ELECTROMYOGRAPHIC FEEDBACK AS A METHOD OF REDUCING HYPERKINESIS IN CHILDREN

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR

THE DEGREE OF DOCTOR OF PHILOSOPHY IN PSYCHOLOGY

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

COLLEGE OF EDUCATION

BY

JOY A. ANDERSON, B.S., M.Ed., M.A.

DENTON, TEXAS

AUGUST 1975

TABLE OF CONTENTS

List of Tables

Abstract

Hyperkinesis is a common and baffling malady among many American elementary-school children. It has been estimated that four out of every 100 children in this age range are hyperkinetic. Hyperkinetic children often have average or above-average intelligence but their excessive motor behavior restricts academic achievement. Although the use of drug therapy and behavior modification techniques have helped parents and teachers deal with the problem of these children, these approaches have not proven to be as effective in the treatment of hyperkinesis as was supposed.

This study was undertaken as a preliminary evaluation of a psychophysiological method for training hyperkinetic children. This method required controlled relaxation and biofeedback training that should help the child develop control over excessive and distracting motor behaviors. The hypothesis basic to this research was that hyperkinetic behavior observed in children is incompatible to a relaxed muscular state. Implementation of relaxation and biofeedback training procedures should sharply reduce the rate of specified hyperkinetic behaviors.

Thirty-six male children between the ages of 6 years to 10 years enrolled in the Plano Independent School District

were the subjects for this study. The thirty-six hyperkinetic subjects were randomly assigned to either one of four independent groups. These four groups were: No treatment (NT), relaxation training (RT), electromyographic feedback training (EMG), and relaxation training in combination with electromyographic feedback training (RTEMG). The null hypotheses were that: (1) there would be no significant difference between groups as measured by the biofeedback instrument; (2) there would be no significant difference between groups as measured by the Observed Behavior Checklist; and (3) there would be no significant difference between groups on time to onset of first recorded hyperkinetic behavior. Significance of difference was arbitrarily determined to be at the $p < .05$ level.

An analysis of covariance and Tukey studentized range tests of significance were performed on the data. This analysis of data revealed hypothesis 1 was rejected. Hypotheses 2 and 3 were supported. Reported results suggest that further research is needed in the exploration of methodology that will generalize relaxation training of hyperkinetic students to classroom behavior.

Electromyographic Feedback as a Method of Reducing Hyperkinesis in Children

The problem of hyperkinetic children is well known and creates one of the most difficult situations faced by teachers, particularly at the elementary school level. The children typically perform poorly and create frequent interruptions of regular class activities. Even more frustrating for the teacher and parents is the fact that the hyperkinetic child is often intellectually capable of doing satisfactory school work, but excessive motor behavior and short attention span preclude academic success.

Millichap (1968) describes the problem of hyperkinesis as

> a frequent behavioral disorder in children and adolescents, affecting boys more commonly than girls. It has been estimated that four out of every 100 grade school children and 40 percent of school children referred to mental health clinics because of behavioral disturbances are hyperactive. They have short attention and concentration spans, and their actions are irrelevant and without clear direction, focus, or object. Restlessness, impulsiveness, and garrulousness disrupt discipline in the home and in the classroom. Thus, children with these behavioral characteristics are often regarded by those with whom they come in contact as spoiled, ill-mannered, and uncoordinated. Although the hyperkinetic child may be mentally retarded, he is often of average or above-average intelligence but below average in school work performance because of poor concentration and impaired motor, memory, and speech functions [p. 1527].

Freedman (1971) agrees that the most obvious symptoms of hyperkinetic disorders are "an increase of purposeless physical activity and a significantly impaired span of focused attention." Furthermore, Freedman states,

> In its clear-cut form, the overt hyperactivity is not simply a matter of degree but of quality. The physical activity appears driven . . . so that the activity is beyond the child's control, as compared to other children. The child is distracted, racing from one idea and interest to another, but unable to focus attention [p. 19].

In a review of the literature of research concerning hyperkinetic children, Keogh (1971) also notes the qualitative distinction of motor activity in hyperkinesis and describes it as "situationally and socially inappropriate." Thus, the qualitative aspects of the excessive motor behavior appear to be as important as the quantitative ones.

The definition and description of the hyperkinetic syndrome have typically been encompassed by terms such as "hyperkinetic behavior disturbance," "minimal brain dysfunction," "learning disability," and many others (Dupree, 1971). Clements (1966) noted 38 such terms used in the literature in reference to various learning problems in children. Part of the confusion arises from the fact that children often have special learning or reading disabilities in addition to the major symptoms of hyperkinesis. Therefore there is a confounding of behavioral, psychological, and medical-neurological conditions. Keogh (1971) concludes that evidence has shown that hyperkinesis is by no means consistently related to cerebral dysfunction. Furthermore, she finds that it is unclear whether deficits of attention, perceptual disorganization, distractibility and related symptoms should be considered as defining parameters or as correlates of hyperkinesis.

It appears that the terms describing the hyperkinetic syndrome are only slightly less varied than the multiplicity of dysfunctions described by these labels. Under these circumstances it may be fruitful to first examine the social and academic behaviors in children that are appropriately functional. Bradfield (1971) lists three sets of behaviors basic to academic achievement.

1. The first set of behaviors includes the ability to pay attention, respond, and follow directions. This is expanded to include the additional preacademic skills of taking part verbally or orally and doing what one is told in terms of reasonable class limits. These skills are basic to succeeding in a regular classroom regardless of the student's visual, intellectual, or physical abilities.

2. The second set of behaviors includes the academic abilities of being neat, being correct, being able to read, spell, write, and do arithmetic.

3. The third set of behaviors requires that the child must be able to function in the instructional settings that occur in the regular classroom, when the teacher is giving directions from the front of the room, when the child is working

> in a small group, or when the child is working independently. Differing kinds of concentration or attention are required when the entire class is reading silently for information than when the teacher is explaining a new concept at the chalkboard [p. 129].

These "productive" responses in classroom situations are typically measured by objective tests and are valued by educators as socially acceptable behaviors. Instructional programs encompassing the above concepts offer optimum opportunities for children to learn the skills necessary to facilitate maximum regular classroom integration. Hyperkinetic children are only minimally successful in achieving any or all of these behaviors. Their attention tends to be adequate, however, during activities that are of high interest.

Particularly distressing to parents, teachers, and investigators alike is the awareness that children afflicted with hyperkinetic disorders are generally potentially of normal to superior intelligence (Freedman, 1970; Millichap, 1968). Their dysfunctional behaviors interfere with their ability to approach this potential. The problem, then, is not the child's intellectual capability but his ability to use his intellect. Keogh (1971) has reviewed research with hyperkinetic children and offered three hypotheses regarding the basis for learning difficulties by these children. The hypotheses are not exhaustive nor necessarily independent, but they do represent three of the more common viewpoints concerning this matter. The first hypothesis represents the medical-neurological syndrome explanation; that is, learning problems are perceived as being caused by neurological impairment. The second hypothesis reflects the view that increased motor activity is the major obstacle to learning, due to the disruption of attention and prevention of accurate intake of information. The third hypothesis suggests that the learning problems are a function of hasty impulsive decisions in learning situations.

Although the literature suggests more support for the first and second hypotheses, the third appears to merit further investigation. The viewpoint that excessive, extraneous movement and impulsivity disrupt the learning process is one that may be susceptible to remediation and therapeutic programs within the schools.

Among the treatment approaches that have been widely used in recent years to reduce the child's level of activity is drug therapy. This type of therapy (Haring, 1969; Millichap, 1968; Millichap, Aymat, Sturgis, Larse & Egan, 1968; Wunderlich, 1970) has improved the management of hyperkinetic children and has led to small but significant improvements in the learning achievements of these children (Millichap <u>et al</u>., 1968). Nevertheless, hyperkinetic children often continue to exhibit behavior problems and do not respond well to the conventional classroom environment.

The practice of drug therapy has grown considerably during recent years. In 1969, the National Institute of Mental Health, a research arm of Health, Education, and Welfare (HEW), estimated that upward of 300,000 American school children were given mood-changing drugs to control their behavior in the classroom (Witter, 1971). In Omaha, Nebraska alone, between 5 and 10 percent of grade school children were being controlled with medically prescribed drugs (Rogers, 1971).

In addition to the mood-changing drugs, occasionally tranquilizers and sedatives are prescribed for hyperkinetic children, i.e., Mellaril, Thorazine, Miltown, Librium, etc. Tranquilizers regulate activity within the brain in such a way that they calm the individual, sometimes relieving both anxiety and aggressive tendencies. Theoretically, they would seem to be ideal for hyperkinetic children, but in actual clinical practice they rarely bring about enough improvement to justify the risks of such side effects as obesity, drowsiness, or dizziness. A significant drawback of these drugs is their tendency to put children "in a fog" and make their school performance worse. Another difficulty is that children quickly develop tolerance to these drugs, so that within a month a child may have to take large doses to get a small effect. The only sedative that is ordinarily prescribed for children is the barbiturate phenobarbital (Luminal). It usually intensifies the problems of a hyperkinetic child by increasing restlessness and excitement.

Recent studies have shown that antidepressant drugs, i.e., Tofranil, Aventyl, and Elavin, may improve the behavior of hyperkinetic children. The same drugs are widely prescribed for bed wetting and for such problems as sleepwalking and night terrors. The antidepressants can produce a number of side effects, such as headaches, drowsiness, a "jazzed up" feeling, blurred vision, muscle tremors, constipation, dizziness, and palpitations.

Central nervous system stimulants are by far the most frequently prescribed medications for hyperkinetic children, i.e., Benzedrine, Dexedrine, Medex, Ritalin, etc. The common side effects of these drugs are loss of appetite, difficulty getting to sleep at night, pinched face with sunken eyes known as the "amphetamine look," and sadness, with a tendency toward crying spells. Some children experience nausea, headaches, cramps, or jitters. The unusual child who is particularly sensitive to the drugs may show any of these symptoms on relatively small doses.

The practice of pharmacological control of hyperkinetic children raises serious questions concerning the long-term physiological and psychological effects of prolonged drug therapy which have not yet been answered. For the present, drug medication represents a convenient but imperfect alternative that is frequently selected as a treatment modality.

Another treatment approach that has received much attention in recent years and which offers considerable promise is referred to as behavior modification. This approach commonly involves an operant conditioning technique by which desirable behavior is conditioned or "shaped" so that undesirable behavior is reduced through the programmed use of reinforcements (Skinner, 1963; Grossberg, 1964). The technique has been employed with considerable success in a wide variety of situations, including the treatment of children with learning disabilities. This method seeks to improve attention and performance through the utilization of external reinforcements according to a pre-arranged schedule. The rationale is to provide the child with reinforcement for relatively small segments of behavior in which appropriate responses are made which are within the child's capabilities. Once the child succeeds in the simplified setting and is rewarded for it, the probability is theoretically increased that the appropriate behaviors will recur in the future. The reinforcements are gradually shifted to encompass broader segments of behavior.

According to Palmer (1970) high anxiety is an important basic component to the hyperkinetic syndrome. The term "anxiety," as used by many investigators, is not behaviorally defined but would appear to be, in some part, analogous to behaviors that require a tense muscular state. There is some evidence, then, that anxiety (muscle tension) interferes with performance in complex learning and problem solving tasks (Spence, 1958; Martin, 1961; Harleston, Smith, & Arey, 1965; Tecce, 1965; Denny, 1966; Spielberger & Smith, 1966). If muscle tension does, indeed, interfere with performance of tasks that is basic to academic learning, another conditioning technique, similar to operant conditioning, may have therapeutic potential. The focus in this approach is to condition the individual to control his muscle tension through relaxation procedures. If muscle relaxation reciprocally inhibits anxiety, it would be expected to increase the efficiency of highly tense subjects in learning situations and to decrease sympathetic nervous system activation during learning. Jacobson introduced a method of systematic training in muscle relaxation as a therapy for various psychosomatic and psychoneurotic syndromes. On the basis of available neurophysiological evidence, he hypothesized that reduced muscle tension should lead to reduced autonomic nervous system activity, especially reduced sympathetic reactivity (Jacobson, 1938).

Although the literature reporting Jacobson's work does not speak directly to the problem of treating hyperkinesis, the probability appears to be increased that muscle relaxation might lead to reduced activity levels in these children. The view that an individual can acquire voluntary control over a variety of physiological functions and, in so doing, alter his psychological states for the better is not a new idea. Techniques such as autogenic training (Schultz & Luthe, 1959) and Jacobson's (1938) progressive muscle relaxation were already well-launched by the second quarter of this century. Budzynski (1972) suggests that at the present time, two developments promise to extend vastly the entire range and power of such an approach: (a) there is accelerated growth and proliferation of electronic instrumentation; researchers are now able to measure physiological events in the intact human which formerly were difficult or impossible to measure; and (b) a related factor is the introduction of the psychophysiological feedback loop called "biofeedback." The core of the biofeedback technique is the precise detection of a physiological event electronically and then reporting it via either an auditory or visual feedback signal thus making the subject immediately and continuously aware of the level of a physiological event. The biofeedback technique is an approach which promises to extend greatly the ability of man to acquire voluntary control over a variety of physiological functions.

Although no systematic study of biofeedback procedures has been conducted with hyperkinetic children, there are many research studies cited in the literature which reveal scientific evidence of the widespread clinical applications of biofeedback technology. Budzynski and Stoyva (1969) have repeatedly shown positive results in many independent studies attesting to the beneficial effects of profound muscle relaxation in alleviating a number of stress-related disorders. Budzynski, Stoyva and Adler (1970) have reported reasonable success in controlling tension headaches by using feedback relaxation of the frontalis muscle. According to these researchers, the frontalis muscle is the focal muscle of their relaxation training because of a certain valuable property of this muscle. When the frontalis muscle is deeply relaxed there seems to be good generalization to other muscle groups. They suggest that if a single muscle is to be used for purposes of relaxation training, then the frontalis is the muscle of choice. Once subjects are able to master this difficult-to-relax muscle, they can usually apply their newly-acquired skill to other muscle groups which have not received specific feedback training. Thus, the subject himself can deliberately produce generalization to other muscles. The biofeedback system will not produce relaxation; it functions as an information source to the subject that reflects the state of his muscle tension.

The purpose of the present study was to evaluate whether muscle relaxation and EMG biofeedback training could be effective treatment modalities for hyperkinesis. No prior systematic research of biofeedback procedures has been conducted and reported in the literature with hyperkinetic children.

Persistently overactive, distractible, and impulsive, the hyperkinetic child is a constant problem to himself and to others. In school he creates chaos; at home, he is boisterous and untidy. Parents and teachers find it difficult to like him; and, saddest of all, often he does not like himself (Stewart & Olds, 1973).

Much of the research on hyperkinesis reported in the professional literature deals with diagnosis and treatment (Freibergs, 1969). The development of diagnostic procedures have typically included physical, neurological, social, behavioral, psychological, and educational evaluations. The physical and neurological approaches focused early on the relationship between brain damage and hyperkinesis. Loss of conceptual ability or "abstract attitude" is the classical symptom reported in individuals known to have suffered cerebral lesions (Battersby, Krieger, Pollack, & Bender, 1953).

In 1924, Dr. Franklin G. Ebaugh of Philadelphia reported severe hyperactivity (hyperkinesis) in a group of seventeen children who had suffered attacks of encephalitis during the 1918 epidemic and had been seen subsequently at the neuropsychiatric clinic at Philadelphia General Hospital. Among the children who recovered from the acute phase of encephalitis, many later showed a catastrophic change in personality; they became hyperactive, distractible, irritable, unruly, destructive, and anti-social. Many of the children had been referred to the hospital clinic by school authorities because they were "unmanageable" and were not making progress in school (Stewart & Olds, 1973). Subsequent to the Ebaugh study, brain injury sustained during the birth process or in the post-natal development period had been found to be a factor precipitating hyperkinetic behavior. Many of the reported studies appear to be suspect on the grounds of inadequate research controls. It appears that research supports only the fact that brain injured children have a higher probability of displaying hyperkinetic behavior than nonbrain-injured children. Only about one out of ten hyperkinetic children who are referred to a psychiatric clinic has any reported history of previous brain injury. By and large, the mothers of these children had uneventful pregnancies, the birth experiences were normal, and the children's early years were free of illness and injuries known to damage the brain. Complications of pregnancy and delivery are no more common among hyperkinetic children than among children in the general population (Stewart & Olds, 1973). A critical evaluation of the literature reveals that the evidence linking hyperkinesis to various signs of brain damage is extremely inconclusive (Douglas, 1965). Thus, brain trauma has been found to be only one possible causative factor. With the development of new drugs that appear to modify behavior, the search for answers to the problem of hyperkinesis expanded to biochemistry.

In 1937, Dr. Charles Bradley published the first report on the effects of benzedrine on children with behavior problems (Bradley, 1937). He was director of the Emma Pendleton Bradley Home in East Providence, Rhode Island, a residence for children suffering from severe behavior disorders. He has prescribed benzedrine to raise the blood pressure in certain children in an effort to rid them of headaches. The benzedrine did not seem to affect the headaches, but it changed the behavior and school performance of the children. It spurred the child's interest in school, apparently improved his ability to work, and calmed his aggressive behaviors. The idea that hyperkinesis has a biochemical factor is suggested by the fact that in approximately half of the diagnosed cases of the syndrome some of the most distressing symptoms can be relieved by giving stimulant drugs (Baldessarini, 1972).

Although mood-changing drugs, i.e., tranquilizers, sedatives, antidepressants and stimulants are not routinely prescribed for hyperkinetic children, improved school performance does not necessarily follow. These children often become drowsy, obese, or dizzy while taking prescribed medications. It has become clear that modifying body chemistry is only one possibility when considering the treatment modality for hyperkinesis. Poor academic performance is part of the child's problem already; he can ill-afford the negative effects of drug therapy.

Conceptual difficulties as characterized by hyperkinetic children have been reported by several authors (Burks, 1960; Clements & Peters, 1962; Rosenfield & Bradley, 1948) without offering any supportive objective evidence. Rather, the children's poor academic performance was somewhat freely interpreted as resulting from specific learning defects in reading, spelling, or in some cases, only arithmetic and number concepts. Burks (1960) has suggested that the conceptual difficulties of hyperkinetic children reflect "inefficient patterning and processing capabilities of the brain." Similarly, Clements and Peters (1962) refer to an impaired "capacity to receive, hold, scan, and selectively screen out stimuli in sequential order." Freiberg (1969) found no objective evidence of cognitive impairment when comparing the performance of hyperkinetic and normal children in a controlled learning situation involving concept formation tasks. However, an interesting point which Freiberg discusses in her article on hyperactive (hyperkinetic) vs. normal children suggests an explanation for performance decrements often observed in the hyperkinetic child. She related the performance decrements of hyperkinetic children as being due to a higher than average sensitivity to frustration. According to Freiberg's consideration of Amsel's (1962) theory regarding frustration she explains that a secondary form of frustration, r_f, or fractional anticipatory frustration, develops over a series of learning trials through a process of classical conditioning. This, in turn, produces two different effects which are in competition during the intermediate phase of learning; activating or drive effects, and inhibitory effects producing a partial decrease in strength of the instrumental response. The inhibitory components of r_f would favor abandoning any hypothesis that had not resulted in reinforcement. Discarding hypotheses after one, or even a few trials would make it impossible to reach a correct solution. Similarly, the activitation component of r_f, by raising the child's level of arousal above an optimum limit, would decrease the likelihood of task-relevant discriminations by interfering with cue function of stimuli (Hebb, 1955). This would retard the discovery of the correct concept by interfering with the search for common elements. Freiberg found a basis for Amsel's theory in that many of the hyperkinetic children in her study had difficulty continuing to search for hypotheses that would lead to the correct response. Some of the children clearly abandoned any attempts at rational solutions, and a few others claimed they had the right answer despite the absence of a confirmation from the experimenter. This appears to be supportive of Werry, Weiss and Douglas (1964) that a chronically excessive level of arousal is the problem underlying distractibility, hypersensitivity, and low frustration tolerance. Thus, the hyperkinetic child seems to have abnormally low response thresholds whether the response be skeletal (hyperkinesis), autonomic (irritability, hypersensitivity), or cognitive (distractibility).

Just as drug therapy has been directed toward reducing the hyperkinetic child's arousal level, a recent psychological technique, behavior modification, has been used to teach the child to increase his response thresholds.

One of the most interesting studies using behavior modification techniques was reported by Patterson, Jones, Whittier and Wright (1965). The report described the procedures used in the conditioning of attending behavior in a hyperkinetic boy. Several weeks of baseline observations of two hyperkinetic children (one designated experimental and one control) provided data on frequency of occurrence of high rate responses such as walking, talking, distraction, and wiggling." Conditioning procedures were then initiated for the experimental subject in an effort to change his classroom behavior. Reinforcement was given following ten-second time intervals in which non-attending behaviors were absent. Involvement by the experimental subject's classmates was also introduced by allowing him to "earn" rewards for them as well as himself. In other words, by suppressing non-attending behaviors he earned token rewards for himself and others, in which case he received social reinforcement or approval from his peers.

The results revealed that the experimental subject showed a marked improvement in attending behavior as opposed to the control subject. It should be noted, however, that the control subject did not participate in any conditioning procedures and that the observers who rated the children's behavior were aware of the identity of the experimental subject. This study would have been improved through the use of "blind" observers and of another control subject given specialized treatment similar to that of the experimental subject. In spite of these limitations and the use of only one experimental subject, the results merit close study.

Similar procedures were used (Cobb, Ray, & Patterson, 1971) in an extension of this research, involving seven hyperkinetic boys in a classroom setting. Attending behavior was improved in the children to the level of that of average male peers, and the gains were maintained during the five-month follow-up period.

A specific conditioning technique that relates closely to behavior modification but has not been reported in the literature relating to hyperkinesis may offer a new approach directed toward reducing the child's high level of random activity. This method is commonly referred to as progressive muscle relaxation (Jacobson, 1938). The procedure developed by Jacobson (1938) was based on his observation that tense, anxious patients typically show elevated levels of muscle tension. Progressive muscle relaxation was designed to teach the patient to replace body tension with a state of physiological relaxation.

The work of Wilson and Wilson (1970) explored the effects of muscle relaxation on paired-associate learning efficiency and on psychophysiological responses during learning. The study did not deal directly with the therapeutic value of muscle relaxation; rather it dealt with some of the basic assumptions underlying the use of muscle relaxation in therapy. Subjects were divided into high, medium, and low anxiety levels and muscle tension, muscle relaxation, and normal tension groups. The hypothesis was tested that muscle relaxation would reciprocally inhibit anxiety (muscle) tension) during a paired-associate learning task. Paired-associate learning efficiency, as well as heart rate, skin conductance, integrated electromyogram, respiration rate, and finger temperature during learning were measured. The results of the Wilson and Wilson study found partial substantiation for the hypothesis under high tension levels, but data for the other groups were inconsistent with the hypothesis. An alternative explanation for the inconsistent results was based on the insufficient strength in the use of muscle tension and muscle relaxation. These researchers suggest that it would be desirable to train subjects much more thoroughly in muscle relaxation prior to studying its effects on learning efficiency and that an experimental situation be devised in such a way that higher levels of muscle tension could be comfortably induced by allowing subjects to rest between trials.

If one were to consider the efficacy of behavior modification and muscle relaxation techniques, singly, each method appears to show promise in relieving symptoms of hyperkinesis. An objective method of monitoring muscle tension levels called "biofeedback" has recently become available. The biofeedback device not only is capable of reporting certain body states on psychophysiological scales but has a proven usefulness in behavior training (modification). Biofeedback appears to have considerable potential, in combination with behavior modification and muscle relaxation in alleviating the high activity level apparent in hyperkinetic children.

The behavior therapy of Jacobson formed the background for the work of Dr. Joe Kamiya of the University of Chicago. In 1968 he published his report on "Conscious Control of Brain Waves" (Kamiya, 1968) describing experiments in which subjects learned to control their brain waves. A computer connected to the electroencephalograph turned a tone signal on whenever the subject produced an alpha brain wave. Many subjects described a feeling of well being and tranquility associated with these waves. Subsequent to Kamiya's work, Budzynski and Stoyva (1971) also found that when subjects were provided with immediate tone feedback as to the presence or absence of alpha brain waves they were able to increase their alpha levels (percent of time EEG record shows alpha rhythms). These subjects indicated that alpha condition was associated with feelings of tranquility and relaxation. They reported that the production of alpha waves was facilitated by the suppression of visual imagery, but that any feelings of tension would immediately block the alpha rhythm. Further, the subjects found that as soon as they began visualizing any scene, unpleasant or pleasant in nature, the alpha rhythm disappeared. Consequently, it was not possible to use the absence of alpha as an indicator of muscle tension.

In other independent studies, Budzynski and Stoyva (1972) found that some subjects show a high amount of alpha most of the time in which there appeared to be little change in percent alpha as the subject switched from subjectivity to unpleasant imagery, or to a condition of no imagery. They also found that some subjects showed little or no alpha, even when they were relaxed.

Neal Miller (1969) reported research that challenges the concept that "learning" in the automatic nervous system is a reflection of skeletal muscle activity. He has shown that heart rate, gastrointestinal contractions, blood pressure, and the rate of saliva and urine formation in animals can be directly controlled through "operant conditioning techniques" via the autonomic nervous system. Dr. Miller reported to have trained rats to increase and decrease their heart rates, blood pressure, intestinal contractions, and other visceral functions by biofeedback techniques that rewarded correct responses. His methods facilitated such fine discrimination that they were even able to teach rats to make one ear blush and not the other. Dr. Miller called this phenomenon "instrumental learning of glandular and visceral responses" and strongly challenged the accepted belief that physiologic functions mediated by the autonomic nervous system were beyond the reach of an individual's conscious control.

Sargent, Green and Walters (1972) of the Menninger Foundation have reported successful results in the treatment of migraine headaches using temperature feedback combined with relaxing "autogenic phrases," a method called "autogenic feedback training." The possibility of using autogenic feedback training for headache patients was first suggested by the experience of a research subject of Doctor Green. She was in training to learn to control brain waves, to reduce electromyographic potential in the forearm musculature and to increase blood flow in the hands, which is measured by hand-skin temperature and is directly related to blood flow in the hands as measured by a photoplethysmograph. In this subject, spontaneous recovery from a migraine headache was correlated with a noticeable increase in blood flow in the hands and an accompanying rise in temperature of 10 degrees Fahrenheit in two minutes. Two other migraine sufferers who heard of the incident requested temperature feedback training; one reported complete relief, the other partial relief. That led the investigators to undertake a clinical trial. They recruited 75 patients; 63 migraine sufferers, ten with tension headaches, two with cluster headaches. After instruction, each was given a "temperature trainer" that measured the difference between index-finger and mid-forehead temperature. Each patient also got a typewritten list of autogenic phrases, such as: "I feel quite quiet," "My arms and hands are heavy and warm," to concentrate on while using the device.

With a month's practice, most patients no longer needed the feedback device. After a year or more, a patient's success was judged by each of the three investigators separately, using different criteria. The researchers considered that 75 percent of the migraine sufferers were improved.

For tension headaches, an entirely different type of biofeedback is being applied by Budzynski and Stoyva of the University of Colorado Medical Center (Budzynski & Stoyva, 1972). They developed an electromyographic feedback device that provides the subject with immediate information as to his level of muscle activity. The subject hears a tone through his headphones and as he relaxes the muscles being monitored, the tone decreases in frequency. A "shaping" procedure constitutes an important part of this training technique--as the subject becomes better at relaxing, the task is made more difficult for him by turning up the gain of the feedback loop. Budzynski, Stoyva, and Adler (1970) placed electromyographic electrodes on the patient's forehead and provided him with an analog tone. This tone tracked the level of tension in the forehead (frontalis), and decreased in pitch as the tension decreased. The patients were told to try to keep the tone low in pitch. Over a period of four weeks to two months, the patients learned to keep the muscles relaxed; in all five patients, headaches diminished markedly in intensity and frequency.

In another application, EMG biofeedback is being tried as a treatment for asthma. At Denver's National Jewish Hospital and Research Center a team headed by research psychologist Robert A. Kinsman is combining the deep-muscle relaxation technique, using EMG biofeedback with a systematic desensitization program (Medical World News, 1973). Although the results have not been analyzed and reported, the investigators have noted a positive statistical trend.

The purpose of this study was to evaluate whether EMG biofeedback and muscle relaxation training are an effective treatment modality for hyperkinesis. The following null hypotheses were tested.

1. It was hypothesized that there would be no significant differences between groups as measured by the biofeedback instrument.
2. It was hypothesized that there would be no significant difference between groups as measured by the Observer's Behavioral Checklist.
3. It was hypothesized that there would be no significant difference between the NT, EMG, RT, or RTEMG groups in "time to onset of first recorded hyperkinetic behavior" as measured by the trained observers (raters).

Method

Subjects

Thirty-six males between the ages of six and ten years enrolled in the Plano Independent School District served as subjects for this study (mean age = nine years;

mean grade level = fourth grade). The population of children in the educational mainstream whose primary academic disability appeared to be the hyperkinetic syndrome as identified jointly by the staff of professional counselors, school psychologists, principals and regular classroom teachers employed by the Plano Independent School District constituted the research population. Forty male subjects were randomly sampled from the population of sixty-two identified hyperkinetic children. Forty-four subjects signed a participation consent form and forty-four parents signed a parental authorization consent form and agreed to keep careful records of medication intake during the term of this investigation (Appendix A). Four subjects were dropped during the course of the study; one from the relaxation training in combination with biofeedback training (RTEMG) group due to diagnosed epilepsy, one from the electromyographic biofeedback training (EMG) group due to kidney surgery, one from the relaxation training (RT) group due to chicken pox and one from the RT group due to the subject's absence during pre-test biofeedback sessions. Children taking prescribed drugs were included in the study. Classroom teachers in the classroom from which the subjects were drawn were unaware (blind) to the experimental conditions of the individual subjects in a particular group and were also unaware (blind) as to which students were selected as subjects.

Apparatus

The following instruments were employed to secure the data for this study.

1. Portable EMG Feedback System Model PE-2. A biofeedback electronic recorder designed specifically to yield physiological measures of muscular tension. Visual display of physiological activity level was reported on a meter output scaled from 6 to 50 representing surface EMG levels from 2.0 to 30.0 microvolts. The auditory feedback is in the form of a series of clicks. The repetition rate of clicks is proportional to the EMG level (Appendix B).

2. Observer's Behavioral Checklist, developed by the author, consists of 28 behavioral manifestations that are most frequently cited in the literature by authorities who are concerned with this particular speciality regarding the hyperkinetic syndrome in children. Trained observers recorded the frequency of designated hyperkinetic behaviors within the classroom setting (Appendix C).

Procedures

The study consisted of four phases; (1) Pre-test, (2) Training, (3) Post-test, and (4) Debriefing.

Pre-test. Observations of classroom behavior; two trained observers (raters) recorded on the *Observers Behavioral Checklist* the frequency of each subject's target behaviors for ten minutes each day, five days a week for two weeks during and within the regular and usual conditions of the child's school attendance. At the end of the two-week observation period a mean of the ten observations was calculated to represent each subject's pre-test behavioral measure. Subjects were randomly observed during their regularly scheduled math, reading, social studies or spelling classes by randomized pairs of observers (raters). Each observer used a stopwatch in order to keep to exactly the same time pattern of observations. On each observation day, the observers (raters) recorded the time interval from beginning of observation to "time to onset of first recorded hyperkinetic behavior" for each child. Interrater reliability was tested and the results of this test are reported in the Results section.

Pre-test. *Biofeedback Test*. Upon completion of the pre-test behavioral phase, 40 subjects were assigned randomly to one of four independent groups, 10 subjects in each group. The biofeedback pre-test was conducted on all subjects immediately after school in the experimenter's office. There were two sessions for the purpose of recording pre-test EMG levels. The initial session was conducted for the purpose of introducing the children to the training program and its environment. The subsequent session was conducted to obtain each subject's EMG pre-test measure. Each subject was tested individually and was requested to use the restroom and to get a drink of water before the experimenter thoroughly cleansed the subject's forehead with the Brasivol compound (fine) with the cotton applicators provided. When the subject entered the experimental setting, he was seated in a chair appropriate for his size and was then given the biofeedback training instructions (Appendix D). All subjects were prepared for testing according to the suggestions outlined in the Technical Manual. The elastic band containing the plastic electrode cups was placed on the forehead so that the center cup was centered on the forehead about one inch above the eyebrows. The earphones were adjusted and an adaptation period to the EMG testing process of one minute preceded each training session to allow the subjects physiological responses to stabilize. EMG biofeedback sessions consisted of eight minutes of continuous practice, and recordings were taken at sixty-second intervals during this eight minute testing phase (Appendix E). EMG meter readings which were erratic due to change in body position, eye blinks, yawning, etc., were not considered valid scores and were not recorded for that time interval. The EMG pre-test score consisted of the average of the eight readings obtained during the pre-test phase.

Training. Upon completion of both the behavioral and EMG biofeedback pre-testing phases, there were five consecutive training sessions for each subject that were appropriate to the subject's group assignment. The four groups were: no treatment (NT), relaxation training (RT), electromyographic biofeedbakc training (EMG), and relaxation training in combination with biofeedback training (RTEMG). Subjects in the NT group met individually in the experimenter's office at the end of each school day and were engaged in activities outlined in the DUSO (Developing Understanding of Self and Others) Series I and II, published by Science Research Associates. Subjects in the RT group practiced the relaxation exercises for children (Appendix F). Each RT subject, while in training, was also tested in the experimenter's office at the end of each school day. Each subject was tested individually and was requested to use the restroom and to get a drink of water before entering the experimental setting. When the subject entered the experimenter's office, he was seated in a chair appropriate for his size and then received the relaxation training exercises (Appendix E). The relaxation routine lasted approximately eight minutes, and the same procedures were followed for each subject during each day of training. The same procedures were followed for the EMG subjects. The subjects met in the experimenter's office and followed the procedures and instructions of the EMG pre-test. The RTEMG group training differed from the RT relaxation group training only in that the RTEMG subjects received the eight minutes of relaxation exercises in the experimenter's office immediately followed by EMG training. Instructions for both types of training were identical to those outlined for the RT and EMG subjects. Three subjects from each group received the training appropriate to their group during the same week. Thus, three NT, three RT, three EMG, and three RTEMG subjects were in active training in a given five-day massed trial period.

Post-test. The post-test measures on classroom hyperkinetic behaviors were a replication of the procedures conducted during the pre-testing phase. Two trained observers recorded the frequency of each subject's hyperkinetic behaviors for ten minutes each day, five days a week, for two weeks. At the end of the two-week observation period, a mean was obtained to represent each subject's post-test behavioral measure.

After each subject received five consecutive training sessions appropriate to his group assignment, one post-test EMG session was subsequently conducted in order to obtain a post-test EMG measure that replicated the pre-test procedure, i.e., it consisted of eight minutes of continuous practice, and recordings were taken at 60-second intervals during the eight-minute testing phase. The EMG post-test score consisted of the average of the eight readings obtained during the post-test phase.

Debriefing interview. At the conclusion of this study each subject was asked about his hypotheses as to what the study was about and was encouraged to give a subjective report of his experience. The opportunity was made available to each subject to receive an alternate training method upon request. The procedures followed throughout the duration of this study were those outlined in the Ethical Principles in the Conduct of Research with Human Participants, published by the American Psychological Association.

Statistical Analysis

Computer analysis of data was performed at the Texas Woman's University Computer Center. An analysis of covariance was conducted to analyze scores yielded by the dependent variables using pre-test as covariant. In testing hypothesis 1, a covariance analysis was used to reveal the possible differences between experimental groups as measured by the EMG instrument. This procedure resulted in an F ratio which indicated whether significant differences were present or not, but did not reveal specifically which groups were involved. Hence, a Tukey's Test was used to find which groups were significantly different from each other. A $p < .05$ level of significance was selected for this statistical test. In testing hypotheses 2 and 3, i.e., Observers Behavior Checklist and Time to onset of first recorded hyperkinetic behavior, differences between experimental groups were tested against treatment conditions (independent variables) for significance by an analysis of covariance. A $p < .05$ level of significance was arbitrarily assigned for all analysis of covariance tests.

Results

In a test of preliminary to actual data collection, interrater reliability was established. In order to establish interrater reliability the eight observers used in this study viewed a video type of a regular classroom setting which consisted of approximately twenty-five second grade students. The procedure was as follows: (1) observers watched one child's behavior for three minutes, another child's behavior for three minutes, etc., for a period of fifteen minutes, (2) rest for five minutes, and (3) repeat the same procedures for six fifteen-minute periods. The data collected during this one and one-half hour period provided information on the number of behaviors and the type of behavior observed by each rater. The correlation coefficient indicated a highly dependable positive correlation ($r > .96$). A summary of the interrater reliability for all possible combinations of eight raters is presented in Table 1.

Results of an analysis of covariance between the four experimental groups, as measured by the biofeedback instrument, revealed a significant difference between groups, $F(1,31) = 11.9842$, $p < .001$ (Table 2). The means and standard deviations for pre and post scores for each treatment group are presented in Table 3.

Table 1

Interrater Reliability Correlation Coefficients for all Possible Combinations of Eight Raters

Raters	Raters 1	2	3	4	5	6	7	8
Correlation Coefficients								
1	1.0000	0.9725	0.9809	0.9793	0.9627	0.9740	0.9755	0.9678
2	0.9725	1.0000	0.9741	0.9836	0.9820	0.9777	0.9822	0.9953
3	0.9809	0.9741	1.0000	0.9772	0.9820	0.9886	0.9773	0.9676
4	0.9793	0.9836	0.9772	1.0000	0.9781	0.9736	0.9855	0.9823
5	0.9627	0.9820	0.9820	0.9781	1.0000	0.9804	0.9883	0.9784
6	0.9740	0.9777	0.9886	0.9736	0.9804	1.0000	0.9714	0.9751
7	0.9755	0.9822	0.9773	0.9855	0.9883	0.9714	1.0000	0.9781
8	0.9678	0.9953	0.9676	0.9823	0.9784	0.9751	0.9781	1.0000

Table 2

Summary of Analysis of Covariance for the

Biofeedback Scores

Source	df	SS	MS	F	p
Between	3	8.2600	2.7533	11.9842	.0001
Within	31	7.1221	.2297		
Total	34	15.3821			

Table 3

Means and Standard Deviations for Pre-and Post-Biofeedback Scores for Each Treatment Group

Group	Mean		Standard Deviation	
	Pre-	Post-	Pre-	Post-
NT	5.3200	4.7320	1.2625	.9374
RT	4.0962	3.7437	.7733	.6624
EMG	4.8378	3.3633	1.0585	.6935
RTEMG	5.1322	3.5911	.9810	.7627

A post-hoc Tukey studentized range statistical test showed the overall differences to reside primarily with the EMG and RTEMG groups being significantly different from the NT and RT groups ($p < .05$). A summary of these tests is presented in Table 4.

A covariance analysis using pre-test as covariant was carried out on Classroom Hyperkinetic Behavioral Measures. A summary of these results is presented in Table 5 and reveals no significant difference between groups.

Table 4

Summary of Tukey Studentized Range Tests of Significance on Adjusted Means

Groups	Groups: No Training	Groups: Relaxation Training	Groups: Relaxation Training and EMG Training	Groups: Electromyographic Feedback Training	r	q.95(4,31)
No Training	-	1.5864	6.5305*	6.2092*	4	3.84
Relaxation Training		-	4.6228*	4.9442*	3	3.49
Relaxation Training and EMG Training			-	.3214	2	2.89
Electromyographic Feedback Training			-	-	-	-

*$p \leq .05$

Table 5

Summary of Analysis of Covariance for the

Classroom Hyperkinetic Behavior

Source	*df*	*SS*	*MS*	*F*	*p*
Between	3	34.6172	11.5391	1.1231	0.3548
Within	31	318.5137	10.2746		
Total	34	353.1309			

The means and standard deviations for pre- and post-scores for each group on Classroom Hyperkinetic Behavioral Measures are presented in Table 6. A summary of behavior by categories is reported in Appendix H.

Table 6

Means and Standard Deviations for Pre-and Post-

Classroom Hyperkinetic Behavioral Measures

for Each Treatment Group

Group	Mean		Standard Deviation	
	Pre-	Post-	Pre-	Post-
NT	29.8250	26.9200	8.5075	6.9952
RT	34.8750	32.2187	9.9314	11.2300
EMG	25.1389	20.7222	8.8774	8.0885
RTEMG	20.8000	18.8722	6.1175	6.1514

A covariance analysis using pre-test as covariant was carried out on Time to Onset of First Recorded Hyperkinetic Behavior. A summary of these results is presented in Table 7 and reveals no significant difference between groups. The means and standard deviations for pre-and post-scores for each group on Time to Onset of First Recorded Hyperkinetic Behavior are presented in Table 8.

Table 7

Summary of Analysis of Covariance for the Time to Onset of First Recorded Hyperkinetic Behavior

Source	df	SS	MS	F	p
Between	3	531.4316	177.1439	1.6826	0.1910
Within	31	3263.6628	105.2794		
Total	34	3795.0945			

Table 8

Means and Standard Deviations for Pre- and Post-
Time to Onset of First Recorded Hyperkinetic
Behavior Scores for Each Treatment Group

Group	Mean		Standard Deviation	
	Pre-	Post-	Pre-	Post-
NT	11.0500	12.7200	4.1086	3.9707
RT	7.9125	16.4562	6.4981	22.1782
EMG	11.9611	7.8111	11.7544	2.8428
RTEMG	7.3167	11.6278	6.7040	7.3879

Discussion

It was obvious to this investigator, after a review of pertinent literature, that arriving at a manageable list of behaviors representative of those observed in the group labeled "hyperkinetic children" would be difficult and perhaps result in an arbitrary and subjective list. As a result, only those behaviors which most authorities agree on as being indicative of hyperkinesis were used. In addition, the reliability of the observers would have to be established. Because the results of this study indicated that there was a significant difference in treatment between the experimental groups by no significant difference in their behavior in the classroom, it would appear that the relaxation skill acquired during the training session did not transfer to the classroom. This finding suggests that future research should be concerned with an effective method for teaching such transfer of training into the classroom.

In the study reported here, subjects were taught to relax without awareness of the usefulness of this skill. It was noteworthy that the EMG and RTEMG groups indicated a significant ability to gain muscle relaxation as measured by the biofeedback instrument than all other treatment groups. The effects of adding the relaxation exercises in combination with the EMG biofeedback instrument (RTEMG) indicated no significant improvement in achieving the relaxation skill. The present study strongly indicates that the EMG biofeedback instrument is the preferred method for teaching relaxation to hyperkinetic children out of the four possible treatment conditions.

Hypothesis 2 was tested _via_ a covariance analysis and yielded no significant difference in classroom hyperkinetic behavior. A number of investigators have examined the conceptual difficulties which are characteristic of the hyperkinetic child (Burks, 1960; Clements & Peters, 1962;

Rosenfield & Bradley, 1948). Freiberg (1969) found that performance decrements often observed in the hyperkinetic child are related to low frustration thresholds. Freiberg's research was supported by the findings of Werry, Weiss, and Douglas (1964) that the hyperkinetic child appears to have abnormally low response thresholds whether the response be skeletal (hyperkinesis), autonomic (irritability, hypersensitivity), or cognitive (distractibility). Cognitive aspects of an experience are generally anticipated as being highly important to success in various types of treatment modalities and display significant relationships to treatment outcomes. If hyperkinetic children have conceptual difficulties and low frustration thresholds as reported by other investigators, this may be considered an important variable in the lack of behavioral change in the classroom situation regardless of treatment.

Also of primary importance within the present study design was an unawareness by the subjects as to the goal of the relaxation training and what behavior was expected by the experimenter, i.e., reduced frequency of hyperkinetic behaviors. Thus, it was the intent of this investigator to extend the work of the research reported on conceptual difficulties and frustration thresholds of hyperkinetic children into methods of effecting behavioral change. Because the results of this study indicate that the relaxation skill, as measured by the EMG instrument, can be taught in a short time span, it is hypothesized that the subjects may need to become aware of the new skill's usefulness to them in avoidance of frustration that should, in turn, free them to better utilize their cognitive potential. The research design excluded overt transfer of training of the relaxation skill into the classroom.

One important direction for further research will be addressed to effective methods of transfer of training of the learned relaxation skill to the classroom. For example, subjects might show significant behavioral differences in the classroom if they received systematic social reinforcement, i.e., praise and approval from teachers and peers for nonhyperkinetic behaviors. This view is supported by Patterson, Jones, Whittier, and Wright (1965). Bradfield (1971) supported the effectiveness of reinforcement programs used in the classroom and noted their effectiveness in improving social and academic behavior in child populations.

Although the results recorded by observers during the pre- and post-behavioral phases did not yield significant differences, the EMG dependent measure shows that significant control was achieved during training. Therefore, to increase the generalization effect, it will be important that emphasis should be extended to assure reinforcement of relaxation training to other learning settings.

Hypothesis 3 was tested *via* an analysis of covariance and yielded no significant difference in time to onset of first recorded hyperkinetic behavior. A replication of this paradigm to another segment of the school year would be desirable in order to check and expand this hypothesis.

It is hypothesized that achievement test evaluations, the ending of the school year, the excitement of the children during field trips to Camp Goddard Environmental Program in Oklahoma, and prescribed medication could have influenced the frequency of a certain type of behavior. Medication of subjects was monitored and could be an influential factor in some types of behavior and should be considered carefully in future research. Four subjects in the NT (no training) group were taking medically prescribed Ritalin either twice or three times daily; three subjects in the RT group were also taking Ritalin; and, by coincidence, medication (Cylert) was begun for two RT subjects during the second week of pre-test behavioral observations. The effect of this medication for these subjects appeared to make a dramatic change in certain of their overt classroom hyperkinetic behaviors; however, four subjects in the EMG group were taking Ritalin and/or Cylert, but the medication appeared to have little effect on any of their overt classroom hyperkinetic behavior. Two subjects in the RTEMG group were taking Ritalin throughout the duration of the study, and no marked changes were noted in their overt classroom behaviors. Again, replication of this paradigm to another segment of the school year and control of medication would be desirable for future research.

With some refinement of the proposed techniques, teaching hyperkinetic children self-control of their hyperkinetic behavior appears to be applicable and feasible. The strongest thrust for future research should be in the methodology of transfer of training with reinforcement of the relaxation skill to the classroom.

Summary

This study dealt with the chronic educational problem of hyperkinetic children in the elementary school grades. Many techniques have been tried to help these students reduce their excessive, extraneous movement, and impulsivity that disrupt regular classroom activities.

The purpose of this study was to evaluate biofeedback and muscle relaxation training as effective treatment modalities for hyperkinesis. The review of the literature for this research revealed massive differences of opinion where diagnosis and treatment of hyperkinesis was concerned. A majority of the recommended methods of diagnosis and treatment were unusable and based on conjecture rather than empirical evidence. Nevertheless, it appears that hyperkinesis, that common and baffling malady among many American elementary school children, may remain a problem until agreement is reached about its treatment.

A review of the specific treatment for hyperkinesis indicates that there is widespread use of pharmacological control. However, the practice of drug therapy raises serious questions concerning the long-term physiological and psychological effects of prolonged practice of this type of treatment for hyperkinetic children.

Because the purpose of this study was to ascertain if biofeedback and muscle relaxation would be efficient in reducing hyperkinesis in children, four hypotheses were tested. It was hypothesized that: (1) there would be no significant difference between the four experimental groups; no treatment (NT), relaxation training (RT), electromyographic feedback training (EMG), and relaxation training in combination with electromyographic feedback training (RTEMG), as measured by the biofeedback instrument; (2) there would be no significant difference between groups as measured by the

Observed Behavior Checklist; and (3) there would be no significant difference between groups in "Time to onset of first recorded hyperkinetic behavior."

The subjects used in this study were 36 male elementary school children sampled from the population of children whose primary academic disability appeared to be the hyperkinetic syndrome as identified by the staff of professional counselors, teachers and psychologists employed by the Plano Independent School District. The EMG biofeedback instrument, Model PE-2, was used to record psysiological levels of muscular tension. The Observed Behavioral Checklist was developed by the author and was used to record the frequency of classroom behaviors defined as hyperkinetic. The checklist consisted of 28 behavioral manifestations that are most frequently cited in the literature by authorities who are concerned with this particular specialty regarding the hyperkinetic syndrome in children.

An analysis of covariance was used to test the differences between pre- and post-test scores of each treatment group. When significant differences were found between groups, a series of Tukey studentized range statistical tests were conducted to find out specifically where the differences were. The Tukey tests showed that the EMG group learned to control the frontalis muscle significantly more effectively than the other groups, and that the relaxation training added little to this effect.

The results of this study indicated that there was no significant difference between the experimental groups in the amount of change observed in classroom hyperkinetic behaviors. Because the results reported in this research did indicate that the relaxation skill could be taught in a short time span, it was hypothesized that the subjects may need to become aware of the usefulness to them of the new skill in order for transfer of training to take place in other learning situations, e.g., the classroom.

Future research should reveal an effective method for such transfer of training. This study was an effort to break new ground in the management of hyperkinetic children. Biofeedback and relaxation training appear to be viable treatment alternatives for hyperkinetic behaviors. This report provides empirical support for the notion that even young children can control their behavior if they are shown how. The next step will be to help them take their new skill into a broader life framework.

REFERENCES

References

Amsel, Frustration nonreward in partial reinforcement and discrimination learning. Some recent history and a theoretical extension. Psychological Review, 1962, 69, 306-328.

Baldessarini, R. J. Pharmacology of the amphetamines. Pediatrics, 1972, 49, 694-701.

Bandura, A. Behavioral psychology. Contemporary Psychology, 1971, 388-394.

Battersby, W. S., Krieger, H. P., Pollack, M., & Bender, M. B. Figure-ground discrimination and the "abstract" in patients with cerebral neoplasms. American Medical Association Archives of Neurology and Psychiatry, 1953, 70, 703-712.

Battersby, W. S., Krieger, H. P., Pollack, M., & Bender, M. B. Biofeedback in action. Medical World News, March, 1973.

Bradfield, R. Behavior modification of learning disabilities. California: Academic Therapy Publication, 1971.

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

Budzynski, T. H. Biofeedback techniques in behavior therapy. In T. X. Barber et al. (Eds.), Biofeedback and self-control. Chicago: Aldine, 1972, 437-459.

Budzynski, T. H., & Stoyva, J. M. An instrument for producing deep muscle relaxation by means of analog information feedback. Journal of Applied Behavioral Analysis, 1969, 2, 231-237.

Budzynski, T. H., Stoyva, J. M., & Adler, C. S. Feedback-induced muscle relaxation: Application to tension headache. Behavior Therapy and Experimental Psychiatry, 1970, 1, 205-211.

Burks, H. F. The hyperkinetic child. Exceptional Children, 1960, 27, 18-26.

Clements, S. D. Minimal brain dysfunction in children: Terminology and identification, phase one of a three-phase project. Washington, D. C.: U. S. Department of Health, Education, and Welfare, 1966. Monograph No. 3.

Clements, S. D., & Peters, J. E. Minimal brain dysfunction in the school-aged child. Archives of General Psychiatry, 1962, 6, 185-197.

Cobb, J. A., Ray, R. S., & Patterson, G. R. Direct intervention in the schools. Journal of School Psychology, 1971.

Cohen, M., Hulten, W., Martin, G., Mingo, A., & Kunzelmann, H. Precision Teaching. Washington: Special Child Publications, Inc., 1970.

Denny, J. P. Effects of anxiety and intelligence on concept formation. Journal of Experimental Psychology, 1966, 72, 596-602.

Dupree, J. Pills for learning. The Wall Street Journal, January 28, 1971.

Douglas, V. I. Children's responses to frustration: A developmental study. Canadian Journal of Psychology, 1965, 19, 161-171.

Ebaugh, F. G. Neuropsychiatric sequelae of acuite epidemic encephalitis in children. American Journal of Diseases in Children, 1923, 25, 89-97.

Freedman, D. X. (Chairman) Report of the conference on the use of stimulant drugs in the treatment of behaviorally disturbed young school children. Washington, D. C.: U. S. Department of Health, Education, and Welfare, January 11-12, 1971.

Freibergs, V. Concept learning of hyperactive and normal children. Journal of Abnormal Psychology, 1969, 3, 388-395.

Grossberg, J. Behavior therapy: A review. Psychological Bulletin, 1964, 62, 73-88.

Harleston, B. W., Smith, M. G., & Arey, D. Test anxiety level, heart rate and anagram problem solving. Journal of Personality and Social Psychology, 1965, 1, 551-557.

Haring, N. G. (Ed.) Minimal brain dysfunction in children. Public Health Service Publication #2015. Washington, D. C.: U. S. Department of Health, Education, and Welfare, 1969.

Hebb, D. O. Drives and the central nervous system (conceptual nervous system). Psychological Review, 1955, 62, 243-254.

Jacobson, E. Progressive Relaxation. Chicago: University of Chicago Press, 1938.

Kamiya, J. Conscious control of brain waves. Psychology Today, 1968, 1, 57-60.

Keogh, B. K. Hyperactivity and learning disorders: Review and speculation. Exceptional Children, 1971, 38, 101-109.

Lindsley, O., Bijou, S., & Haughton, E. Behavioral Principles and the Exceptional Child. Virginia: The Council for Exceptional Children, 1971.

Martin, B. The assessment of anxiety by physiological behavioral measures. Psychological Bulletin, 1961, 58, 234-255.

Miller, N. E. Learning of visceral and glandular responses. Science, 1969, 163, 434-445.

Millichap, J. G. Drugs in management of hyperkinetic and perceptually handicapped children. Journal of American Medical Association, 1968, 206, 1527-1530.

Millichap, J. G., Aymot, F., Sturgis, L. H., Larsen, K. W., & Egan, R. A. Hyperkinetic behavior and learning disorders. Battery of neuropsychological tests in controlled trial of methylphenidate. American Journal of Diseases of Children, 1968, 116, 235-244.

Palmer, J. O. The psychological assessment of children. New York: John Wiley & Sons, Inc., 1970.

Patterson, G. R., Jones, R., Whittier, J., & Wright, M. A. A behavior modification technique for the hyperactive child. Behavior Research and Therapy, 1965, 2, 217-226.

Rogers, J. Drug abuse--just what the doctor ordered. Psychology Today, September, 1971, 16.

Rosenfield, G. G., & Bradley, C. Childhood behavior sequelae of asphyxia in infancy with special reference to pertussis and asphyxia neonatorum. Pediatrics, 1948, 2, 74-84.

Satterfield, J. H. et al. Physiological studies of the hyperkinetic child. American Journal of Psychiatry, 1972, 128, 102-108.

Schultz, J. H., & Luthe, W. Autogenic training: A psychophysiological approach in psychotherapy. New York: Grune and Stratton, 1959.

Skinner, B. F. Operant behavior. American Psychologist, 1963, 18, 503-515.

Spielberger, C. D., & Smith, L. H. Anxiety, stress, and serial-position effects in serial-verbal learning. Journal of Experimental Psychology, 1966, 72, 589-595.

Spence, K. W. A theory of emotionally based drive and its relation to performance in simple learning situations. American Psychologist, 1958, 13, 131-141.

Stewart, M. A., & Olds, S. W. Raising a hyperactive child. New York: Harper & Row, 1973.

Stock, C. Minimal brain dysfunction child: Clinical manifestations, definitions, descriptions and remediation approaches. Colorado: Pruett Press, Inc., 1969.

Sykes, D. H. et al. Attention in hyperactive children and the effect of methylphenidate (Ritalin). Journal of Child Psychology and Psychiatry, 1971, 12, 129-139.

Tecce, J. J. Relationship of anxiety and response competition in problem solving. Journal of Abnormal Psychology, 1965, 70, 465-467.

Werry, J. S., Weiss, G., & Douglas, V. Studies on the hyperactive child: Some preliminary findings. Canadian Psychiatric Association Journal, 1964, 9, 120-130.

Wilson, A., & Wilson, A. S. Psychophysiological and learning correlates of anxiety and induced muscle relaxation. Psychophysiology, 1970, 6, 740-748.

Wolpe, J. Psychotherapy by reciprocal inhibition. Stanford: Stanford University Press, 1958.

Wolpe, J., & Lazarus, A. A. Behavior therapy techniques. New York: Pergamon Press, 1966.

Wunderlich, R. C. Hyperkinetic disease. Academic Therapy, 1969-1970, 5, 99-108.

Appendix A

Consent to Research Procedures

Request for Parental Authorization for Student's Participation in the Muscle Relaxation Study

Dear Mr. and Mrs. ____________________________:

I am the Associate School Psychologist for the Plano Independent School District and I am also a doctoral student at the Texas Woman's University. I am requesting your permission for ____________________________ (Student's Name) to participate in an experimental study for my dissertation. The purpose of this study is to investigate several methods of teaching children muscular relaxation. As part of my study, I will be using electromyographic feedback which is simply an objective monitor of the degree of skeletal muscle relaxation. The tasks involved are presented in a pleasant manner and most children find the one-to-one involvement to be fun.

In order not to disrupt the normal functioning of the classroom, it will be necessary to have the children participate in the experiment after school. It will take approximately ten minutes eight consecutive afternoons to complete all tasks in the experiment. I will notify you in advance prior to the time that it will be necessary for your child to remain after school. After completion of this study, I will be happy to discuss the results with you and your child. Should your child not be selected for this investigation I would be willing, at your request, to offer ______________ (child's name) any one of the alternative relaxation programs used in this study for the same period of time.

If your child is taking any prescribed medication it will be helpful to me if you will keep a daily record of the medication intake. I would like to set up a personal conference with you within the next few weeks to discuss any questions that you might have. Your cooperation and prompt return of the permission letter will be greatly appreciated. Sincerely yours,

Joy A. Anderson
Associate School Psychologist

Authorization (by parents) for Student's Participation
in the Muscle Relaxation Study

I, ______________________________________, give my permission for my child to participate as a subject in your research study. I understand that you are comparing several methods of muscle relaxation and that my child will receive one of these alternative methods.

He/she may remain after school for twenty minutes on the assigned days provided I am notified in advance.

I also agree to keep an accurate record of my child's medication program during the course of the study.

______________________	______________________
Student's Name	Parent's Signature
______________________	______________________
School	Date

____
Joy A. Anderson, Investigator

Authorization (by students) to Participate in
the Muscle Relaxation Study

____
Date

I, __________________________________, would like to volunteer as a subject in your research study. I understand that you are comparing several methods of muscle relaxation and that I will receive one of these alternative methods.

I agree to stay after school on the assigned days, provided I am notified in advance.

____
Student's Signature

____
School

____
Joy A. Anderson, Investigator

Appendix B

Portable EMG Feedback System

Model PE-2

Technical Considerations

Portable EMG Feedback System

Model PE-2

Technical Considerations

The Portable EMG Feedback System PE-2 is designed to provide accurate and meaningful feedback of surface EMG levels as low as 2 microvolts.

The effective bandpass of the unit is 95 to 1000 Hz. A sharp high-pass filter eliminates unwanted signals below 95 Hz. In the region of the head, EEG rhythms are large in amplitude compared to relaxed EMG and, therefore, must be filtered out. Below the head, especially in the area of the neck and shoulders, there is a large heart signal (EKG), which must be eliminated. The fast-rising wavefront of the EKG signal can overwhelm low level EMG signals even with high-pass filters cut at 30 Hz. This means that the feedback will be driven primarily by the EKG rather than the EMG signal.

The PE-2 is also quite effective at reducing 60 Hz noise artifact which can be a large problem in unshielded environments. This type of noise can be generated in the electrode leads if they are unshielded. The 60 Hz noise is of even greater magnitude if electrode resistances are unbalanced. A high impedance differential input amplifier with high common mode rejection can eliminate a good deal of the

60 Hz caused by unshielded leads and electrode resistance unbalance; however, filtering is usually required to reduce the remaining 60 Hz noise to below EMG level expected from relaxed muscle.

A sharp high-pass filter, in conjunction with a high performance preamplifier can eliminate almost all of the above mentioned unwanted signals, yet still allow the system to respond to the single motor unit firing produced by relaxed muscle. This is because of the very fast-rising wavefront of such a single motor unit spike.

The PE-2 fulfills all of the requirements of an EMG-sensitive, noise insensitive device. Electrode leads are housed in a low noise cable; the preamp has a high input impedance and high common mode rejection; a sharp high-pass filter removes signals below 95 Hz; and finally, the equivalent noise generated by the preamp semiconductors is quite small (2 microvolts peak-to-peak).

The auditory feedback is in the form of a series of clicks. The repetition rate of the clicks is proportional to the EMG level. Thus, as the EMG level rises the click rate will increase. The frequency of the clicks can vary from below one per second to approximately 100 per second. The user learns to produce a slow click rate signifying a low EMG level.

Muscle tension information is also made available to the experimenter and/or client through the meter output. The meter pointer will track moment-to-moment changes in the EMG as well as providing an indication of general EMG level. The meter reading, as well as the auditory click rate, is also dependent upon the sensitivity setting. Three sensitivity settings are provided. Typically, the low setting is the choice when initiating training. At this setting, it is not too difficult to learn to reduce the click rate and/or meter reading. When the client has learned to keep the clicks at a low rate and the meter reading below 15, the second (medium) sensitivity setting can be chosen. Once again the client learns to lower the EMG, at which point the high sensitivity is selected. This gradual increase in difficulty has been found to accelerate progress in learning to reduce EMG levels (Technical Manual, pp. 9-10).

Operation

Electrode Application and Basic Operation

Before applying the electrodes to any location, the skin must be thoroughly cleansed of skin oils. The Brasivol compound should first be rubbed over the area where the electrodes will be placed. The compound is then wiped off, and the skin is ready for electrode application. Note: if skin irritation (reddening) results, reduce the amount of rubbing for the next preparation.

The Beckman clear electrode paste is then squeezed from the tube into the electrode cups. The paste should completely fill the cup. The excess should be smoothed off without causing "holes" in the cup filling.

If the forehead placement is selected, do not fasten the headband too tightly as this may cause some discomfort after a period of time.

Electrode Placements

The forehead placement is the most useful location for EMG training and, therefore, the electrodes are set in an elastic band which is designed to be used primarily for this purpose. The band should be located so that the center electrode is centered on the forehead about one inch above the eyebrows.

After usage, clean the electrode cups with water and a toothbrush. Never handle the electrodes by the wires leading from them. Rather, grasp the electrodes themselves when filling or cleaning them.

After applying the electrodes, plug the electrode cable into the rear of the console. Be sure to position the connector to fit the "key." Do not force the connection. Turn the sensitivity (middle knob) to "low," and then turn the left know to "on." Adjust the volume to a comfortable level with headphones in place. Note: The meter, if used, should be positioned so that it can be seen without straining the eye muscles.

Electronic engineers were consulted during the preliminary stages of this research study for purposes of determining the linearity of the EMG display scale. The technical information which was obtained established that the EMG level is a linear function of resistance using 1,000 ohms, 10,000 ohms, 27,000 ohms, 75K, 100K, 230K, 1 MEG, and 10 MEG (Table 1). For example, consider the hook up of the 100K off the Standard Dummy Subject which is 10,000 ohms. In this 100K (high resistance) range, the meter needle stabilizes on 35 (relatively no needle bounce), and the headphone clicks are so rapid that they could be considered a continuous hum. Essentially there is no way to count the frequency of the clicks, since counts-per-minute is in ratio to the meter reading by a factor of 10. In other words, the meter reading shows a relationship between the needle reading and the audible counts per minute. In the higher range, the meter reading (not counts per minute) is the variable used to convert to the EMG signal. The needle on the meter output is very steady because the input making the audible signal is a constant at 100K and is much less of a percentage signal than it is at 1,000 ohms, 10,000 ohms, and at 27,000 ohms.

Referring now to the 300K, which is approximately at the top of the meter output scale, i.e.,

300K Low Sensitivity Setting = 45

300K Medium Sensitivity Setting = 47

300K High Sensitivity Setting = 48

most of the signal information obtained is between 1,000 and 100,000 ohms which covers the bulk of the scale. The problem encountered in the 300K range is that of being able to read the meter accurately. Thus, in trying to read the difference between 45, 47, and 48 there is scatter in the EMG. When transferring the meter reading over to EMG, one meter unit at 300K makes six EMG units on the Medium Sensitivity Chart Scale, six EMG units on the Low Sensitivity Chart Scale, and 2 1/2 EMG units on the High Sensitivity Chart Scale. Forty-nine is the highest meter reading given on the EMG High Sensitivity Chart Scale and is equal to 22.0. Therefore, it appears that everything above this would be read as 22.0. It should also be noted that 49 does not appear on the Low or the Medium Scale.

It has also been found that a one meter unit increase from 46 (20) to 47 (21), choosing these numbers arbitrarily, corresponds to an EMG change of:

Low Sensitivity Setting	(4.6) (4.8) 24.8--30.0	*Δ = (0.2) 5.2
Medium Sensitivity Setting	(3.4) (3.5) 18.8--22.0	*Δ = (0.1) 3.2
High Sensitivity Setting	(3.0) (3.1) 14.2--16.0	*Δ = (0.1) 1.8

*Δ = Delta

The above numbers show that measurement of EMG is much more precise at lower meter readings in terms of EMG units. At the low end of the scale, however, there is a great deal of needle bounce which affects readability. Therefore, the best precision appears to be in the middle of the meter scale. It appears that the use of the High Sensitivity for Low Meter readings and the use of Low Sensitivity for High meter readings give the best results. Therefore, for data analysis, the raw meter reading data was transformed to EMG level prior to statistical use, using only the middle range of the meter scale for all subjects.

The EMG PE-2 has been found to be an extremely sensitive instrument; therefore, every precaution was taken to avoid flourescent lights, or electrical appliances during training sessions.

After consultation with local engineers, this investigator contacted Mr. John Picchiottino, President, Biofeedback Systems, Inc., who is the manufacturer of the EMG Model PE-2, by telephone on December 18, 1974. Mr. Picchiottino answered several questions concerning the electronic capabilities of the PE-2 EMG instrument.

1. EMG instrument does not measure galvanic skin response, but it does measure voltage resulting from muscle activity. Following the "all or none" law of electrical impulse, the individual muscle fibers are either "off" or "on" and the number of the individual muscle fibers "on" determines muscle tension. EMG is proportional to electrical activity which is proportional to muscle activity. The meter signal picked up by the machine is a voltage of varying frequency and amplitude. The muscle activity voltage is easily conducted through the flesh to the skin. "Fat" does not hinder detection of the signal. However, the electrode contacts must be located in the center of the muscle being measured.

2. The EMG instrument was calibrated by an audioscilator to derive the EMG (peak to peak) 200 Hz amplitude in sinewave form. This 200 Hz is not a true sinewave, but is in "sawtooth" sinewave form, and represents a weighted equivalent of 200 Hz.

3. Dummy subject relationship, i.e., resistor vs. EMG curve has no meaning. EMG measures voltage as a result of muscle activity.

4. AC current such as is common to business and household is 60 cycle. This is considered to be a common source of background noise and has been considered in the design of the instrument. The engineers who served as consultants for this study concluded that there was no logical basis for adjusting readings to compensate for (1) skin resistance, (2) background noise, or (3) "Hi-lo output error." As a final analysis, the EMG Model PE-2 was checked with an Impedance Bridge, Type 1650 A, manufactured by General Radio Company, Concord, Massachusetts, and the above conclusions were supported.

EMG Model PE-2 Linearity Scale

Although most of the resistors used in establishing the linearity scale were at 10% tolerance, several of the resistors were only available at the 5% tolerance, i.e., 100K, 300K, 1,000K, and 3,000K; therefore, this could have some effect on the precision band. In order to establish more points on the linearity evaluation scale, two resistors were used in parallel. However, even if all resistors were ± 10%, the parallel resistors will have a different ± percent (which will be approximately ± 15%). Therefore, the calculations of the precision bands might be in slight error because using two resistors for PE-2 hook up makes it difficult to know the function of the resistor deltas on signal output if both resistors are not the same tolerance.

For a 1000 ohm resistor and 10% tolerance, true resistance is:

$$1000 \pm 10\% \text{ of } 1{,}000$$
$$\text{or } 1000 \pm 100$$
$$\text{or } 900 \text{ to } 1100 \text{ ohms}$$

For a 100,000 ohm resistor and 10% tolerance, true resistance is:

$$100{,}000 \pm 10\%$$
$$\text{or } 100{,}000 \pm 10{,}000$$
$$\text{or } 90{,}000 \text{ to } 110{,}000 \text{ ohms (or 90 to 110 ohms)}$$

With a more precise tolerance, i.e., 1%, true resistance is:

$$1000 \pm 1\%$$
$$\text{or } 1000 \pm (.01)\ (1000)$$
$$\text{or } 1000 \pm 10$$
$$990 \quad 1010$$

Definitions and Inter-relationship of units

I = Ampere--Mkt unit of electric current

R = Ohm-----Mkt unit of electrical resistance

E = Volt----Mkt unit of electrical potential difference

Inter-relationship of Units

$$E = I \quad R$$

$$\text{or } R = \frac{E}{I}$$

$$\text{or } I = \frac{E}{R}$$

Table A

EMG Model PE-2 Linearity Evaluation

Sensitivity Setting	Low			Medium			High		
	Meter	Counts Per Minute	EMG	Meter	Counts Per Minute	EMG	Meter	Counts Per Minute	EMG
Resistance, ohms									
1 K							0-4	6	-
10 K (Dummy)							6-9	50	1.7
27 K	6-8	56	2.3	8-10	85	2.3	12-14	140	2.2
75 K	26-27		6.2	30		5.3	34		5.5
100 K	35		9.4	38		8.6	41.0		8.8
230 K	42		14.4	44		14.3	45		12.6
300 K	45		20.6	47		22.0	48		18.4
1 MEG	49.5			50			50		
10 MEG	50			50			50		

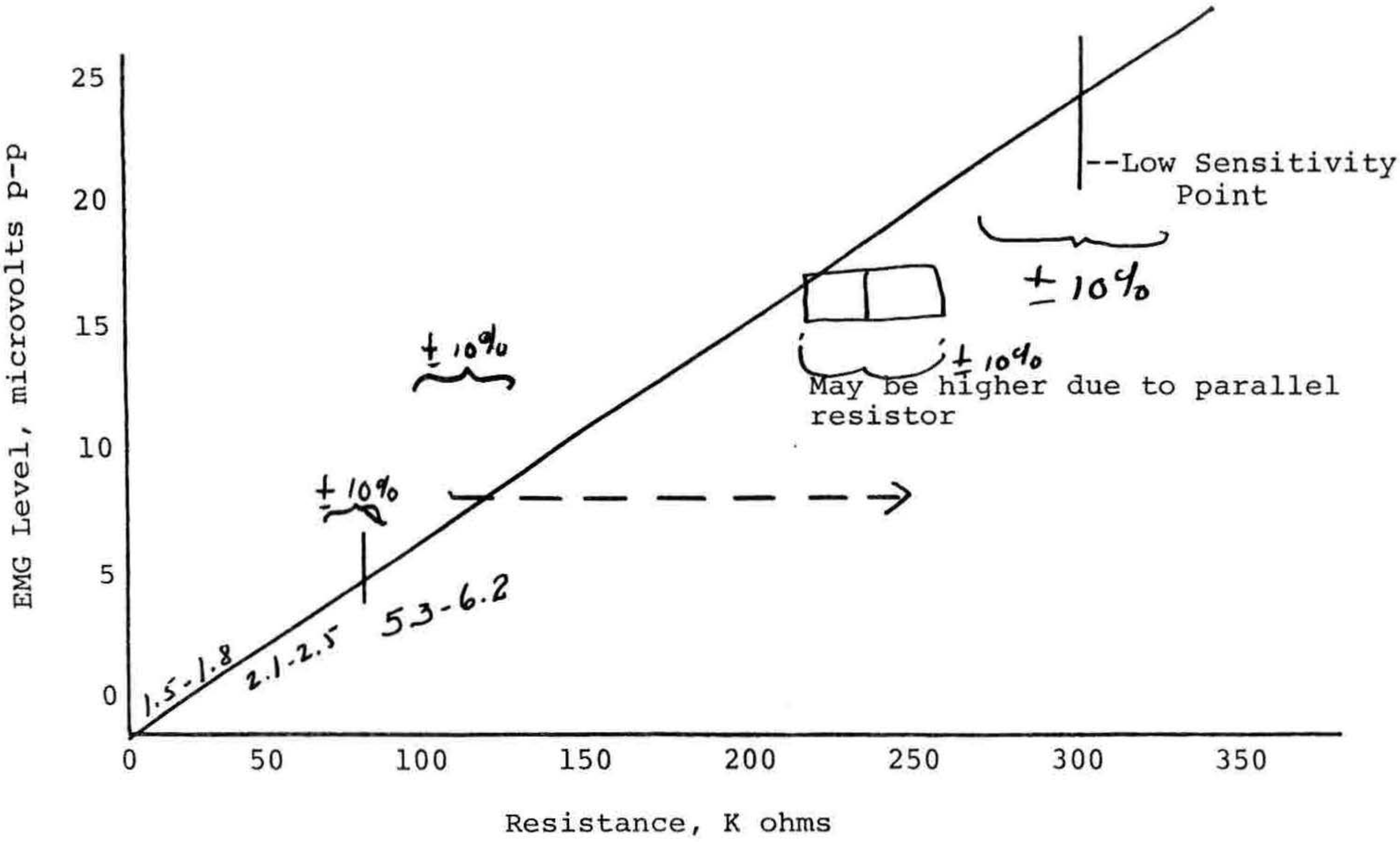

Figure 1. EMG Model PE-2 Linearity Scale

Appendix C

Instructions to Observers (Raters) for Recording Hyperkinetic Behaviors

OBSERVER'S BEHAVIORAL CHECKLIST FOR RECORDING OBSERVED HYPERKINETIC BEHAVIORS

BEHAVIOR KEY

Student's Name________________________ School Code_____ Student's Age_____

Student's activity during observation period: Math, Reading, Spelling, or Social Studies

Date________________________

Time of observation period					
Time to onset of first recorded hyperkinetic behavior					
Rater's Number					
AGGRESSIVE TO OTHERS:	Day 1	Day 2	Day 3	Day 4	Day 5
1. Hitting with hands					
2. Hitting with objects					
3. Throwing objects					
4. Tripping					
5. Doesn't leave others' belongings alone					
AGGRESSIVE TO SELF:					
1. Popping knuckles					
2. Biting fingernails					
3. Pulling hair					
4. Slapping face					
DISRUPTIVE:					
1. Breaking small objects					
2. Speaking out inappropriately					
3. Loudly commenting during quiet period					
4. Kicking/throwing objects					
5. Crawling/rolling on floor					
6. Tapping desk					
7. Facial "antics"					
8. Inappropriate sounds					
9. Bouncing up and down in chair					
10. Legs, arms, feet in constant motion					
11. Taling/mumbling					
12. Scribbling/doodling					
13. Upset--crying/sobbing					
14. Tipping chair					
15. Inappropriate motor responses					
16. Playing with objects on/in desk					
17. Attentive to inappropriate stimuli					
DESTRUCTIVE:					
1. Chewing on non-chewables					
2. Tearing work materials					

Observer's Checklist for Recording Observed Hyperkinetic Behaviors

A. Overt Physical Behavior Directed Toward Others: (Aggressive to Others)

1. Fighting or hitting classmates in "anger."
2. Hitting other students with books, pencils, tablets, open hand, etc.
3. Throwing objects at others, i.e., crayons, spitballs, erasers, etc.
4. Tripping other students with feet, hands, or book-satchels with the deliberate intent to make the student fall.
5. Snatching, grabbing or breaking the belongings of others, i.e., clothing, books, tablets, pencils, paper, etc.

B. Overt Behavior Directed Toward Self: (Aggressive to Self)

1. Persistently popping knuckles.
2. Persistently biting fingernails.
3. Persistently pulling hair.
4. Persistently slapping face, etc.

C. Disruptive Behaviors: (Disruptive)

1. Breaking combs, pencils, crayons, erasers, etc.
2. Blurting out the answer to questions directed at other students.
3. Loudly commenting during a quiet period, i.e., yelling at teacher or other classmates.
4. Kicking or throwing objects, i.e., balls, footballs, chairs, desks, etc.
5. Crawling or rolling on floor.
6. Persistently tapping desk with pencil, small objects or hands.
7. Facial "antics."
8. Whistling, humming, singing, clicking tongue or talking to other classmates without teacher permission.
9. Twisting, squirming or bouncing up and down in chair.
10. Swinging arms, shuffling feet, or kicking legs in constant motion.
11. Talking or mumbling to self.
12. Scribbling and doodling on work paper.
13. Easily upset, i.e., frequently crying or sobbing.
14. Tipping chair back and forth on two legs.

15. Frequently exhibiting motor responses that appear meaningless and inappropriate to the apparent stimulus, i.e., standing without purpose; slinging long hair; shuffling papers without purpose; hitting body against chalkboard, bookcase; moving mouth (no noise); engaging in numerous activities within a very short period of time but completing nothing.
16. Playing with objects in desk, i.e., toys, crayons, pencils, paper, and/or rubbing or rolling comb, pencil, eraser, or crayons on desk.
17. Frequently attending and/or looking to irrelevancies in his environment rather than focusing attention on the major aspects or significant elements of the expected task. Child's attention is easily drawn to extraneous stimuli, i.e., student walking past classroom door, visitor entering room, teacher talking to another student, etc., thus, child appears overattentive to inappropriate stimuli.

D. Destructive Behaviors: (Destructive)

1. Frequently chewing on pencil, paper, crayons, etc.
2. Tearing pages in textbooks or other instructional materials.

Instructions to Observers (Raters) for Recording Hyperkinetic Behaviors

Please refer to the Observer's Checklist for Recording Observed Hyperkinetic Behaviors and familiarize yourself with the four major categories and the behaviors subdivided under each category. There are 28 behaviors that have been operationally defined for the purpose of this study as "hyperkinetic," and it is very important that we all evaluate the frequency of those 28 target behaviors in exactly the same way. Please take five minutes to study the Checklist and familiarize yourself with the general form.

Now, if you will, let me explain each item on the Checklist and please hold your questions and comments until the end of my explanation. Are you ready to begin?

You will have a Checklist for each day you observe each child. The first two weeks of observation procedure constitute the pre-test behavioral phase and following the five weeks of experimental intervention, all observers (raters) will repeat the same process of observation which will constitute the post-test behavioral phase. Therefore, in the final data analysis, there will be daily Checklists on each child who is paritcipating in this study during both the pre-test and post-test phases.

I have assigned each observer (rater) a number and you will team together to observe the children according to the Randomized Pairs of Raters listed on the attached sheets.

Please make a note of your assigned Rater Number and use this number consistently throughout the duration of this study: (1) BS; (2) AR; (3) LL; (4) GH; (5) NL; (6) JA; (7) NH; (8) SN. Should any one of you become ill or foresee being absent for several days, please give me a call so we can make arrangements for one of the other observers to cover your observation period during the time you are absent from school. If at all possible, please call me at home the night before, if you foresee being absent the following day or days. My schedule will be kept very flexible during the weeks of the data collection, so I can possibly cover your observation times, or I can make arrangements with the building principals to give release time to another observer to cover your observation times during your absence. If you have any questions, please make a note of them, and we will discuss them at the end of this discussion period.

TABLE B

RANDOMIZED PAIRS OF RATERS

School	Day 1 and Day 6						Day 2 and Day 7						Day 3 and Day 8					
	9AM	10AM	11AM	1PM	2PM	3PM	9AM	10AM	11AM	1PM	2PM	3PM	9AM	10AM	11AM	1PM	2PM	3PM
Aldridge (A)	1,2			1,2			1,3			1,3			5,6			5,6		
Davis (B)	3,4			3,4			2,4			2,4			7,8			7,8		
Sheppard (C)	5,6			5,6			5,7			5,7			1,2			1,2		
Weatherford (D)	7,8			7,8			6,8			6,8			3,4			3,4		
Barron (E)		1,2			1,2			1,3			1,3			5,6			5,6	
Mendenhall (F)		3,4			3,4			2,4			2,4			7,8			7,8	
Forman (G)		5,6			5,6			5,7			5,7			1,2			1,2	
Sigler (H)		7,8			7,8			6,8			6,8			3,4			3,4	
Meadows (I)			1,2			1,2			1,3			1,3			5,6			5,6
Christi (J)			3,4			3,4			2,4			2,4			7,8			7,8
Memorial (K)			5,6			5,6			5,7			5,7			1,2			1,2

Day 4 and Day 9						Day 5 and Day 10					
9AM	10AM	11AM	1PM	2PM	3PM	9AM	10AM	11AM	1PM	2PM	3PM
5,7			5,7			2,6			2,6		
1,6			1,6			3,8			3,8		
2,4			2,4			4,7			4,7		
3,7			3,7			1,5			1,5		
	5,7			5,7			2,6			2,6	
	1,6			1,6			3,8			3,8	
	2,4			2,4			4,7			4,7	
	3,7			3,7			1,5			1,5	
		5,7			5,7			2,6			2,6
		1,6			1,6			3,8			3,8
		2,4			2,4			4,7			4,7

The date of each observation period is important to quick identification of the two-week observation periods as either pre-test or post-test. Please make certain that each two raters have synchronized your stopwatches at the beginning of each observation period. This next item, "Time to onset of first recorded hyperkinetic behavior," will be analyzed to determine whether or not the child's "Time to onset of hyperkinetic behavior" has increased from pre-test to post-test. If each observer (rater) will compute the time interval in seconds and place that number on the line that states, "Time to onset of first recorded hyperkinetic behavior," that will give me a check on the two raters' computations. For example, if you begin your observation period at 10:15 a.m. and the child's first observed hyperkinetic behavior is recorded as five seconds, then record (:05). An average of these "Times to onset of first recorded hyperkinetic behaviors" will be computed for each child during the pre-test and post-test phases and will be statistically analyzed to determine if there has been a significant increase in "Time to onset of first recorded hyperkinetic behavior," following the experimental intervention as defined for purposes of this study.

I would like to have a record of the child's medication intake because this is usually available from the school secretary or the school nurse. The child's medication intake will be an important variable in this study especially if he is taking the medication at school.

If the observers (raters) will keep the importance of this variable in mind throughout the duration of this study, it will be most helpful in the final data analysis. All parents are asked to monitor the child's medication program when they sign the authorization form for their child to participate in the muscle relaxation study. However, the parents cannot monitor the child's medication intake while he is at school, thus, the observers (raters) must be sensitive to this variable at all times. Any information regarding the child on any given observation and/or training day should be noted in detail on that particular child's daily record.

In the training session with Dr. Robert Dain, he stressed that the child being observed should be observed while engaged in approximately the same task on each observation day. For your convenience, please circle the activity that you will be observing the child's behavior during the observation period, for that particular day. Any one of the four listed activities, i.e., math, reading, social studies, or spelling, are considered to be approximate activities for the purpose of this study. Again, if you have any questions please make a note of them, and we will discuss and answer all of your questions at the end of this session.

Now, there are three points that I want to stress throughout the remainder of this session which I feel that if we all understand we will have a high percent of agreement between two raters at all times. (1) Each behavior must be discrete to be counted; in other words, behavior occurs or it does not, and the reliability of the two raters is based on whether or not they agree, "Yes, that behavior did indeed occur" or likewise agree, "No, that behavior did not occur." (2) One behavior is one behavior no matter how long it is sustained (for purposes of this study we will not attempt to record "duration" of behavior). (3) A complete cycle of behavior must occur in order to be counted as one. Now, keeping these three points in mind, let's look at each behavior and decide what numerical value will be appropriate for that particular behavior.

A. Overt Physical Behavior Directed Toward Others: (Aggressive to Others)

1. Fighting or hitting classmates in "anger." Note: If a child is engaged in fighting or hitting one classmate in "anger" that is counted as one behavior no

matter how long the behavior is sustained. If he engages in fighting or hitting another (different) classmate in "anger" that is counted as two behaviors.

2. Hitting other students with books, pencils, tablets, open hands. Note: If a child hits another student with a book, then puts it down and hits the same student or another student with his open hand, that is counted as two behaviors. However, if the student hits three different kids with one sustained swing of his book, that would be counted as one behavior.
3. Throwing objects at others, i.e., crayons, spitballs, erasers, wadded paper. Note: Complete cycle of behavior must occur in order to be counted as one, a second complete cycle of behavior must occur to be counted as two. For example, if a child throws one eraser, but, by chance, the eraser hits two different kids, this is counted as one behavior.
4. Tripping other students with feet, hands, or booksatchels with the deliberate intent to make the student fall. Note: Count same as above, one behavior is counted for tripping one student with

feet, or tripping the same student or another student with hands would be considered another complete cycle or behavior and would be counted as two, and tripping the same student and/or another student with a book-satchel would be considered a complete cycle of behavior and would be counted as three behaviors.

5. Snatching, grabbing, or breaking the belongings of others, i.e., clothing, books, tablets, pencils, paper. Note: One behavior is one behavior no matter how long it is sustained. For example, if a child is grabbing at the clothing of another child for three continuous minutes, that is counted as <u>one behavior</u>. However, if the same child is snatching at the clothing of three different children, then consider this three different behaviors. If the same child is grabbing at the clothing of a child for three continuous minutes, stops to engage in <u>another</u> activity for a few seconds, then begins grabbing at the clothing of the same child again, this is counted as two complete cycles of behaviors.

B. <u>Overt Behavior Directed Toward Self</u>: (<u>Aggressive to Self</u>)

1. Persistently popping knuckler. Note: One behavior is one behavior no matter how long it is sustained. If a

student is persistently popping his knuckles, i.e., for a period of three seconds, count that as one behavior.

2. Persistently biting fingernails.
3. Persistently pulling hair.
4. Persistently slapping face.

Note (2, 3, 4): If a child is biting his little fingernail and begins immediately to bite his third fingernail, count that as one behavior no matter how long the fingernail biting is sustained. If a child is pulling his hair continuously for two seconds, count that as one behavior. Now, if the same child returns to biting his fingernails count that as a second nailbiting behavior. If another child is slapping his face, count that as one behavior, but if he engages in another activity, then later begins slapping his face, count that as a second face-slapping behavior.

C. Disruptive Behaviors: (Disruptive)

1. Breaking combs, pencils, crayons, erasers.

Note: If a child breaks every tooth out of his comb during a continuous time period, count that as one behavior. If he then picks up his pencil and breaks it, count that as one behavior, and if he breaks

10 crayons count that as 10 complete cycles of behavior. Or, as another example, if he only breaks several teeth out of his comb, count that as a continuous time period and give him one count, then if he switches to breaking 10 crayons, give him 10 counts, and if he again switches back to breaking the rest of the teeth out of his comb, during a continuous time period, count that as one behavior.

2. Blurting out the answer to questions directed at other students. Note: Count the number of complete cycles of behavior that occurs, i.e., each "blurting out" behavior would be counted as one.
3. Loudly commenting during a quiet period, i.e., yelling at teacher or other classmates. Note: Count each comment or each "yelling out" behavior as a complete cycle of behavior.
4. Kicking or throwing objects, i.e., balls, footballs, chairs, desks. Note: Each behavior must be discrete to be counted. A complete cycle of behavior must occur to be counted as one.
5. Crawling or rolling on floor. Note: One behavior is one behavior no matter how long it is sustained. For example, if a child is continuously rolling on the floor for three minutes, it would be very difficult

for two raters to agree on the number of "rolls," thus, rolling on the floor is counted as one behavior. However, if the child decides to crawl to the front of the room, that is counted as a second behavior and is counted as one no matter how long it is sustained.

6. Persistently tapping desk with pencil, small objects, or hands. One behavior is one behavior no matter how long it is sustained. If a child persistently taps his pencil on his desk, it would be very difficult for two raters to agree on the number of pencil taps, thus, count it as one behavior, but if he engages in another activity for a few seconds/minutes and begins again tapping desk with pencil, then count that as another complete cycle of behavior.
7. Facial "antics." Note: If a child is making facial "antics," i.e., sticking his tongue out at one of his neighbors and immediately turns to his opposite neighbor while remaining with his tongue still sticking out, that will be counted as one behavior. However, if he sticks his tongue out at one neighbor and then makes a different facial "antic" to the opposite student, i.e., rolls his eyes with his mouth open, then that will be counted as two behaviors, i.e., two

facial "antics." The same procedure will be followed for all behaviors that can be counted as discrete movements.

8. Whistling, humming, singing, clicking tongue, or talking to other classmates without teacher permission. Talking to other classmates includes talking to neighbors or talking to others at various locations in the room without teacher permission. It will include whispering and/or talking in a normal or loud tone of voice without permission from the teacher to engage in group discussions or team project assignments. Note: Each behavior is one behavior no matter how long it is sustained. If a child is talking to his neighbor, without teacher permission, for a three-minute period of time, that will be counted as one behavior. However, if the same child is engaged in "talking behavior" to three different classmates, without teacher permission, that will be counted as three behaviors. The same procedure will be followed for all behaviors that can be counted as discrete movements.
9. Twisting, squirming or bouncing up and down in chair. Note: Again, a complete cycle of behavior must occur in order to be counted as one. If a child is

bouncing up and down in his chair, he must return to his original position before it is counted as one. Twisting and/or squirming in chair must be counted in the same manner, when the child returns to his original position then it is counted as one.

10. Swinging arms, shuffling feet, or kicking legs in constant motion. Note: Complete cycle of behavior must occur to be counted as one. If a child is swinging his arms, he must swing his arm back to the original position before it is counted as one. If the same child is engaged in kicking his legs he must complete a cycle of kicking his legs back to the position where he started his legs in motion to be counted as one. He would then be given a numerical value of two, one for a complete cycle of "arm swinging" and one for a complete cycle of "kicking his legs."

11. Talking or mumbling to self. Note: One behavior is one behavior no matter how long it is sustained. However, if a student talks or mumbles to himself for three continuous minutes, that would be given one behavior count; but if he stops and engages in <u>another</u> behavior, <u>without</u> talking or mumbling to self, then begins again a few seconds/minutes later to

engage in "talking or mumbling to self behavior," that is counted as two complete cycles of behavior.

12. Scribbling and doodling on work paper. Note: One behavior is one behavior no matter how long it is sustained. However, if a student scribbles on his work paper, then puts his pencil down and picks it back up again, count this as a complete cycle of behavior. If he continues another complete cycle of behavior continue to count it as one behavior each time the cycle is completed.
13. Easily upset, i.e., frequently crying or sobbing. Note: One behavior is one behavior no matter how long it is sustained. If a child is crying continuously for five minutes, count that as one behavior. However, if the child engages in another activity for a few minutes and later repeats the crying or sobbing, count that at another complete cycle of behavior.
14. Tipping chair back and forth on two legs. Note: Each behavior must be discrete to be counted, therefore, a complete cycle of tipping chair from back legs to front legs to back legs, or vice versa, must occur in order to be counted as one.
15. Frequently exhibiting motor responses that appear meaningless and inappropriate to the apparent

stimulus, i.e., standing without purpose, slinging long hair; shuffling papers without purpose; hitting body against chalkboard, bookcase; moving mouth (no noise); engaging in numerous activities within a very short period of time but completing nothing. For example, a child who is observed to be standing without purpose for a period of four minutes, that will be counted as one behavior. However, when his behavior changes, count each complete cycle of behavior as one.

16. Playing with objects in desk, i.e., toys, crayons, pencils, paper, and/or rubbing or rolling comb, pencil, eraser, or crayons on desk. One behavior is one behavior no matter how long it is sustained. When behavior changes, count each complete cycle of behavior as one.

17. Frequently attending and/or looking to irrelevancies in his environment rather than focusing attention on the major aspects or significant elements of the expected task. Child's attention is easily drawn to extraneous stimuli, i.e., student walking past classroom door, visitor entering room, teacher talking to another student, thus, child appears overattentive to inappropriate stimuli. Note: Count one

behavior for each time the child's attention is drawn to extraneous stimuli. Please disregard the duration, and record only the frequency of times that the child is not attending to the relevant aspects of the classroom situation.

D. Destructive Behaviors: (Destructive)

1. Frequently chewing on pencil, paper, crayons. Note: If a child is continuously chewing on his pencil for three minutes, count that as one behavior. If he, however, begins chewing on his paper, count that as a second complete cycle of behavior.

2. Tearing pages in textbooks or other instructional materials. Count each page torn as a complete cycle of behavior and give him a total numerical value of the number of pages torn.

ARE THERE ANY QUESTIONS?

Appendix D

Instructions for Electromyographic Feedback Training for Children

Instructions for Electromyographic Feedback Training for Children

Today we are going to practice hearing our forehead muscle (point to forehead). We will be able to hear it when it is tight, and when it is relaxed. When your forehead muscle is tight, you will hear the clicks in your headphone go faster and when it is relaxed, you will hear the clicks slow down. When your forehead muscle is tight, the needle (point to meter out-put) will go up (point to right) and when your forehead muscle is relaxed, the needle will go down (point to the left). OK, remember now, when your forehead muscle is tight, the clicks in your headphone go FAST, and the needle points UP--when your forehead muscle is relaxed, the clicks in your headphones go SLOW, and the needle points down.

Do you have any questions?

Are you ready to begin? OK. First, I want to wash your forehead so that it will be nice and clean, and then I will let you wear this little band around your forehead so that you can hear your forehead muscle. (Wash forehead, apply Beckman's paste to plastic cups, attach headband, and adjust headphones.)

Ask child to be seated in chair in the experimental room. Now, are you comfortable? Good. Please try hard and pay attention to your forehead muscle. Try to hear it when it is smooth and relaxed. Please take a deep breath and let it out slowly. (Record EMG scores, but first give the child one minute to stabilize. Begin recording for the next eight minutes at sixty second intervals.)

You did a good job hearing your forehead muscle. That is the end of our session for today.

Appendix E

Biofeedback Meter Recording Instrument

*Biofeedback Meter Recording Instrument

NAME______________________________ TRAINER____________________
DATE______________________________ GROUP____________________
PRE-TEST_______ POST-TEST_______ TRAINING SESSION_______

Sen. Setting	Trials 1	2	3	4	5	6	7	8
	6	6	6	6	6	6	6	6
	7	7	7	7	7	7	7	7
	8	8	8	8	8	8	8	8
	9	9	9	9	9	9	9	9
	10	10	10	10	10	10	10	10
	11	11	11	11	11	11	11	11
	12	12	12	12	12	12	12	12
	13	13	13	13	13	13	13	13
	14	14	14	14	14	14	14	14
	15	15	15	15	15	15	15	15
	16	16	16	16	16	16	16	16
	17	17	17	17	17	17	17	17
	18	18	18	18	18	18	18	18
	19	19	19	19	19	19	19	19
	20	20	20	20	20	20	20	20
	21	21	21	21	21	21	21	21
	22	22	22	22	22	22	22	22
	23	23	23	23	23	23	23	23
	24	24	24	24	24	24	24	24
	25	25	25	25	25	25	25	25
	26	26	26	26	26	26	26	26
	27	27	27	27	27	27	27	27
	28	28	28	28	28	28	28	28
	29	29	29	29	29	29	29	29
	30	30	30	30	30	30	30	30
	31	31	31	31	31	31	31	31
	32	32	32	32	32	32	32	32
	33	33	33	33	33	33	33	33
	34	34	34	34	34	34	34	34
	35	35	35	35	35	35	35	35
	36	36	36	36	36	36	36	36
	37	37	37	37	37	37	37	37
	38	38	38	38	38	38	38	38

*Biofeedback Meter Recording Instrument--Continued

Sen. Setting	Trials 1	2	3	4	5	6	7	8
	39	39	39	39	39	39	39	39
	40	40	40	40	40	40	40	40
	41	41	41	41	41	41	41	41
	42	42	42	42	42	42	42	42
	43	43	43	43	43	43	43	43
	44	44	44	44	44	44	44	44
	45	45	45	45	45	45	45	45
	46	46	46	46	46	46	46	46
	47	47	47	47	47	47	47	47
	48	48	48	48	48	48	48	48
	49	49	49	49	49	49	49	49
	50	50	50	50	50	50	50	50

Meter output recordings taken every 60 seconds for 8 minutes.

*Meter readings recorded on this instrument are in terms of raw meter readings and will be converted to EMG level prior to statistical analysis.

Manufacturer's Chart for Converting Raw Meter Readings to EMG Levels

B. Meter Readings versus EMG Level

Meter Reading	EMG Level (microvolts p-p) L	M	H	
6	2.1	1.8	1.5	(f = 200 Hz)
7	2.3	2.0	1.6	
8	2.5	2.2	1.7	
9	2.7	2.3	1.8	
10	2.9	2.4	1.9	
11	3.0	2.5	2.0	
12	3.2	2.6	2.1	
13	3.4	2.7	2.2	
14	3.6	2.8	2.4	
15	3.8	2.9	2.5	
16	4.0	3.0	2.6	
17	4.2	3.1	2.7	
18	4.3	3.2	2.8	
19	4.4	3.3	2.9	
20	4.6	3.4	3.0	
21	4.8	3.5	3.1	
22	5.0	3.6	3.2	
23	5.2	3.8	3.4	
24	5.4	4.0	3.5	
25	5.8	4.1	3.7	
26	6.0	4.3	3.8	
27	6.4	4.5	4.0	
28	6.7	4.7	4.2	
29	7.0	5.0	4.3	
30	7.4	5.3	4.5	
31	7.8	5.6	4.7	
32	8.2	6.0	4.9	
33	8.5	6.4	5.2	
34	8.9	6.8	5.5	
35	9.4	7.2	5.8	
36	9.8	7.6	6.2	
37	10.4	8.0	6.6	
38	11.0	8.6	7.0	
39	11.6	9.2	7.6	
40	12.4	9.8	8.1	

Manufacturer's Chart--Continued

Meter Reading	L	M	H
41 --------------	13.2	10.6	8.8
42 --------------	14.4	11.5	9.4
43 --------------	15.8	12.8	10.2
44 --------------	17.8	14.3	11.2
45 --------------	20.6	16.3	12.6
46 --------------	24.8	18.8	14.2
47 --------------	30.0	22.0	16.0
48 --------------	-	28.0	18.4
49 --------------	-	-	22.0
50 --------------	-	-	-

Appendix F

Instructions for Relaxation Training for Children

Instructions for Relaxation Training for Children

Today we're going to do some special kinds of exercises called "relaxation exercises." In order for you to get the best feelings from these exercises, there are some things you must do. First, you must follow my instructions. You need to do exactly what I say. Second, you must tune in to your muscles. Throughout these exercises, pay attention to how they feel--when they are tight and when they are relaxed. And, third, you must practice. The more you practice, the more relaxed you can get.

Do you have any questions?

Are you ready to begin? Okay. First, get as comfortable as you can in your chair. That's fine. Now, close your eyes and don't open them until I say so. Remember to follow my instructions, try hard and pay attention to your body. Take a deep breath and let it out slowly.

1. <u>HANDS AND ARMS</u>

   Pretend you have a whole lemon in your hand. Now squeeze it hard. Try to squeeze all the juice out. Feel the tightness in your hand and arm as you squeeze. Now drop the lemon. Feel the relaxation. Take another lemon and squeeze it. Try to squeeze it harder than the first one. That's right.

Real hard. Now drop your lemon and relax. Once again, take another lemon and squeeze all the juice out. Good. Now relax and let the lemon fall from your hand. Now remember to keep your eyes closed. Pretend you have a whole lemon in your other hand. Now squeeze it hard. Try to squeeze all the juice out. Feel the tightness in your hand and arm as you squeeze. Now drop the lemon. Feel the relaxation. Take another lemon and squeeze it. Try to squeeze it harder than the first one. That's right. Very hard. Now drop your lemon and relax. Once again, take a lemon in your hand and squeeze all the juice out. Good. Now relax and let the lemon fall from your hand.

2. ARMS AND SHOULDERS

Eyes closed. Now pretend you are a furry, lazy cat. You want to stretch. Stretch your arms out in front of you. Raise them up over your head. Way back. Feel the pull in your shoulders. Stretch higher. Now just let your arms drop back to your side. Okay. Let's stretch again. Stretch your arms out in front of you. Raise them up over your head. Pull them back. Way back. Push hard. Now let them drop quickly. This time let's have a big giant stretch. Stretch your arms way out in front of you. Raise them up high over your head. Push them way, way, back. Notice the tightness in your arms and shoulders. Hold it tight now. Let them drop again very quickly and feel how good it is to be relaxed.

3. FACE AND NOSE

Take a deep breath and let it out slowly. Remember, now, keep your eyes closed. Here comes a pesky old fly. He has landed on your nose. Try to get him off by wrinkling up your nose. Make as many wrinkles in your nose as you can. Scrunch them up hard. You've chased him away. Now you can relax your nose. Oops, here he comes back again. Right back on your nose. Wrinkle up your nose. Wrinkle it up hard. Hold it just as tight as you can. Okay, he flew away now. Relax your face. It feels good just to let your face relax. Up-oh! This time that fly has come and he's on your forehead. Wrinkle up your forehead. Make lots of wrinkles. Try to catch him in all those wrinkles. Hold it tight now. Okay, you can let go. He's gone for good. Now you can just relax. Your face feels nice and smooth and relaxed.

4. LEGS AND FEET

Keep your eyes closed. Now, pretend that your knee itches and you can't scratch it with your hands. Try to scratch it with your toes without bending your knees. Reach your toes up and try to make them touch your knees. Stretch your toes. Feel the tightness in your let muscles as you try to touch your knees. Okay, relax now. Let your feet go loose. Notice how nice your legs feel when they can be relaxed.

That itch is still there now! Try to touch your knees with your toes. Stretch hard. You're stretching hard now. That's good. Now relax, let them go loose. Feel how much nicer that is. Once more, try to make your toes touch your knees. You can almost make it. Stretch harder. Keep trying. That's very good. Now let go and feel relaxed.

5. FEET

Now pretend that you are standing barefoot in a big, fat mud puddle. Squish your toes down deep into the mud. Try to get your feet down to the bottom of the mud puddle. Push down, spread your toes apart, and feel the mud squish up between your toes. Now you are out of the mud puddle. Relax your feet. Let your toes go loose, and feel how nice that is. It feels good to be relaxed. Back into the mud puddle! Squish your toes down. Push your feet. Hard! Try to squeeze it up. Okay, come out of the mud puddle now. Relax your feet, relax your toes. It feels so good to be relaxed. No tightness anywhere.

6. CONCLUSION

Stay as relaxed as you can. In a few minutes I will ask you to open your eyes, and that will be the end of our exercises for today. As you go through the day, remember how good it feels to be relaxed. Practice these exercises every day to get more and more relaxed. A good time to practice is at night after you've gone to bed when the lights are out. It will help you go to sleep. Then, when you are a really good relaxer, you can help yourself relax at school. Today is a good day, and you are ready to go back to class feeling very relaxed. Slowly now, open your eyes.

Appendix G

Letter of Medical Consultation

Dallas North Medical Clinic
1400 North Central Expressway
Plano, Texas 75074
H. C. Chancellor, M. D.
Telephone
(214) 424-8596

March 1, 1975

To Whom it May Concern:

Re:Joy Ann Anderson

I served as medical consultant to Miss Anderson during the course of her dissertation study entitled "Electromyographic Feedback as a Method of Reducing Hyperkinesis in Children".

H. C. Chancellor, M. D.

HCC/vp

Appendix H

Summary of Percent Decrease Between Pre-and Post-Categories of Behavior by Groups

Summary of Percent Decrease Between Pre- and

Post-Categories of Behavior

by Groups

Group	Categories of Behavior			
	A	B	C	D
NT (No Training)	35%	1%	9%	64%
RT (Relaxation Training)	42%	59%	23%	40%
EMG (Electromyographic Feedback Training)	11%	41%	14%	68%
RTEMG (Relaxation Training and EMG Training)	54%	56%	25%	64%

Categories of Behavior:

A. Overt Physical Behavior Directed Toward Others.
B. Overt Behavior Directed Toward Self.
C. Disruptive Behaviors.
D. Destructive Behaviors

Although there was no overall significant difference between groups in observed pre- and post-classroom hyperkinetic behavior, the results of this study indicated that there was a percent decrease in all categories of behavior between the four experimental groups. The NT (no treatment) group showed a 35 percent decrease in behaviors directed toward others whereas the RT (relaxation training) had a 42 percent decrease, the EMG (biofeedback training) group appeared to be the least effective, showing only an 11 percent decrease while the RTEMG (relaxation training in combination with EMG training) showed a dramatic reduction (59 percent) in this particular category. It would appear that the relaxation exercises (training) added to the effects of the EMG training in overt behavior directed toward others (behavioral category A). It is hypothesized that the relaxation training exercises did have some transfer of training, although limited in terms of overall significance, by lowering the level of anxiety experienced by hyperkinetic children during scholastic achievement testing present during the post-test phase of this study. Many of the subjects were observed to have fifteen to twenty minutes to sit between sections of the achievement tests where rigid structure was imposed on all children by the testing situation. The relaxation exercises could have lowered the level of anxiety and impulsivity during this "time out" period particularly in overt behavior directed toward others (behavioral category A). It is noteworthy that on one occasion, one first grade child (from group RT) verbally commented on his use of "squeezing lemons" during an achievement test when his arm became tense and tired from writing. It is possible that this same youngster could have shown aggressive behaviors toward others had he not internalized the relaxation concept by indicating self control during a stressful situation such as scholastic testing.

In behavioral category B, Overt Behavior Directed Toward Self, the NT group showed a one percent decrease whereas the RT, EMG, and RTEMG groups showed a 59 percent, 41 percent, and 56 percent decrease, respectively. It appears that the experimental treatments had a definite effect in decreasing the behaviors in this particular category. Self directed behaviors which are generally thought to be less disturbing to others showed a marked decrease even though the hyperactive child was restricted to his seat during long periods of scholastic testing and rigid testing procedures.

In behavioral category C, Disruptive behaviors, the NT group showed a nine percent decrease while the RT group showed a 23 percent decrease, the EMG group indicated a 14 percent decrease and the RTEMG group showed a 25 percent decrease. Again, it would appear that the experimental treatments had an effect in reducing the behaviors in this particular category and that the relaxation exercises added to the EMG treatment in reducing disruptive behaviors in the classroom situation. The results of this study indicate that the relaxation exercises did have a limited but definite influence on reducing the frequency of certain types of behaviors. It is hypothesized that the relaxation exercises had more of a carryover value into the classroom situation in terms of behavioral categories than the overall effects of the results of this study indicate. Therefore, future research might consider the effects of relaxation exercises (training) on hyperkinetic children as a singular treatment modality using longer training periods before the determinants of this experimental treatment can be understood.

All experimental groups showed a marked decrease in destructive behaviors, i.e., Category D. The NT group showed a 64 percent decrease, the RT showed a 40 percent decrease, the EMG showed a 68 percent decrease, and the RTEMG group showed a 64 percent decrease. A larger number of specific behaviors in category D might have yielded data more sensitive to treatment differences. The possible emission of behaviors in this category were controlled by the testing situation, i.e., children had only test booklets, answer sheets and two pencils on their desks instead of their usual classroom materials. As a result, behaviors in this category appear to be decreased because of uncontrolled environmental conditions as well as possible treatment effects.

Appendix I

Definition of Terms

Definition of Terms

The following definitions are accepted for purposes of this study.

Relaxation: A muscular state of the individual that is incompatible with hyperkinetic behavior.

Electromyographic Feedback: An objective monitor of the degree of skeletal muscle relaxation.

Hyperkinesis: The term hyperkinesis was used to indicate the behavioral manifestations that are most frequently cited in the literature (Stock, 1969; Stewart, 1967; Bradford, 1971; Cohen, 1970; Lindsley, Bijou, & Haughton, 1971) by authorities who are concerned with this particular specialty regarding the hyperkinetic syndrome in children. The behaviors identified as hyperkinetic do not constitute and exhaustive survey or total review of the literature; but the 28 specific behaviors defined served to identify those behaviors observed and described as hyperkinetic for purposes of this study. The 28 behaviors that were operationally defined as hyperkinetic were subdivided into four categories and were recorded by observers (raters) during math, reading, social studies, or spelling classes.

Time To Onset of First Hyperkinetic Behavior: The period of time measured by observers (raters) between the timed beginning of each observation period and the onset of behavior defined for the purpose of this study as "hyperkinetic."