research schedule for some individuals. Other improvements were noted for some in the ability to perform concrete cognitive tasks, in symptoms of anxiety, and in subjective feelings of tension. The issue of a decreased need for antipsychotic medications and sedatives was discussed in conjunction with elements of the treatment intervention. Finally, the treatment process allowed individuals to realize the relationship between tension and ideation and provided a setting within which they could practice redirection and refocusing of cognitions. The initial premise that the treatment be used as an adjunct to other accepted treatment modalities seems well founded in view of the present findings.

Limitations

Some of the major limitations of this study concern the research design itself. The most obvious limitation in the single-case study design involves the generalization of results. It is not known if the results from cases presented in the present study would be relevant to other individuals. The subjects were not a representative, random sample, and it cannot be inferred that they were characteristic

of any given population of schizophrenics. Therefore, in the absence of random sampling of subjects, the generality of findings to other patient populations is restricted. Since the treatment procedures were repeated with four individuals, it is possible to make inferences to other patients with similar characteristics, the most important being the diagnostic criteria and the clinical condition of the patient.

Similarly, the lack of randomization in terms of therapists and treatment settings also restricts the generality of findings. It cannot be assumed that other clinicians in different treatment settings would achieve the same results. The investigator was the same individual who provided the clinical treatment to subjects, and there is the possibility that changes in behaviors were a result of increasing comfort subjects might have experienced with the investigator.

A more serious problem might exist if the outcome of measures was influenced by experimenter bias. This seems unlikely because EMG measures, cognitive tests, and true/false tests of anxiety only need to be recorded, leaving the interpretation to the scores themselves. Scores on the self-rating scales could have been more easily influenced by the investigator in some way communicating to the subjects that certain results were desired.

Because of the lack of post-treatment follow-up and patient controls in this study, there were threats to internal validity which necessitate that conclusions about the effects of treatment on behavior be interpreted with caution. For example, there was no information provided about the natural course of the behaviors studied. It is

possible that variables other than the treatment intervention, such as history and maturation, could have contributed to the changes which were observed. These threats were, in part, minimized by repeating baseline measures over seven sessions in order to establish the course of changes in behaviors which might have naturally occurred. But the baseline measures alone do not firmly establish that changes in the Treatment phase occurred because of the treatment intervention. Therefore, statements of causality cannot be made, and inferences about the results should be made with some reservation.

Another limitation lies within the self-rating scales which were developed for this study. Even though they appeared to have face validity, no reliability coefficients were determined prior to the study for these scales. Therefore, any significant results reported from the scales should be interpreted with caution.

Finally, it is important to emphasize that awareness and modification of muscular tension requires extensive practice and training. Although changes in behaviors were noted during the study, it cannot be established that in the absence of additional training, individuals would continue to experience improvements in symptoms of anxiety and in their ability to control tension levels.

Implications for Future Research

In this study, data were presented which suggested that a combined treatment program of EMG biofeedback with Progressive Relaxation can be a viable therapeutic intervention for clinically stable schizophrenics. There are several ways in which future research could expand

on these preliminary findings. First, the study should be replicated with adequate controls for factors which could affect outcomes. It needs to be established with certainty to which degree physiological, cognitive, and emotional behaviors are affected by the proposed treatment. This could be accomplished by extending the study for post-treatment follow-up and by altering the research design so that other subjects serve as controls.

In addition, the clinical applicability of the proposed treatment intervention could be tested by using the same techniques with a wider variety of subjects, particularly those who are psychologically less stable, and with other therapists and treatment settings.

Finally, the relationship between schizophrenics' ideation and physical tension seems to be a viable topic for research. It was suggested in this study that states of physical tension in schizophrenics are reinforced and maintained by perseverative, stressful ideation. Further studies could explore the benefits of using EMG biofeedback training to enhance awareness of such ideation and to teach schizophrenics a process for altering or refocusing cognitions. In this respect, combinations of relaxation therapies such as Quieting Response Training or autogenic training, such as Open Focus Exercises developed by Fehmi, might be used to enhance the physical, mental, and emotional integration of this specific population.

APPENDICES

APPENDIX A

SELF-REPORT RATING SCALES

APPENDIX A

Following are three questions which subjects were asked to rate according to the way they presently felt.

1. What is your present general level of tension? Rate yourself on a scale from 1-10, with 1 being very low, 5 moderate, and 10 very high.

2. When you feel tense, how well do you feel you can lower your level of tension? Rate yourself on a scale from 1-10, with 1 being no ability to lower tension levels, 5 moderate ability, and 10 being very good ability to lower levels of tension.

3. Are you aware of the times when tension is increasing or decreasing during your daily routine? Rate yourself on a scale from 1-5, with 1 being never aware, 2 being almost never aware, 3 being sometimes aware, 4 being often aware, and 5 being almost always aware.

APPENDIX B

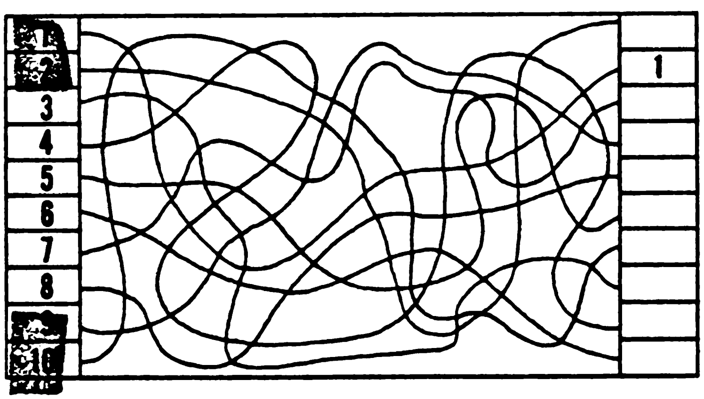
REPETITIVE PSYCHOMETRIC MEASURES

APPENDIX B

INSTRUCTIONS

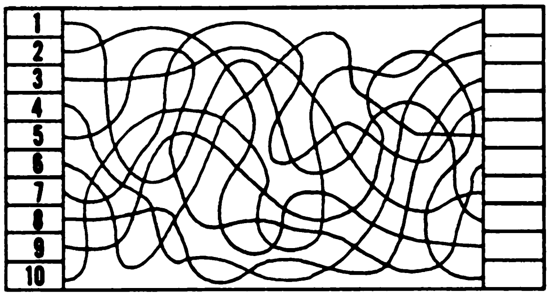
(V)

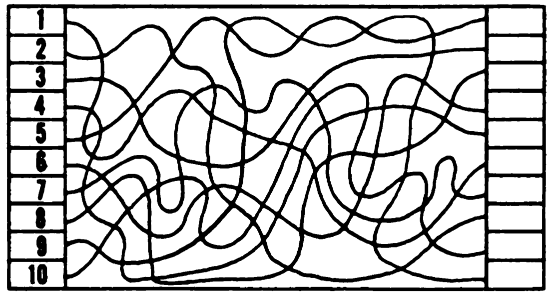
Your task is to follow a single line from beginning to end through a whole group of lines. Look at the figure below. At the left-hand side you will see a set of numbered boxes. A line begins at the side of each one of these boxes and ends at an empty box on the right. You are to write the correct number in the box on the right. Look at the line beginning at the side of box 1 and follow it with your eyes to the point where it ends at a box on the right. Notice that the figure 1 has been written in the proper box. For practice, fill in the other boxes. Remember, the lines must be followed with your eyes; do not follow with your finger or pencil.

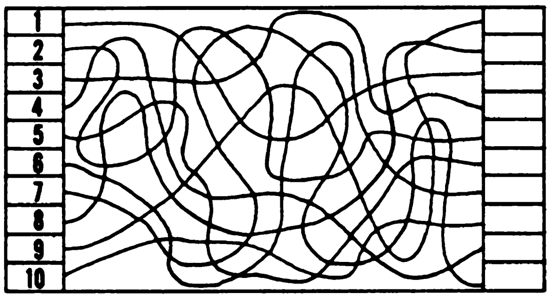


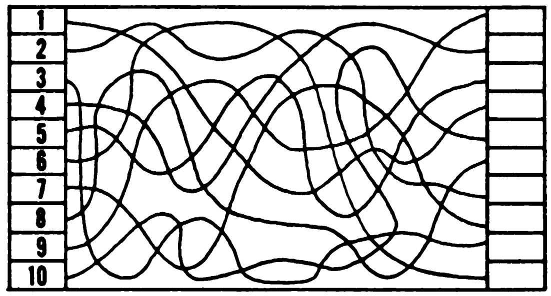
V—Form 2

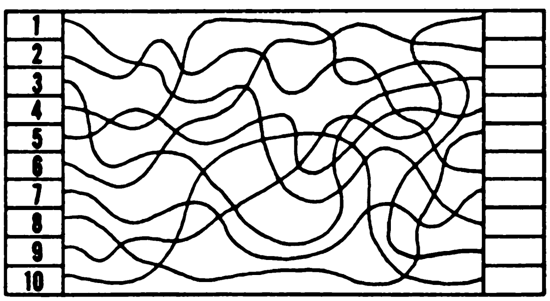
Follow each line with your eyes to its proper cell on the right and write the number of the line in the cell.

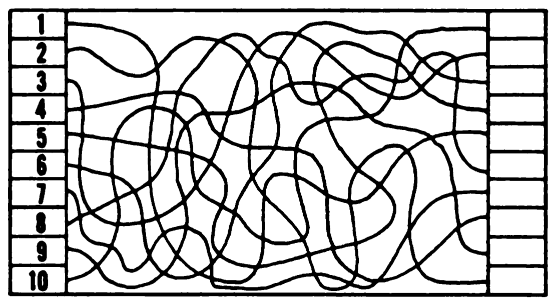


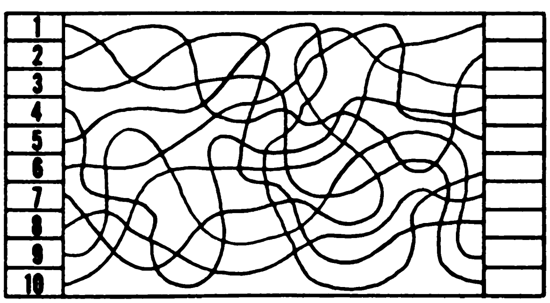


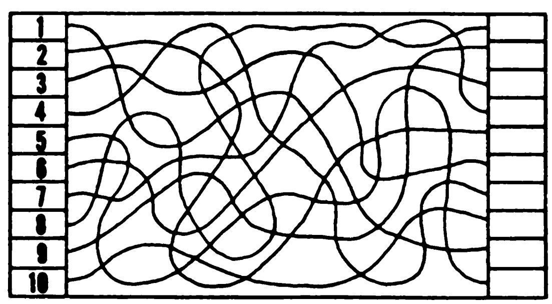












Subject____________________ **Date**______________ **Examiner**__________________

INSTRUCTIONS

(SC)

Look at the two rows of letters below.

A M G E (W I N D) T E Y K Z C I (R O C K) W Q E (H O W L) O Z N P E

(B E L T) O T (H U L L) V A Y F S M I (P L A N) (F O U R) Y U N T R I

Notice that a circle has been drawn around groups of four consecutive letters that spell out a common English word. Only four-letter words are marked. The same letters are used in only one word at a time.

Below are more rows of letters on which to practice. Draw a circle around each set of four adjacent letters which spell out a common English word. Go ahead. Do not wait for any signal. Read along the rows from the left side of the page to the right side.

K I Y O U R G A C S P I H A N D V Z Q J U X D I E D O L R O O M

V O R S Z R E A D U O F T E B E E N A Q P A U N T A Q S E R T L

X J A K C O W B N O S E L I Q X E S T F A S T W D O M T R I Z E

E L B I E B E S T B T R E X D O W N G U T N E L A S T W I T C I

When the signal is given (not yet), turn the page and draw a circle around each set of four adjacent letters in a row that spells out a common English word. Go from left to right in each row. Work fast. Mark only <u>four</u>-letter words.

SC-Form 1 Draw a circle around each four-letter word in the rows below

Date______________

Subject________________

L K Y S A N D T E H P E E K L H R G X Z P U I L R O A M I G R D S O H A C K J T J O R S P V
L Y D N F J H S I C K R A W H U N P L I Y R A S H W Z O K F L I T J H U B G H A S H K C Z U
K U Y H G K L M B G F Y J W O R E H U G T K N G F D S O M E U H T G F D L M B G Y U I J F X
O P K J H N B G R E A D T G H I K E N H P E R K J H Y G T R J H G T R J H G F R V Y B J I U
F U S E T H J N H G R F Y U H G F D C S A Q M O R E F G U H U J H T R F I J K H F V E I N J
U P O L J U H Y T R F G H D W Q A P K H B V T U S E N T J U H S A M E T H O O K H T G X E K
K I N Y H E D F G U M E R E G W I N K I H T D Z P O K N G R Q A X V S T O P L O U Y G C D Q
Q D G S L A M J H R E A L O J H T F R E D J S Z V N I J K J R E W Z N P U H M O S T Y X A P
P L I N E K Y F C M W Q P Z G X J T G M A K R Y I J G R D M A K E A S I A J O P L G Z X W Y
K U H T R G H V D E N E W S J K I G T E D N J M O N K U Y T R F W D E T R I M L K J N E G Y
I J H Y T C E D S R V B N M L K I R O N D H E A P J G U F W E Q S D B J U Y H Y T F U Z X P
J I U Y C O L T S E E M U F G D S H J K L G R A Y I H T R D W X C V B J K G F T R E O U R S
P M O R E H Y T Q S C F T Y J M O K N H T R F C U D O S E H V F C U R H J N V F M U S S O Z
K I J H G V C D W H U I F O O L K J H H T E V O O R O S Y X C C J U P A V E H G U C D W R H
K O P T F X W D V R U S H J N G B T F D S E O L P K J H V W A L K O H C D W G N K U Y T D C
H V D E W G R E W T P J B C D Q A Z F Y M I L L O H C W D F G J B I R P L A N H T D B G I F
I H V F E W D V H U O K N N O S E T F X P K N Z W Y S K J H G I Z M O L D H V E G K L K U G
R G N J Y T F X D W D X O T I L T N H E A T O J B V C F V E A L O B J R F E G S H O W Z G W
U G N R F S U U H S I D E X F Y J L M G R T E A R I J H B G F C D S X W F B J I O K N B V Z
Z A D G J L W A I T H O O B Z G D A L U N B S L A Y I H V D W Q D G H N K P I G V L A N D G
N H T D Z W I L L X J B G G J H V E F U H S A F E M I N E J Y G F C D W F B E U I P L J B V
J L O S T H T R D V B H T Y D S Q Z J O P L J F E L T H V W E F D V H U I J B F G H Y T R R

Examiner__________

INSTRUCTIONS

(NF)

This is a test to see how quickly and accurately you can add. It is not expected that you will finish all the problems in the time allowed. Work steadily and as quickly as you can without sacrificing accuracy.

You are to write your answers in the boxes below the problems. Examples of the problems are given below with the first one correctly worked. Practice for speed on the others.

Practice Problems:

4	7	12	84	7	34	17	45	31	80
9	6	5	54	38	81	50	41	52	78
1	15	67	72	80	51	74	89	19	15
14									

NF-Form 1

35 38 31	24 23 96	10 16 25	16 86 91	20 38 47	33 42 96	32 38 44	51 97 33	26 1 49	38 50 13
66 14 68	67 90 5	40 84 51	67 45 18	14 11 20	64 75 33	5 73 96	71 88 2	95 5 74	86 90 19
20 64 5	46 19 26	78 58 93	73 97 70	90 79 60	97 15 22	51 6 35	40 15 85	14 93 15	2 20 13
7 68 14	97 71 65	10 86 52	88 85 68	23 85 74	9 54 87	99 87 37	42 66 78	99 47 22	64 54 41
17 90 41	53 26 23	77 59 52	58 21 55	71 19 99	71 23 31	59 41 52	36 61 23	50 33 69	72 12 96
26 46 42	99 98 53	61 63 32	65 71 37	53 62 32	58 33 27	4 26 7	49 16 36	80 7 51	70 45 80
32 5 31	90 3 62	79 72 43	78 93 90	53 15 90	13 57 6	55 12 18	38 10 44	58 14 32	59 21 53
17 77 98	37 4 10	93 74 50	23 47 71	78 67 74	87 21 12	35 76 86	20 33 73	96 50 58	43 25 7
52 49 79	42 17 83	7 46 86	44 9 19	38 62 62	15 90 6	51 52 76	29 84 50	13 77 3	42 27 10

Subject ____________________ Examiner ____________________ Date ____________

INSTRUCTIONS

(FC)

In this test you are to copy each of the figures in the dotted space to the right of it. The little circles show you where to begin. There is a dot for every corner.

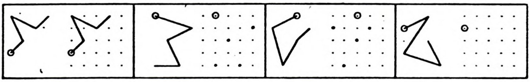
Figure A has been copied as an example in the dotted space to the right of it.

Copy figure B in the dotted space. Begin at the small circle and use the heavy dots as guides.

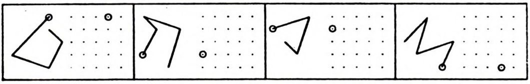
Copy figure C in the dotted space in the same manner.

Copy figure D in the dotted space.

A B C D



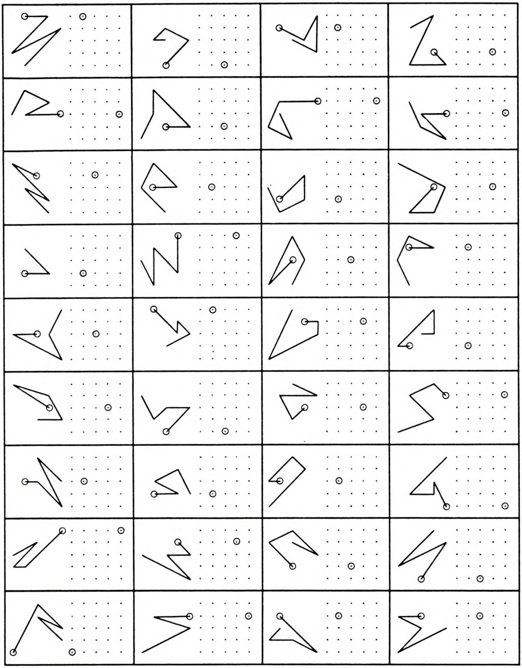
Copy each of the following figures in the same way. Begin at the small circles. Your lines do not have to be straight but they should begin and end on dots. Make corrections if you wish, but do not waste time erasing. Go right ahead. Do not wait for any signal.



When the signal is given (not yet) turn the page and copy more figures of the same kind.

Work rapidly because your mark will be the total number of figures correctly copied. You may not be able to finish in the time allowed.

FC—Form 1



Subject____________________ **Date**__________ **Examiner**________________

INSTRUCTIONS

(PS)

Look at the rows of numbers below. A ring has been put around the first number in each row. The numbers in the row that are like the circled number are crossed out.

(3) 7 2 ~~3~~ 9 0

(7) ~~7~~ 2 8 6 3

(1) 0 8 6 3 ~~1~~

(4) 6 9 ~~4~~ ~~4~~ 1

Cross out the numbers in the following rows that are like the circled numbers at the beginning of each row.

(2) 1 9 5 2 3

(8) 6 7 1 5 8

(5) 9 5 4 8 2

(3) 4 5 3 5 2

Here are more practice rows. Cross out each number in a row that is like the circled number at the beginning of each row.

(8) 7 6 0 3 5 2 1 0 5 8 4 7 9 3 2 6 5 8 5 3 8 0 1 1 8

(2) 5 9 1 0 7 9 4 2 0 0 8 3 4 2 0 8 6 1 6 9 3 5 8 6 1

(5) 5 8 2 5 9 7 3 4 6 8 5 3 2 0 1 9 6 7 4 5 6 7 2 4 3

(5) 3 5 8 0 1 8 1 0 7 4 2 5 7 5 8 7 4 3 2 7 9 0 1 8 7

(4) 5 3 6 9 1 2 2 5 3 7 5 8 0 3 8 6 0 5 3 4 2 1 9 7 5

(3) 8 3 4 7 1 8 2 0 2 7 4 3 6 8 0 1 8 6 3 6 4 7 9 6 5

(7) 4 5 8 5 7 4 5 8 7 3 2 6 8 4 5 9 1 1 0 7 8 4 2 7 6

(9) 6 4 5 4 7 5 8 0 1 8 3 2 5 4 5 7 9 6 8 0 1 7 5 3 9

(1) 0 7 9 5 3 3 4 7 9 1 7 0 4 0 2 3 7 5 8 1 5 3 7 9 0

When the signal is given (not yet), turn the page and cross out each number in a row that is like the circled number. Work Fast. Find as many numbers as you can in the time allowed.

PS-Form 1a Cross out each number in a row that is like the circled number.

(3) 6 1 6 9 0 2 8 9 5 7 7 2 8 4 4 4 2 3 4 7 8 6 4 5 1 0 4 9 4

(5) 3 0 1 9 4 0 7 5 3 5 1 0 4 7 0 7 5 8 8 2 2 3 8 8 8 0 1 4 7

(4) 1 3 0 9 4 0 3 2 2 1 2 2 9 5 0 6 1 5 9 3 7 8 0 8 8 2 6 3 5

(1) 2 6 9 5 0 1 7 7 1 7 6 8 1 4 0 8 5 0 8 5 0 8 2 0 1 2 1 8 4

(5) 0 9 8 5 3 5 8 5 2 3 4 3 3 0 8 3 7 0 6 0 0 6 5 0 4 4 9 7 1

(7) 8 4 6 5 0 8 7 6 4 0 8 6 2 5 3 4 0 5 9 2 9 7 2 4 7 6 0 6 6

(9) 6 1 6 9 9 4 8 9 5 8 1 8 0 7 7 4 5 5 4 0 3 0 1 9 4 4 2 4 5

(4) 5 6 7 0 0 7 6 7 4 0 6 2 7 5 2 3 7 1 3 9 8 5 7 5 5 4 9 0 3

(3) 0 8 9 7 4 0 3 4 9 7 0 3 0 9 5 9 9 6 8 3 0 4 7 3 0 7 1 9 6

(7) 8 9 9 5 5 0 1 8 0 1 7 7 5 8 1 4 8 5 3 5 7 9 8 8 5 4 3 8 0

(4) 1 7 9 6 0 9 4 9 2 7 7 8 9 8 1 0 3 5 8 4 8 5 3 4 7 6 7 7 2

(3) 3 7 6 6 4 2 7 7 4 2 4 3 5 1 6 6 0 4 5 8 3 3 4 1 5 2 0 3 1

(6) 9 8 4 2 2 3 4 4 2 5 3 3 4 2 5 2 5 8 9 2 9 2 6 3 7 1 2 0 8

(8) 6 3 6 0 1 1 4 7 5 5 0 1 1 6 1 9 3 0 9 4 0 0 2 6 5 7 8 0 1

(0) 7 7 8 8 3 7 4 4 2 7 8 0 9 1 9 2 6 6 2 6 2 3 7 5 7 2 1 4 5

(2) 4 2 3 4 0 9 9 5 4 8 7 6 3 4 1 0 3 7 3 4 2 8 2 4 1 1 3 0 6

(9) 0 2 3 7 8 6 6 6 7 6 8 0 8 9 3 0 0 0 9 4 8 4 1 7 9 3 7 9 4

(6) 6 0 7 9 4 1 0 9 3 4 1 4 6 9 3 5 4 6 1 9 5 1 5 6 2 6 8 7 2

(7) 8 9 4 4 2 3 2 1 8 2 8 5 0 0 7 3 8 9 9 6 8 9 3 1 2 9 6 6 6

(7) 3 5 2 4 7 4 4 6 7 3 9 7 7 9 2 6 3 7 0 1 9 0 8 2 1 7 0 4 4

(0) 5 6 9 3 4 2 9 4 1 4 9 9 7 1 4 5 5 9 4 9 4 1 5 8 8 6 4 1 4

(2) 8 6 5 0 2 1 3 0 7 9 1 1 3 5 8 7 6 9 4 9 5 5 7 3 9 5 5 4 9

(8) 1 6 4 6 0 5 8 0 9 0 6 6 8 4 5 1 1 4 5 0 6 3 0 7 5 1 6 1 4

(3) 8 6 9 8 1 8 7 4 2 1 6 8 6 8 4 9 7 1 4 3 1 1 2 9 3 7 2 0 5

(9) 6 0 5 0 2 0 9 4 9 8 2 8 0 0 7 6 0 9 4 0 5 0 8 6 9 3 1 4 6

Subject________________ Date__________ Examiner__________

PS-Form 1a **Cross out each number in a row that is like the circled number.**

(3)	6	1	6	9	0	2	8	9	5	7	7	2	8	4	4	4	2	3	4	7	8	6	4	5	1	0	4	9	4
(5)	3	0	1	9	4	0	7	5	3	5	1	0	4	7	0	7	5	8	8	2	2	3	8	8	8	0	1	4	7
(4)	1	3	0	9	4	0	3	2	2	1	2	2	9	5	0	6	1	5	9	3	7	8	0	8	8	2	6	3	5
(1)	2	6	9	5	0	1	7	7	1	7	6	8	1	4	0	8	5	0	8	5	0	8	2	0	1	2	1	8	4
(5)	0	9	8	5	3	5	8	5	2	3	4	3	3	0	8	3	7	0	6	0	0	6	5	0	4	4	9	7	1
(7)	8	4	6	5	0	8	7	6	4	0	8	6	2	5	3	4	0	5	9	2	9	7	2	4	7	6	0	6	6
(9)	6	1	6	9	9	4	8	9	5	8	1	8	0	7	7	4	5	5	4	0	3	0	1	9	4	4	2	4	5
(4)	5	6	7	0	0	7	6	7	4	0	6	2	7	5	2	3	7	1	3	9	8	5	7	5	5	4	9	0	3
(3)	0	8	9	7	4	0	3	4	9	7	0	3	0	9	5	9	9	6	8	3	0	4	7	3	0	7	1	9	6
(7)	8	9	9	5	5	0	1	8	0	1	7	7	5	8	1	4	8	5	3	5	7	9	8	8	5	4	3	8	0
(4)	1	7	9	6	0	9	4	9	2	7	7	8	9	8	1	0	3	5	8	4	8	5	3	4	7	6	7	7	2
(3)	3	7	6	6	4	2	7	7	4	2	4	3	5	1	6	6	0	4	5	8	3	3	4	1	5	2	0	3	1
(6)	9	8	4	2	2	3	4	4	2	5	3	3	4	2	5	2	5	8	9	2	9	2	6	3	7	1	2	0	8
(8)	6	3	6	0	1	1	4	7	5	5	0	1	1	6	1	9	3	0	9	4	0	0	2	6	5	7	8	0	1
(0)	7	7	8	8	3	7	4	4	2	7	8	0	9	1	9	2	6	6	2	6	2	3	7	5	7	2	1	4	5
(2)	4	2	3	4	0	9	9	5	4	8	7	6	3	4	1	0	3	7	3	4	2	8	2	4	1	1	3	0	6
(9)	0	2	3	7	8	6	6	6	7	6	8	0	8	9	3	0	0	0	9	4	8	4	1	7	9	3	7	9	4
(6)	6	0	7	9	4	1	0	9	3	4	1	4	6	9	3	5	4	6	1	9	5	1	5	6	2	6	8	7	2
(7)	8	9	4	4	2	3	2	1	8	2	8	5	0	0	7	3	8	9	9	6	8	9	3	1	2	9	6	6	6
(7)	3	5	2	4	7	4	4	6	7	3	9	7	7	9	2	6	3	7	0	1	9	0	8	2	1	7	0	4	4
(0)	5	6	9	3	4	2	9	4	1	4	9	9	7	1	4	5	5	9	4	9	4	1	5	8	8	6	4	1	4
(2)	8	6	5	0	2	1	3	0	7	9	1	1	3	5	8	7	6	9	4	9	5	5	7	3	9	5	5	4	9
(8)	1	6	4	6	0	5	8	0	9	0	6	6	8	4	5	1	1	4	5	0	6	3	0	7	5	1	6	1	4
(3)	8	6	9	8	1	8	7	4	2	1	6	8	6	8	4	9	7	1	4	3	1	1	2	9	3	7	2	0	5
(9)	6	0	5	0	2	0	9	4	9	8	2	8	0	0	7	6	0	9	4	0	5	0	8	6	9	3	1	4	6

Subject____________________ Date______________ Examiner______________

PS-Form 1b **Cross out each number in a row that is like the circled number.**

(0) 7 6 3 8 7 7 9 2 9 0 3 0 6 1 1 8 0 7 2 9 6 2 0 7 4 4 1 5 6

(6) 0 5 2 8 8 3 4 4 1 0 7 9 5 4 1 9 8 1 4 5 9 1 7 5 2 0 6 9 5

(8) 3 5 9 6 3 5 6 5 5 0 6 9 5 8 9 2 9 8 3 0 5 1 2 8 0 9 7 1 9

(1) 0 8 5 0 6 2 7 4 6 9 9 5 9 9 1 0 5 0 7 1 3 4 9 9 0 6 3 1 9

(3) 9 8 2 0 9 8 9 5 2 4 3 6 2 2 6 3 1 4 7 6 4 4 2 1 8 0 8 1 4

(5) 9 5 8 0 0 6 4 7 8 7 5 5 6 9 7 8 8 0 0 8 8 8 3 5 5 4 4 8 6

(3) 8 5 0 8 0 7 3 4 1 2 3 7 9 3 4 8 7 6 3 9 0 8 2 2 9 7 0 2 2

(3) 0 6 9 2 7 0 6 6 8 9 4 6 8 8 1 6 1 2 7 5 6 1 9 6 8 0 0 9 1

(6) 5 4 4 3 9 5 6 5 9 1 8 2 8 8 2 7 4 3 7 4 9 6 3 2 2 4 0 4 1

(2) 7 2 6 7 5 0 2 6 4 1 3 1 9 2 7 2 2 9 4 0 7 4 7 7 4 4 6 0 6

(9) 1 3 0 7 0 6 9 9 1 1 9 0 7 2 2 4 2 1 0 3 6 6 9 9 5 3 7 2 8

(6) 8 4 3 4 9 4 6 8 8 8 4 4 7 3 1 3 6 2 2 6 2 1 2 6 9 8 4 0 8

(4) 8 9 0 8 1 5 8 7 7 5 4 7 4 5 2 4 5 9 1 3 5 7 0 0 0 4 7 5 4

(0) 6 9 1 3 4 5 1 9 7 4 2 6 7 2 7 8 6 0 1 1 1 8 8 3 0 9 5 2 8

(1) 0 4 5 5 1 6 0 1 9 1 4 2 1 0 3 3 7 1 2 9 1 3 4 2 3 7 8 2 1

(1) 2 8 8 3 9 7 3 4 3 6 5 0 2 7 6 1 1 8 4 0 4 2 8 5 0 1 3 9 2

(2) 8 7 7 8 3 0 9 7 6 3 8 8 0 7 3 6 9 6 1 3 1 6 4 9 4 2 0 9 6

(1) 9 5 2 3 5 9 5 1 5 6 5 1 2 2 5 9 6 5 9 8 6 2 8 3 6 8 2 5 8

(6) 7 2 4 5 5 2 6 7 0 3 5 5 8 2 1 6 5 6 3 7 9 2 4 6 8 6 6 8 6

(6) 0 5 8 4 4 7 3 7 7 0 7 5 0 0 3 7 9 9 2 4 5 1 3 4 2 6 5 2 9

(5) 3 8 5 3 4 1 3 7 7 3 6 0 6 6 9 3 8 5 0 5 8 8 3 8 7 3 8 5 9

(2) 4 6 3 7 3 8 7 3 6 7 4 3 8 4 8 9 3 4 2 5 2 6 2 4 0 7 9 9 2

(8) 3 0 8 0 1 2 4 5 1 3 8 9 9 2 2 2 8 1 5 0 7 7 5 9 5 1 7 7 7

(1) 6 4 4 4 2 4 3 3 4 3 6 1 5 1 9 9 0 7 3 2 7 4 9 3 7 0 9 3 9

(6) 0 7 9 0 1 8 1 5 7 5 7 1 7 8 6 5 7 6 3 1 1 1 6 1 7 8 5 7 6

Subject____________________ Date____________ Examiner____________

APPENDIX C

TAYLOR MANIFEST ANXIETY SCALE

APPENDIX C

Instructions

The examiner reads the items to the subject. The subject is instructed to answer TRUE if the statement is true or mostly true for him. He is to answer FALSE if the statement is false or mostly false for him.

Questions

1. I do not tire quickly.
2. I am often sick to my stomach.
3. I am about as nervous as other people.
4. I have very few headaches.
5. I work under a great deal of strain.
6. I cannot keep my mind on one thing.
7. I worry over money and business.
8. I frequently notice my hand shakes when I try to do something.
9. I blush as often as others.
10. I have diarrhea ("the runs") once a month or more.
11. I worry quite a bit over possible troubles.
12. I practically never blush.
13. I am often afraid that I am going to blush.
14. I have nightmares every few nights.
15. My hands and feet are usually warm enough.
16. I sweat very easily even on cool days.
17. When embarrassed I often break out in a sweat which is very annoying.

18. I do not often notice my heart pounding and I am seldom short of breath.

19. I feel hungry almost all the time.

20. Often my bowels don't move for several days at a time.

21. I have a great deal of stomach trouble.

22. At times I lose sleep over worry.

23. My sleep is restless and disturbed.

24. I often dream about things I don't like to tell other people.

25. I am easily embarrassed.

26. My feelings are hurt easier than most people.

27. I often find myself worrying about something.

28. I wish I could be as happy as others.

29. I am usually calm and not easily upset.

30. I cry easily.

31. I feel anxious about something or someone almost all of the time.

32. I am happy most of the time.

33. It makes me nervous to have to wait.

34. At times I am so restless that I cannot sit in a chair for very long.

35. Sometimes I become so excited that I find it hard to get to sleep.

36. I have often felt that I faced so many difficulties I could not overcome them.

37. At times I have been worried beyond reason about something that really did not matter.

38. I do not have as many fears as my friends.

39. I have been afraid of things or people that I know could not hurt me.

40. I certainly feel useless at times.

41. I find it hard to keep my mind on a task or job.

42. I am more self-conscious than most people.

43. I am the kind of person who takes things hard.

44. I am a very nervous person.

45. Life is often a strain for me.

46. At times I think I am no good at all.

47. I am not at all confident of myself.

48. At times I feel that I am going to crack up.

49. I don't like to face a difficulty or make an important decision.

50. I am very confident of myself.

APPENDIX D

SUBJECT'S CONSENT FORM FOR ELECTROMYOGRAPHIC

BIOFEEDBACK STUDY

APPENDIX D

1. I have freely consented to take part in a scientific study being conducted by: *Carol A. Keating*
   under the supervision of: *William Hinds, Ph.D.*
   Academic Title: *Professor of Counseling, Personnel Services, and Educational Psychology*

2. I understand that to participate in the study, I will be aksed to:
   a. reply to questions about myself which will be presented orally.
   b. allow the examiner to place surface electrodes on the frontalis muscle of my forehead in order to record the tension of that muscle.
   c. perform short paper-and-pencil tests.
   d. practice relaxation exercises with the aid of a tape-recorded program.

3. I understand that I will be participating in a treatment program approximately four days per week, with each session lasting approximately one hour.

4. I understand that this program will be conducted over a period of time of not less than three weeks and not more than ten weeks.

5. I understand that I will not be required to discontinue any ongoing therapy, such as medication therapy or individual or group therapy, during the study.

6. I understand that I am free to discontinue my participation in the study at any time without penalty.

7. I understand that the results of the study will be treated in strict confidence and that I will remain anonymous. Within these restrictions, results of my own test data will be made available to me at my request.

8. I understand that my participation does not guarantee any beneficial results to me, but that there is a probability that this may occur.

9. I understand that, at my request, I can receive additional explanation of the study after my participation is completed.

____________________ ____________________

Signed Date

____________________ ____________________

Witnessed by Date

APPENDIX E

PERSONAL DATA INVENTORY

APPENDIX E

Name____

Birth Date______________________________ Sex_______________

Marital Status____________________ (single, married, widowed, divorced)

Education_________________________

Occupation____

Current Living Situation____

Onset of Psychiatric Illness______________________________________

Previous Hospitalizations____

____

Medications Taken in Past 6 Months________________________________

____

Current Medications and Dates of Changes__________________________

____

____

Persons directly involved in study: Name and Function

____

____

____

____

APPENDIX F

PHYSICIAN'S CONSENT FORM FOR ELECTROMYOGRAPHIC BIOFEEDBACK STUDY

APPENDIX F

1. I freely consent to allow my patient: ____________________
   to take part in a scientific study being conducted
   by: *Carol A. Keating*
   under the supervision of: *William Hinds, Ph.D.*
   Academic Title: *Professor of Counseling, Personnel Services, and Educational Psychology*

2. I have been fully informed of the requirements of my patient for participation and believe that he/she is medically and psychologically able to participate in the proposed treatment program.

3. I agree to assess the psychological well-being of my patient during this study and will withdraw my consent if, in my judgment, the program is detrimental to his/her well-being.

4. I understand that my patient will continue with any current psychopharmacological and psychotherapeutic treatment which I consider beneficial, and that it is preferable that such treatments not be altered during the course of the study.

5. If alterations in current treatments (outlined in statement 4) are necessary, I will inform the examiner of such changes.

6. I understand that, at my request, I can obtain results of test outcome data and will treat such materials with utmost confidentiality.

7. I understand that participation in this study does not guarantee any beneficial results to my patient, but that there is a probability that this will occur.

______________________________ ______________________________
Signed Date

______________________________ ______________________________
Witnessed by Date

REFERENCES

REFERENCES

Alexander, A. B. An experimental test of assumptions relating to the use of electromyographic biofeedback as a general relaxation technique. Psychophysiology, 1975, 12(6), 656-662.

Basmajian, J. (Ed.). Biofeedback. Principles and practice for clinicians. Baltimore: Williams & Wilkins Co., 1979.

Benson, H. The relaxation response. New York: William Morrow & Co., Inc., 1975.

Broen, W. E., Jr. Schizophrenia: Research and theory. New York: Academic Press, 1968.

Brown, B. Stress and the art of biofeedback. New York: Bantam Books, Inc., 1978.

Canter, A., Kondo, C., & Knott, J. A comparison of EMG biofeedback and progressive muscle relaxation training in anxiety neurosis. British Journal of Psychiatry, 1975, 121, 470-477.

Coursey, R. Electromyograph feedback as a relaxation technique. Journal of Consulting and Clinical Psychology, 1975, 43, 825-834.

Dahlstrom, W., Welsh, G., & Dahlstrom, L. An MMPI handbook: Volume II. Minneapolis: University of Minnesota Press, 1975.

Feighner, J., Robins, E., Guze, S., Woodruff, R., Winokur, G., & Munoz, R. Diagnostic criteria for use in psychiatric research. Archives of General Psychiatry, 1972, 26, 57-63.

Fenz, W., & Velner, J. Physiological concomitants of behavioral indexes in schizophrenia. Journal of Abnormal Psychology, 1970, 76(1), 27-35.

Ford, M., Stroebel, C., Strong, P., & Szarek, B. Quieting response training: Treatment of psychophysiological disorders in psychiatric patients. Proceedings of the Biofeedback Society of America. Twelfth Annual Meeting, March 1981, Louisville, Kentucky.

Freedman, A., Kaplan, H., & Sadock, B. (Eds.). Comprehensive textbook of psychiatry. Baltimore: Williams & Wilkins Co., 1976.

Fuller, G. Biofeedback: Methods and procedures in clinical practice. San Francisco: Biofeedback Press, 1977.

Gaardner, K., & Montgomery, P. Clinical biofeedback: A procedural manual. Baltimore: Williams & Wilkins Co., 1977.

Gellhorn, E. Motion and emotion: The role of proprioception in the physiology and pathology of the emotions. Psychological Review, 1964, 71(6), 457-472.

Goldstein, I. The relationship of muscle tension and autonomic activity to psychiatric disorders. Psychosomatic Medicine, 1965, 27, 39-52.

Green, E., & Green, A. Beyond biofeedback. San Francisco: Delacorte Press, 1977.

Hersen, M., & Barlow, D. Single case experimental designs: Strategies for studying behavior change. New York: Pergamon Press, 1976.

Jessup, B., & Neufeld. Effects of biofeedback and "autographic relaxation" techniques on physiological and subjective responses in psychiatric patients: A preliminary analysis. In J. Stoyva, J. Kamiya, T. X. Barber, N. Miller, & D. Shapiro (Eds.), Biofeedback and self-control. 1977/78. New York: Aldine Publishing Co., 1979.

Kazdin, A. Methodological and interpretive problems of single case experimental designs. Journal of Consulting and Clinical Psychology, 1978, 46(4), 629-642.

Kratochwill, T. (Ed.). Single subject research: Strategies for evaluating change. New York: Academic Press, Inc., 1978.

Lader, M. H., & Mathews, A. M. Electromyographic studies of tension. Journal of Psychosomatic Research, 1971, 15, 479-486.

Lang, P., Rice, D., & Sternbach, R. The psychophysiology of emotion. In N. Greenfield & R. Sternbach (Eds.), Handbook of psychophysiology. New York: Holt, Rinehart & Winston, 1972.

Lehman, H. Psychopharmacological treatment of schizophrenia. Schizophrenia Bulletin, 1975, 13, 27-45.

Lezak, M. Neuropsychological assessment. New York: Oxford University Press, 1976.

Malmo, R., & Shagass, C. Physiologic studies of reaction to stress in anxiety and early schizophrenia. Psychosomatic Medicine, 1949, 11, 9-24.

Malmo, R., Shagass, C., Davis, J., & Eng, M. Electromyographic studies of muscular tension in psychiatric patients under stress. Journal of Clinical and Experimental Psychopathology, 1951, 12(1), 45-66.

Malmo, R., Shagass, C., & Smith, A. Responsiveness in chronic schizophrenia. Journal of Personality, 1951, 19, 359-375.

Mednick, S. A learning theory approach to research in schizophrenia. Psychological Bulletin, 1958, 55(5), 316-327.

Moran, L., & Kimble, J., Jr. Repetitive psychometric measures: Equating alternate forms. Psychological Reports, 1964, 14, 335-338.

Moran, L., & Mefferd, R., Jr. Repetitive psychometric measures. Psychological Reports, 1959, 5, 269-275.

Olton, D., & Noonberg, A. Biofeedback: Clinical applications in behavioral medicine. Englewood Cliffs, N.J.: Prentice-Hall, 1980.

Raskin, M., Johnson, G., & Rondestvedt, J. Chronic anxiety treated by feedback-induced muscle relaxation. Archives of General Psychiatry, 1973, 28, 263-267.

Reinking, R., & Kohl, M. Effects of various forms of relaxation training on physiological and self-report measures of relaxation. Journal of Consulting and Clinical Psychology, 1975, 43(5), 595-600.

Schwartz, G., & Beatty, J. Biofeedback: Theory and research. New York: Academic Press, 1977.

Spohn, H., Lacoursiere, R., Thompson, K., & Coyne, L. Phenothiazine effects on psychological and psychophysiological dysfunction in chronic schizophrenics. Archives of General Psychiatry, 1977, 34, 633-644.

Taylor, J. A personality scale of manifest anxiety. The Journal of Abnormal and Social Psychology, 1953, 48(2), 285-290.

Taylor, M., & Abrams, R. A critique of the St. Louis psychiatric research criteria for schizophrenia. American Journal of Psychiatry, 1975, 132(2), 1276-1280.

Tecce, J., & Cole, J. Psychophysiologic responses of schizophrenics to drugs. Psychopharmacologia, 1972, 24, 159-200.

Tecce, J., & Cole, J. The distraction-arousal hypothesis, CNV, and schizophrenia. In D. Mostofsky (Ed.), Behavior control and modification of physiological activity. Englewood Cliffs, N.J.: Prentice-Hall, 1976.

Thoresen, C., & Anton, J. Intensive experimental research in counseling. Journal of Counseling Psychology, 1974, 21(6), 553-559.

Townsend, R., House, H., & Addario, D. A comparison of biofeedback-mediated relaxation and group therapy in the treatment of chronic anxiety. American Journal of Psychiatry, 1975, 132, 598-601.

Tuttle, W., & Schottelius, B. Textbook of physiology. St. Louis: C. V. Mosby Co., 1969.

Whatmore, G. Some neurophysiologic differences between schizophrenia and depression. American Journal of Psychiatry, 1966, 123, 712-716.

Whatmore, G., & Ellis, R. Some motor aspects of schizophrenia: An EMG study. American Journal of Psychiatry, 1958, 114, 882-889.

Whatmore, G., & Kohli, D. The physiopathology and treatment of functional disorders. New York: Grune & Stratton, Inc., 1974.

White, O. R. A manual for the calculation and use of the median slope--A technique of progress estimation and prediction in the single case. Working Paper #16. Eugene, Oregon: Resource Center for Handicapped Children, 1972.

White, O. R. The "split middle"--A "quickie" method of trend estimation. Experimental Education Unit, Child Development and Mental Retardation Center, University of Washington, 1974.