12-1979

The Effects of EMG Biofeedback Assisted Relaxation Training on the Classroom Behaviors of Emotionally Impaired Children

Elizabeth Hein Akey

Western Michigan University

Follow this and additional works at: http://scholarworks.wmich.edu/masters_theses

Part of the Psychoanalysis and Psychotherapy Commons, and the Special Education and Teaching Commons

Recommended Citation

http://scholarworks.wmich.edu/masters_theses/1957

This Masters Thesis-Open Access is brought to you for free and open access by the Graduate College at ScholarWorks at WMU. It has been accepted for inclusion in Master's Theses by an authorized administrator of ScholarWorks at WMU. For more information, please contact maira.bundza@wmich.edu.
THE EFFECTS OF EMG BIOFEEDBACK ASSISTED RELAXATION 
TRAINING ON THE CLASSROOM BEHAVIORS 
OF EMOTIONALLY IMPAIRED CHILDREN

by

Elizabeth Hein Akey

A Thesis
Submitted to the 
Faculty of The Graduate College
in partial fulfillment 
of the
Degree of Master of Arts

Western Michigan University
Kalamazoo, Michigan
December 1979
ACKNOWLEDGEMENTS

I recognize that the assistance and support of many people were essential to this research. I would particularly like to thank the members of my thesis committee, Dr. Paul Mountjoy, Dr. Malcolm Robertson, and Dr. Wayne Fuqua. I am also grateful for the support and cooperation of many people in the Kalamazoo Public School System, particularly Kim Thomas, Coordinator of Ancillary Services; Elmer Christenson, Principal of Westwood School; and Jane DeRight, Special Education Teacher.

I also owe thanks to Dr. William Hampstead for introducing me to biofeedback and for providing encouragement and technical assistance during my research, and to Jenny Johnson, Connie Wray, and Dan Pawluk for serving as the independent observers.

Finally, I was very glad to have the love and support of Frank, Alison, and the rest of my family.

Elizabeth Hein Akey
INFORMATION TO USERS

This was produced from a copy of a document sent to us for microfilming. While the most advanced technological means to photograph and reproduce this document have been used, the quality is heavily dependent upon the quality of the material submitted.

The following explanation of techniques is provided to help you understand markings or notations which may appear on this reproduction.

1. The sign or “target” for pages apparently lacking from the document photographed is “Missing Page(s)”. If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting through an image and duplicating adjacent pages to assure you of complete continuity.

2. When an image on the film is obliterated with a round black mark it is an indication that the film inspector noticed either blurred copy because of movement during exposure, or duplicate copy. Unless we meant to delete copyrighted materials that should not have been filmed, you will find a good image of the page in the adjacent frame.

3. When a map, drawing or chart, etc., is part of the material being photographed the photographer has followed a definite method in “sectioning” the material. It is customary to begin filming at the upper left hand corner of a large sheet and to continue from left to right in equal sections with small overlaps. If necessary, sectioning is continued again—beginning below the first row and continuing on until complete.

4. For any illustrations that cannot be reproduced satisfactorily by xerography, photographic prints can be purchased at additional cost and tipped into your xerographic copy. Requests can be made to our Dissertations Customer Services Department.

5. Some pages in any document may have indistinct print. In all cases we have filmed the best available copy.

University Microfilms International
300 N. ZEEB ROAD, ANN ARBOR, MI 48106
18 BEDFORD ROW, LONDON WC1R 4EJ, ENGLAND

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
AKEY, ELIZABETH HEIN
THE EFFECTS OF ENG BIOFEEDBACK ASSISTED
RELAXATION TRAINING ON THE CLASSROOM
BEHAVIORS OF EMOTIONALLY IMPAIRED CHILDREN.
WESTERN MICHIGAN UNIVERSITY, M.A., 1979


### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>16</td>
</tr>
<tr>
<td>II</td>
<td>16</td>
</tr>
<tr>
<td>II</td>
<td>17</td>
</tr>
<tr>
<td>II</td>
<td>17</td>
</tr>
<tr>
<td>II</td>
<td>18</td>
</tr>
<tr>
<td>II</td>
<td>19</td>
</tr>
<tr>
<td>II</td>
<td>19</td>
</tr>
<tr>
<td>II</td>
<td>20</td>
</tr>
<tr>
<td>II</td>
<td>22</td>
</tr>
<tr>
<td>II</td>
<td>23</td>
</tr>
<tr>
<td>II</td>
<td>24</td>
</tr>
<tr>
<td>II</td>
<td>25</td>
</tr>
<tr>
<td>II</td>
<td>25</td>
</tr>
<tr>
<td>II</td>
<td>26</td>
</tr>
<tr>
<td>II</td>
<td>26</td>
</tr>
<tr>
<td>III</td>
<td>27</td>
</tr>
<tr>
<td>IV</td>
<td>36</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>42</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>45</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

FIGURE                        Page
1  Average EMG during Biofeedback Sessions............ 28
2  Percent of Observed Intervals in which Inappropriate Behavior Occurred 30
3  Average Daily Points Earned.......................... 33
4  Weekly Total of Talkouts............................... 34
CHAPTER I

INTRODUCTION

One part of the Michigan Special Education Code definition of "Emotionally Impaired" persons includes students who are "disruptive to the learning process of other students or [themselves] in the regular classroom over an extended period of time" (Michigan Department of Education, 1977, p. 3). Some of the behavior problems which are often cited as evidence of such disruptions are short attention spans, excessive levels of motor activity, high levels of distractibility, and poor impulse control. In general, these behaviors can be termed inadequate coping responses to environmental stimulation. If left uncontrolled, these inadequate responses will seriously hinder both the educational and social development of such students.

Two approaches that are frequently used in helping students control these behavioral problems are the administration of pharmacological agents, such as Ritalin, and the use of various behavioral management techniques in separate classrooms for students classified as emotionally impaired (EI). However, both of these approaches have certain disadvantages. One disadvantage of stimulant medications is that their effectiveness appears to be limited to children with organic disorders (Satterfield, Cantwell, Lesser, & Podosin, 1972). In addition, the long-term administration of drugs to children raises
several medical and ethical issues (Hentoff, 1970; Keogh, 1971; Ladd, 1970). Also, although many of the students meet with success in the specialized settings, it is desirable that they learn to function in a normal educational setting. This is particularly important in view of the federal law mandating that each child be educated in the "least restrictive environment" possible.

An alternative approach to working with children with such behavioral difficulties has been suggested by researchers in the field of biofeedback. In general terms, this approach centers on the concept that training children in relaxation using biofeedback techniques may have desirable effects on their coping responses. One explanation for this is that when the children learn to relax in stressful situations, they are able to break their patterns of inappropriate responding and substitute new behaviors. The new behaviors which are more appropriate will then be maintained and generalized as they are reinforced in the children's natural environments (Hampstead, 1979). Another possibility is that children who demonstrate such overactivity and excitability continually maintain high levels of physiologic arousal (Braud, 1977; Krause, 1978), and thus are unable either to recognize that their arousal levels are high or to lower their arousal levels when this would be appropriate. As Gaarder and Montgomery (1977) point out, "a variable cannot be controlled unless information about it is available to the controller" (p. 19); consequently, once such children begin to receive information from the biofeedback machine about their physiologic states, they are more able to learn to recognize and control their levels of
arousal. Also, Budzinski (1969) has found evidence that people react more quickly to changes in environmental stimuli when they are tense or highly active than when they are relaxed. This finding suggests that high physiologic arousal levels contribute to the behavioral problem of distractibility. Furthermore, some researchers have reported that high levels of physical arousal inhibit cognitive processes (Gaarder & Montgomery, 1977); thus, the children may be more able to progress academically when they are physically relaxed.

A major advantage to the use of biofeedback assisted relaxation training in treating the problem behaviors of students is that this approach focuses on relaxation as a means of self-control. In the biofeedback process, the children are utilizing information coming from themselves to control their level of physiologic arousal and are not dependent upon the external control of another person. Changes in the feedback signal, indicating control over their level of arousal, reinforce their efforts at self-monitoring and regulation. By extension, then, the children are learning a means of self-control.

On the theory that relaxation training provides students with one self-control skill and with a beneficial means of coping with stress, some schools have begun to incorporate such training into their regular curriculum. For example, Hughes and Collins (1978) have reported on a program to teach relaxation to nursery school children, and Cautela and Groden (1978) stated that all students in one program for severely retarded children were taught relaxation when they entered.

One large scale program in biofeedback assisted relaxation
training has been implemented in a South Dakota school system.

Englehart (1978) studied 120 students in the first through twelfth grades who used hand temperature and electromyograph (EMG) instruments while practicing relaxation, and found that the mean EMG activity levels decreased and mean hand temperatures increased following training. These students were also given pre- and post-tests on the Piers-Harris Children's Self-Concept Scale and on Spielberger's State-Trait Anxiety Inventory. Results from these tests indicated that there were statistically significant increases in the students' mean scores on the self-concept measure and significant decreases in trait anxiety levels had decreased after the relaxation training. This study did not include, however, any control groups or measures of test-retest reliability.

Kahn (1978) also investigated the effect that biofeedback assisted relaxation training has on children's anxiety levels. As he points out, "education clearly generates significant occasions for text anxiety" (p. 20); therefore, if students can learn to relax and moderate this anxiety, their academic performance may improve. To test this possibility, he selected 30 highly anxious children between 8 and 12 years old and divided them into three groups of 10 each. The first group received EMG biofeedback assisted relaxation training, using the frontalis muscle as the measurement site; the second group received the same training plus therapy centered around their anxieties; and the third group served as a no-treatment control group. All subjects were also administered pre- and post-tests of Spielberger's State-Trait Anxiety Inventory and, as a
measure of their intellectual functioning in test situations, the
Wechsler Intelligence Scales for Children-Revised (WISC-R). Results
from this study indicated that subjects from both treatment groups
were successful in lowering their forehead muscle tension levels.
The post-tests also showed significant reductions in state anxiety
levels and some improvement in the WISC-R scores for subjects in
both treatment groups; however, there were no changes in the trait
anxiety levels. Also, biofeedback training alone was shown to be
as effective as biofeedback plus therapy in leading to these changes
on the post-tests.

Along with these studies exploring the application of biofeed­
back techniques in educational settings, there is a growing body
of biofeedback research using hyperactive and hyperkinetic children
as subjects. These studies are very relevant to the present research
involving EI children because all three categories encompass many
of the same behaviors. For instance, Laufer and Denhoff (1957)
characterize the "hyperkinetic syndrome" as including symptoms such
as hyperactivity, impulsiveness, short attention span, variability,
irritability, and explosiveness. Similarly, Braud, Lupin, and
Braud (1974) include in their definition of "hyperactivity" the
behavioral problems of overactivity, impulsiveness, short attention
spans, and emotionality. As noted before, behavioral problems such
as these often create disruptions to the learning process and are
therefore cited as evidence of emotional impairment in students.

Braud et al. (1974) conducted a pilot study using one 6½
year old hyperactive boy as the subject. During the baseline phase,
the subject's frontalis EMG activity levels were monitored. On the basis of these data, the researchers established a threshold criterion of the bioelectric amplitude which the subject exceeded 20% of the baseline time. The biofeedback instrument was then adjusted so that a tone would be emitted whenever the subject exceeded this threshold level. During the training phase, the subject was asked to sit quietly and keep the tone off. The goal of this training was for the subject to maintain a low to medium arousal level and to refrain from high peaks or burst of activity. One of the researchers also observed the subject during the training periods and rated his emotionality on a 10 point scale. After eight of the 11 training sessions, the subject's parents and teacher were asked to have him practice sitting quietly whenever he became upset or overactive. Results from this study indicated that the subject did learn to hold his activity level beneath the established threshold during the training phase and at a follow-up session seven months later. The experimenter's ratings of the subject's emotionality during sessions, as well as the parents' and teachers' subjective impressions of the child's behavior, suggested that the subject's self-control had improved considerably. Finally, post-tests on a series of psychological measures showed improvement in academic and perceptual performances over scores achieved by the subject ten months earlier, beyond the improvements that would have been expected over such a time span.

Braud (1977) later conducted a more extensive study using 15 hyperactive and 15 non-hyperactive children. The parents of all...
subjects completed several behavioral rating scales at the beginning and end of the study. Independent testers also administered the Bender-Gestalt test, the Visual-Sequential Memory subtest of the ITPA, and the Digit Span and Coding subtests of the WISC-R. The frontalis EMG levels of all subjects were also recorded during baseline sessions.

After these initial assessments were concluded, there was no further contact with the non-hyperactive subjects until the follow-up phase. The 15 hyperactive subjects were assigned to three groups for the experimental phase: a biofeedback group, a progressive relaxation group, and a hyperactive control group. Subjects in the biofeedback group practiced relaxation and received visual feedback as to their forehead arousal levels during 12 training sessions. Those in the progressive relaxation (PR) group spent an equal amount of time following tape-recorded relaxation instructions. Both groups of subjects were requested to practice relaxation at home daily and to use the technique to handle stressful situations. One additional EMG monitoring session was conducted weekly for subjects in all three of the hyperactive groups. In addition, the parents of all hyperactive subjects were asked to complete home behavior checklists three times per week.

Results of this study indicated that relaxation training had positive effects both on the activity levels and the home behavior of experimental subjects. Both biofeedback and PR training were effective in teaching the hyperactive subjects to reduce their EMG activity levels, and the biofeedback group showed greater reductions
than the PR group. Also, parents' ratings of hyperactivity at home decreased for both these groups. Furthermore, slight improvements were noted in the performance of these subjects on the post-test battery. Neither the hyperactive control group nor the non-hyperactive control group showed changes on any of these measures.

Simpson and Nelson (1974) selected breathing as the physiologic process to monitor in their work with hyperactive children, reasoning that this is frequently used in autogenic training and that such children would find it simpler to establish control over this single "higher order" behavior than to attempt to focus simultaneously on several "lower order" behaviors such as being in seat and maintaining their attention spans. Accordingly, these researchers trained three boys from a school for learning disabled children to maintain regular rates and amplitude of breathing by giving them biofeedback along with token reinforcement for achieving the desired breathing pattern. After a few sessions, the researchers began fading the reinforcement and presenting academic tasks to the subjects in an effort to make the experimental setting more similar to a classroom setting. A control group of three other children from the school participated in an equal number of sessions in the same setting and were reinforced for completing similar academic tasks. Although the experimental subjects showed more change, the regularity in breathing did increase in all six subjects over the course of the study. The authors suggest that this is because the control subjects had to sit quietly in order to complete their academic tasks and receive reinforcement. They also noted no transfer of effects to the subjects'
regular classrooms despite their efforts to program for generalization.

Although the studies discussed above report generally favorable effects of biofeedback training, they rely on either pencil and paper measures or the subjective impressions of parents, teachers, and experimenters as the dependent variables. The validity of such measures is often limited, hinging upon the accuracy of assumptions such as that the researcher and subjects are defining terms in the same way and that the subjects are correctly assessing and honestly reporting the situation (Wiggins, 1973). Furthermore, research has often shown a poor correspondence between self-reports and non-test behavior (Mischel, 1968). Consequently, the relevance of these findings to the subjects' behaviors in their natural environments is often unclear.

One study including objective observations in the subject's natural environment was conducted by Lubar and Shouse (1976). The subject for this study was an 11-year old boy who had been diagnosed as hyperkinetic. Lubar and Shouse first reinforced him for producing alpha brain waves (12-15 Hz), which are associated with deep relaxation, and then instituted a reversal phase in which he was reinforced for producing theta brain waves (4-8 Hz), which are associated with high arousal states. Concurrent with the EEG biofeedback training, an independent observer observed the subject in his regular classroom and recorded occurrences of several appropriate and inappropriate behaviors. Results from this study indicated that the subject increased and decreased his production of alpha and theta brain waves.
as expected and that the subject's frontalis EMG activity levels decreased slightly when his alpha brain wave production increased. Also, the classroom observations showed some positive behavioral changes during the reinforcement for alpha phases, including decreases in self-stimulation, inappropriate play with objects, and out of seat behavior, and increases in sustained attention and compliance with teacher's directions. However, there were no clear effects noted in the areas of sustained schoolwork or social interactions.

Baldwin, Benjamins, Meyers, and Grant (1978) also attempted direct observations of the subjects' behaviors in relation to biofeedback training, but with less positive results. The subjects for this study were four boys aged 8 to 12, of average intelligence, and diagnosed hyperactive. The biofeedback procedure used in this study was twice-weekly training sessions in relaxation with the assistance of EMG feedback. The same behavioral categories were used as in Lubar and Shouse's (1976) research. The behavioral observations were made after each biofeedback session during, first, a ten-minute unsupervised study period, and second, the initial ten minutes of a math tutoring session. Once per week, the subjects' parents and tutors were also asked to complete the Connors Parent-Teacher Questionnaire on hyperactivity. The study employed a single subject reversal design with four phases: baseline, EMG biofeedback assisted relaxation training, false feedback as a reversal, and return to accurate feedback.

All of the subjects in this study were able to lower their
EMG activity levels with the biofeedback training. However, the occurrences of hyperactive behavior during the unsupervised study period and the tutoring period actually increased over the course of the study and the parent and tutor ratings of hyperactivity remained stable throughout. In this study, therefore, biofeedback assisted relaxation training was not shown to have a positive effect on the subjects' performance of various hyperactive behaviors. The authors suggested that for these subjects, the social context, rather than their level of relaxation, appeared to determine the subjects' level of hyperactivity.

Haight, Irvine, and Jampolsky (1976) also failed to find any positive effects of biofeedback training for the hyperactive adolescents in their study. The purpose of this study was to test the effects of EMG biofeedback training on the subjects' frontalis muscle tension and on the pre- and post-training performance on measures of hyperactivity, lability, self-esteem, and visual and auditory attention spans. The four experimental subjects, who had participated in one session of PR training and an additional ten sessions of EMG biofeedback assisted relaxation training, showed no significant change in EMG levels from their baseline levels. Also, both the experimental subjects and a matched control group who had received only the one PR session showed equal improvement on the post-test measures.

Two other researchers who questioned whether biofeedback training was effective in producing relaxed states in, or in changing the behaviors of, hyperactive children were Nall (1973) and Jeffrey
(1978). The former reported on one study using hospitalized hyperkinetic children as subjects. One group of subjects was given feedback as to their alpha brain wave production (training group), another was given false EEG feedback (placebo group), and a third received no treatment (control group). During the one week of daily sessions, both the training and the placebo groups increased their alpha production. Additionally, no changes were noted on daily behavior checklists completed by the subjects' therapists or on the subjects' pre- and post-test performance on several attentional tests. Similarly, Jeffrey (1978) noted that subjects in both treatment and control groups had lower EMG activity levels on a post-test than on the pre-test, even though subjects in the treatment group had had ten sessions of EMG biofeedback training over periods of two to three weeks. However, the negative findings of these two studies are tempered by the relatively short time spans involved in the training.

Hampstead (1979) conducted an additional study which attempted to assess the effects of training hyperactive children in EMG biofeedback assisted relaxation on their academic and social behaviors. The first experiment in this study used an A-B-A-B-A design, with EMG activity levels monitored but no feedback provided to the subjects during the A phases and with machine-produced audio feedback available to the subjects during the B phases. The second experiment utilized the same design, but added the contingency of verbal feedback given by the experimenter to the audio biofeedback in the final B phase. Each phase ran for one week, with three sessions each week. There were three subjects in each experiment, all between 6½ and 9 years
old, and also six matched control subjects. The control subjects were seen once each at the beginning and end of a six-week interval, at which times they had their EMG activity levels monitored under baseline conditions and they were administered a battery of psychological tests. Hampstead found that the experimental subjects were able to lower their EMG levels with the biofeedback and were then able to maintain these lower levels during subsequent A phases. The control subjects, however, showed no change in EMG levels from their initial pre-test to the post-test. Furthermore, he found that the machine-produced biofeedback signal alone was as effective as the signal plus verbal feedback in leading to reduced EMG activity.

This study also included the elements of parent and teacher ratings of hyperactivity three times per week. Both the parents and the teachers were aware of the biofeedback training. The parent ratings for four of the six experimental subjects indicated that their at-home behavior improved during the course of the biofeedback training. Teacher ratings, however, showed positive change in only one of the four subjects for whom this data was available.

The inconsistent results in previous studies may be due in large part to differences in experimental design and procedures. For example, some researchers have stressed the importance of outside practice of relaxation for generalization of the benefits of biofeedback training (Brown, 1977; Gaarder & Montgomery, 1977); yet in those studies which included this element, it is unclear how frequently such practice occurred for each subject or how much effect this practice had on the attained results. This latter question is
particularly relevant to studies in which parents were asked to prompt and monitor their children's relaxation practice, in that no distinction could be made between the biofeedback treatment effects and non-specific effects due to parent expectations or to the new interactions established between parent and child.

Another procedural element which varies considerably between studies is the length of the biofeedback training program. Those studies which included low numbers of training sessions over relatively short time spans in general report more negative results than studies which included longer training programs. This is consistent with the findings of DeGood, Klaus, Tennenbaum, and Greenwald (1978), who noted that for adults with psychosomatic health problems, EMG levels in the training setting did not decrease significantly after a fourth weekly biofeedback session, but that subjects who had either four or eight additional sessions showed more generalization and maintenance of the beneficial effects of biofeedback on their presenting problems. In relation to children with behavioral problems, Braud (1977) noted that six weeks of twice-weekly sessions seemed to be too short a period and that "training should be extended to ten or twelve weeks" (p. 23).

A third and critical limitation to the studies cited here is that, as noted before, the majority of them use pencil and paper measures and/or subjective ratings as dependent variables. In fact, of all these studies, only Lubar and Shouse (1976) attempted independent observations in the subject's natural environment. There are several aspects in which all the other studies are limited by their
choice of dependent variables. First, in those studies using parent and teacher ratings, expectancy effects, rather than any real changes in the subjects' behaviors, may account for any changes which show up in the ratings. Also, as discussed above, the relevance of pencil and paper measures to a person's actions in real-life situations is questionable. Furthermore, the extent to which any new behaviors learned in experimental settings generalize to the subjects' natural environment cannot be objectively assessed in any study except the one by Lubar and Shouse.

Review of past research does not clarify whether biofeedback assisted relaxation training can be effective in leading to improvements in the classroom behaviors of EI students. Accordingly, this study will attempt to determine, first, if EI students can learn to lower their activity levels with the assistance of EMG biofeedback, and second, what changes, if any, occur in their classroom behaviors after the biofeedback training.
CHAPTER II

METHOD

Subjects

Four children in an upper elementary classroom for emotionally impaired (EI) students served as the subjects for this study. All were male, and they ranged in age from 10 to 12 years. Their IQ's were in the low-normal to normal range. They had been placed in EI classrooms between 1½ and 3 years earlier, a fact which indicates that their behavioral problems were of a long-term and persistent nature. The disruptive behaviors cited as establishing the appropriateness of the EI classification for them included high rates of talkouts, much time spent out of seat, distractibility, frequent temper outbursts, short attention spans, and overactivity.

These four subjects were selected from a classroom of eight EI students according to the following criteria: (a) their academic records indicated that they were overly active in the school setting, (b) they had no prior exposure to biofeedback training, and (c) they showed high rates of EMG activity and of inappropriate classroom behavior in preliminary recording sessions. In addition, their parents needed to grant permission for them to participate in this study. Each of the other four students in the classroom failed to meet one or more of these conditions.
Setting

The biofeedback training was carried out in a small room within the school where the children were enrolled. This room was located off the library, so it was relatively quiet and free from distractions. It was furnished with an easy chair and footstool for the subject, a desk for the biofeedback trainer, and a screen to separate the subject and trainer. The room was lit with standard fluorescent lighting.

The behavioral observations were gathered in the self-contained classroom to which the subjects had been assigned at the beginning of the school year.

Apparatus

The instrument used to monitor EMG activity and to provide auditory analog feedback was the M55 unit manufactured by J & J Enterprises, Polusko, Washington. The auditory feedback from this unit was presented in the form of clicks which varied in rate and pitch as a function of increases or decreases in the amount of EMG activity present on a moment to moment basis. The unit's threshold capability was also employed to insure that the subjects did not purposefully maintain high activity levels in order to achieve a "siren" effect in the feedback. The threshold level and the instrument's sensitivity to EMG level changes were adjusted to insure that there was a sufficient range of pitches and rates available for the subjects to discriminate easily any changes which occurred. A filter with a lower limit of 100 Hz and an upper limit of 200 Hz was utilized.
throughout the study to control for EKG artifacts and 60 cycle interference.

The M55 EMG unit was connected to an LGS-150 Scorekeeper, also by J & J Enterprises. The LGS-150 accumulated data from each 30-second trial used in this study and automatically averaged this data and displayed it in digital form, accurate to two decimal places, at the end of each trial.

Differential surface EMG recordings were obtained from three silver/silver chloride electrodes provided with the M55. The two active electrodes were centered above each eye and on the midline of the forehead. The ground electrode was also placed on the midline, equidistant from the two active electrodes. The frontalis muscle skin sites were prepared by first wiping the area with a cotton pad soaked in an abrasive cleanser, then rinsing the area with a cotton pad soaked in isoprophyl alcohol. Redux paste was used as an electrode interface. The electrodes were held in place by individual adhesive discs. After the electrodes were positioned, the active electrode resistance was checked and maintained between 3k and 5k ohms.

Response Definition

Measurements were taken of EMG activity levels during biofeedback sessions and of inappropriate behavior in the classroom. In addition, two measures of the subjects' classroom behaviors, which were collected by the teacher throughout the school year, were used as indicators of the teacher's assessment of the subjects' behaviors.
**EMG activity levels**

EMG sessions were scheduled, with few exceptions, twice weekly during baseline and training phases and once weekly during the follow-up phase. All sessions without feedback, i.e., baseline and follow-up, lasted 15 minutes, during which there were 30 trials of 30 seconds each. Training sessions were extended by five minutes, to a total of 40 trials in 20 minutes, in order to allow the subjects more opportunity to practice relaxation and receive feedback. Data provided by the LGS-150 Scorekeeper on the EMG activity levels during each trial were averaged across the session, and this average served as the measure of the subject's EMG activity level that session. Preceding each session, there was a three minute habituation period, with data from this period omitted from the session average. Also, the training sessions concluded with three minutes of no feedback as a means of prompting the subjects to maintain their lowered activity levels. Data from these three minutes were also omitted from the session average. A sample EMG recording sheet is contained in Appendix A.

**Inappropriate classroom behaviors**

A list of target inappropriate behaviors was gathered from the teacher and the subjects' academic records. This list was found to be very similar to the definitions of deviant classroom behavior developed by Becker, Madsen, Arnold, and Thomas (1967) and used in order studies of hyperactive children (e.g., Ayllon, Layman, & Kandel, 1975). Accordingly, the definitions of Becker et al. (1967), with a few minor adaptations, were used for this study. The six
categories of inappropriate classroom behavior recorded by the independent observer in this study were gross motor behaviors, disruptive noise with objects, disturbing others directly and aggression, inappropriate vocalizations, improper sitting position, and orienting away from work. Complete definitions for these categories, along with a sample observation sheet, are contained in Appendix B.

**Teacher-recorded information**

A token reinforcement system was in effect in this classroom, with points awarded to the students by the teacher and classroom aide for completing work accurately, working hard, minding their own business, and sitting properly. There was also a bonus category used for individual target behaviors or unusual situations. Points could be exchanged near the end of each day for a variety of small items or for access to special free-time activities. The minimum daily points needed for access to the "store" or free time were 400. Each student's points were recorded on individual sheets. These sheets, showing daily earnings, were saved by the teacher for the experimenter to collect weekly. These point sheets were collected beginning in Week 3 for Subjects 3 and 4 and in Week 4 for Subjects 1 and 2, through Week 17. No points were recorded during Week 18, as it was close to the end of the school year and normal classroom activities were largely suspended.

In Week 6, coincidental with the beginning of the first training phase, the teacher removed Subject 2 from the point system and placed him on a separate checklist. This checklist was similar to
the point sheet, but had the additional categories of "refraining from weird body gestures" and "not being verbally aggressive to teacher or peers." Every fifteen minutes, the teacher would place either a positive check or a minus sign beside each category. Four times during the day, the subject was able to participate in a special activity if he had earned at least 90% checks during the preceding period. A score of 90% for Subject 2 was, therefore, comparable to earnings of 400 points for the other subjects.

The teacher also maintained records of the number of "talk-outs" received by each student. In this classroom, the definition for "talkout" encompassed any incidence in which the teacher intervened in the student's behavior in a punishing manner. Some of the specific behaviors included in this definition were talking without permission or in a negative or abusive manner, being out of seat without permission, and disturbing or aggressing other students in the classroom. The first occurrence of any of these behaviors each morning or afternoon resulted in a warning; a second and any further occurrences during the same half day were scored as talkouts. Records of the warning and talkouts each student had received that half day were kept on the blackboard. At the end of each half day, the teacher transferred this information to a permanent record sheet, which was later shared with the experimenter.

Data from these two teacher-recorded measures are, for several reasons, somewhat unreliable. One difficulty is that on numerous occasions the subjects' point sheets were not passed on to the experimenter. Also, as is commonly the case in natural
environments, there were elements of subjectivity in the administration of these positive and negative contingencies. However, the measures do have validity as indications of the teacher's assessment of the subjects' classroom behavior.

Classroom Observations

An independent observer was in the subjects' classroom three times per week during weeks 1 through 11 and two times per week for the remainder of the study. Each observation session lasted approximately 90 minutes, during which the subjects were working on individualized assignments at their desks. These sessions were generally scheduled for Tuesday and Wednesday mornings and for Thursday afternoons. Some variations in this schedule, including the elimination of the Tuesday morning session during the last weeks of the study, were necessitated by the limited availability of observers and by changes in classroom activities.

The observers watched and recorded the behaviors of one subject at a time for six consecutive 10-second intervals, rotating in sequential order among the four subjects. Under this schedule, each subject was observed for an average of 14 minutes spaced throughout each observation session. If one or more of the six categories of inappropriate behavior occurred during a 10-second interval, the observer marked which one(s) had occurred on a recording sheet within the appropriate interval space. If none of these behaviors occurred, a +, indicating appropriate behavior, was marked for that interval. A partial interval definition of an
occurrence was used, such that if an inappropriate behavior occurred in any part of an interval, the whole interval was scored as inappropriate.

The primary measure taken from the data gathered by the independent observer was, for each subject, the percentage of observed intervals in which any one or more of the six inappropriate behaviors had occurred. This served as the primary definition of inappropriate classroom behavior. Two auxiliary measures were also used to monitor any topographical changes in the subjects' behaviors. One of these was the percent intervals of occurrence for each of the six separate behavior categories, and the other was the number of categories scored in each interval.

Observer reliability

Three undergraduate psychology students served as the observers for this study. Each one was trained to recognize occurrences of the inappropriate behaviors and to use the recording sheet. Reliability checks were run in the subjects' classroom twice at the end of the observers' training and twice more during the second month of the study. For these checks, the observers were given prepared sheets showing the sequence in which the subjects were to be observed. They also listened through earphones to a tape indicating the 10-second observation intervals. During these reliability checks, the observers were positioned such that they could not see each other's recording sheets, so that the possibility of biased observations would be limited.
Using the formula of agreements divided by the sum of agreements plus disagreements, reliabilities were calculated for all instances of agreement as well as separately for agreements on occurrences and nonoccurrences of inappropriate behavior. The overall agreement was 87%, agreement on occurrences of inappropriate behavior was 80%, and agreement on nonoccurrences of inappropriate behavior (occurrences of appropriate behavior) was 73%. In addition, separate reliabilities were calculated for total agreement, agreement on occurrences, and agreement on nonoccurrences for each of the six behavior categories. Total agreement on each separate category ranged from 88% to 96%. Agreement on occurrences ranged from 30% to 65%, with the lowest scores in the two categories which occurred least frequently, and agreement on nonoccurrences ranged from 85% to 96% (Complete reliability figures are contained in Appendix C.). These figures indicate that while agreement on exactly which inappropriate behavior was occurring was sometimes low, the observers generally agreed that the subject was behaving inappropriately.

Procedure

The classroom teacher recorded points and talkouts throughout the entire school year. The independent observers began to observe and record in the classroom one month prior to the baseline phase, and continued their observations on the schedule given above throughout the study.

During the first week of the study, each subject came to the room where the EMG sessions were conducted and had the purpose of the
biofeedback machine explained to him. Each subject was then attached to the biofeedback instrument so that he could see how the machine worked and have a chance to experiment with it for a short while. No data were recorded during these introductory sessions.

This study was conducted between the first week in January and the second week in June. The study was interrupted on three occasions: for one week after Week 2 when a snowstorm closed the schools, for one week after Week 7 because of an equipment failure, and for two weeks after Week 12 while the students and observers were on vacation.

Baseline

During the individual EMG sessions, the subjects were directed to sit quietly and rest. It was explained to them that this would show how good they already were at relaxing and controlling themselves. After the three-minute habituation period, the subjects' frontalis EMG activity levels were recorded for 15 minutes. No feedback was given to the subjects as to their performance.

Biofeedback assisted relaxation training

For this phase, the additional instruction was given to the subjects to listen to the tone from the biofeedback unit and to try to keep it very low. They were also asked to remember how they felt when the tone was low, so that they could learn to make themselves feel that way without the machine. It was also stressed to them that they would be the ones who determined what the machine would do,
rather than the machine controlling them. They were given no other
directions in relaxation techniques, but occasionally were prompted
to bring the tone down low and were praised for achieving a low
arousal level.

The subjects received the rate- and pitch-proportional feedback for 20 minutes each session. While the electrodes were being attached and removed, they also talked briefly with the biofeedback trainer about how they felt when the tone was low and about how they could use the skill of relaxing at other times.

Follow-up

The subjects were told that they would no longer hear the biofeedback tone, since this would give them more time to practice relaxing on their own and would also show how well they could do at controlling themselves without the machine telling them how they were doing. As in the baseline phase, they were then connected to the M55 unit for a 3-minute habituation and 15-minute recording period.

Experimental Design

A multiple baseline design between two groups of subjects was used. Subjects 1 and 2 had five weeks in baseline, eight weeks in biofeedback training, and five weeks in follow-up. Subjects 3 and 4 spent 12 weeks in baseline, five weeks in biofeedback training, and one week in follow-up. To reduce the possibility of bias, neither the independent observers nor the classroom teacher knew what phase the subjects were in at any given time.
CHAPTER III

RESULTS

Measurements taken during the biofeedback sessions indicate that with the assistance of biofeedback, all four subjects were able to reduce their frontalis EMG activity levels. Figure 1 (p. 28) gives the session averages of EMG activity levels for each subject. As this figure shows, the subjects had high activity levels during the baseline phase. With the audio feedback, however, two subjects were able to maintain low activity levels associated with a normal resting state, while two reduced their muscle activity to levels associated with deep relaxation.

In Group 1, Subject 1 produced high and erratic EMG activity levels during baseline but was able gradually to reduce and stabilize these levels, while Subject 2 achieved and maintained low EMG activity levels after the third week of training. During four weeks of no-feedback follow-up sessions, both of these subjects were able to maintain EMG activity significantly below baseline levels and consistent with the levels they attained with feedback. The subjects in Group 2 stabilized their EMG activity levels at high rates during their extensive baseline phase but showed immediate reductions when the audio feedback was introduced in Week 13. Both of these subjects then maintained EMG levels consistent with the initial reductions throughout the remainder of the training and follow-up phases.
Figure 1. Each subject's average frontalis EMG during biofeedback sessions. Subjects were asked to "sit quietly" and were given no feedback as to their EMG levels. During training, they received audio biofeedback as to their EMG levels. During follow-up, feedback was no longer available to them (In this and the following figures, the gaps after Weeks 2, 7, and 12 indicate the breaks in the study discussed in the Methods chapter, and missing data points for individual subjects were due either to subject absences or to equipment difficulties).
Because all four subjects did achieve lower frontalis EMG activity levels during the training and follow-up phases than during baseline, biofeedback was demonstrated to be an effective aid in the reduction of muscle tension in EI children.

Data collected by the independent observers on the subjects' classroom behavior produced less definite results. Figure 2 (p. 30) indicates, for each subject, the percentage of observed intervals in which any of the six categories of inappropriate behavior were scored as occurring. Because of fluctuations in the observations schedule, the number of data points per week varies between one and three. These figures show that the classroom behaviors of all four subjects were highly variable throughout the course of the study. This variability, due largely to factors outside of the control of this study, obscures any possible positive effects of the biofeedback-assisted relaxation training.

Examination of the data for each individual subject does reveal some positive changes in the classroom behavior of Subjects 1 and 3. The data for Subject 1 show a slight trend toward more appropriate behavior in the training and follow-up phases. One indication of this trend is that he demonstrated inappropriate behavior over 67% of the time on four out of 10 baseline observation days, with the rate for one of these days being 98%. However, his highest rates of inappropriate behavior during the training and follow-up phases were 64% and 53%, respectively. Subject 1 also shows a definite trend toward more appropriate behavior during the last three weeks of the study.
Figure 2. For each subject, the percent of observed intervals in which the independent observer scored one or more categories of inappropriate behavior as occurring.
Some improvement can also be seen in the classroom behavior of Subject 3. During baseline, the percentage of observed intervals in which he behaved inappropriately ranged from 21% to 72%; however, the range dropped to 10% to 53% during the training phase. Also, at the follow-up observation session, he was scored for inappropriate behavior only 23% of the time.

Although some improvement was noted in the classroom behavior of Subjects 1 and 3 during the course of this study, no such changes were found for the other two subjects. The rates of inappropriate behavior for Subject 2 remained more consistent across time than for any other subject, with no notable changes between the phases of this study. Subject 4, on the other hand, varied in his behavior more widely than the other subjects in the early weeks of the study and showed a deterioration in his classroom behavior after Week 10. His behavior during the last four weeks was judged by the school personnel to be so unacceptable that he was suspended many of the days; he was absent on several of the other days.

The two auxiliary measures of inappropriate classroom behavior yielded little additional information. For all subjects, three of the behavior categories (gross motor behaviors, sitting position, and orienting away from work) were found to occur more frequently than the other three categories; however, the rates of occurrence of any of these categories did not change significantly during the study. Also, the percentage of intervals in which two or more categories of inappropriate behavior occurred, indicating larger-scale disruptions than would the occurrence of a single inappropriate
behavior, remained in fairly constant proportion to the total percentage of intervals scored inappropriate.

The two teacher-recorded measures, classroom point earnings and talkouts, show few systematic changes in the teacher's evaluation of the subjects' classroom behavior. As Figure 3 (p. 33) shows, Subject 3 was the only one who consistently earned at least 400 points; the average daily earnings of the other subjects were quite variable from week to week. Subject 1 does show improvement in the follow-up phase, which coincides with the findings of the independent observer. The point earnings for Subject 4 reflect the teacher's deteriorating evaluation of his behavior during the study, but with some inconsistencies in the training phase. Figure 4 (p. 34) indicates the total number of talkouts, or reprimands for inappropriate behavior, recorded by the teacher. Again, the talkout data for Subject 4 indicates that he frequently acted inappropriately. Subject 1 shows little change in the number of talkouts he received. Subjects 2 and 3 did receive fewer talkouts during their training phases than during baseline. However, for Subject 2 the beginning of the training phase coincided with the teacher's introduction of a new checklist for this subject; therefore, the improvement may be due more to the checklist changes than to the biofeedback training.

Thus, the improvements which were noted on the teacher-recorded measures were that two subjects decreased the number of talkouts they received and a third subject increased his point earnings. However, the reliability problems with these measures which were discussed
Figure 3. For each subject, the average daily points earned in the classroom during each week. The criterion for earning access to free time equalled 400 points. Subject 2 was on a separate checklist from Week 6 on; his criterion for free time was having at least 90% positive checks.
Figure 4. For each subject, the weekly totals of talkouts recorded by the teacher (*Subject 4 was in school less than half of the days during Weeks 15 through 18).
above and the occurrence of some changes in classroom procedures leave questionable how much of these improvements can be attributed to the biofeedback training.
CHAPTER IV

DISCUSSION

The results from this study indicate that EI children are able to lower their activity levels with the assistance of EMG biofeedback. The effectiveness of the biofeedback was demonstrated through the multiple baseline design, in that subjects in both groups reduced their frontalis EMG activity levels when they began receiving biofeedback. In addition, subjects in Group 1, who had eight weeks of biofeedback training, displayed lower EMG levels than the subjects in Group 2, who had only five weeks of training. Furthermore, the subjects were able to maintain lower-than-baseline EMG levels without feedback during one to four weeks of follow-up sessions.

The question of whether the classroom behaviors of EI children will improve when they learn through biofeedback to control their activity levels remains unresolved. On the measures taken by the independent observer, two of the four subjects did show trends toward more appropriate behavior after the biofeedback training began. Three of the subjects also had at least one indicator of improvement on the two teacher-recorded measures of classroom behavior. While these results may tend to support the theory that biofeedback training can be beneficial for EI children, they are not definite enough to constitute proof.
There were some indications that the classroom behavior measurement procedures may have been insufficient for assessing any changes in the subjects' behavior due to the biofeedback training. For example, the wide variations noted in the subjects' behaviors during baseline led to difficulties in isolating any training effects during the later phases. Also, in an interview conducted at the conclusion of this study, the teacher noted that the subjects generally returned from the biofeedback sessions in quiet moods and resumed their schoolwork quickly. This suggests that pre- and post-session classroom observations might have revealed some immediate, albeit short term, improvements in the subjects' behavior. This possibility could not be assessed in the current study because the biofeedback sessions rarely occurred immediately prior to the classroom observation periods.

One further limitation of the measurement procedures was that the behavioral definition of inappropriate classroom behavior was quite strict. The strictness of this definition raised questions as to how the standards of behavior set for these EI children compared to the behavioral standards for children their age in regular classrooms. Accordingly, one of the independent observers spent an afternoon during Week 16 in a regular fifth grade classroom in the same school, using the same procedures as in the rest of this study to observe four students chosen at random. Over a ninety minute period, during which they were involved in activities similar to those occurring in the EI classroom, these four students were scored as behaving inadequately between 40% and 62% of the time. Since
these figures are comparable to the rates of inappropriate behavior observed in the subjects of this study (see Figure 2, p. 30), it is questionable how much improvement could be expected from these subjects when such strict behavioral definitions were applied.

A final indication that the subjects may have improved their behavior in ways that the measurement procedures were insensitive to came in the interview with the teacher at the study's conclusion. During this interview, she mentioned positive changes in Subjects 1, 2, and 3 in areas that could have been affected by the biofeedback training. For example, she noted that during the previous two months, Subject 1 had been on task much more of the time, had frequently accepted her interventions for minor behavioral problems instead of spiralling into worse behavior, and had not had any tantrums in the classroom. She also mentioned that Subject 2 was less impatient and more accepting of her interventions. Furthermore, she said that Subject 3 was doing very well both academically and behaviorally by the end of the school year. Her comments on the behavior of Subject 4 reflected the severe difficulties he had presented in class during the last two months and were consistent with his high rates of inappropriate behavior as recorded by the independent observer. These assessments by the teacher cannot serve as proof that the biofeedback-assisted relaxation training was beneficial for these subjects; they do, however, suggest that further research using different behavioral definitions, or perhaps focusing on the subjects' behaviors immediately prior to and after biofeedback sessions, might be able to reveal some behavioral improvements.
Another area which needs to be explored in future research is the academic progress of children learning relaxation skills. The individualized nature of assignments for subjects in the current study created difficulties in achieving any reliable measures of their academic progress; therefore, this study focused solely on the occurrence of disruptive behaviors in the classroom. The academic progress of subjects is, however, an important consideration for similar research.

Also worth consideration in future biofeedback research are several factors which were found to affect the progress of the biofeedback training. One of these was that with three extra weeks in the training phase, the subjects in Group 1 were able to achieve and maintain lower EMG activity levels than did the subjects in Group 2. This finding is consistent with Braud's (1977) observation that hyperactive children seem to require extensive biofeedback training programs, possibly continuing for as long as ten to twelve weeks.

Another factor which might have hindered the training program for subjects in Group 2 was the lengthy baseline period they experienced. Their behavior during this long baseline phase did establish that the situational contingencies of sitting quietly in an unstimulating room were not sufficient for inducing states of relaxation; however, the range of EMG activity levels both within and between sessions decreased for these two subjects as the baseline phase went on. In other words, although they remained at above normal activity levels throughout the 12 weeks of baseline, their activity levels were much less erratic and more stable by the end
of this phase. Therefore, when they finally began receiving the biofeedback, they were exposed to less variation in the feedback tone and needed to make subtler, more difficult, discriminations between muscle tension levels in order to achieve a more relaxed state. This finding implies that subjects who initially produce wide variations in physiologic activity readings during a session may achieve more success with biofeedback training than subjects with stable initial readings.

A third factor affecting the progress of the biofeedback training was the motivation of the subjects. Biofeedback theory assumes that changes in the biofeedback signal reinforce the subject's efforts at physiologic control (Brown, 1977); however, the audio feedback alone often seemed to be insufficient reinforcement for the EI children who served as subjects for this study. For them, the reinforcing nature of the biofeedback signal was dependent partly upon the novelty of the situation and partly upon the effectiveness of the biofeedback trainer's instructions. Pairing the signal with some sort of back-up reinforcer, such as awarding small toys or snacks when the subject achieves a desired criterion or interconnecting an electric toy to run when the subject's arousal level is below a certain threshold, would probably increase the signal's reinforcing value. An additional problem was that these subjects had difficulty conceptualizing the biofeedback assisted relaxation training as relevant to and potentially helpful in their daily lives; they, therefore, had little motivation to learn the skill or to apply it in their natural environments.
Several steps could be taken to improve the chances of biofeedback assisted relaxation training having a generalized effect on the natural environments of EI children. One step would be to add in an element of counseling, with the subject and biofeedback trainer discussing and rehearsing specific situations in which relaxation can be useful. Another step would be to move part of the training into the subjects' classrooms and to involve their teacher. This step could include, for example, conducting group relaxation or "body awareness" exercises as a regular part of the classroom activities and training the teacher to prompt and reinforce the students' efforts to reduce their muscle tension levels. A final step that could aid in generalization would be to involve the subjects' parents in reinforcing their children's use and practice of relaxation techniques at home. All of these possible procedures were omitted from the current study because of methodological considerations; they would nevertheless enhance the chances of success in a practical application of the biofeedback training techniques.

In conclusion, the biofeedback was demonstrated to be an effective aid in training EI children to reduce their physiologic activity levels during the biofeedback sessions. There were also some indications in the data collected by the independent observer and by the teacher that there were improvements in the subjects' classroom behaviors concurrent with the biofeedback training. However, further research is needed to verify that such biofeedback assisted relaxation training can lead to improvements in the behavior of EI children in their natural elements.
REFERENCES


Nall, A. Alpha training and the hyperkinetic child—is it effective? Academic Therapy, 1973, 9, 5-19.


APPENDIX A

EMG Scores

<table>
<thead>
<tr>
<th>Pre</th>
<th>Training</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
<td>3.</td>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
<td>4.</td>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
<td>5.</td>
<td>5.</td>
</tr>
<tr>
<td>6.</td>
<td>6.</td>
<td>6.</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>7.</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>8.</td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td>9.</td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td>10.</td>
</tr>
<tr>
<td>11.</td>
<td></td>
<td>11.</td>
</tr>
<tr>
<td>12.</td>
<td></td>
<td>12.</td>
</tr>
<tr>
<td>13.</td>
<td></td>
<td>13.</td>
</tr>
<tr>
<td>15.</td>
<td></td>
<td>15.</td>
</tr>
<tr>
<td>16.</td>
<td></td>
<td>16.</td>
</tr>
<tr>
<td>17.</td>
<td></td>
<td>17.</td>
</tr>
<tr>
<td>18.</td>
<td></td>
<td>18.</td>
</tr>
<tr>
<td>19.</td>
<td></td>
<td>19.</td>
</tr>
<tr>
<td>20.</td>
<td></td>
<td>20.</td>
</tr>
<tr>
<td>21.</td>
<td></td>
<td>21.</td>
</tr>
<tr>
<td>22.</td>
<td></td>
<td>22.</td>
</tr>
<tr>
<td>23.</td>
<td></td>
<td>23.</td>
</tr>
<tr>
<td>24.</td>
<td></td>
<td>24.</td>
</tr>
<tr>
<td>25.</td>
<td></td>
<td>25.</td>
</tr>
<tr>
<td>27.</td>
<td></td>
<td>27.</td>
</tr>
<tr>
<td>28.</td>
<td></td>
<td>28.</td>
</tr>
<tr>
<td>29.</td>
<td></td>
<td>29.</td>
</tr>
<tr>
<td>30.</td>
<td></td>
<td>30.</td>
</tr>
<tr>
<td>31.</td>
<td></td>
<td>31.</td>
</tr>
<tr>
<td>32.</td>
<td></td>
<td>32.</td>
</tr>
<tr>
<td>33.</td>
<td></td>
<td>33.</td>
</tr>
<tr>
<td>34.</td>
<td></td>
<td>34.</td>
</tr>
<tr>
<td>35.</td>
<td></td>
<td>35.</td>
</tr>
<tr>
<td>36.</td>
<td></td>
<td>36.</td>
</tr>
<tr>
<td>37.</td>
<td></td>
<td>37.</td>
</tr>
<tr>
<td>38.</td>
<td></td>
<td>38.</td>
</tr>
<tr>
<td>39.</td>
<td></td>
<td>39.</td>
</tr>
<tr>
<td>40.</td>
<td></td>
<td>40.</td>
</tr>
</tbody>
</table>

Date________________________

Student_____________________
APPENDIX B

CLASSROOM OBSERVATIONS

Response Definitions

Gross Motor Behaviors

Getting out of seat; standing up; running; hopping; skipping; jumping; walking around; rocking in chair; moving chair; disruptive movement without noise.

Disruptive noise with objects

Tapping pencil or other objects; clapping; tapping feet; rattling or tearing paper. Does not include accidental dropping of objects or noise made while performing gross motor behaviors as defined above.

Disturbing other directly and aggression

Grabbing objects or work; knocking neighbor's book or other objects off desk; destroying another's property; hitting, kicking; shoving; pinching; slapping; striking with object; throwing object at another person; poking with object; attempting to strike; biting; pulling hair.

Disruptive vocalizations

Answering teacher without raising hand or being called on;

making comments or calling out remarks when no question has been asked; calling teacher's or aide's name to get her/his attention; crying; screaming; singing; whistling; laughing loudly; coughing loudly; carrying on conversations with other children when it is not permitted.

**Improper position**

Not sitting with body and head oriented toward the front of the desk with feet on the floor, e.g., sitting on feet; standing at desk; sitting with body sideways but head facing front.

**Orienting**

Turning head or head and body to look at another person; attending to another child; looking away from front of desk (must be of four seconds duration to be scored).
### Recording Sheet for Independent Observers

**Observer:** ________________  **Time:** Begin ______ End ______  

**Date:** ________________  **Page** ______ of ________

- **X** = gross motor
- **N** = noise
- **A** = disturb others/aggression
- **V** = vocalizations
- **S** = sitting
- **O** = orienting
- **+** = appropriate behavior

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
</tr>
</thead>
</table>

**NOTES**
# APPENDIX C

**OBSERVER RELIABILITY**

<table>
<thead>
<tr>
<th>Agreements on</th>
<th>Occurrences</th>
<th>Non-occurrences</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Motor</td>
<td>55%</td>
<td>85%</td>
<td>88%</td>
</tr>
<tr>
<td>Noise</td>
<td>30%</td>
<td>96%</td>
<td>96%</td>
</tr>
<tr>
<td>Agression/Disurbing Vocalization</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Sitting Position</td>
<td>60%</td>
<td>92%</td>
<td>92%</td>
</tr>
<tr>
<td>Orienting</td>
<td>63%</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>Any Inappropriate behavior</td>
<td>80%</td>
<td>73%</td>
<td>87%</td>
</tr>
</tbody>
</table>

*This category was scored only in two 10-second intervals by one observer during the entire study; therefore, data for this category have been omitted.*
APPENDIX D

INFORMED CONSENT FORM

Dear Parent,

When people are relaxed they are more able to learn. Currently the most popular method of helping a student relax is with a pill. The pills can make him act relaxed but they do not teach him to relax by himself.

Another way would be to teach the student to relax by himself. The student can learn to relax by himself/herself if he/she becomes more aware of when he/she is tense and when he/she is relaxed.

A new method of teaching students to relax, being used across the country, is called biofeedback. This uses a machine which lets the student know how relaxed or tense he/she is. As the students get this information or "feedback," they can learn to relax themselves whenever they want to. This way they can learn self control in other situations as well. We would like to study the usefulness of this technique with several of our students. What we will be doing in this study is to train the students to relax with the aid of the biofeedback machine and then watch to see if their behaviors in the classroom improve.

Procedures

Four students in Westwood's classroom for emotionally impaired will be the subjects. Only students whose parents give permission will be included in this study.

The biofeedback training will be carried out with one student at a time in one of the rooms in Westwood School. The subjects will also be observed in their regular classroom.

The biofeedback equipment which will be used is made by J & J Enterprises and is owned by the Kalamazoo Public Schools.

The study will run for about ten weeks during the Winter, 1978, school term. Biofeedback sessions will be conducted two times a week and classroom observations three times a week. Records will be kept of the following two things: forehead muscle activity (EMG levels) and classroom behavior. These two things are explained below:
APPENDIX D (Continued)

1. EMG Levels. Forehead muscle activity of each student will be measured during individual sessions lasting about 45 minutes. To get these measurements, we need to:
   a. clean the student's forehead carefully with alcohol,
   b. tape three electrodes, each holding a little conductive jelly, to the student's forehead to measure forehead muscle activity,
   c. connect each electrode by wire to the recording machine so it can be measured.

2. Classroom Behavior. An observer will sit in the student's classroom three times a week for two hours at a time. He/she will record how often each student does certain inappropriate things, such as talking without permission, using objects to make noises, moving about without permission, not sitting correctly, and disturbing others. The observer will not say anything; he/she will just write down what the students do.

There will be three phases to this research. All students in the study will be included in all three phases, but at different times. The parents will be told when their child moves to a new phase.

   Phase 1. The subjects' forehead muscle activity (EMG levels) will be recorded as described above, but they won't be told how they are doing. Classroom observations will also begin at this time.

   Phase 2. The students will hear a noise from the biofeedback machine that tells them how relaxed they are during their training sessions. They will also talk briefly with Mrs. Akey about how they can use the skill of relaxing during the rest of the day. Classroom observations will continue as before.

   Phase 3. This will be the follow-up to the study. Classroom observations will continue. Subjects' forehead muscle activity will be recorded as before, with no noise telling the students how they are doing.

There may be some risks and uncomfortable things for the students in the study. These are:

   1. Discomfort from the electrode placement. The careful cleaning of the students' foreheads may seem unpleasant to some of them. Also, when the adhesive tape holding the electrodes in place is pulled off, it may hurt for a moment. Mrs. Akey will be careful so that these things don't hurt too much.
APPENDIX D (Continued)

2. Possible discouragement. If the students or others connected with the program hope for too much success, they may get discouraged, and the result might be that the students start acting worse. Mrs. Akey will try to prevent this by maintaining contact with the parents and teacher to see if they have noticed any problems. If this happens, Mrs. Akey and the parents will decide together whether the child should continue in the program.

3. Possible disruption of the student's schoolwork. Because each student will be out of the classroom for the biofeedback sessions for about 45 minutes two times a week, they may not get as much schoolwork done. This should not be a big problem, though, because their teacher will help schedule these sessions so that the students will not miss the most important schoolwork.

If the students do learn to relax, this may help them in many ways. They may have a longer attention span, may not move around so much, and may show more self control. If this happens, they should be able to make better progress in school and to get along with other people better.

If this program works for the students in this study, then it can also be used for other students in E.I. classrooms. This program may help all of these students to learn more self control so that they can do better in school and at home.

Betsy Akey, Research Project Coordinator
WESTERN MICHIGAN UNIVERSITY

G. Kim Thomas, Coordinator of Ancillary Services
KALAMAZOO PUBLIC SCHOOLS

BA/GKT/cjk
CONSENT FORM

I have had the proposed study explained to me and have read the attached summary of it, including the statement of possible risks and benefits. Mrs. Akey has also offered to answer all the questions I have, now, or later, about this study. I understand that I may withdraw my permission for my child to take part in the study any time I want by letting Mrs. Akey know in writing.

I understand that specific data gathered during this study will be included in a master's thesis and, if accepted, in a published article. The data regarding my child will be given in such a way that he/she cannot be individually identified. The data to be included in the thesis and possible article are: age, sex, IQ range, length of time in an Emotionally Impaired classroom, EMG scores, classroom observation scores, and frequency of home practice. The only people who will know who the subjects are and see the raw data are: Mrs. Akey; the classroom observers; the Director of Special Education, Dr. Tim Crown; the Coordinator of Ancillary Services, Mr. Kim Thomas; and after the study is done, the classroom teacher and aide. I have been assured that these people will all respect my and my child's rights to privacy. To be sure that no other people find out the children's name, records of the study will be kept in locked files at all times.

I hereby given permission for Elizabeth H. Akey to include my child in the study described in this statement.

Signed__________________________

__________________________

(relationship)

__________________________

(date)

__________________________

(witness)

__________________________

(date)