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THE EFFECTS OF EEG BIOFEEDBACK TRAINING ON THE BEHAVIOR OF HYPERACTIVE CHILDREN

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THE EFFECTS OF EEG BIOFEEDBACK TRAINING ON THE BEHAVIOR OF HYPERACTIVE CHILDREN

by

Jeffrey Lynn Parziale

A Dissertation Submitted to the Faculty of the

DEPARTMENT OF COUNSELING AND GUIDANCE

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY

In the Graduate College

THE UNIVERSITY OF ARIZONA

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THE UNIVERSITY OF ARIZONA
GRADUATE COLLEGE

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entitled The Effects of EEG Biofeedback Training on the Behavior of Hyperactive Children

and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosphy.

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I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

Philip J Lauver
Dissertation Director

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Date

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ABSTRACT

Satterfield (1974) and others, i.e. Lubar and Shouse (1978) have suggested a relationship between arousal level and hyperactivity such that low cortical arousal was related to lowered inhibitory control on the part of the hyperactive child. The present study was designed to test this theory using EEG activity as a measure of arousal and certain psychological tests and rating scales as dependent measures. Also, to investigate the utility of the procedure in a small clinic setting.

The sample consisted of 16 hyperactive males between the ages of 6-12. These children were placed into either the placebo or experimental group.

A controlled group outcome design was utilized in this study. Data consisted of four biofeedback measures and four test measures. Following a pre-test battery and baseline session, children received seven weeks of training. Finally, a post-test battery and baseline session concluded the study.

The results were summarized and placed on graphs and tables. Biofeedback data displayed measurable change in the predicted direction, as did rating scale

data. Three other test measures displayed positive, but non-significant changes.

Implications for the study were noted. Recommendations for practitioners and future research centered on the concepts of generalization, parental involvement and practice.

CHAPTER 1

INTRODUCTION TO HYPERACTIVITY

Hyperactivity in children has become a popular issue in the last twenty years (Safer & Allen, 1976). Yet despite considerable research and numerous books and articles, many questions remain unanswered and the concept of hyperactivity continues to defy simple categorization (Ross & Ross, 1976; Whalen & Henker, 1980).

While numerous definitions, descriptions and lists of behavior exist, most identify the following six symptoms as fairly characteristic of hyperactivity; overactivity, short attention span, low frustration tolerance, impulsivity, distractability, and often, aggressive behavior (Safer & Allen, 1976).

Hyperactivity is a major behavioral problem in school systems. Most authors suggest that 4 - 8% of elementary school age males are hyperactive. (Miller, 1970; Burks, 1960; Werner, Bierman, French, Simonian, Connor, Smith, and Campbell, 1968).

Etiological investigations concerning hyperactivity have generated numerous proposals such as minimal brain damage and other various birth-related factors (Burks, 1960;

Laufer, Denhoff, and Solomons, 1975), chemical imbalance (Feingold, 1975), and environmental causation (Battle & Lacey, 1976; Werry, 1972).

Safer & Allen (1976) suggest that 95% of hyperactive children display no evidence of an injured area of the brain. Werry (1972) reviewed the current research literature from the standpoint of the role of brain damage. He concluded that in the majority of cases it was impossible to determine which of several potential causative factors (including brain damage) was primarily responsible for a child's hyperactivity.

While the relationship of brain damage and hyperactivity is unclear, it is apparent that many hyperactive children manifest a number of signs that would indicate neurological dysfunction or impairment. A variety of equivocal (soft) neurological signs and abnormal EEG tracings have been found in these children (Safer & Allen, 1976; Satterfield, 1975; Shetty, 1971). (Neurological and EEG findings will be discussed at greater length later in this chapter.

The predominant treatment for hyperkinesis is drugs. Bradley (1937) was the first to prescribe amphetamine drugs in the treatment of hyperkinesis. Dexadrine and Ritalin are still the most frequently prescribed drugs. Recently, Tofranil (imipramine) and Cylert have also been used with some success. These stimulant and anti-depressant drugs are known to increase norepinephrine. This fact, and other data, have caused several authors (Silver, 1971; Wender, 1971) to postulate deficiencies or dysfunctions in the monoamines (norepinephrine, dopamine, serotonin) as causal factors in the syndrome.

Stimulant drug therapy has been somewhat successful in reducing hyperactivity and increasing attention span, resulting in improvement on cognitive, perceptual and motor tasks (Conners, 1971). Drugs appear to be less effective in the decrease of irritability, explosiveness and other aspects of emotionality (Denhoff, Davids, & Hawkins, 1971; Weiss, Werry, Minde, Douglas, and Sykes, 1968).

Behavior modification is the most frequently used non-drug treatment for hyperkinesis. Other treatment forms include group counseling, dietary management, and classroom intervention (Ross & Ross, 1976).

Recently, biofeedback has been investigated for its potential in treating hyperactivity, Views of the hyperactive child as excessively active or anxious strengthened the notion that behavioral control through biofeedback could reduce hyperactivity by reducing overall tension levels (Braud, 1978). This exploration was also encouraged by those (Brown, 1974, 1977; Green, 1978) who were touting biofeedback as a virtual "cureall". The ensuing sections contain a brief analysis of the mechanics of biofeedback and a review of specific applications related to hyperactivity.

Overview of Biofeedback

Biofeedback is a methodology for accquiring learned control over internal bodily processes. Essentially, biofeedback is operant conditioning of autonomic, electro-physiological and neuromuscular responses. The basic procedure typically involves making some external stimulus contingent upon some clearly delineated change of internal responses, resulting in control of the targeted response. This procedure may occur with or without awareness on the part of the organism as to exactly what manipulations must be performed to achieve such control. Such feedback-mediated control of physiological activity has been demonstrated in a variety of species, including rats, cats, monkeys and humans (Brown, 1977; Birk, 1973). Target responses are usually of the following types: 1) electromyographic activity (EMG) representing activity of specific muscles; 2) autonomic activity that can be detected in a variety or organ systems; or 3) electrophysiological activity, such as brain waves or evoked potential. The external stimulus is typically a light or tone that provides the subject with information about the internal response. It tells the subject that the response has occurred and may even provide information as to the parameters of the response. This external stimulus can also act as a primary or secondary reinforcer in that its contingent presentation can change the probability that the internal response will occur (Hartje, 1980; Gaarder & Montgomery, 1977).

Biofeedback Application for Hyperactivity

Reserach over the past twenty years has suggested the EMG is an effective means of producing relaxation (Basmajian, 1963; Budzynski & Stoyva, 1969; Green, Walters, Green & Murphy, 1969; Brown, 1977). Research investigating the potential usefulness of EMG biofeedback with hyperactive children began in the early 1970's, and was epitomized by Mulholland's 1973 Psychology Today article urging professionals to try biofeedback in the classroom (Prout, 1977). Generally, researchers were attempting to lower muscle tension of hyperactive children based on the rationale that this would lead to concomitant reductions in activity level and therefore a decrease in hyperactivity (Braud, 1978).

In the first study, Braud, Lupin and Braud (1975) used EMG biofeedback with a 6½ year old boy who was extremely hyperactive and who was having scholastic and behavioral difficulties. The child was given 11 biofeedback training sessions with a twelfth follow-up session seven months later. Braud, et al. reported disappearance of numerous symptoms by the fifth session, a decrease in frustration level and an increase in the child's confidence level. The boy also showed significant pre- to post- test battery improvement. Finally, in the twelfth session seven months later the child still demonstrated control over his tension and activity levels on command. The child's behavior was erratic in everyday living situations, possibly because of failure of the relaxation skills to fully generalize (Braud, 1980).

Connoly, Besserman and Kirschvink (1974) first demonstrated the use of EMG biofeedback with a group of hyperactive chidren averaging 9 years, 8 months of age received eight sessions of EMG training to reduce levels of activity and improve school performance. The children significantly reduced average EMG levels and showed significant improvement on the Spraque Teacher and Parent Rating Scale and WISC-R subtests. The use of Jacobson-like progressive relaxation tapes in the school environment to supplement the EMG training was an important procedural aspect of this study. Another significant aspect of this training procedure was generalization training of the relaxation skills. This was an attempt to aid the children in using their relaxation skills in the school and home environment. Connoly et al. also reported that two of the six children were removed entirely from Ritalin and placed into biofeedback training at the end of the study. The authors cautioned against over-generalization from their findings because of the small sample and uncontrolled nature of the study.

Haight, Irvine, and Jampolsky (1976) administered EMG training using a no-treatment control group. The study consisted of eight hyperactive males between the ages of 11 and 15 years having I.Q.'s ranging from 62 to 97. The boys were assigned to two groups of four with all subjects being given one 45-minute relaxation sessions, a battery of psychometric tests, and two days of 30-minute baseline monitoring sessions of forehead EMG. This was followed by a period of four weeks during which the control group attended normal classes and the experimental group received bi-weekly EMG training sessions. Subsequent to training, all eight children were retested and given two EMG monitoring sessions to measure changes in muscle tension.

Results showed a decrease in EMG levels for the experimentals, although neither this decrease nor relative EMG levels were significant statistically. Haight et al. concluded that EMG training did not reduce forehead muscle tension levels in these children, and that while tests and rating scales showed improvement, this may have been due to placebo or experimenter effects and not training.

Braud (1978) compared the pre-treatment measures of 15 hyperactive children and 15 normals and found the hyperactive children had significantly higher EMG levels, more behavioral problems, and lower test scores. Using both an EMG and a progressive relaxation group, Braud found significant pre- to post- improvements on all rating scales and tests. Braud concluded that both EMG biofeedback and relaxation training and significant effects on muscle tension levels, cognitive functioning, and hyperactive behaviors, particularly in the area of emotionality-aggression.

Jeffrey (1978) conducted a study involving EMG biofeedback training and a no-treatment control group. The author failed to describe important procedural details in this preliminary report but mentioned some general impressions about EMG training with these children. Jeffrey administered ten 30-minute training sessions using both visual and auditory feedback to the experimental group. However, both the experimental and control groups showed significant EMG reductions when tested post-training as compared to pre-test levels. Absolute EMG levels are not reported for this study, so clear interpretations of these findings are not possible.

Baldwin, Benjamins, Meyers, and Grant (1978) conducted a study that directly contradicts most published findings of EMG biofeedback training for childhood hyperkinesis. Four hyperactive boys, average or above in intelligence, were recruited for a single subject reversal design involving EMG training. The study consisted of a two-week baseline period, three weeks of 30-minute bi-weekly frontalis EMG training sessions, one to two weeks of reversal with false feedback, and two more weeks of true EMG feedback. After each session, the boys had 10 minutes of unsupervised study time and 20 minutes of math skill tutoring during which their behavior was video-taped through a one-way mirror. The Conners' Parent-Teacher Questionnaire was administered once weekly to both the parents and tutor. EMG biofeedback did result in significantly lower forehead tension levels during training. In the reversal training phase, three of the four EMG records returned to high baseline levels. The video-taped behavioral observations showed that hyperactivity in the laboratory increased from the baseline phase until the last EMG biofeedback sessions. Most of the activity increases occurred during a 10-minute unsupervised study period immediately following the 30-minute biofeedback sessions. The parent and teacher ratings also failed to show changes from one experimental phase to the next. The increase in hyperactive behavior observed during the unsupervised study period did not generalize to the home or tutoring environments. The author concluded from these findings that EMG biofeedback with hyperkinetic children is not an effective treatment procedure for hyperactivity. Some caution may be given to these results due to small sample size, short training period, and lack of emphasis on generalization during the study period. Most probably these children were more excited by the entire procedure than relaxed. This possibility is supported by the dramatic increase in hyperkinetic behaviors immediately after the children were unhooked from the biofeedback equipment.

In reviewing the EMG literature, Bhatara, Arnold, Lorance, and Gupta (1979) suggested that research findings were highly equivocal and often flawed by an abundance of methodological problems. Braud (1978) and Jeffrey (1978) failed to demonstrate a clear-cut advantage for using EMG biofeedback over a more simplistic relaxation paradigm, such as progressive relaxation. Bhatara et al. suggest further controlled studies using well-defined samples are needed.

In a related article, Gariulo and Kuna (1979) suggest caution in the use of EMG bioffedback with hyperactive children. They cite the work of Satterfield and Dawson (1971) and Shetty (1971) who suggested that hyperactive children may possess low CNS arousal and not over-arousal. Given this concept of under-arousal, Gariulo and Kuna reason the EMG relaxation may have a negative effect on hyperactive children since it may serve to weaken the inhibitory mechanism the child has. They go on to suggest the possible use of biofeedback to increase CNS arousal levels.

Satterfield (1975), in summarizing the principal findings of four reported studies concluded:

1. There is an identifiable subgroup of "good responder" hyperactive children who are found to have low CNS arousal.

2. The pre-treatment CNS arousal level is negatively correlated with the severity of the child's behavioral disturbance; in other words, the lower the child's CNS arousal level, the greater his problem with motor control, attention span, and impulsivity.

3. Stimulant medication in these low arousal hyperactive children functions like a stimulant. It increases CNS arousal level.

4. Those hyperactive children with the greatest increase in CNS arousal level resulting from stimulant medication obtained the best clinical response measured by teacher rating scales.

He hypothesizes that low CNS arousal is associated with low CNS inhibitory control. This lack of inhibitory control over sensory functions may result in easy distractability, with low arousal children responding to irrelevant stimuli as readily as relevant stimuli. He further suggests that increased arousal and the associated increased inhibitory control over sensory function should enable the child to inhibit non-meaningful stimuli in order to selectively attend in a learning situation. The findings of Shetty (1971) and Laufer, Denhoff, and Solomons (1957) further corrobrate this hypothesis, both having used stimulant drugs to increase arousal levels. In Shetty's study, an increased amount of alpha rhythms followed dextroamphetamine administration.

Satterfield concludes that the essence of his Theory is one of low arousal and insufficient inhibitory control over motor outflow and sensory input. This lack of inner control results in flooding of the brain by numerous sensory signals, any of which might trigger a motor response. In such a state, the child's behavior is controlled by the stimuli, relevant or irrelevant, over which he has little or no control. He is therefore not free to choose to learn or not to learn, but is affected by stimuli that most normal children would ignore or inhibit. Stimulant medication then, does not reduce these disturbing impulses, rather, it restores the CNS to a more normal state in which the child can be in control of sensory input and motor responses.

Lubar (1980) citing the work of Satterfield and the pool of EMG research, concludes the EMG biofeedback alone is not effective in remediating hyperactivity. He suggests the use of Sensori-Motor Rhythm (SMR) biofeedback, based on the work of Barry Sterman (1972, 1974). Sterman first noted the occurence of a 12 - 16 Hz EEG rhythm in cats when they were resting. Later, (1974) Sterman applied SMR training to epileptics. He was able to show an attenuation of siezure activity in SMR-trained epileptics.

Lubar and Bahler (1976) first applies SMR training in a 14 year old epileptic who was also hyperkinetic. As predicted, the conditioning of SMR activity resulted in a decrease of siezure activity but also a reduction in excessive motor behavior.

In the first study of SMR training of a non-epileptic hyperkinetic child, Lubar and Shouse (1976) expanded the experimental phase, including SMR training. Phase one was a baseline condition with no drug present for six EEG monitoring sessions plus 15 daily behavioral rating sessions during which the child's classroom behavior was coded. The EEG was monitored for (a) 4-7 Hz signal above 5 microvolts occurring in the absence of 12-14 Hz events, (b) 6 SMR events occurring within a .5 second interval, and (c) EMG criteria; a predetermined number of EMG signals between 30 Hz and 300 Hz. Phase two was the re-administration of Ritalin for six EEG monitoring sessions and 15 behavioral rating sessions. The inclusion of Ritalin into this experiment design was done for the purpose of demonstrating beneficial gains for the child above those already produced by the stimulant medication.

Experimental phase three began two months later when the child was given Ritalin plus 78 sessions of SMR biofeedback training. The correct light, tone, or money was provided when the child produced 12-14 Hz activity in the absence of 4-7 Hz activity. EMG levels were monitored continuously from the chin and 45 behavioral rating sessions were obtained during this period. Experimental phase four included SMR reversal training during which the child was reinforced for augmenting 4-7 Hz activity and suppressing 12-14 Hz SMR activity. Fifteen behavioral rating sessions were obtained during this period. Phase five was a return to the feedback contingencies of phase three, with the child reinforced for SMR augmentation and 4-7 Hz suppression. Phase five included 28 training sessions and 15 behavioral rating sessions.

The results of Lubar and Shouse's study (a) confirmed that SMR levels increased during augmentation training and decreased during suppression training; (b) demonstrated that SMR levels are negatively correlated with motor inhibition, i.e, lower EMG levels and (c) that hyperkinetic behaviors observed in the classroom significantly followed SMR training contingencies, i.e., that SMR augmentation and 4-7 Hz suppressions were related to behavioral improvements in the classroom and these improvements disappeared during reversal training and reappeared when contingencies were reestablished.

Shouse and Lubar have replicated this experimental design with approximately eight more children and have extended their procedures to include the monitoring of more physiological variables such as GSR and auditory evoked potentials (1976, 1977). Shouse and Lubar report similar positive findings for these case studies.

Statement of the Problem

Problems with the work of Sterman and Lubar seem to center around two issues. First, the inordinate number of sessions (sometimes as many as 100) make this procedure unwieldy in many clinical settings. Secondly, as Gatchel and Price (1979) suggest, it is difficult to determine whether behavioral changes are due to increase in a particular frequency or to overall EEG normalization. Satterfield and Dawson (1971) point to a marked EEG slowing on the part of hyperactive children. This point, coupled with the growing belief that much hyperactive behavior is due to central nervous system underarousal suggests that encouraging the production of higher level EEG activity which is normally found when an organism is attending to a task (Lubar, 1980), coupled with decreased motor activity (as measured by low EMG output) might produce the desirous effects of increased inhibitory control over sensory functioning. This increased control should yield a decrease in inappropriate motor activity and an increase in the organism's ability to discriminate relevent and irrelevent stimuli (Lubar, 1980; Satterfield, 1975).

The current study, then, will attempt to examine the hypothesis that increased EEG arousal, through encouragement of 12-14 Hz activity and suppression of 4-7

Hz will lead to increased motor inhibition as measured by EMG and increased attentional process as measured by the test battery. It will also attempt to assess the feasability of a program, based in a small clinic, which emphasizes short-term intervention.

Hypothesis

Hypothesis 1

Hyperactive children in the experimental group will demonstrate a pre- to post- training decrease in slow EEG (theta) activity.

Hypothesis 2

Hyperactive children in the experimental group will demonstrate a pre- to post- training increase in higher level (beta) EEG activity.

Hypothesis 3

Hyperactive children in the experimental group will demonstrate a pre- to post- training decrease in EMG activity.

Hypothesis 4

Hyperactive children in the experimental group will demonstrate improved home behavior as by behavioral rating scales.

Hypothesis 5

Hyperactive children in the experimental group will show improvement in performance as measured by a group of tests and subtests (Coding, Digit Span, Bender-Gestalt tests).

CHAPTER 2

METHOD

Subjects

Sixteen hyperactive children participated in the study. Selection was based on criteria developed by Lubar & Shouse (1977).

1) Male
2) Between 6-12 years of age
3) No history of autism or retardation
4) Consensus of parents, teacher, physicians or other professionals on two symptoms.
   a) undirected, ceaseless motor activity
   b) abbreviated attention span

Children participating in the study were referred by local pediatricians and all but two had a history of medication usage for hyperactivity.

The children ranged in age from 8-11, with a mean age of 10.4.

Apparatus

Three major pieces of equipment were used. The first was an ASI 120a electroencephalograph analyzer recommended by Lubar (1980). This instrument monitored EEG activity for beta (10-14 Hz grequency; 30-60 microvolts amplitude) and theta (4-10 Hz frequency).

EMG activity was monitored by an ASI 1500c feedback myograph, calibrated for an initial threshold of 15 microvolts. This threshold determined the level of EMG activity necessary to activiate the EMG input of the display panel. This initial setting was then modulated downward in 1 microvolt increments based on the criteria of an 50% reading in any given 30-second data period. This modulation reflected an increased level of difficulty for activation of the display panel.

These two units were coupled with an ASI 5100 digital integrater for data collection. Feedback was provided via a four light display panel. Three red and one green light signaled criteria for four measures, EMG, beta, theta, and composite. Data consisted of measures reflecting percentage of on time for an individual light during the data period.

A relaxation tape developed by Mimi Lupin (1980) was used with the experimental group during the first training session. This tape emphasized muscle relaxation and provided initial training in focusing on internal processes. The control group listened to a tape of comparable length on the value of courage.

Test Battery

The test battery included the Bender-Gestalt, the Digit Span and Coding subtests from the WISC-R, and the Connors' Behavior Rating Scale. The test instruments have been evaluated in depth elsewhere, (Safer & Allen, 1976; Ross & Ross, 1976; Braud 1974) and have been utilized in this study as measures of attention span, a key symptom in hyperactivity. The Connors' Rating Scale has been employed in numerouse studies investigating hyperactivity (Braud, 1974; Glow, 1981; Trites, Blouin, Ferguson, and Lynch, 1981; Safer & Allen, 1976).

Connors (1969, 1970) employed factor analysis to select items that were related to hyperactivity and other behavior problems. Through this process, he attempted to isolate clusters that discriminated between normal, neurotic, and hyperactive children. The scale used in this study was developed originally for drug studies and provides a fairly responsive indicator of hyperactive behavior.

Experimental Design

This study was a controlled group outcome study (Blanchard & Young, 1974). The experiment involved three phases (Fig. 1): a pre-training phase in which instrument levels were recorded and tests administered, a training phase, and a post-training phase in which instrument levels

GROUP	PRE-TRAINING	TRAINING SESSIONS		POST-TRAINING
		Session 1	Session 2-14	
HE	Test battery; EEG-EMG baselines	Taped relaxation training	Contingent biofeedback training	Re-administering of test battery; EEG-EMG baselines
HP	Test battery; EEG-EMG baselines	Taped Story	Non-contingent biofeedback exposure	Re-administering of test battery; EEG-EMG baselines

Figure 1. Experimental design, showing the three phases for the experimental and placebo groups.

were re-measured and tests re-administered. Sixteen hyperactive children were randomly assigned to either the treatment group (n=8) or the placebo group (n=8).

Procedures

Local pediatricians were contacted and asked to recommend children for this experiment. Interested families were invited to attend an orientation meeting during which the experimenter explained the nature of the experiment, the necessary commitments of time, the possible risks and benefits, and answered questions from children or parents. The experimenter then distributed copies of the Information Sheet (Appendix B) and Consent Forms (Appendix A). Separate forms for children and parents were utilized, each requiring a signature. Parents were given a Connors' Behavior Rating Scale (Appendix C) and a Subject Information form (Appendix D) to complete. The children were informed that tokens could be earned each session and used to select prizes that would be available at the end of the experiment.

The pre-training phase involved administering the test battery and recording EMG and EEG baselines. EEG monitoring was accomplished via standard occipital-temporal electrode placement. In this placement, the two active electrodes are placed, one above the left ear and one in the back of the head. The ground electrode is placed above the left eye. All three electrodes are held in place by a Velcro band. EMG monitoring was achieved via placement of electrodes over the forearm flexor. These three electrodes were held in place using double adhesive discs. Baseline sessions consisted of three 30-second data sets for each of the four biofeedback measures. During the pre-training baseline sessions, the children were briefly introduced to the equipment. Each piece of equipment was demonstrated and the corresponding electrodes were examined. The children were encouraged to touch the electrodes with the equipment both on and off to emphasize that it was not dangerous, nor could it hurt or shock them. If the child appeared apprehensive, the experimenter attached the electrodes to his own arm or forehead and briefly demonstrated what the machine would do.

Upon obtaining all baseline data, the children were randomly assigned to either the experimental or placebo group. During the first training session, the experimental children listened to a 15-minute progressive relaxation tape (Appendix E). Subsequent to the tape, the experimental children were monitored for EEG and EMG baselines. The placebo children listened to a comparable tape recording on the value of courage (Appendix F). After the tape, they also received EEG and EMG monitoring.

Experimental training sessions 2-14 involved the implementation of the contingent feedback paradigm. Experimental children were encouraged to produce 12-14 Hz EEG activity and to inhibit 4-7 Hz activity, and EMG activity above the 15 microvolt threshold. Feedback was provided via a light display panel. The panel contained four lights, three red and one green. The first red light signified theta and was activated whenever EEG activity was higher then the maximum frequency setting. The second red light represented beta, and was activated whenever the amplitude of EEG activity exceeded the minimum setting of 30 microvolts and stayed within the frequency band width. The third red light signified EMG readings fell below threshold. When all three red lights came on, the final green light came on.

The experimental children were informed of the function of each light. They were told that the first light would come on whenever they were not feeling drowsy and not daydreaming. The second light would come on whenever they were alert and concentrating; and the third light would come on whenever they were relaxed. Finally, the fourth light would come on only when all three other lights were on. They were also informed that periodic readings would be taken and that a token would be issued for each 30-second period during which the green light was activated at least 50% of the time.

During the training session, the experimental children were encouraged to concentrate or relax in order to activate the appropriate light. Referneces to the relaxation tape were made periodically to cue them in relaxation. Math problems were used to cue concentration. After each session, the children were praised for their cooperation and given earned tokens. Encouragement to practice relaxation and concentration at home and school was provided and parents were urged to cooperate or even participate in home practice.

In sessions 2 through 14, the placebo children were hooked up to the equipment and monitored. Reference to the light panel consisted of an explanation that it provided information to the experimenter. These children were informed that for cooperating and sitting quietly, they would receive 2 tokens per session. After each session, the children were praised for their cooperation and given 2 tokens.

At the conclusion of training, all the children were re-administered the test battery and re-measured for EEG and EMG baselines. The parents were asked to complete another Connors' Rating Scale. The parents and children then attended a short debriefing session, in which the children selected their prizes and the results of the child's performance were discussed.

Data Analyses

Eight measures were analyzed for pre- to post- and experimental to placebo group comparisons. These eight analyses included four biofeedback measures (EMG, beta, theta, composite); two WISC-R subtests (Coding and Digit Span); the Bender-Gestalt, and the Connors' Rating Scale. Eight separate analyses of variance were performed on the data.

Biofeedback data consisted of percentage socres measuring amount of time at criterion for a given recording period. WISC-R subtest data were reported as scaled scores. Connors' data consisted of a weighted sum that could vary from 39 to 156. Finally, Bender-Gestalt scores were based on an analysis of total errors.

Post hoc analysis was then performed to examine differneces in the group means. The Newman-Keuls procedure was utilized for this test (Winer, 1962).

CHAPTER 3

RESULTS

The findings of this study will be addressed in terms of the five major hypotheses. The first three hypotheses deal directly with biofeedback data, and will be discussed and graphically displayed as a whole. The fourth hypothesis concerns the Connors' Rating Scale. The last hypothesis involves the Bender-Gestalt, Coding, and Digit Span, these three measures will be displayed together graphically. Summary tables are given in Appendix G.

Biofeedback Data

Data for the four biofeedback measures are given in Table 1. These scores represent group means for both the experimental and placebo groups.

Hypothesis 1

Table 1 and Figure 2 display the group means and pre- to post- changes in theta activity. The experimental group mean decreased from 48.0 to 4.3 while the placebo group mean decreased from 55.7 to 38.5. The experimental children showed a significant decrease in theta activity

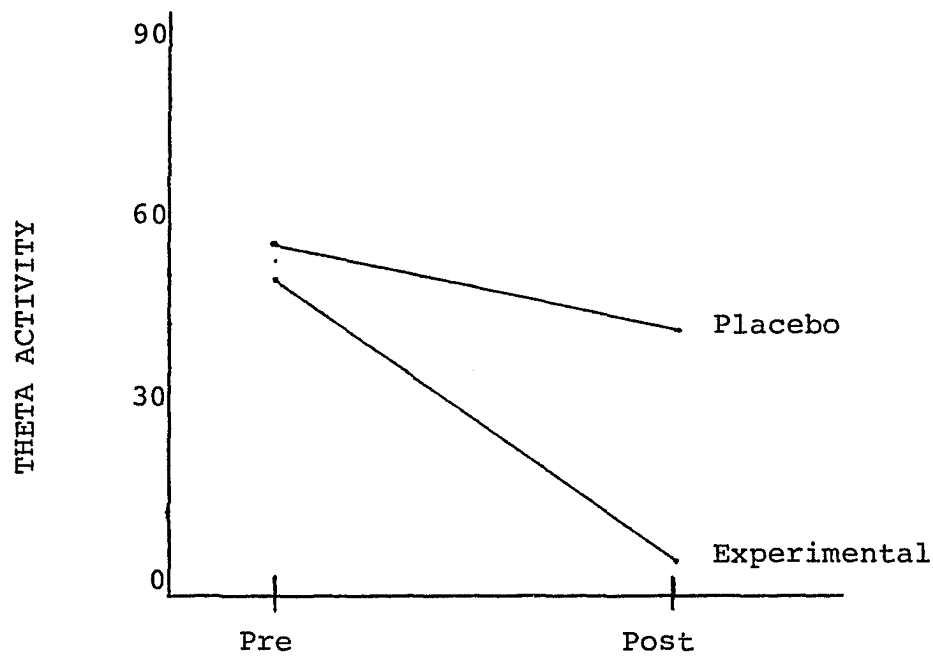

Figure 2. Proportion of time in theta state during Pre- and Post- testing.

over the training period when post hoc analysis of the group means was performed. ($F(1,14) = 5.21$, $p<.05$.

Table 1. Group mean comparison between the experimental and placebo group for the biofeedback measures.

	Experimental Group		Placebo Group	
	Pre	Post	Pre	Post
EMG	31.5	81.9	27.8	35.3
Beta	3.82	51.2	5.1	12.2
Theta	48.0	4.3	55.7	38.5
Composite	5.6	67.9	6.1	14.1

Hypothesis 2

Table 1 and Figure 3 gives the results for beta activity. The experimental group mean increased from 3.82 to 51.2 while the placebo group mean increased from 5.1 to 12.2. The increase in the experimental group was found to be statistically significant when post hoc analysis of the group mean was performed. ($F(1,14) = 12.33$, $p<.01$.

Hypothesis 3

Table 1 and Figure 4 give the group means and pre- to post- changes in EMG activity. The experimental group mean increased from 31.5 to 81.9 while the placebo group

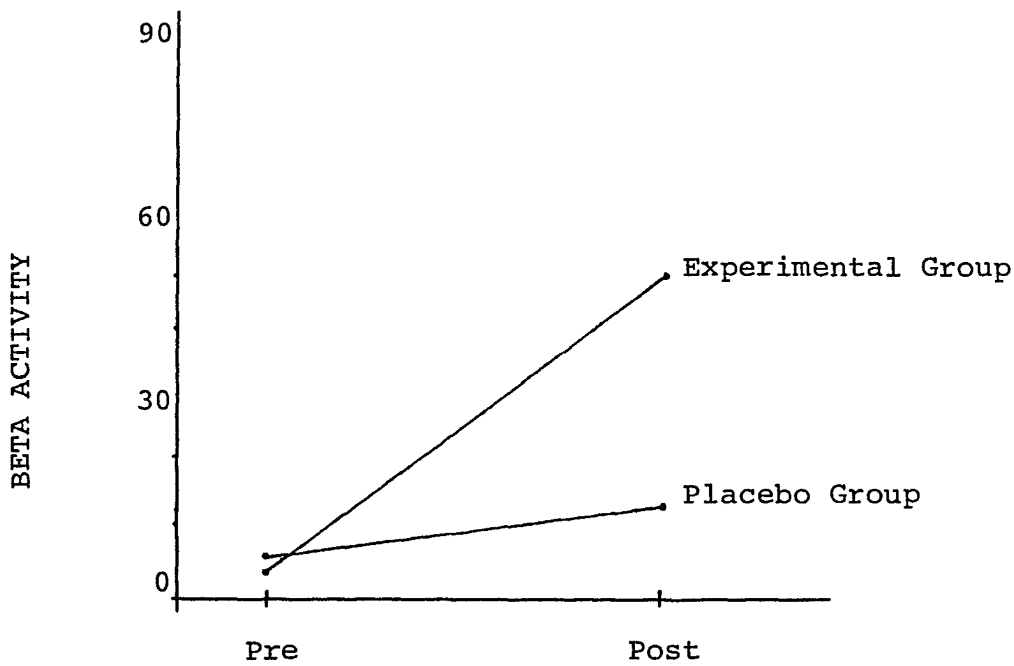

Figure 3. Proportion of time in beta state during pre- and post- testing.

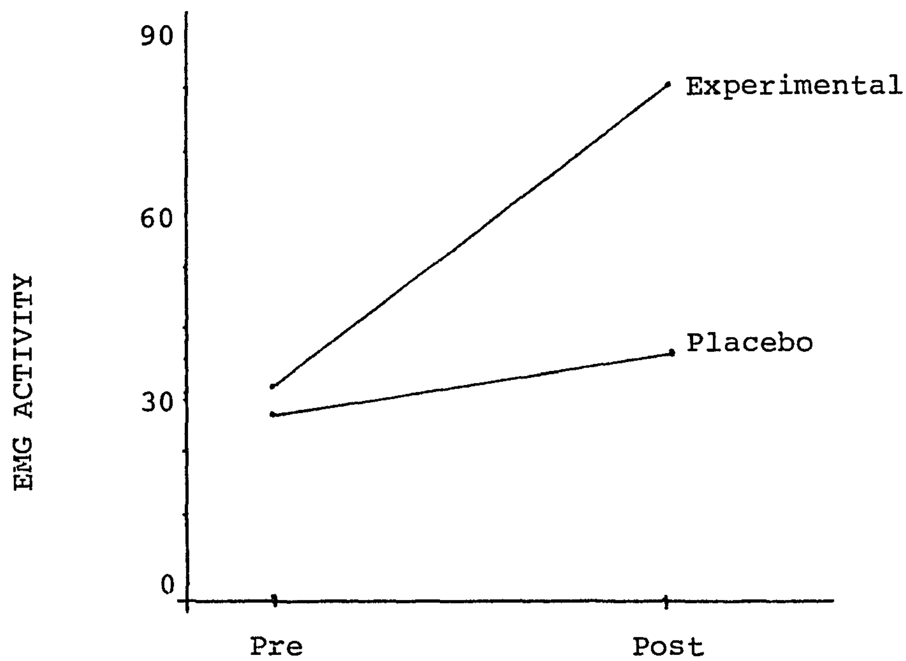

Figure 4. Proportion of time in EMG state during Pre- and Post- testing.

mean increased from 27.8 to 35.3. (F (1,14)= 23.8 $p<.01$). The increase in EMG activity in the experimental group was found to be significant when tested by post hoc analysis. The relaxation levels achieved by the experimental group after training were considerably higher than those of the placebo group.

The composite data presented in Table 1 and Figure 5 represented the target response for the experimental children. In terms of the light panel discussed in the last chapter, the composite light was activated only when the other three lights were on. Analysis of this data, therefore, should tend to amplify the relative strength of changes for the other three measures, and perhaps most graphically represent the pre- to post- testing changes in the experimental group.

The experimental group mean increased from 5.6 to 67.9 while the placebo group mean increased from 6.1 to 14.1 (F (1,14) = 43.69, $p<.01$). Post hoc analysis of group means demonstrated a significant pre-test to post-test increase for the experimental group.

In summary, the experimental children demonstrated the hypothesized changes in biofeedback levels during the training period. Significant increase (EMG, beta, composite) and/or decreases (theta) were found in the experimental group when examined pre- to post- test and significant post-test

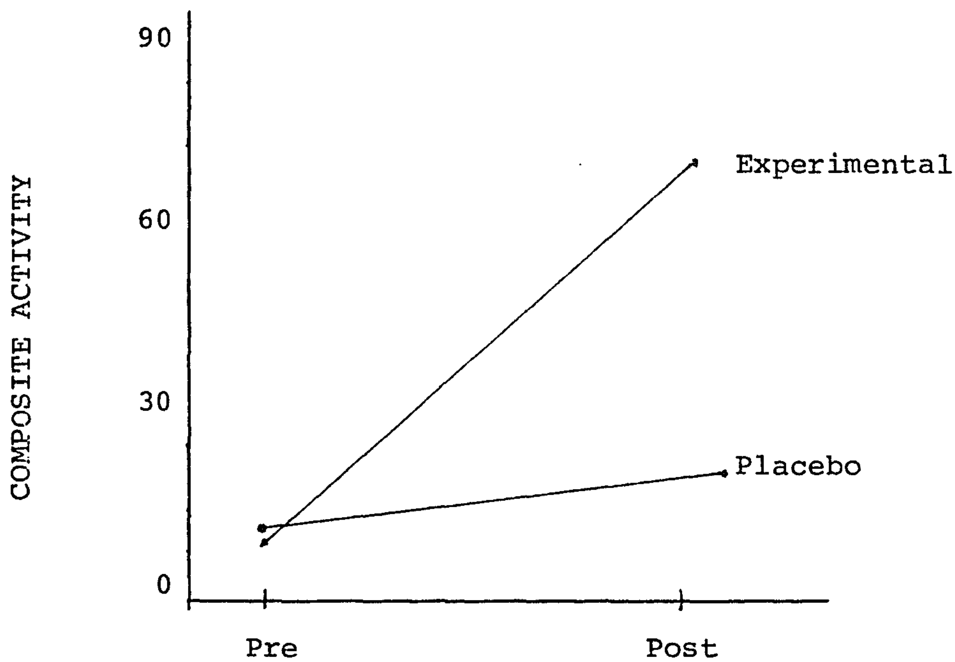

Figure 5. Proportion of time in composite state during pre- and post- testing.

differences between the experimental and placebo groups were found for all four measures.

Conners Rating Scale

Hypothesis 4

The Conners Rating Scale for hyperactivity was completed by parents - both at the beginning and at the end of the study. Total scores for this test can vary from 39 to 156 points. Data for this scale are given by Table 2 and Figure 6. The experimental group scores decreased from an average of 95 (Range 119-76) to 68 (Range 85-58) while the placebo group scores decreased from 92.2 (Range 114-83) to 87 (Range 104-68), ($F(1,14) = 13.8$ $p < .01$). Post hoc analysis of group means demonstrated a significant pre-test to post-test decrease for the experimental group.

Test Data

Hypothesis 5

The Coding subtest of the WISC-R was given as an assessment of short-term memory. Table 3 and Figure 7 shows that the experimental groups' scores increased while the placebo groups' scores remained the same. An analysis performed on the data demonstrated no significant difference between the two groups, ($F(1,14) = 2.0$, $p < .25$). The experimental group failed to show significant improvements in their Coding scores after the training period.

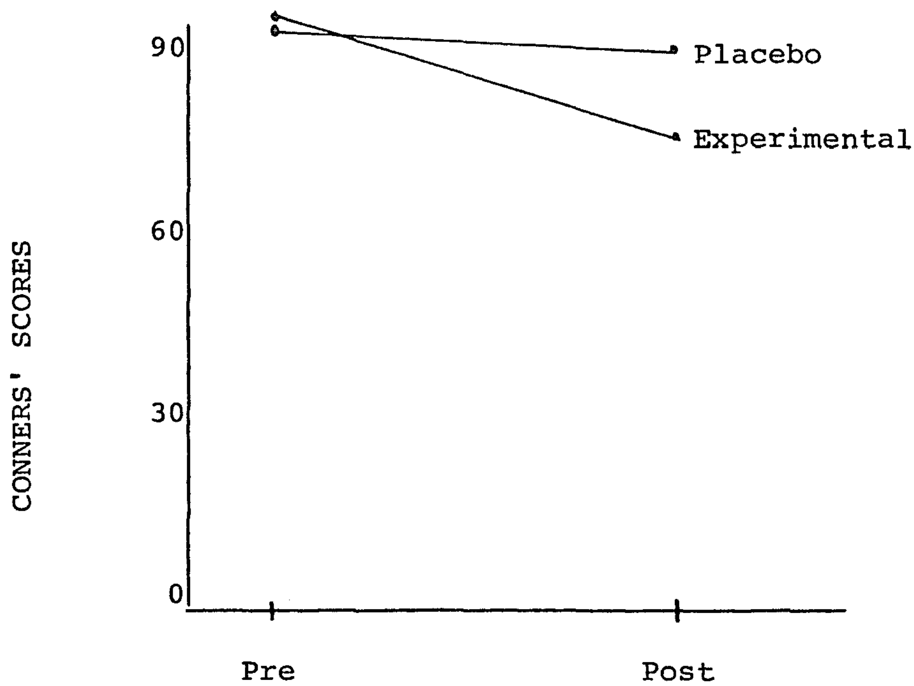

Figure 6. Conners' Rating Scale scores during pre-test and post-test.

Table 2. Total scores on the Conners Rating Scale for the experimental and placebo groups.

Child	Experimental Group		Placebo Group	
	Pre	Post	Pre	Post
1.	114	85	104	97
2.	101	75	87	102
3.	95	68	87	89
4.	103	66	82	68
5.	76	58	102	83
6.	119	67	79	81
7.	78	67	83	74
8.	77	60	114	104
Mean =	95	68	92	87

Table 3. Group mean comparison between the experimental and placebo group on the three test measures.

	Experimental Group		Placebo Group	
	Pre	Post	Pre	Post
Bender-Gestalt	9.0	7.6	9.4	8.4
Coding	4.6	7.1	4.1	4.1
Digit-Span	7.8	11.0	7.5	7.75

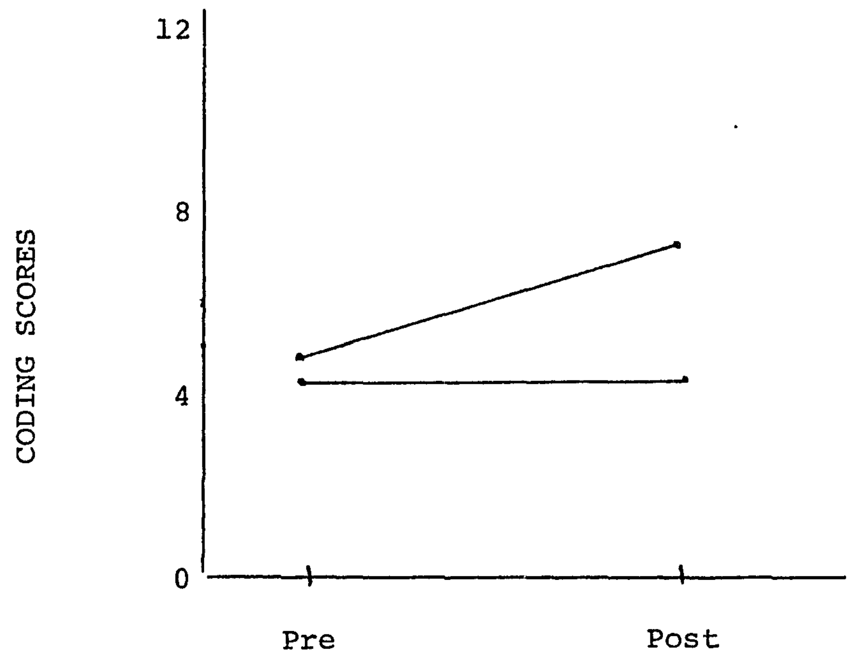

Figure 7. Coding scores during pre-test and post-test.

The Digit Span subtest of the WISC-R was administered to the children as a measure of short-term auditory memory. Table 3 and Figure 8 shows that the experimental group improved their scores from an average of 7.8 to 11.0 while the placebo group improved only slightly, from 7.5 to 7.75, (F 1,14) - 2.3, $p < .25$). The experimental group failed to demonstrate a significant increase in scores over the training period.

Table 3 and Figure 9 display the Bender-Gestalt data. The experimental group decreased after training from an average of 9 errors to 7.6 errors, while the placebo group decreased from an average of 9.4 errors to 8.4, ($F (1,14) = 1.28$, $p < .25$). Post hoc analysis of the data demonstrated no significant mean differences. The experimental group failed to improve significantly on the Bender-Gestalt over the training period.

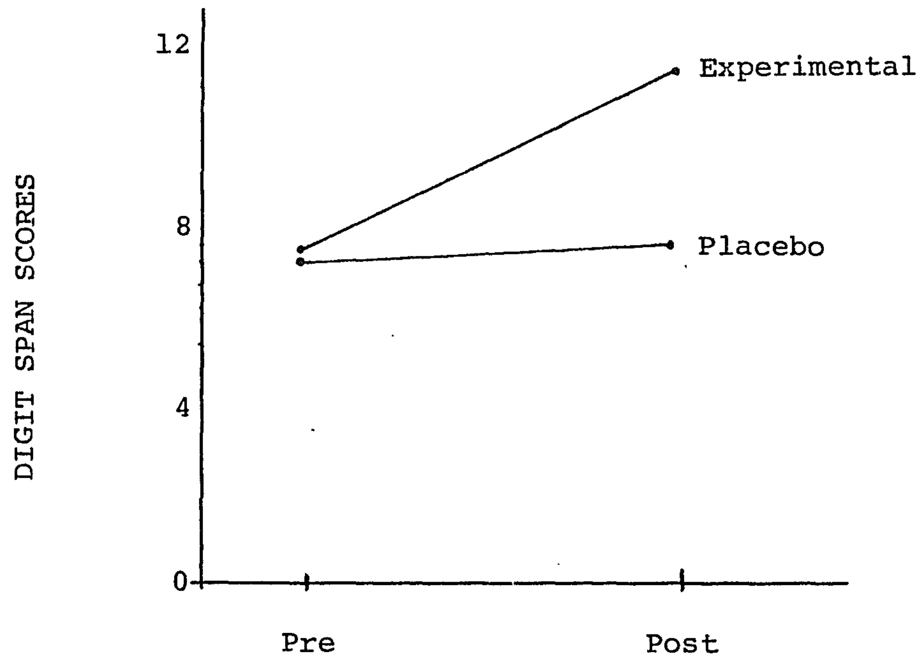

Figure 8. Digit Span scores during pre-test and post-test.

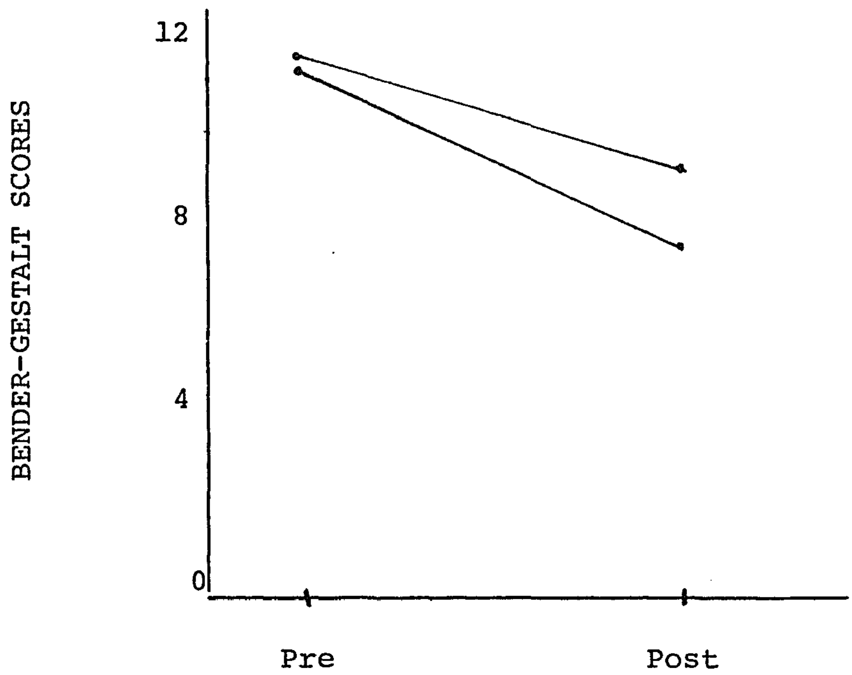

Figure 9. Bender-Gestalt scores during pre-test and post-test.

CHAPTER 4

DISCUSSION & RECOMMENDATIONS

The results seem to indicate that multi-channel biofeedback training is efficacious for hyperactive children. The four biofeedback measures changed in the desired direction, suggesting that the concept of increased arousal coupled with relaxation is indeed workable.

Examining the data in light of Satterfield (1975) and Shetty, (1971), the current study tends to add some support to the theory that increased cortical arousal leads to a decrease in hyperactive behavior and an increase in attention. The biofeedback data certainly provide positive evidence, particularly the composite scores. The task of maintaining a consistantly low level of muscle tension in conjunction with heightened beta activity, normally correlated with anxiety, supports the work of Sterman (1972) and Lubar and Shouse (1976). It suggests that hyperactive children can learn to selectively attend to stimuli and maintain a low level of EMG activity.

The data from the Conners Rating Scale also tends to support the theory, in that scores for the experimental children decreased significantly. These scores represented changes pre- to post-testing as observed by the children's parents. This supports the previous work of Braud (1978) and Haight et al. (1976). The other three measures (Bender-Gestalt, Coding and Digit Span) failed to demonstrate significant effects, suggesting that mere modification of brain wave patterns without corresponding attention to generalization is not sufficient for producing changes in specific tasks. Braud (1980) has suggested that such attention is required to produce desired effects in the subjects' natural environment. Haight et al. (1976) for example, utilized the feature of having subjects relax with eyes open as a way of approximating the classroom environment.

An important feature of the study was determining the workability of a short-term program. As mentioned earlier, previous studies (Lubar and Shouse, 1976; Lubar, 1980) utilized highly sophisticated instrumentation and high numbers of training and observation sessions. The results of the current study seem to indicate that a short-term program can produce significant effects in the desired direction. A somewhat longer training period, coupled with more emphasis on parental involvement and home practice should produce even more positive effects, particularly in the area of test measures.

In reference to the area of parental involvement, it is interesting that parents seem to be divided into two distinct groups: those greatly interested and participating, and those not at all interested and generally non-participating. There were several parents who regularly assisted their child at home in practicing the relaxation and concentration components of the training program. Braud (1980) strongly urges the use of logs and diaries to monitor the weekly activities of children to determine the effectiveness of training and extent of practice.

Another area not explored in this study, but vitally important, is that of school behavior. The reason this area was not included was the relative logistical problem of teachers filling out the rating scales and a focus aimed at the feasability of the procedure. It is clear, however, that any program purporting to produce positive behavior changes in hyperactive children must ultimately become involved in the classroom. Measures such as the Coding and Digit Span subtests do not necessarily directly relate to all areas of school performance.

Based on the current study, a few incidental observations were made. First, the children were eager to participate and generally had little difficulty learning to relax. This supports studies such as Connoly et al. (1974) and Haight et al. (1976). Second, in every case in which a parent made verbal comments concerning the child's behavior, invariably behavior at home improved before behavior in school. Five experimental group parents and three control group parents verbalized positive improvements in their child's at home behavior, while only two of these parents reported improved classroom behavior. Third, as the experimental children progressed through training, particularly toward the end, they became measurably excited about the prize they were going to earn. The experimenter felt that post-test performance on Coding and Digit Span may have been effected by the knowledge that they would recieve their prizes upon completion of testing. Fourth, rate of improvement seemed to be increased in proportion of the extent of parental participation. Fifth, the older children seemed to progress at a somewhat faster rate than the younger children. Sixth, three of the experimental children became ill for short periods during training, and upon their return, biofeedback score briefly returned to baseline levels. Recovery in these instances was rapid and complete.

Recommendations for Future Research and Practitioners

Future research in this area, as mentioned earlier, must focus on generalization. Another focus should be defining reliable parameters for EEG activity. Blanchard and Young (1974) have been somewhat critical of the relative absence of solid work in EEG biofeedback. A closer examination of the relationship between changes in EEG activity and behavior will undoubtedly produce more effective methods of defining and treating hyperactivity/

Applications of this approach for practitioners also lead to a focus on generalization to the home and classroom. Specifically, ways to create and encourage more involvement by teachers and parents need to be discovered. Braud (1978) has suggested the use of daily and weekly logs and also the home use of relaxation programs. Parents and teachers should recieve both training and information concerning biofeedback. This type of intimate knowledge can certainly promote positive movement from the clinic to other settings.

In retrospectthen, the two personal goals for this study were to develop a program based on the work of Satterfield(1975) and Lubar and Shouse(1976) that would be workable in a clinical setting and would have direct implications for the treatment of hyperactive children. Workable suggests relatively short-term; relatively inexpensive and easily adaptable to a more complete program. These goals have been achieved within reasonable limits.

APPENDIX A

INFORMED CONSENT FORM

THE EFFECTS OF EEG BIOFEEDBACK
TRAINING ON THE BEHAVIOR OF
HYPERACTIVE CHILDREN

Parent Consent Form

I understand that:

1. The purpose of this study is to test the effectiveness of EEG biofeedback training as a possible therapy for hyperactive children.

2. The testing and rating scales used will provide valuable information about childhood behavioral problems and will be used to help both my child and other children in the future.

3. To participate in the study, I will agree to fill out weekly rating forms for my child.

4. The study will last nine weeks. My child should be brought to Mountain View Counseling Center twice a week for a total of 30 minutes, plus two one hour sessions before and after the seven week period.

5. My child's name will be kept confidential but group results of the study will be released to others. All information gathered will also be held confindential.

6. My child may be placed into a group that does nct receive biofeedback training. My child will have the opportunity to obtain this training after the close of the study.

7. Possible risks of this study could include an increase in hyperactive symptoms or a failure of the child to improve.

8. Possible benefits include improvement in the child's behavior and school performance and a reduction in medication.

9. I am free to consult the supervisor of this study, Dr. Phil Lauver, at the University of Arizona, 626-3218 at any time.

10. I understand that in the unlikely event of physical injury resulting from the research procedures, the cost of medical care and hospitalization is not available and must be borne by me.

11. Any questions will be answered by the investigator, Mr. Jeff Parziale.

I have read the above 'Parent Consent'. The nature, demands, risks, and benefits of the project have been explained to me. I understand that I may ask questions and that I am free to withdraw from the project at any time without incurring ill will. I also understand that this consent form will be filed in an area designated by the Human Subject Committee with access restricted to the principal investigator or authorized representatives of the particular department. A copy of this consent form is available to me upon request.

Parent/Guardian____________________________________

Date______________________

CHILD'S CONSENT FORM

This study is going to help us find out more about children who are often overactive. You will be asked to take some short tests and then you will learn about biofeedback. Biofeedback is a big word, but it simply means that your body will tell us about itself through a small machine that looks like a stereo. To do this, we will put a few wires on your arm and head. There will be no pain or risk, since the wires are held in place by using paste or a small band. You cannot be shocked in any way.

After the wires are in place, you will be asked to follow a few simple directions. You will also be told how you can collect tokens with which you may purchase prizes at the end of the study.

If you don't understand something, just ask.

Subject's signature________________________________

Date____________________

APPENDIX B

SUBJECT INFORMATION SHEET

Subject Information Sheet

Hyperactive Children and Parents or Guardian

This study is designed to measure how an experimental form of therapy will effect children that are hyperactive. The study first determines each child's behavior and mental functions before treatment as well as measures his electromyogram (EMG) or muscle tension and his electroencephalogram (EEG) or brain wave.

The experimenters will give biofeedback training at Mt. View Counseling Center twice a week for seven weeks and then re-measure the child's behavior and mental functions, EMG, and EEG to look for possible changes.

The EMG biofeedback training will be done by attaching three flat electrodes to the child's forearm. The electrodes will be attached by adhesive tape and will not in any way puncture the skin. The electrodes are also passive; no electrical shock or current will be given to your child. In fact, it is the child that will "shock" the EMG machine; the small electrical currents produced by the muscles contracting will be detected by the machine; amplified and measured by the experimenter, and shown to the child in the form of light feedback.

Electroencephalograph (EEG) training will be done to examine the role of the brain wave activity in the hyperkinetic syndrome. Flat electrodes will be pasted to your child's scalp and can be removed effortlessly along with the paste by a solvent. Again, the electrodes are passive; no shock will be delivered to the child at any time. The EEG only measures the very faint electrical activity produced by the brain. Some of the standard procedures for measuring the EEG involve asking the child to breath deeply or rapidly or to concentrate and focus attention on something, i.e. a math problem. Any risk is astronomically small and is by far outweighed by the potential benefits of doing EEG training.

Biofeedback training has been shown to be effective in helping hyperactive children in a number of ways. The purpose of this study is to determine if hyperactive children can learn to make minor adjustments in their brain wave patterns, and if so, can these adjustments lead to positive changes. To measure change, we will be giving your child a short test battery prior and subsequent to training. This test battery includes a rating scale and information sheet you will fill out for your child. The rating scale simply asks you to indicate whether or not your child exhibits a number of behavioral problems. The tests include a set of drawings to ascertain motor-visual skills and two short-term memory instruments to ascertain attention span.

Of the published studies investigating the effects of EMG or EEG biofeedback on hyperkinetic children, most have found positive results. No published data has ever reported harmful effects from EMG or EEG biofeedback conditioning. However, parents and children should remember that this is an experimental treatment that cannot guarantee positive results.

APPENDIX C

CONNERS' BEHAVIORAL RATING SCALE

CONNERS' BEHAVIORAL RATING

Rate 1 - 4

Problem Area	Not At All	Just A Little	Quite A Bit	Very Much
1. Sits fiddling with small objects.	1	2	3	4
2. Hums and makes other odd nosies.	1	2	3	4
3. Falls apart under stress of examination.	1	2	3	4
4. Coordination poor.	1	2	3	4
5. Restless or overactive.	1	2	3	4
6. Excitable.	1	2	3	4
7. Doesn't pay attention - inattentive.	1	2	3	4
8. Difficulty in concentrating.	1	2	3	4
9. Oversensitive.	1	2	3	4
10. Overly serious or sad.	1	2	3	4
11. Daydreams.	1	2	3	4
12. Sullen or Sulky	1	2	3	4
13. Selfish	1	2	3	4
14. Disturbs other children.	1	2	3	4
15. Quarrlesome	1	2	3	4
16. "Tattles".	1	2	3	4
17. Acts "smart".	1	2	3	4

Problem Area	Not At All	Just A Little	Quite A Bit	Very Much
18. Destructive.	1	2	3	4
19. Steals.	1	2	3	4
20. Lies.	1	2	3	4
21. Temper Outbursts.	1	2	3	4
22. Isolate himself from other children.	1	2	3	4
23. Appears to be unaccepted by group.	1	2	3	4
24. Appears to be easily led.	1	2	3	4
25. No sense of fair play.	1	2	3	4
26. Appears to lack leadership.	1	2	3	4
27. Does not get along with opposite sex.	1	2	3	4
28. Does not get along with same sex.	1	2	3	4
29. Teases other children or interferes with their activities.	1	2	3	4
30. Submissive.	1	2	3	4
31. Defiant.	1	2	3	4
32. Impudent.	1	2	3	4
33. Shy.	1	2	3	4
34. Fearful.	1	2	3	4
35. Excessive demands for teacher's attention.	1	2	3	4

	Problem Area	Not At All	Just A Little	Quite A Bit	Very Much
36.	Stubborn.	1	2	3	4
37.	Overly anxious to please.	1	2	3	4
38.	Uncooperative.	1	2	3	4
39.	Attendence problem.	1	2	3	4

APPENDIX D

SUBJECT INFORMATION

SUBJECT INFORMATION FORM

CHILD'S NAME____

BIRTH DATE____

PARENT'S NAME_______________________________________

ADDRESS____

HOME PHONE_________________ WORK PHONE______________

BIRTH HISTORY PREMATURE________CAESAREAN___________

WEIGHT AT BIRTH_________LBS. _________OZ.

SHORT LABOR_________LONG LABOR_______BREECH__________

OXYGEN DEPRIVATION AT BIRTH__________FORCEP BIRTH___

DISEASE IN FIRST TRIMESTER__________________________

STRESS DURING PREGNANCY______________________________

LENGTH OF TIME ON DIET_______________________________

OTHER PROBLEMS DURING PREGNANCY OR AT BIRTH_________

____

<u>CHILDHOOD PROBLEMS</u>

CHILD HAD HIGH FEVER__________TEMPERATURE___________

CHILD HAD A FALL______________SIEZURES______________

EEG ABNORMALITY_______________ALLERGIES_____________

HYPOGLYCEMIA_______OTHER CHILDHOOD ILLNESS__________

MEDICATION TYPE_____________DOSAGE_________________

PAST TREATMENT HISTORY______________________________

APPENDIX E

TRANSCRIPT OF RELAXATION EXERCISE

RELAXATION EXERCISE

The following is a transcript of a pre-recorded relaxation tape used in training session one with the experimental group.

Copies of this tape are commercially available from Mimi Lupin, M.A. at the following address.

Self Management Tapes
1534 Oak Stream
Houston, Texas 77043

Today I am going to teach you how to relax. First, find a comfortable place to lie down or sit where you will not be disturbed. Be sure that your clothing is not too tight. If it is, you may wish to loosen your belt. Perhaps you may wish to take off your shoes. Now let's start our new adventure. Let's keep our eyes open for now. The first thing that we want to do is understand how it feels to be tense. Make your hands into fists and squeeze them hard, but not enough to hurt. Feel how tight they are. This is called tension, and we say that our arms feel tense. Now let go of the tension in your hands. Let's squeeze them again while I count to five - (slowly) 1 - 2 - 3 - 4 - 5, and now let go. Feel the tightness leave your arms. It feels good, doesn't it? This is how it feels to be relaxed. Now I am going to teach you to make your whole body feel relaxed just like your arm is now. Being relaxed is such a nice feeling. It is just like floating on a cloud in the sky. Wouldn't it be nice to feel this way all day long? You'll like being relaxed all day because you'll feel so much better, and you'll be able to understand whatever you want much more easily. Being relaxed will help you to make better grades in school. To begin to learn to relax, tighten just one part of your body at a time, leaving the rest of your body limp as a rag doll. When I tell you to tighten one part of your body, tighten it as much as possible, but leave every other part limp. When I tell you to tighten a part of your body, I will count from one to five and you will keep that part of your body tense until I reach five. Now let's begin. Keeping the rest of your body relaxed, wrinkle up your forehead as tightly as you can and hold it. 1 - 2 - 3 - 4 - 5. Relax and let go. Smooth out all the wrinkles in your forehead. Take a deep breath, hold it, (pause) - - and let go slowly. Now close your eyes as tightly as you can. Make them tighter and tighter. Keep all the rest of your body relaxed. Hold it and feel the tension. 1 - 2 - 3 - 4 - 5. Relax and let go. Take a deep breath, hold it, - - - -, and let go. Now close your mouth. Push your tongue hard against the roof of your mouth. Feel the tension in your chin. Hold it, 1 - 2 - 3 - 4 - 5. Relax and let go. Take a deep breath, hold it, - - - -, and let go. Now think about the muscles in your cheeks. Keep the rest of your body relaxed, but open your mouth as widely as you can. Feel the tension, hold it, 1 - 2 - 3 - 4 - 5. Relax and let go. Take a deep breath, hold it, - - - -, now let go. Lift your head just a little off your pillow or chair. Touch your chest with your chin. Feel the tension in your neck. Hold it, 1 - 2 - 3 - 4 - 5. Relax and let go. Now take a deep breath, hold it, - - - -, and let go. O. K., think about your forehead, your eyes, and your cheek muscles. Make sure they are still relaxed. Have you let them all go? That's good. Now lift your shoulders up as high as they will go. Hold it, 1 - 2 - 3 - 4 - 5. Relax and let go. Take a deep breath, hold it, - - - -, and let go. Keep your face, neck, and shoulders relaxed. Arch your back as though you had a pillow under it. Hold it, 1 - 2 - 3 - 4 - 5. Now let go. Take a deep breath, hold it - - - -, and let go. Next, stretch your arms out by your sides and press your hands down as hard as they will go. Take a deep breath, hold it, - - - -, and let it out slowly. Feel the tension in your shoulders. Hold it, 1 - 2 - 3 - 4 - 5. Relax and let go. Take a deep breath, hold it, - - - -, and let go. Relax your whole body. Now, while your face, chest, and shoulder muscles stay limp, make each hand into a fist and life your arms a little way off the bed or chair, hold it, 1 - 2 - 3 - 4 - 5. Relax and let go. Take a deep breath, hold it, - - - -, and let go slowly. Let your arms flop at your sides and relax them completely. Now, check your face, neck, and chest muscles. Make sure they are still relaxed. If not, let them go again. Soon you will be able to tell when you have tension in any part of your body, and you will learn that you can always relax and let go of that tension.

While the rest of your body stays limp, tighten up your stomach muscles. Try to make your stomach touch your backbone. Hold it, 1 - 2 - 3 - 4 - 5. Relax and let go. Take a deep breath, hold it, - - - -, and let go completely. Can you feel how wonderful it feels when all the tension leaves your body? Relaxing and letting go is easy, and it gets easier each time you do it. Next, you are going to tighten the muscles in your legs above your knees. Hold them tight, 1 - 2 - 3 - 4 - 5. Relax and let go. Take a deep breath, hold it, - - - -, and let go. Now, keep the rest of your body completely relaxed except your heels. Press them down as hard as you can, as though you were trying to make them go through the floor. Hold it, 1 - 2 - 3 - 4 - 5. Relax your legs and let your body go limp. Take a deep breath, hold it, - - - -, and then let it go. Now, pull your toes toward your face as hard as you can. Feel the tension in the backs of your legs. Hold it, 1 - 2 - 3 - 4 - 5. Relax and let go. Take a deep breath, hold it, - - - -, and let it go. Next, keep your entire body limp and push your toes away from your face. Pretend that you are trying to push the wall away with your toes. Hold it, 1 - 2 - 3 - 4 - 5. Relax and let go. Take a deep breath, hold it, - - - -, and let it go. Feel how much more relaxed your feet are.

Now, think about your face, your shoulders, your chest, your stomach, your arms and legs and make sure that each part is relaxed. You'll enjoy a good feeling each time you do these exercises. Each time you do them, you will learn to be more and more relaxed. Now, the next time you begin to feel upset, remember how you feel right now. When you want to relax, think about your forehead muscles, take a deep breath, and let go of all the tension in your forehead. Letting go helps you feel more peaceful and calm. - - - - Being peaceful and calm is the only way you'll want to feel. - - - - It helps you to like yourself and others better. It helps you to feel better and makes school work easier. So, if you do get upset or angry, remember to relax and let go. Now you may open your eyes. You may return to your play or studies, or if you are ready for bed, just let yourself drift into a peaceful sleep.

APPENDIX F

TRANSCRIPT OF TAPED STORY

THE VALUE OF COURAGE

The Story of Jackie Robinson
By Spencer Johnson, M.D.

Now, we are going to listen to a story. Do you like stories? Do you know who Jackie Robinson was? Well, when I turn on the tape recorder, just settle back and listen very carefully and you will learn who he was.

Once upon a time there lived a boy named Jackie Robinson. Looking at him you might think he was just an ordinary boy. He walked like his friends, he talked like his friends. He even dressed like his friends. But there was one thing about Jackie that made him very special. Can you guess what that was?

Jackie could run faster, jump higher, and throw a ball harder than anyone on his block. But, Jackie didn't have much time for play. His family was poor, and Jackie worked to help out. He delivered newspapers after school. On weekends, he sold hotdogs at a baseball stadium near his home in California. He worked hard and sold lots of hotdogs. Of course, he watched the games too, when he got the chance. One day as he watched, he noticed something he had seen before, but had not really thought about.

He looked at the pitcher and catcher. He looked at the batter and first baseman. He looked at the other players sitting in the dugout. "There aren't any black players," he thought to himself. When he got home that evening he asked his mother why blacks didn't play in the major leagues. "Aren't they good enough players," he asked. His mother answered that they played well enough, but only white people were allowed to play in the big leagues.

"That's not fair," Jackie shouted angrily. His mother answered, "No, I don't suppose it is, but you must control your temper. It's one thing to be brave. It's another to have courage". Jackie didn't understand what that meant, at least not yet anyway. But he knew how he felt. He felt angry! Jackie's temper always got the better of him when it came to unfairness. But his mother understood. "Someday it might change, but not by fighting. Now, finish your dinner because I have a surprise for you." What do you suppose the surprise was?

It was a baseball. Oh, it wasn't the kind of baseball like you buy in the store. It was a rag ball. Jackie's mother had made it out of woolen socks and bits of colored cloth and tied it with bits of string and lots of love. Jackie was so excited when he saw that rag ball, he let out a yell that rattled the windows. After that, he played with his rag ball every chance he got when he wasn't in school or working. But one day Jackie hit his ball too hard. It went up, up, and up into the air. What do you think happened? The rag ball split apart. Bits and pieces of colored cloth went everywhere. Jackie was heartbroken. "I've killed it," he wept. But then, he thought he heard his rag ball talking to him. The voice seemed to say, "Don't cry, Jackie. I'm alright." Now, Jackie knew his rag ball was in bits and pieces, and he knew that it really couldn't talk. When it seemed as though his rag ball was talking to him, it was really his own thoughts that he heard. But, as Jackie grew up, he imagined he took "Rags" with him everywhere. When he became discouraged or angry, it seemed that "Rags" would talk to him.

When Jackie grew up, he went to college at UCLA - the University of California at Los Angeles. He was the first person in the history of the college to win sports awards in basketball, football, baseball, and track all in the same year. But Jackie couldn't stay in school. His mother had worked hard for many years, and she could no longer afford to help him go to college. So, Jackie quit school and began getting paid to play professional football. But he didn't play long. Can you guess why? Jackie quit football to join the Army. Jackie didn't want to go to war, but the United States had declared war and Jackie wanted to help his country. After the war, Jackie needed a job again. It seemed he heard "Rags" say, "Why not try baseball." Since black people were not allowed to play in the major leagues, Jackie went to Kansas City and joined the Monarchs, an all-black baseball team. While he was playing for the Monarchs, sports writer started noticing what a good hitter and catcher he was, and started writing stories about him. Soon, an important man who lived far away was also talking about Jackie. Who do you think the man was, and what do you suppose he was saying?

He was Branch Rickey, president of the Brooklyn Dodgers, a famous big league baseball team. He asked Jackie to play on one of their try-out baseball teams in Montreal. Mr. Rickey was critized for hiring a black. It took courage, but he sent for Jackie anyway. As soon as he arrived Jackie asked Mr. Rickey, "Are you looking for a black man who is afraid to fight back?" Mr. Rickey answered, "No, I am looking for a ball player with enough courage not to fight back."

Jackie's team mates were not good to him at first. They didn't back him up when players on the other teams and people in the stands called him bad names. But, Jackie knew if he lost his temper and fought he would be thrown off the team, and it would be harder for other blacks to ever be allowed to play in the big leagues. So, he just kept playing the best he could and refused to fight or become angry.

One day one of his team mates, Pee Wee Reese came up and put his arm around Jackie's shoulder, and gave him encouragement. He knew how hard it was for Jackie to keep quiet and not lose his temper when people were mean to him. After that, Jackie played harder than ever, and soon his other team mates and the people that came to watch the games began to accept Jackie.

Jackie went on to become one of the greatest baseball players in history, and he paved the way for other black people to be able to play in the big leagues.

APPENDIX G

SUMMARY TABLE FOR ANALYSIS OF VARIANCE DATA

THETA ANOVA

	df	SS	MS	F
A	1	3535.143		11.11 Sig. .99
Subjects within groups	14	4452.73	318.05	
B	1	7408.199		25.51 Sig. .99
AB	1	1533.15		5.21 Sig. .95
B x subjects within groups	14	4065.149	290.36	

NEWMAN-KEULS PROCEDURE

Means	48	39	4
55	-	-	*
48		-	*
39			*

* $q_{.95}$ (r,14)

BETA ANOVA

	df	SS	MS	F
A	1	2895.604		11.13 Sig. .99
Subjects within groups	14	3641.265	260.09	
B	1	5871.45		22.66 Sig. .99
AB	1	3195.282		12.33 Sig. .99
B x subjects within groups	14	3627.613	259.11	

NEWMAN-KEULS PROCEDURE

Means	12	5	4
51	*	*	*
12		-	-
5			-

* $q_{.95}$ (r,14)

EMG ANOVA

	df	SS	MS	F	
A	1	5072		4.72	Sig. .95
Subjects within groups	14	15059	1075		
B	1	6690		43.4	Sig. .99
AB	1	3665		23.8	Sig. .99
B x subjects within groups	14	2172	154		

NEWMAN-KEULS PROCEDURE

Means		35	32	28
	82	*	*	*
	35		-	-
	32			-

$*q_{.95}$ (r,14)

COMPOSITE ANOVA

	df	SS	MS	F	
A	1	5692.445		32.71	Sig. .99
Subjects within groups	14	2435.76	173.98		
B	1	9877.151		72.95	Sig. .99
AB	1	5913.281		43.67	Sig. .99
B x subjects within groups	14	1895.425	135.38		

NEWMAN-KEULS PROCEDURE

Means		14	6	6
	68	*	*	*
	14		-	-
	6			-

$*q_{.95}$ (r,14)

CONNERS ANOVA

	df	SS	MS	F	
A	1	504		1.9	NS
Subjects within groups	14	3850	275		
B	1	2064		29.0	Sig. .99
AB	1	981		13.8	Sig. .99
B x subjects within groups	14	994	71		

NEWMAN-KEULS PROCEDURE

Means		92	87	68
	95	-	*	*
	92		-	*
	87			*

$*q_{.95}$ (r,14)

CODING ANOVA

	df	SS	MS	F	
A	1	25		1.3	NS
Subjects within groups	14	275	19		
B	1	15		1.8	NS
AB	1	16		2.0	NS
B x subjects within groups	14	112	8		

DIGIT SPAN ANOVA

	df	SS	MS	F	
A	1	28		1.6	NS
Subjects within groups	14	244	17		
B	1	25		3.1	NS
AB	1	19		2.3	NS
B x subjects within groups	14	121	8		

BENDER-GESTALT ANOVA

	df	SS	MS	F	
A	1	3		.2	NS
Subjects within groups	14	189	13.5		
B	1	12		15	Sig. .99
AB	1	1		1.28	NS
B x subjects within groups	14	11	.78		

REFERENCES

Allen, E. K., Henkel, L. B., Harris, F. R., Baer, D. M., & Reynolds, N. J. Control of hyperactivity by social reinforcement of attending behavior. Journal of Educational Psychology, 1967, 58, 231-237.

APA Diagnostic & Statistical Manual of Mental Disorders. DSM-III (Third Edition).

Baldwin, B. G., Benjamins, J. K., Myers, R. M., & Grant, C. W. EMG biofeedback with hyperactive children: a time series analysis. Proceedings of the Biofeedback Society of America, Ninth Annual Meeting, 1978.

Basmajian, J. V. Control and training of individual motor units. Science,1963, 141: 440-441.

Battle, E. S., & Lacey, B. A context for hyperactivity in children, over time. Child Development, 1972, 43, 757-773.

Bhatara, V., Arnold, L. E., Lorance, T., & Gupta, D. Muscle relaxation therapy in hyperkinseis: Is it effective? Journal of Learning Disabilities, 1979 12 (3), 49-53.

Blanchard, E. B., & Young, L. D. Clinical applications of biofeedback training. Archives of General Psychiatry, 1974, 30, 574-589.

Bradley, C. The behavior of children receiving benzedrine. American Journal of Psychiatry, 1937, 94, 577-585.

Braud, L. W. The Effects of EMG Biofeedback and Progressive Relaxation Upon Hyperactivity and its Behavioral Concomitants. Unpublished doctoral dissertation, University of Houston, 1974.

Braud, L. W. The effects of frontal EMG biofeedback and progressive relaxation upon hyperactivity and its behavioral concomitants. Biofeedback and Self-Regulation, 1978, 3, 1 69-89.

Braud, L. W., & Holliday, E. E. The effects of reinforcement on sitting behavior in a hyperactive girl. Unpublished manuscript, 1974.

Braud, L. W., Lupin, M. N. & Braud, W. G. The use of electromyographic biofeedback in the control of hyperactivity. Journal of Learning Disabilities, 1975, 8(7), 21-26.

Brown, B. B. New Mind, New Body; Biofeedback: New Directions for the Mind. Harper & Row Publishers, 1974.

Brown, B. B. Stress and the Art of Biofeedback. Harper & Row Publishers, 1977.

Budzynski, T., & Stoyva, J. An instrument for producing deep muscle relaxation by means of analog information feedback. Journal of Applied Behavior Analysis, 1969, 2, 213-237.

Burks, H. The hyperkinetic child. Exceptional Child, 1960.

Cantwell, D. P. Diagnosis, management, current research. The Hyperactive Child, Spectrum Publications, 1975.

Clements, S. D. Minimal brain dysfunction in children. Identification and terminology. Public Health Service Publication No. 1415, 1966.

Clements, S. D. Minimal brain dysfunction in children. In Sapir, S., & Nitzburg, A. (Eds.). Children with Learning Problems. New York: Brunner-Mazel Publishers, 1973.

Conners, K. C. A teacher rating scale for use of drug studies with children. American Journal of Psychiatry, 1969, 126:6, 152-156.

Conners, K. C. Symptom patterns in hyperkinetic, neurotic and normal children. *Child Development*, 1970, 41, 667-682.

Conners, K. C. Recent drug studies with hyperkinetic children. Journal of Learning Disabilities, 1971, 4(9), 12-19.

Connoly, D. P., Besserman, R., & Kirschvink, J. Electromyography biofeedback on hyperactive children. *The Journal of Biofeedback*, 1974.

Denhoff, E., Davis, A., & Hawkins, R. Effects of dextroamphetamine on hyperkinetic children. A controlled double-blind study. *Journal of Learning Disabilities*, 1971, 4(9) 27-34.

Gaarder, K. & Montgomery, P. *Clinical Biofeedback: A Procedure Manual*. Baltimore, Williams and Wilkins, 1977.

Gargiulo, R. M. Arousal level and hyperkinesis: implications for biofeedback. *Journal of Learning Disabilities*, 1979, 12(3). 4-5.

Gatchel, R. J., & Price, K. P. *Clinical Application of Biofeedback*, Pergman Press, 1979.

Glow, R. A. Cross-Validity and Normative Data on the Conners' Parent and Teacher Rating Scales. In *Psychosocial Aspects of Drug Treatment for Hyperactivity*. Edited by K. Gadow & J. Loney, Westview Press, Inc., Boulder, Colorado, 1976, 107-147.

Haight, M. J., Irvine, A. B., & Jampolsky, G. G. The response of hyperkinesis to EMG feedback. *Proceedings of the Seventh Annual Meeting of the Biofeedback Research Society*. Colorado Springs, Colorado, 1976.

Hartje, J. C. *Biofeedback: Health Without Drugs*. Hwong Publishing Company, 1980.

Haynes, S. N., Moseley, D., & McGowan, W. T. Relaxation training and biofeedback in the reduction of frontalis muscle tension. *Psychophysiology*, 1975.

Jeffery, T.B. The effects of operant conditioning and electromyographic biofeedback on the relaxed behavior of hyperkinetic children. Proceedings of the Biofeedback Society of America, Ninth Annual Meeting, 1978, 192-194.

Johnson, S., M.D. The story of Jackie Robinson. The Value of Courage, Value Communications, Inc. Publishers, 1977.

Laufer, M.W., Denhoff, E. & Solomons, G. Hyperkinetic impulse disorder in children's behavior problems. Psychosomatic Medicine, 1957, 19, 38-49.

Lubar, J.F., & Shouse, M.N. EEG and behavioral changes in the hyperkinetic child concurrent with training of the sensorimotor rhythm SMR: A preliminary report. Biofeedback and Self-Regulations, 1976, 1:293-306.

Lubar, J.F. Proceedings of the Biofeedback Society of America, 11th Annual Meeting, Colorado, 1980.

Lupin, M. Personal Communication, Houston, Texas, 1980.

Miller, R.G. Hyperactivity, self-concept, and achievement. Dissertation Abstracts International, 1970, 31 (5A).

Mulholland, T.B. It's time to try hardware in the classroom. Psychology Today, 1973, 103-104.

Orne, M.T. Biofeedback, APA, 1979.

Pigeon, G. & Enger, A. Increasing assignment completion and accuracy in a hyperactive first grade student. School Application of Learning Theory, 1972, 4.

Pihl, R.D. Conditioning procedures with hyperactive children. Neurology, 1967, 17, 421-423.

Prout, H.T. Behavioral intervention with hyperactive children: A review. Journal of Learning Disabilities, Volume 10, 1977.

Ross, D.M., & Ross, S.Q. Research, Theory, and Action. Hyperactivity, 1976.

Ross, A.O. Psychological Aspects of Learning Disabilities and Reading Disorders, McGraw-Hill Book Company, 1976.

Safer, D. J., & Allen, R. P. The Hyperactive Child: Diagnosis and Management. University Park Press, 1976.

Sargent, J., Green, E., & Walters, E. Preliminary report on the use of Autogenic Feedback Training in the treatment of migraine and tension headaches. Psychosomatic Medicine, 1973, 35, 129-135.

Satterfield, J. H. Neurophysiologic studies with the hyperactive child. In Cantwell, chapter 4, The Hyperactive Child, 1975.

Satterfield, J. H., & Dawson, M. E. Electrodermal correlates of hyperactivity in children. Psychophysiology, 1971, 8, 2, 191-197.

Shetty, J. Alpha rhythms in the hyperactive child. Nature, 1971, 234, 476.

Silver, L. B. A proposed view on the etiology of the neurological learning disability syndrome. Journal of Learning Disabilities, 1971, 4(3), 6-16.

Simpson, D. D., & Nelson, A. E. Attention training through breathing control to modify hyperactivity. Journal of Learning Disabilities, 1974, 7(5), 15-24.

Trites, R. L., Blouin, A. G. A., Fergerson, H. B., Lynch, G. W. The Conners' Teacher Rating Scale: an epidmiologic, inter-rater reliability and follow-up investigation. In Psychosocial Aspects of Drug Treatment for Hyperactivity, edited by K. Gadow & J. Loney, Westview Press, Inc., Boulder, Colorado, 1976, 151-173.

Twardosz, S., & Sajivaj, T. Multiple effects of a procedure to increase sitting in a hyperactive, retarded boy. Journal of Applied Behavioral Analysis, 1972, 5, 73-78.

Weiss, G., Werry, J., Minde, K., Douglas, V., & Sykes, D. Studies on the hyperactive child - V: The effects of dextroamphetamine and chlorpromazine on behavior and intellectual functioning. Journal of Child Psychology and Phychiatry, 1968, 9, 145-156.

Wender, P.H. Minimal Brain Dysfunction in Children. New York: John Wiley & Son, Inc., 1971

Werner, E., Bierman, J.M., French, F.E., Simonian, K., Conner, A., Smith, R.S., & Campbell, M., Reproductive and environmental casualties: A report on the 10 year follow-up of the children of the Kauai pregnancy study. Pediatrics, 1968, 42, 112-124.

Werry, J.S. Organic factors in childhood psychopathology. In H.C. Quay & J.S. Werry (Eds.), Psychopathological Disorders of Childhood.

Whalen, C.K., & Henker, B. Hyperactive Children: The Social Ecology of Identification and Treatment. Academic Press, 1980.

Siner, B.J. Statistical Principals in Experimental Design, McGraw-Hill, 1962.