



1985

An Investigation of the Effects of EMG Biofeedback Training and Relaxation Training on Dimensions of Attention and Learning of Hyperactive Children

John T. Tomassetti
Loyola University Chicago

Follow this and additional works at: https://ecommons.luc.edu/luc_diss

 Part of the [Education Commons](#)

Recommended Citation

Tomassetti, John T., "An Investigation of the Effects of EMG Biofeedback Training and Relaxation Training on Dimensions of Attention and Learning of Hyperactive Children" (1985). *Dissertations*. 2364.
https://ecommons.luc.edu/luc_diss/2364

This Dissertation is brought to you for free and open access by the Theses and Dissertations at Loyola eCommons. It has been accepted for inclusion in Dissertations by an authorized administrator of Loyola eCommons. For more information, please contact ecommons@luc.edu.



This work is licensed under a [Creative Commons Attribution-NonCommercial-No Derivative Works 3.0 License](#).
Copyright © 1985 John T. Tomassetti

AN INVESTIGATION OF THE EFFECTS
OF EMG BIOFEEDBACK TRAINING AND
RELAXATION TRAINING ON DIMENSIONS OF
ATTENTION AND LEARNING OF
HYPERACTIVE CHILDREN

by

John T. Tomassetti

A Dissertation Submitted to the Faculty of the Graduate
School of Loyola University of Chicago in Partial
Fulfillment of the Requirements for the Degree of
Doctor of Philosophy

January

1985

ACKNOWLEDGEMENTS

First of all, I wish to thank Maryellen Tomassetti whose consultation, encouragement and patience were crucial to the completion of this accomplishment.

Many persons have contributed to the investigation reported here. Although everyone who contributed is not acknowledged individually, appreciation is extended to each one. For major contributions, gratitude is extended to members of my dissertation committee; Dr. Joy J. Rogers and Dr. Ronald R. Morgan their knowledge and expertise greatly facilitated my efforts to conduct this study. Most of all, I must express special gratitude for the assistance extended by my director, Dr. Martha Ellen Wynne, who always provided the direction and guidance required for this project.

I wish to thank Dr. Stanford L. McDonald, who graciously agreed to be on my committee after having served as my intern supervisor and who introduced me to biofeedback.

Finally, I express my appreciation to Dr. Todd J.

Hoover for assisting me in reorganizing and finally getting my computer programs to execute correctly.

VITA

The author, John T. Tomassetti, is the son of John Thomas Tomassetti, Sr. and Gilda Ann (Sirianni) Tomassetti. He was born November 18, 1937, in New Britain, Connecticut.

He attended elementary and secondary schools in the public schools of New Britain, Connecticut. He also attended Carson Long Institute, New Bloomfield, Pennsylvania.

Mr. Tomassetti served in the United States Navy and was later employed as a pilot. He then worked as a manufacturing engineer in the aircraft industry.

In September, 1970, Mr. Tomassetti entered the University of Connecticut receiving the degree of Bachelor of Arts in psychology in May, 1974. Mr. Tomassetti received his Master of Arts degree in psychology from Illinois State University in December, 1976.

His professional experience includes Staff Psychologist at SPEED Developmental Center, Chicago Heights, Illinois. He presently holds a position as a Clinical Psychologist with the Illinois Department of Mental Health and Developmental Disabilities, Kankakee, Illinois.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	ii
VITA	iv
Chapter	
I. INTRODUCTION	1
II. REVIEW OF THE LITERATURE	12
Description and Diagnosis of Hyperactivity . . .	12
Behavioral Correlates	18
Overt Behavior	18
Internal States	20
Definition of Hyperactivity	21
Historical Perspective	21
Etiology	29
Overview	29
Organic Factors	29
Biological Factors	31
Psychological Factors	33
Prognosis	35
Treatments of Hyperactivity	39
Pharmacological Interventions	39
Dietary and Orthomolecular Treatments	44
Environmental Manipulation	47
Psychotherapy	48
Cognitive-Behavioral Therapy	51
Metacognition	58
Locus of Control	61
Development of Relaxation Training	63
Biofeedback	70
EMG Biofeedback Training	79
EMG Biofeedback Relaxation Technique	86
III. METHOD	92
Hypotheses	93
Subjects	94
Description of Biofeedback Apparatus	96
Procedure	97
Group 1 Relaxation Training	98
Group 2 EMG Biofeedback Training	99
Group 3 Control Group	100

Instrumentation	100
Design and Statistical Analysis	107
IV. RESULTS	109
V. DISCUSSION	119
Recommendations for Future Research	128
REFERENCES	137

LIST OF TABLES

	Page
1. DSM-III Attention Deficit Disorder	17
2. Means and Standard Deviations	112
3. EMG Training Group	113
4. Relaxation Group	115
5. Control Group	117

CHAPTER I

INTRODUCTION

The understanding of hyperactivity and the clinical approaches utilized in treating it have undergone an evolution from a physiochemical to a cerebral-cognitive viewpoint which, in turn, is reflected in the progression of the descriptive labels assigned to this condition. Changing clinical approaches have resulted in various descriptive diagnoses identifying hyperactivity as minimal brain damage, minimal brain dysfunction, minimal cerebral dysfunction, a hyperkinetic reaction of childhood, a hyperkinetic child syndrome, and currently, an attention deficit disorder with hyperactivity (American Psychiatric Association, 1980). Today, most diagnostic descriptions of hyperactivity recognize that attentional difficulties are the most persistent of symptoms for the hyperactive child. In addition, other overt behavioral symptomology associated with this diagnosis often includes impulsivity, distractibility, short attention span, low frustration tolerance, excessive motor activity, and emotionality. More recently, studies have suggested that activity levels are not as prominent a feature of the disorder as is inattentiveness (Achenbach, 1982; Schwartz &

Johnson, 1981; Zins & Ponti, 1982). While many behaviors may be associated with hyperactivity, all definitions have suggested that it is not a result of other disorders such as mental retardation, childhood psychosis, emotional disturbance, physical handicap, and gross brain damage. However, hyperactive behaviors unquestionably exist within these other diagnostic categories. The present investigation is concerned with children for whom hyperactivity is their primary difficulty. Hyperactive children are typically of average intelligence; however, their behaviors tend to interfere with adequate performance in the highly structured classroom setting (Routh, 1980; Safer & Allen, 1976; Schwartz & Johnson, 1981; Whalen & Henker, 1976; Zins & Ponti, 1982). Accordingly, a significant discrepancy often exists between hyperactive children's intellectual potential and their level of academic achievement (Bateman, 1965; Mendelson, Johnson, & Stewart, 1971).

Research indicates that academic achievement and locus of control are inversely related (Crandall, Katkovsky, & Crandall, 1965; Rotter, 1966; Rotter, & Hochreich, 1975). These findings seem to imply that a child who does not perceive his or her situation as a consequence of his/her behavior is more likely to obtain low achievement scores. Possibly, then, most hyperactive children's learning and attention difficulties appear to them to be beyond their

control (Leviton & Kiraly, 1979; Omizo & Michael, 1982). This outlook could discourage them from efforts to work towards greater self-control which, in turn, could foster behaviors that will continue to interfere with learning and academic achievement.

Research also has demonstrated that many of the characteristics associated with the hyperactive disorder or attention deficit disorder continue into adulthood; i.e., the attentional and impulse control difficulties persist, but the heightened gross motor levels decrease (American Psychiatric Association, 1980). Comparisons of intelligence scores for older and younger hyperactive males reveal that the older group exhibits lower levels of intellectual functioning than the younger group (Loney, 1974). Similarly, longitudinal studies have found that symptoms of impulsivity, aggression, delinquency, and excitability tend to persist through adolescence and adult years (Borland & Heckman, 1976; Minde, Lewin, Weiss, Laviguer, Douglas, & Sykes, 1971). As Braud (1978) suggested, such problems could persevere because the hyperactive individual fails to develop necessary self-control techniques.

Historically, there have been two different theoretical traditions concerned with the treatment of the hyperactive child: medical and psychological. In the medical model, the predominant treatment for hyperactive children was to

place them on stimulant drug therapy. Stimulant drug therapy usually includes the administration of methylphenidate (Ritalin) and often has not had a substantive effect on motor function. Stimulant drugs appear to have their primary effects on attention span and impulse control, perhaps because of their ability to energize inhibitory brain mechanisms (Barkley, 1981). Changes in other behaviors seem to be the result of these improvements in attention and control of impulsivity. However, despite these behavioral changes, medication reportedly causes little improvement in the academic achievement of hyperactive children, nor is their long-term outcome altered appreciably by drug use during childhood (Barkley, 1977; Barkley & Cunningham, 1978; Henker & Whalen, 1980). Ross (1980) noted that behavioral changes tend to be of longer duration when the change is attributed by the individual to his/her own efforts rather than solely due to an external agent (e.g., drugs). While stimulant drugs appear to be effective in improving the day-to-day management of hyperactive children, other treatments are required if the goals of therapy include improvement of academic achievement as well as that of long-term social adjustment. Furthermore, positive gains seen during drug administration tend to disappear once the medication is discontinued (Ross, 1980). Consequently, medication does not appear to be a panacea for treating

hyperactivity, and it is now widely recognized that medication should not be used as the sole form of therapy for hyperactive children (Barkley, 1981).

An alternative orientation, developed by psychologists, has been the utilization of behavior modification and operant conditioning techniques as sources of learned self-control for the hyperactive individual. These techniques have been broadly applied when treating problem behaviors, especially when coupled with attentional training and relaxation procedures. While behaviors such as time spent sitting (Braud & Holiday, 1971; Phil, 1967; Twardoz & Sojraj, 1972), attention to immediate tasks and the completion of assigned work (Allen, Henkel, Harris, Baer, & Reynolds, 1967; Pigeon & Enger, 1972; Toffler, 1972) have increased due to the employment of operant conditioning procedures, low frustration tolerance, impulsivity, distractibility, deficits in information processing, and emotional lability have continued to be resistant to change. All things considered, operant techniques have been successful in controlling disruptive behavior, yet they have not been effective in producing improvements in academic achievement (Barkley, 1977, 1981).

Recent research findings suggest that the limited success of these treatment paradigms may be due to their inefficacy for shifting the child's locus of control internally

(Carlson, 1982; Omizo & Michael, 1982). Because an external agent (drugs, concrete reinforcer, therapist, etc.) assumes responsibility for regulating behavior, the child is not provided the opportunity to develop self-control. Thus, traditional treatments may actually reinforce the hyperactive child's external orientation and so perpetuate his/her poor problem solving style and result in limited overall gains with respect to academic achievement. Barkley (1981) speculated that hyperactive children have not only a deficit in attention, but also in the "acquisition of age-appropriate rule-governed behavior (self-control)" (p. 47). They appear to have difficulty in the developmental task of shifting from external to internal control. In other words, they need to learn to shift behavioral control from social stimuli (e.g., other people) to internal stimuli (private events) and ultimately, to problem solving (Barkley, 1981). Barkley further postulates that "from these difficulties can arise those impressions of poor concentration, impulsivity, lack of inhibition, poor social relationships, and poor academic achievement often noted in hyperactive children" (p. 231). As a result, they need to learn rule-governed behavior (self-control) and problem solving techniques.

Recently, psychologists have been utilizing biofeedback training as a potent source of learned self-control for

the hyperactive child. Biofeedback training has been found to have significant impact on hyperactivity and its behavioral concomitants through self-regulation of both attentional and physiological process. This utilization of biofeedback training is very much in keeping with the current understanding of hyperactivity and is a continuation of the psychological orientation toward its treatment.

Relaxation training has been reported to be a successful treatment modality used to modify the behavioral correlates of hyperactivity (Braud, Lupin, & Braud, 1974, 1975; Braud, 1978; Connoly, Basserman, & Kirschink, 1974; Hampstead, 1979; Henry, 1980; Lupin, Braud, & Duer, 1974; Menking, 1980; Omizo & Willing, 1982). The two basic types of relaxation induction, electromyographic (EMG) biofeedback training and progressive relaxation, both provide the child an opportunity to develop control over physiological responses. Initially, EMG training was developed to assist hemiplegics regain control over paralyzed muscles (Marinacci & Horande, 1960). The technique was soon altered to induce the opposite effect, muscle relaxation, and was used to relieve chronic spasms (Jacobs & Felton, 1969). This later application was subsequently elaborated into a short-term treatment for chronic anxiety (Raskin, Johnson, & Rondesvedt, 1973), and for relaxation-induction (Long, 1974; Reed & Saslow, 1980; Schandler &

Grings, 1976).

Intrigued by the seeming efficacy of EMG training in facilitating psychophysiological relaxation, Braud, Lupin, & Braud (1975) successfully treated a 6 1/2 year old boy for hyperactivity with this method. Braud (1978) replicated her treatment with five subjects and found significant reductions in hyperactivity, distractibility, and "emotionality-destructiveness". These data suggest EMG and relaxation training may be promising treatment modalities for the hyperactive individual.

Research further indicates that EMG treatment seems to shift locus of control internally (Carlson, 1977, 1982; Stern & Berrenberg, 1977). If it is true that internally oriented individuals tend to exhibit better problem solving skills and higher academic performance (Crandall, Katkovsky, & Crandall, 1965; Rotter & Hochreich, 1975), then it would appear that EMG and relaxation training may also help hyperactive children improve the attention and concentration skills needed for efficient academic performance and improve their self-control. Because this technique teaches control over muscle tension and has been found to enhance cognitive performance (Dunn & Howell, 1982; Omizo, 1982), it may be a useful technique for improving the hyperactive child's attention, self-control, and subsequent scholastic competency.

The present investigation was designed to examine the effects of relaxation training on the attention/concentration, EMG levels, rule-governed behavior (self-control), locus of control, and academic achievement scores in hyperactive children. Specifically, its purpose is to determine whether group-administered relaxation training improves these scores as effectively as does individually-conducted EMG biofeedback training.

Because the estimated incidence of hyperactivity among school age children is between 5% (Barkley, 1981; Firestone & Douglas, 1975) and 20% (American Psychiatric Association, 1980; Conrad, 1977; Safer & Allen, 1976; Sandoval, 1980), effective behavioral management of the hyperactive child is one of the greatest challenges facing contemporary education. Not only do hyperactive children's inappropriate behaviors upset the external learning environment, but seem to be intimately involved with their overall lower level of academic achievement (Barkley, 1981).

EMG biofeedback training has been demonstrated to be effective in reducing hyperactive behaviors (Braud, 1978; Dunn & Howell, 1982) and increasing academic performance (Dunn, 1982). This technique necessitates individual treatment, elaborate equipment, and usually, the services of a psychologist. Thus, while EMG relaxation appears to be advantageous for the child, its implementation in a suffi-

cient scale to impact on the entire population of hyperactive school children does not seem economically feasible.

Progressive relaxation training has been used successfully to treat behavioral correlates of hyperactivity (Braud, Lupin, & Duer, 1974; Braud, 1978), and to enhance cognitive performance (Dunn & Howell, 1982; Klein & Deffenbacher, 1977). Additionally, tentative evidence exists that such treatment will improve attention skills and shift locus of control orientation internally and improve overall scholastic performance. Moreover, the cassette-taped format of current relaxation programs makes it possible for a para-professional to provide this treatment to several children simultaneously. Thus, a distinct possibility exists that group-administered relaxation may be an economical tool through which a school district can help improve the scholastic performance of its entire population of hyperactive students.

The research question to be addressed in the present study are as follows: to what extent, if any, does participation in relaxation training affect the academic achievement, attention/concentration, rule-governed behaviors and locus of control of hyperactive school children? What differences, if any, will be observed on measures of achievement, attention/concentration, rule-governed behavior, and locus of control between children receiving indi-

vidually-administered EMG biofeedback training and those receiving group-administered relaxation training and of the control group?

CHAPTER II

REVIEW OF THE LITERATURE

This chapter will define hyperactivity and discuss its major features, its etiology and misconceptions about it. Following this presentation, a number of intervention and treatment methods will be reviewed. The chapter will conclude with relaxation and biofeedback training strategies and methods used in or related to this investigation.

Description and Diagnosis of Hyperactivity

The definitive meaning of the term "hyperactivity" has stimulated staccato debate in the last few years. The subject which was once calmly considered by a few physicians and educators has now developed into a major concern within medicine and education. On the one hand, some defend the position that the condition results from some type of brain malfunction and requires urgent and vigorous medical and psychological intervention. Others believe that the condition reflects merely the breadth of normal variation. Those who hold the latter position fear the consequences of "labeling" children, deeming treatment an inappropriate and exaggerated response to normal variance. Educators feel that hyperactivity in children is a prevalent

problem both in public schools and in schools for mentally retarded children and that identification is, indeed, necessary in order to facilitate treatment (Safer & Allen, 1976).

Wender and Wender (1978) emphasize some important issues concerning the terminology associated with the diagnosis and treatment of hyperactivity. Although the problems associated with learning disabilities and the behavioral difficulties that accompany hyperactivity are usually considered as two separate entities, more often than not they occur together in the same child. However, not all hyperactive children have the kinds of perceptual and thought difficulties that are seen in learning-disabled children and not all those with learning disorders have the behavioral problems of the hyperactive child. Treatment of the behavior problems of hyperactivity and the academic difficulties surrounding learning disabilities are considered to be different.

Many terms are used in the literature regarding these children. Such references include maturational lag, hyperkinetic reaction, immaturity of the nervous system, perceptual-motor problems, minimal brain dysfunction, minimal cerebral dysfunction, and minimal brain damage. Because descriptors have been used in widely dissimilar ways by various investigators, the same children have been described by different terms and different children by the

same terms. Thus, research findings cannot be easily compared (Cantwell, 1975; Barkley, 1981).

If the words "brain damage" imply structural abnormality of the brain, then "brain damage syndrome" is an inaccurate term. Although some hyperactive children may have brain damage, the majority do not (Barkley, 1979; Chess, 1960; Kinsbourne, 1980; Stewart, Pitts, Craig & Dieruf, 1966; Wender & Wender, 1978; Werry, 1972). Moreover, most brain-damaged children do not exhibit the behaviors commonly associated with the hyperactive child (Rutter, Lebovici, Eisenberg, Sneznevskij, Sadoun, Brooke & Lin, 1969). Clements and Peters (1972) draw attention to the fact that in the research and in public discussions, one sees the term MBD used almost interchangeably with hyperactivity, but the two categories are not identical.

Barkley (1981) states that an important part of the definition of hyperactivity is that the typical behavior pattern will have been present from an early time in the child's life. There are periods when his/her behavior is much better or much worse, depending on the amount of emotional stress he or she is undergoing at a particular time but, basically, the attention deficit, excess activity level and lack of impulse control are present all the time. A child who suddenly becomes hyperactive at age seven or eight without any prior indications should have a careful

medical examination. Such an unusual development might indicate the presence of an illness such as hyperthyroidism or a lesion in the brain. The intensity of the overactivity and related behaviors varies greatly. One child may manifest a problem by merely talking too much while another may be so active and aggressive that he will require residential placement.

Behavior problems--notably increased activity levels, impulsivity, and distractability--lead the list of stated reasons for referral of children with hyperactivity. There is no unitary cause (Werry, 1968), and the problem is much more frequently diagnosed in the United States than in England (Barkley, 1981; Bax, 1978). Sandberg, Rutter, and Taylor (1978) suggest that the majority of children termed hyperactive simply have disorders of conduct, correlating highly with increased activity rather than measures of central nervous system dysfunction. Their study group, however, was drawn from clients of a psychiatric clinic and may not reflect an adequate cross section of the population of interest here (i.e., hyperactive children in standard school systems). The contribution of variables of temperament also deserves further study. Certain behavioral characteristics have a strong predictive value for both activity and learning performance (Matheny, Dolan, & Wilson, 1976). At the present time the emphasis is in the

direction of separating activity from learning disorders, because of the continued inability to demonstrate strong consistent links across these groups of children, yet who at times share many of the same disabilities. In support of this contention, the recently adopted terminology of the Diagnostic and Statistical Manual III (DSM-III) of the American Psychiatric Association (1980) is presented in Table 1.

TABLE 1

DSM-III Attention Deficit Disorder

Diagonstic Criteria for Attention Deficit Disorder
with Hyperactivity

-
- A. Hyperactivity (at least two of the following)
1. Excessive running or climbing
 2. Difficulty sitting still or excessive fidgeting
 3. Difficulty staying seated
 4. Motor restlessness during sleep
 5. Always on the go or acts as if "driven by a motor"
- B. Inattention (at least three of the following)
1. Often fails to finish things he or she starts
 2. Often does not seem to listen
 3. Easily distracted
 4. Difficulty concentrating on school work or other tasks requiring sustained attention
- C. Impulsivity (at least three of the following)
1. Often acts before thinking
 2. Excessive shifting from one activity to another
 3. Has difficulty organizing work (not due to cognitive impairment)
 4. Needs a lot of supervision
 5. Frequently calling out in class
 6. Difficulty waiting for turn in games or group situations
- D. Onset before the age of seven
- E. Duration of illness at least 6 months
- F. Does not meet the criteria for a pervasive developmental disorder or manic disorder
-

Source: Diagnostic and Statistical Manual of Mental Disorders, 3rd edition, 1980.

Note. DSM III also provides for a diagnosis of attention deficit disorder without hyperactivity (same criteria, except child is judged never to have displayed signs of hyperactivity, Criterion C) and for the diagnosis of attention deficit disorder, residual type (child once met criteria for attention deficit disorder with hyperactivity, but hyperactivity is no longer present).

Behavioral Correlates

Overt Behavior

Safer (1973) emphasized that children with more than one known developmental correlate of hyperactivity have an increased likelihood of becoming hyperactive: Thus, children with low birth weight, a congenital mishap, and a pertinent family history are more vulnerable than those with low birth weight alone. For example, enuresis in early years is often a factor. Many continue to exhibit reversals in writing after ages six (for girls) and seven (for boys). Most are delayed in acquiring fine motor coordination such as fastening buttons and tying shoe laces.

The neurologist may examine the child for "soft" and "hard" signs of neurological impairment. Soft signs are slight deviations from the statistical norms in the performance of various tasks and in physical appearance. Such deviations are found more often in those with impairment of the central nervous system but are also found in normal individuals. Alone, they do not indicate brain injury but, if soft signs are present in quantity, together with other evidence, one may suspect neurological damage. In contrast, hard signs are not found in normal children and may indicate brain damage (Lubar & Deering, 1982).

Hyperactive children appear to evidence more soft signs and more abnormalities on the EEG than do youngsters with no behavior and/or learning problems. Nevertheless, these findings reveal little about the individual child, because many who display hyperactive behavior and/or have learning disabilities have no neurological abnormalities and many normal children show EEG abnormalities and soft signs. To cloud the picture even more, different examiners often draw different conclusions from the same electroencephalograms. Such disagreements may call into question the validity of these measures (Barkley, 1981; Ross & Ross, 1982; Stewart & Olds, 1973).

Satterfield, Cantwell, Saul and Yustin (1974) stated that an abnormal EEG tends to support the diagnosis because approximately 50% of hyperactive children have abnormal EEGs, whereas only about 15 to 20% of normal children have such irregularities.

Soft neurological signs also are associated with impaired fine motor coordination relative to age-expected ability. Impairment in areas of rapid finger movement, finger flexion and extension, finger-thumb coordination and pronation and supination (Werry, Minde, Guzman, Weiss, Dogan & Hoy, 1972).

Internal States

Aside from antisocial behavior, the most significant emotional symptoms seen in hyperactive children are depression and low self-esteem (Cantwell, 1975). In a five-year follow-up study Weiss, Minde, Werry, Douglas, and Nemeth (1971), noted significant depression, markedly low self-esteem and lack of ambition in a majority of their sample which, in their opinion, was a reaction to continuing failures.

Children who repeatedly fail when they can see their peers accomplishing the same tasks easily may begin to feel that they are both stupid and bad. They may feel powerless to have any control over their lives. Peers reject them; teachers scold them; parents punish them. The experience of such impotence, the lack of mastery in common tasks, and the futility of always being wrong may result in chronic depression based on poor self-image for these children. Such individuals may lose motivation to try because failure is so frequent and painful. Antisocial behaviors such as fighting, stealing, and lying often develop as compensation. For these children psychotherapy and/or family therapy and counseling are critical to restoring self-confidence, improving self-image, and alleviating the depression (Satterfield, 1975).

Definition of Hyperactivity

As the previous discussion has implied, there are many views of what constitutes hyperactivity. Trites (1979) has described it succinctly. He stated that while many behaviors have been ascribed to hyperactivity, a parsimonious definition of the condition would most "likely refer to behaviors such as restlessness, impulsivity, distractibility, attentional deficiency, and a tendency to seek stimulus" (p.ix). Many authors agree with this description and that included in the DSM-III (American Psychiatric Association, 1980), but the definition given by Barkley (1981) adds additional clarification that is helpful in understanding and treating the disorder:

Hyperactivity is a significant developmental deficiency of age-appropriate attention, activity level and impulse control and rule-governed behavior (noncompliance, self-control, and problem solving) which arises by infancy or early childhood, is significantly pervasive in nature, and is not the direct result of mental retardation, severe language delay or emotional disturbance, or gross sensory impairment. (p. 14)

Historical Perspective

The philosopher of science, T. S. Kuhn (1962), has reported that on a few rare occasions in history of science, a new conceptualization attracts the attention of others and changes the very nature of theory and research in that field. Long periods follow in which activity is devoted to refining details of the new paradigm. Scientific progress

takes place during these periods in a quantitative sense, but qualitative developments do not occur until the next paradigm shift. These are the observations of Lahey, Hobbs, Kupfer, and Delamater (1979) who make such an analysis in terms of psychology and education: Although about 10% of all children are currently given the diagnostic labels of learning disabilities or hyperactivity, the working hypotheses of psychology and education did not view these disorders as such prior to the 1950s. No doubt children had such problems before then, but they did not fit into existing conceptualizations.

The first paradigm shift occurring in the 1950s resulted in the definition of learning disabilities and hyperactivity as medical model "disease" entities. Major theorists of the 1950s hypothesized neuropsychological deficits to account for the behavioral deviance. This identification resulted in psychological and educational intervention for the first time in history. The specific first-paradigm theories generated much controversy, dominating theory and practice for almost twenty years. The assumption was that learning disabled and hyperactive children suffered from brain damage, but of a "minimal" kind.

When it became clear that hard evidence of brain damage was unusual in these populations, the term "minimal brain dysfunction" was substituted for "minimal brain

damage". This reconceptualized the disorders into functional rather than anatomical terms.

Recently a major new direction for neuropsychological theories has arisen. Sophisticated research procedures have been employed to try to relate individual differences in neurological and biochemical variables to learning and behavior problems. Unlike previous organic theories, these recent working hypotheses are used in operational, testable forms. Therefore, it should be possible to determine if covariations between behavioral and physiological variables might exist within the near future.

While there is much empirical support for some of the newer neuropsychological theories, particularly those that posit chronic differences in autonomic arousal, the data are far from consistent and conclusive at this point (Barkley, 1977; 1981). One group of investigators (Lubar & Shouse, 1979) has stimulated considerable interest by suggesting through their preliminary clinical findings that arousal theory may be directly translatable into treatment methods for hyperactivity through the technology of biofeedback.

In the mid-sixties a variety of theories were proposed which explained the problems in terms of "perceptual-disorders", implicating every sensory modality, and defined perception in such broad Gestalt-like terms that virtually every intellectual process was included. However, each

theory was quite specific in hypothesizing "causes" of learning and activity problems and in recommending methods of remediation.

Kephart (1971) suggested that perceptual-intellectual dysfunction developed when early motor-learning experiences were abnormal or deficient. He believed that normal intellectual development could not proceed until the sensory-motor deficits had been alleviated. Accordingly, Kephart prescribed elaborate programs of physical exercises, forced changes in sleep positions, and forced crawling. Kephart's rationale was that children must learn their body's orientation in space before they could perceive the spatial organization of letters and numbers.

Getman and Kane (1964) proposed a perceptual-motor theory that emphasizes the role of ocular muscle movements and visual-motor integration. They have developed a battery of training exercises that form the basis of "developmental optometry." Such methods are widely used today by optometrists and others in treatment for children with learning and behavior problems.

Frostig and Horne (1964) and Fernald (1943) have posited perceptual theories which put less emphasis on motor learning. They have given less prominence to the question of etiology but have developed extensive programs to treat perceptual dysfunction. The "Frostig Kits" attempt

to remediate deficits in the visual perception of children through exercises such as copying abstract geometric figures. Fernald's program emphasized the intergration of the visual, audutory, kinesthetic, and tactile modalities through such techniques as cut-out letters covered with sand paper.

Another theoretical approach views disorders of "psycholinguistic processes" as the cause of learning and behavior problems. The term is used broadly as being synonymous with the term "intelligence". The Illinois Test of Psycholinguistic Abiliites (ITPA), is an instrument which has been developed for use in a proposed program for remediating such deficits.

In the early 70s, the beginnings of what now appears to be a full paradigm shift became evident. Writers began discussing hyperactivity and learning disabilities, not as labels for medical-model disease entities, but as labels that designate broad maladaptive patterns of behavior. Academic and activity problems were no longer perceived as symptoms of underlying neurological or psychological disorders; but, instead as behavior problems that can be modified in the same manner as any other behavior disorder. A considerable amonut of substantiating evidence as to the efficacy of this approach was produced between 1975 and 1978 (O'Leary, Pelham, Rosenbaum & Price, 1976; Lahey, 1976).

These people also began investigating alternative behavioral strategies. At the time of his review, Lahey regarded the information as tentative, asserting that much still remains to be learned, particularly about the long-term effects of behavioral and other methods of treatment.

Lahey, Hobbs, Kupfer, & Delamater (1979) surveyed behavioral approaches in education. Generally speaking, these approaches to teaching and therapy are defined by three primary characteristics:

1. Individualization and mastery learning: The child learns each task to mastery before progressing to the next.
2. Direct teaching: Behavioral methods are aimed directly at the behaviors that need to be modified rather than at inferred mental or physiological disorders that are believed to underly the maladaptive behavior.
3. Emphasis on measurement: Frequent or continual measurement provides feedback on the effectiveness or ineffectiveness of behavior-change methods and allows modification of the procedures.

Areas of intervention which have proven to be of questionable targets are (a) attentional deficits, (b) activity level, and (c) perceptual and cognitive disorders.

Although studies demonstrated that one could improve a child's attending behaviors through the use of reinfor-

cers, it did not follow, as was theorized, that academic learning would also improve (Marholin & Steinman, 1977). That promising approach appears to have been a false lead. Research also revealed that it is not apparently necessary to modify impulsivity, in the sense of brief latencies, to increase the accuracy of responding in underachieving children. It seems adequate to focus on the reduction of inaccurate responding (Lahey et al., 1979).

There are some data which suggest that diagnosed hyperactive children do not differ at all from normal controls in gross motor activity (Saxon, Magee & Siegel, 1977). In terms of the selection of appropriate targets for intervention, the suggestion was that the behaviors that must be altered are the same behaviors that must be changed in any child with behavior problems: the inappropriate behaviors themselves.

This focuses on the question of whether the inappropriate behaviors of diagnosed hyperactive children can be modified using the same behavior therapy methods used with other children with behavior problems. O'Leary, Pelham, Rosenbaum and Price (1976) found tentative evidence that the label of hyperactivity is irrelevant to the choice of treatment methods and the effectiveness of treatment. It seems that these children respond to behavior therapy the same way other children do.

Conduct problems and academic learning deficits are behaviors which justify modification. High rates of inappropriate behaviors bring children into conflict with their environments. A number of studies provide encouraging evidence that high rates of conduct problems can be successfully reduced through behavioral procedures. The studies also reveal that hyperactive or learning-disabled children respond in essentially the same way to behavioral interventions as any other children (Achenbach, 1982; Ayllon & Roberts, 1974).

Another characteristic common to both learning-disabled and hyperactive children is deficits in academic learning. The rationale upon which first-paradigm approaches to learning disorders were based is that academic intervention will not be successful until the underlying learning problems have been solved. There is evidence that such an approach can be successful. Clearly, reading, writing, and arithmetic can be taught more effectively to learning-disabled and/or hyperactive children using behavioral methods of instruction. What is critically needed, however, is well-controlled research dealing with the long-term effectiveness of behavior modification with such children. Although a review of existing evidence is strongly supportive of behavioral instruction methods, the quality of the current research is lacking in some respects. (Lahey, 1976,

1977; Lahey et al., 1979).

Etiology

Overview

At the present time, there appear to be two major views on the presumed etiology of hyperactivity: the organic disease (medical) model and the social-environmental (behavioral) model (Porges & Smith, 1980). While the two are not mutually exclusive, they do connote important differences in appropriate intervention strategies. The first approach suggests treatment of the inferred nervous system dysfunction through pharmacological, orthomolecular, or dietary techniques; while the later encourages psychological treatments (Porges & Smith, 1980). In many cases, a combination of the approaches may be the treatment of choice. The following is a summary of etiological issues and factors.

Organic Factors

One of the most common explanations of hyperactivity has been that it resulted from brain injury, usually postulated to have occurred around the time of birth. For example, in the classification system formulated by the Group for the Advancement of Psychiatry (1966), they describe a syndrome "frequently seen in preschool and young school-age children with cerebral cortical damage of a diffuse

nature resulting from cerebral insult at birth. . ." (p.266) and frequently characterized by hyperactivity, distractibility, and impulsivity.

While brain damage may increase the risk of hyperactive behaviors (Achenbach, 1982; Rutter, 1977; Werry, 1968), it does not always cause hyperactivity nor are all hyperactive children brain damaged (Achenbach, 1982; Barkley, 1981; Ross & Ross, 1982; Schwartz & Johnson, 1981). In fact, Safer and Allen (1976) suggest that the use of the term "brain damage" is inappropriate with these children because more than 95% of them have no evidence of an injured area of the brain. The DSM-III also states that a diagnosable neurological disorder is present in only about 5% of the cases. Routh (1980) emphatically stated that he will not use the concept of MBD again until he is shown that the syndrome exists.

As a result of the evidence in the research, the conclusion is that there is little evidence that hyperactive children as a group are brain-damaged, and reference to the group in these terms appears clearly inappropriate. However, there is evidence in the literature that, for some children, their hyperactive behavior may be related to biological factors.

Biological Factors

There has been an increasing interest in identifying a genetic basis for hyperactive behavior. An extensive review of these studies is contained in Ross and Ross (1982) and Cantwell (1975). At this time, it appears quite possible that there is a genetic component to some hyperactive behavior that may be hereditary in nature (Cantwell, 1975; McMahon, 1980), although additional research is required to substantiate this possibility (Barkley, 1981; Ross & Ross, 1982).

Physiological overarousal and underarousal have both been hypothesized as important factors in hyperactivity in children (Achenbach, 1982), although more emphasis appears to have been placed on viewing these children as seeking additional stimulation. Neurologic immaturity has been hypothesized because many (30-50%) show patterns of underarousal on EEG's (Hastings & Barkley, 1978). Zental (1975) proposed that because of a less than optimal level of arousal, they engage in higher rates of activity to increase stimulus input. However, there remains a need for further documentation through research before this hypothesis can be accepted and no definitive conclusions regarding the arousal state of the CNS of hyperactive children presently can be made (Ferguson & Pappas, 1979).

Chemical toxins such as lead poisoning (from

ingesting lead-based paints, and from air pollution caused by leaded gasoline) have been postulated as possible bases for hyperactivity. David (1974) found some evidence to support this hypothesis, and it appears that increased lead levels may be a cause of some hyperactivity (Safer & Allen, 1976; Schwartz & Johnson, 1981).

An area that has received considerable attention and publicity as a possible cause of hyperactivity is that it may be an allergic reaction (or heightened sensitivity) to food additives. The chief proponent of this approach has been Feingold (1975), whose book, Why Your Child is Hyperactive, became a national best-seller. Although the approach claims a wide following among many parents, it is based largely on "clinical impressions" rather than empirical research. Feingold suggested that these children have a heightened sensitivity to artificial coloring, flavors, and other food additives, and that these lead to hyperactivity for many of them. Unfortunately, there is only weak research support for this as a causal factor (Achenbach, 1982). Further discussion of this topic is contained later in this chapter.

To summarize this section, it is apparent that research has been unable to provide conclusive evidence of brain damage in most children. However, the studies suggest that there may be some subtle biological factors

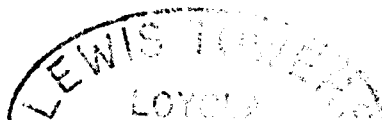
that may play a role in the development of hyperactivity. At this time efforts to identify a single etiological basis for hyperactivity generally have been unsuccessful (Kenny, 1980).

Psychological Factors

Not as much has been written about possible psychological, environmental, or social factors which may contribute to the development of hyperactivity. As a result, it is difficult to judge their potential influence on hyperactivity and to make definitive statements regarding their roles.

There have been several studies which have shown that hyperactive behavior can be influenced by its consequences (Mash & Dalby, 1979; Porges & Smith, 1980; Willis & Lovaas, 1977). There also is some evidence to indicate that social situations, emotional difficulties, and social learning may lead to hyperactivity (Porges & Smith, 1980), and that it may be acquired as a function of direct reinforcement or through observational learning processes (Ross & Ross, 1982).

It is a widely accepted assumption that a child's environment (e.g., home and school) is also an important determinant of whether a child is labeled hyperactive. For example, parents' child-rearing practices or their personal beliefs about child development influence whether the child is identified as hyperactive by the family with a subsequent



referral for a professional opinion. Similarly, one classroom environment may facilitate the optimal development of some children, while being detrimental to others. It seems entirely possible that these factors can significantly influence children's behavior. The responses of adults (and others) can exacerbate the child's initial problems and the child's behavior can similarly influence that of adults reciprocally.

While the need for additional research to explicate relevant psychological factors (as well as organic, biologically based ones) undeniably exists, the conceptualization proposed by Barkely (1981) does appear promising. As noted earlier, he postulated that hyperactive children have deficiencies in learning rule-governed behavior and in problem solving skills. Fortunately, these behaviors were shown to be modifiable through behavioral methods (Lahey et al., 1979). These methods will be reviewed later.

According to Barkley's (1981) perspective, hyperactive children may have experienced some problem in the development of rule-governed behaviors which lead to self-control. The problem could result from (a) neurological dysfunction which inhibits the translation of linguistic stimuli into behavior; (b) inadequate training to adhere to rules presented in that language; (c) lack of internalized rules or self-speech resulting from training; or (d) deficient

training in problem solving. Difficulties could be experienced in any of these areas, with those occurring in the earlier steps affecting the later stages.

Prognosis

Available research pertaining to the natural history and prognosis in the hyperactive disorder has been appraised by Barkley (1981) and Cantwell (1975a). Early investigators tended to emphasize that the symptoms would disappear as the child grew older (Laufer & Denhoff, 1957). However, while some of the symptoms of hyperactivity may diminish with age (Rutter, 1977), it now appears that this initial optimism was unjustified. After reviewing a number of studies, Cantwell stated the data strongly suggest that the hyperactive child syndrome is a precursor of significant psychiatric and social pathology in adulthood and that alcoholism, sociopathy and hysteria are the most likely psychiatric outcomes for many hyperactive children. Follow-up studies of hyperactive children indicate that antisocial behavior (including drinking problems) is prevalent by adolescence. Moreover, retrospective studies of adults with antisocial behavior indicate that a significant percentage were hyperactive, aggressive, and impulsive as youngsters. Barkley (1981) and Cantwell (1975a) stated the findings are strongly suggestive that the adult outcome of hyperactive children is likely to continue to be poor as one might

predict from their "fairly-well-established poor outcome in adolescence."

These follow-up studies also provided information on the effects of various treatment modalities on the long-term outcome of hyperactive children. However, none of the studies clearly demonstrated that treatment of any type significantly alters the prognosis of hyperactive children. It is true that the data are sparse, and none of the studies can be considered to involve children who were intensively and consistently treated over the course of childhood. Barkley summarizes the findings as follows:

1. Prospective and retrospective follow-up studies of hyperactive children indicate they are prone to develop significant psychiatric and social problems in adolescence and later life.
2. Antisocial behavior, serious academic retardation, poor self-image, and depression seem to be the most common outcomes in adolescence.
3. Alcoholism, sociopathy, hysteria, and possible psychosis appear to be probable psychiatric outcomes in adulthood.

Some conditions which appeared to contribute to these conclusions were that children with the most antisocial behavior at follow-up were more likely to have fathers who had learning or behavior problems as children and who had

been arrested as adults. Families of the ultimately antisocial children had been rated as significantly more pathological at initial evaluation. Three specific items on the rating scale; i.e., poor mother-child relationship, poor mental health of the parents, and punitive child-rearing practices, distinguished the families of the ultimately antisocial children from the rest of the group.

Weiss, Minde, Werry, Douglas, and Nemeth (1971) found that the 20 percent of the children in their study who were succeeding at school on follow-up had higher initial full-scale IQs. This was confirmed by Minde, Lewin, Weiss, Lavigueur, Douglas and Sykes (1971) in a more detailed look at academic outcome of a small subsample of these children. Those least academically successful differed from those who were most successful academically in having lower WISC full-scale IQ scores and a greater verbal-performance discrepancy on the WISC, as well as indication of verbal difficulties and visual-spatial problems. Dykman, Peters, and Ackerman (1973) found those with less evidence of neurological abnormality to be less retarded academically at follow-up. The only significant predictors of "good" and "poor" outcome in the Minde study (Minde, Weiss & Mendelson, 1972) were initial aggression scores and initial scores on the Psychopathic Scale of the Peterson-Quay checklist. However, the "poor" outcome group did tend to have

initially higher scores on most target symptoms as well as evidence of a low initial IQ, a positive history of neurological abnormalities, lower socioeconomic status, and more unfavorable ratings of their family environment.

There were twenty children who could be said to have deteriorated over the follow-up period. No clear-cut predictive characteristics of these children were evident; however, there were three children in the "poor" group at follow-up who had been considered well-adjusted at initial evaluation. All three of these had definite schizoid tendencies.

In sum, the initial belief was that symptoms of hyperactivity disappear with maturity. However, follow-up studies suggest that many hyperactive children develop psychiatric and social difficulties later in their life. The data to date cannot conclusively indicate what treatment can significantly alter the prognosis of the hyperactive child. Overall, certain conditions which appear to contribute to the poorest prognosis are those involving families that were significantly more pathological, children with lower IQ's, and children prone to traits suggestive of probable psychopathology.

Treatments of Hyperactivity

A number of approaches to the treatment of hyperactive children that have been reported. More popular ones include pharmacological treatments, dietary and orthomolecular techniques, behavioral and cognitive-behavioral approaches, and environmental manipulation. Fringe therapies, such as specific exercise regimens and psychosurgery, have also been advocated (Barkley, 1981; Glow & Glow, 1979).

It should be kept in mind that the treatments discussed are not mutually exclusive. They frequently are used in combination with one another. In addition, they are generally not the exclusive domain of one profession and a multifaceted, interdisciplinary approach is frequently the norm in treating these children and their families. Furthermore, no simple formula can be applied for selecting the treatment of choice.

Pharmacological Interventions

The Federal Drug Administration estimated that prior to 1970, 150,000 to 200,000 American school children were being treated with stimulant drugs, while the National Institute of Mental Health estimated that up to 4,000,000 hyperactive children would benefit from these medications (Grinspoon & Singer, 1973). Rose and Rose (1974) estimated that 250,000 American children were receiving stimulants at

the request of their teachers (Glow & Glow, 1979).

The use of stimulant drugs with hyperactive children has become the most common form of treatment (Achenbach, 1982; Safer & Allen, 1976) the reason for its popularity is, quite simply, its effectiveness. It is difficult to dispute the efficacy of short-term stimulant treatment in the management of hyperactive children (Gittleman, Abikoff, Pollack, Klein, Katz, & Mattes, 1980; Safer & Allen, 1976). Based upon a literature review on the effects of stimulant drugs, Whalen and Henker (1976) estimate that somewhere between 60 and 90 percent of hyperactive children improve with Ritalin (methylphenidate). Nevertheless, there continues to be serious concern about the possible deleterious effects that may result from the use of the drugs.

The drug treatment of hyperactivity has been thoroughly reviewed by Sroufe (1975). Other papers with unique coverage are those of Campbell (1976) Connors (1972), Sprague and Werry (1971), Henker and Whalen (1980) and a special issue of Psychopharmacology Bulletin (1973). The controversy concerning clinical use of stimulants has been reviewed by Grinspoon and Singer (1973). Glow and Glow (1979) highlight the main findings of this research.

About two-thirds of children diagnosed as hyperactive demonstrate a favorable response to amphetamines and

related drugs such as methylphenidate when parent, teacher, or clinician ratings of behavior are used as the criterion. As yet, no way of predicting good responders has emerged, although research by Connors (1972; 1974), Saletu, Saletu, Simeon, Viamontes and Itil (1975), Satterfield (1973) and Satterfield and Cantwell (1974) is focused on the goal of identifying discriminating factors. A related problem with the use of the drugs is that of predicting which children will benefit from them (Achenbach, 1982). Many clinical, environmental, familial, social, and neurological factors may be related to treatment response (Cantwell, 1977). Research has so far failed to discriminate between those who will and will not benefit (Barkley, 1981; Stephens, Pelham & Skinner, 1984).

Studies of the effects of stimulants on hyperactive children are consistent in one respect: reported behavior, activity, and productivity show desired change in the majority of children; objectively measured change is more fragile and unreliable (Glow & Glow, 1979).

Minor tranquilizers (i.e., anxiolytics, benodiazepines etc.) are being abandoned in the treatment of hyperactive children of normal intelligence because of ineffectiveness (Werry & Aman, 1975) and evidence of impaired performance on cognitive tasks (Sprague & Sleator, 1973). Clinical practice with institutionalized, retarded, hyperkinetic chil-

dren is different. Sedatives and tranquilizers are widely used in these cases and psychostimulants are virtually restricted to short-term patients admitted for assessment or parent relief (Glow & Glow, 1979).

The most important finding in regard to long-term effects of stimulant drugs is that, when treatment is discontinued, problems of attention, school achievement, and behavior remain (Barkley, 1981; Minde, Weiss, & Mendelson, 1972; Weiss & Minde, 1974; Weiss, 1975). Weiss (1975) compared children who received methylphenidate over a long term and children who discontinued medication. The findings within the methylphenidate-treated group were that those whose families were coping more adequately at referral were better adjusted five years later than those whose families were less adequate. However, there was not better outcome for those treated with long-term methylphenidate than for those whose medication was refused or discontinued. Whalen and Henker (1976) have applied attribution theory to explain this finding. Attribution theory concerns the modification of relationships between stimulus events and the subjects' responses by the individuals' perception of themselves as an active agent or source of behavior or as a passive recipient of environmental influences. Children who attribute their improved behavior and attention to treatment with drugs rather than to their own

efforts will thus be predisposed to resume previous behavior patterns when the drug is withdrawn. Treatment is palliative rather than curative, and there is no evidence that treated children are better off when treatment is discontinued than when it was begun (Glow & Glow, 1979).

The drugs currently in use for the treatment of hyperactive children are stimulants, phenothiazines, and tricyclic antidepressants. Katz, Saraf, Gittelman-Klein (1975) offer guidelines and some explanations concerning use. The drugs of choice are stimulants, because the largest percentage of hyperactive children respond to them. In fact, the clinical response is superior to both phenothiazines and tricyclic antidepressants. Phenothiazines also decrease motor activity; however, with stimulant treatment the children are less sedated, more alert, and can concentrate better. The side effects associated with phenothiazines are, for the most part, less acceptable to child, parent, and teacher. Fewer children treated with phenothiazines maintain a favorable response over time.

Finally, it should be noted that there is no evidence to indicate that drug treatment (by itself) significantly alters the long-term prognosis for hyperactive children (Cantwell, 1977), although the drugs are useful for short-term interventions. They may be particularly beneficial in highly stressful, frustrating cases or in crisis situations in

which it is critical to provide some "relief" to parents and teachers while new behavior management techniques are being implemented. Additional research, however, is needed. The problems encountered with the use of stimulant medications have clearly indicated a need for supplemental intervention.

Dietary and Orthomolecular Treatments

A popular but controversial treatment approach for hyperactivity is the Feingold or Kaiser-Permanente diet. This regimen eliminates foods with artificial coloring and flavoring, natural salicylates, and preservatives contained in commonly eaten foods. About 20,000 children are now estimated to be on this diet (Bassuk, Schoonover, Galenberg, 1983), and Feingold (1976) and other advocates claim improvement in about half of hyperactive children who follow this regimen.

Feingold claimed that when the child responds favorably to the diet, the first area in which improvement is seen is in behavior. The child usually becomes less aggressive, less impulsive, and his/her ability to concentrate improves. Improvement in fine and gross motor coordination, and finally, cognition and perception, should follow, particularly in younger children (Feingold, 1975; 1976). Recent controlled studies, however, suggest a much less sanguine outlook for dietary treatment of attention deficit disorder.

children (Conners, 1980; Conners, Goyette, Southwick, Lees, & Andrulonis, 1976; Harley & Matthews, 1980; Harley, Matthews, & Eichman, 1978; Harley, Ray, Tomasi, Eichman, Matthews, Chun, Cleeland & Traisman, 1978; Spring & Sandoval, 1976; Trites, Tryphonas & Ferguson, 1980). These studies have generally found only a small number of hyperactive children who may be behaviorally sensitive to food additives and who consequently show improvement from such dietary manipulation. Preschool children generally respond more positively than older children (Harley & Matthews, 1980; Henker & Wahlen, 1980). Although the overall efficacy of the Feingold diet remains questionable, it may have secondary effects that have as yet remained virtually unexplored. For example, Henker and Whalen (1980) pointed out that families often undergo radical changes in lifestyle to ensure that the child faithfully follows the diet. Any resulting changes in the constellation of the family structure may have effects on the child's behavior (i.e., parents' tracking behavior of child may improve, child may begin to receive more positive attention). Harley and Matthews (1980) add that maintenance of the diet may positively alter family dynamics by encouraging parents and children to spend more time together, sharing in food preparation and increasing exchanges of mutual support.

Some medical research has attempted to link hyperactivity and other behavioral disorders to biochemical imbalances or to a deficiency of essential nutrients in the brain of normally occurring substances in the human body (Pauling, 1968; Cott, 1972). From this perspective, treatment of hyperactivity would focus on the use of orthomolecular techniques of giving the child large doses of vitamins to correct this imbalance or deficiency. Palmer, Rapoport, and Quinn (1975) concluded that, although there have been some claims of positive results with the use of megavitamin therapy, no controlled double blind studies had been conducted to objectively assess its effect. In fact, material sold in "health food" stores is not regulated by the FDA, has variable composition, and has frequently been found to be contaminated with pesticides and heavy metals (such as lead). Moreover, large doses of the fat-soluble vitamins (A,D,E, and K) can be toxic in children (and adults)(Bassuk, Schoonover, & Gelenberg, 1983). Therefore, the efficacy of this form of treatment for hyperactivity has yet to be demonstrated.

In summary, while the merits of orthomolecular treatments need further documentation, it appears that the dietary approach either has a very small effect on some hyperactive children or no effect in most cases (Achenbach, 1982). Even if the diet has no specific effect on the child's

hyperactive behaviors, there seems to be some benefit in limiting intake of "junk foods", soft drinks, sugars, etc., and to increasing family interactions.

Environmental Manipulation

The overarousal and underarousal theories of hyperactivity have resulted in various interventions which focus on manipulation of the child's physical environment. The belief is that the classroom may be contributing to the child's disruptive, hyperactive behavior because of the way it is physically organized. Adherents of the underarousal theory attempt to create a more stimulating environment in the regular classroom. This is generally accomplished by increasing both visual and auditory stimulation. For example, Scott (1970) introduced background music in the classroom and found that it decreased the activity level of hyperactive children and increased their work output.

An example of the opposite approach can be seen in the minimal stimulation programs originally designed by Strauss and Lehtinen (1947). These were based on the view that the hyperactive child is brain-injured and that his/her distractibility is caused by an oversensitivity to environmental stimulation. Therefore, all visual distractors such as pictures, bulletin boards, and toys were removed, the room was painted in a neutral color, and noise was kept to a minimum. In addition, teachers were required to dress

plainly and children's desks were often turned to face the wall in order to reduce any social stimulation. The class size was kept small so that the children received a great deal of individual attention.

The validity of such approaches has been questioned (Douglas, 1972). However, some of the concepts of the minimal stimulation programs are still implemented in classrooms today. For example, study carrels are often used for children who are hyperactive or distractible, and psychologists frequently recommend that distractors at home or in the classroom be limited. A program's use of structure, order, and predictability may be helpful with hyperactive children. Most importantly, Ross and Ross (1976) point out that the true value of these programs was their emphasis on adapting the classroom to the needs of the child and the idea that the school could be changed to help the child (rather than insisting that the child adapt to the school).

Psychotherapy

The term psychotherapy is generally limited to treatment which has been designed and implemented by a professionally-trained person such as a psychiatrist or psychologist. Psychotherapy conveys no information about the severity of the maladaptive behavior, the duration or intensity of the treatment process or the theoretical

background and affiliation of the therapist (Ullman & Krasner, 1969). The procedures include a diverse group of techniques; for instance, psychoanalysis, hypnosis, operant conditioning, modeling, and psychodrama are all included in its general rubric (Rimm & Masters, 1980; Ross & Ross, 1976).

Two fundamentally different approaches, traditional psychotherapy and behavior therapy, have dominated the field (O'Leary & O'Leary, 1972). Traditional psychotherapy is based on a psychoanalytic or medical model that embraces the disease concept of behavior abnormalities (Bandura, 1969). According to this concept, abnormalities of behavior are symptoms of an underlying psychic disturbance or neurosis. The therapist's task is to identify the underlying cause of the behavior and modify or eliminate the behavior by effecting changes in the intrapsychic organization of the individual through the restructuring of some of his internal mediating processes. Central to the disease concept is the assumption that long-term benefits from treatment can only be achieved if the individual gains some understanding of the psychic forces that underlie his maladaptive behavior. The development of such insight becomes one of the primary targets of the person's ability to behave adaptively in terms of bringing his life situation under his own control (Ross & Ross, 1976, 1982).

Behavior therapy is based on a sociopsychological model that assumes that maladaptive behavior is a learned response acquired as a method of coping with the demands of the environment (Ullman & Krasner, 1969). The maladaptive behavior is learned; therefore, it is potentially modifiable. The therapist's goal is to effect a change in the behavior through the application of general learning principles, the emphasis in treatment being on a direct attack on the problem behavior. The treatment process has an empirical basis and consists of the teaching of specific responses. Its use does not preclude the spontaneous acquisition of insight; in the process of utilizing newly learned responses, clients sometime gain an understanding of the reasons for their previously maladaptive behavior (Bandura, 1969; O'Leary & O'Leary, 1972; Rimm & Masters, 1980).

In the first half of this century the proponents of these two conceptually different approaches were polarized, with each faction strongly rejecting the viewpoint of the other. Traditional psychotherapy was firmly entrenched and its proponents were highly critical of the attempts of behavior therapists to place the treatment of behavior problems on a more objective basis. However, the following twenty years maintained an attack in the form of criticisms of traditional psychotherapy (Skinner, 1953) and empirical

demonstrations which forced a reconsideration of some of the basic tenets of these therapeutic procedures (Bandura & Walters, 1963). Eysenck's text (1960) and empirical demonstrations of reinforcement and other procedures (Bijou, 1965) strengthened the position of behavior therapy. One effect has been a convergence of traditional psychotherapy and behavior therapy so that there is presently some overlap, with some clinicians using methods based on learning theory and some behavior theorists incorporating concepts and variables central to traditional psychotherapy in their approaches to behavior change (Urban & Ford, 1981).

Cognitive-Behavioral Therapy

Recently, a number of therapeutic techniques have been developed which recognize the interplay of both the cognitive and the behavioral determinants of the child's functioning. Supporters of this approach generally identify attentional deficits and impulsivity as key features for intervention with hyperactive children (Douglas, 1972; Keough & Barkett, 1980) as they believe that these factors can disrupt a child's behavior. Interventions tend to focus on teaching the child to develop internal control and more effective problem solving style that will ultimately lead to lasting cognitive and behavioral change (Keough & Barkett, 1980). These approaches include self-monitoring, self-reinforcement, training in verbally mediated self-control, and

modeling of effective cognitive and/or interpersonal problem solving. Several representative approaches and studies utilizing these techniques will be presented in this section.

There are many approaches to therapy and some cause considerable speculation. One, fairly new to the scene, is called cognitive-behavioral intervention (CBI). Kendall and Hollon (1979) explain some issues: Although total equivalence with strict behavioral approaches was never suggested, this new therapy is a rational amalgam of two positions. It is not a new therapy, but is, instead, a purposeful attempt to preserve the demonstrated efficiencies of behavior modification within a less doctrinaire context and to incorporate the cognitive activities of the client in the efforts to produce therapeutic change.

Some people felt that cognitions (i.e., thoughts) are subject to the same laws of learning as are overt behaviors (Cautela, 1967; Homme, 1965; Ullman, 1970). This position led to attempts to apply functional analytic assessment procedures and contingency-based intervention procedures to the modification of covert events. Kendall and Hollon (1979) discussed some controversy concerning this. Recent theoretical advances by recognized learning theorists, such as Kanfer's ideas about self-regulation (Kanfer, 1970) and Bandura's theory of self-efficacy (Bandura, 1977) have extended the process of molding covert cognitive processes

into testable formulations that are easily formed into behavioral paradigms.

It has seemed reasonable to some to combine cognitive treatment strategies with explicit behavioral contingency management in order to facilitate meaningful outcomes; namely, self-instructional training via modeling with a response-cost contingency (Kendall & Finch, 1978).

Such a method is analogous to systematically reinforcing an individual for engaging in the behaviors (i.e., evaluating beliefs, rehearsing self-statements) pinpointed by cognitive theorists as likely to produce cognitive change. Thus, incentive manipulations of environmental contingencies can be used to facilitate a client's engagement in cognitive-restructuring or self-instructional training. A method is emerging of greater flexibility in terms of models, without sacrificing the strict standards of assessment and evaluation (Kendall & Hollon, 1979).

Meichenbaum (1977) found that impulsive children do not habitually and spontaneously analyze their experience in cognitively-mediated terms (i.e., both verbal and imaginal) and that they do not formulate and internalize rules that might guide them in new learning situations. The child's inadequate performances may be characterized in this way: (1) failure to comprehend the nature of the problem and to discover what mediators to produce (2) having the correct

mediators within their repertoires but fail to produce them spontaneously and appropriately (3) the mediators which the child produces may not guide ongoing behavior. The cognitive process may thus be seen from a mediational theory viewpoint as a three-stage process of comprehension, production and mediation and inferior performance can stem from a deficiency at any one or combination of these stages.

The procedure of self-instructional training is administered on an individual basis, as follows:

1. An adult model performs a task while talking to himself out loud (cognitive modeling).
2. The child performs the same task under the direction of the model's instructions (overt, external guidance).
3. The child performs the task while instructing himself aloud (overt, self-guidance).
4. The child whispers the instructions to himself as he goes through the task (faded, overt self-guidance).
5. The child performs the task while guiding his performance via private speech (covert self-instruction).

Over several training sessions the package of self-statements modeled by the experimenter and rehearsed by the child (initially aloud and then covertly) is enlarged by means of response chaining and successive-approximation

methods. In the thinking-out-loud phase, the model displays several performance-relevant skills: (1) problem definition ("What is it I have to do?"); (2) focusing attention and response guidance ("Carefully . . . draw the line down"); (3) self-reinforcement ("Good. I'm doing fine"); and (4) self-evaluative coping skills and error-correcting options ("That's okay . . . Even if I make an error I can go on slowly").

Hollon and Kendall (1979) state that cognitive-behavioral interventions are generally integrative and require a theoretical model that is also integrative. But these authors admit that, ultimately, reliance on stimulus-response paradigms (or a cognitively mediated or S-O-R paradigm) may be outmoded. They quote Meichenbaum in a personal communication (1978) in which Meichenbaum argued that reliance on stimulus-response terminology may misrepresent current developments and retard further progress in the area. The danger lies in uncritically accepting concepts and assumptions long associated with such terminology. Meichenbaum suggests formulation of a new language system, which goes beyond stimulus-response terminology.

Hollon and Kendall assure the reader that the use of such terminology does not imply an adherence to any simple deterministic model, certainly not a model that necessarily attributes all variation in motoric, cognitive, or affective

processes to external environmental events. Bandura's notion of reciprocal determinism may prove to be particularly useful in conceptualizing the nature of causality across classes of events (Bandura, 1978). They emphasize Bandura's position that various classes of phenomena (i.e., environmental, person, or behavioral variables) may act on, and interact with, one another over time. Although external events influence subsequent behaviors or cognitions and affects, behaviors can also influence subsequent external events. Person variables, such as cognitive systems or affective propensities, can, by influencing subsequent motoric acts, influence subsequent external events. In other words, although individuals are, to a certain extent, influenced by their environment or their perceptions of their environments, they also play a large part in molding those environments. Models, such as the reciprocal interaction model, do not so much ask which kinds of phenomena "cause" which other classes; but start from the premise that each class may be influenced by variations in any other class. The issue becomes one of specifying the nature of the various relationships across time and evaluating the stochastic weight given any variable in the functional relationship.

Hollon and Kendall also discuss Beck's idea that, in some instances, ongoing trains of rumination appear largely

autonomous from outside stimuli and that it is the progression of material in the ruminations that is most consistent across situations, not the greater interaction between environment, person, and behavior that more typically is true. It is this predominance of idiosyncratic cognitive sets that Beck views as the core of some types of psychopathology, such as depression (Beck, 1976). Mahoney (1977) has suggested that a weighted combination of phenomenological and situational factors provides the best predictor of subsequent behavior.

At this time, too little is known about the parameters of information processing, attention, perception, inference, memory organization and retrieval, expectancy formation, and attribution, despite their implications for cognitive-behavioral models; but increasing attention is being given to these considerations.

Notable contributions have been made by theorists such as Bandura (1977) with his articulation of self-efficacy theory and Kanfer's articulation of self-control theory (Kanfer, 1970). Efforts to draw on experimental cognitive psychology are increasing, and efforts to integrate cognitive and behavioral theories have become increasingly sophisticated (Kanfer, 1970; Mahoney, 1974, 1977). The goal remains to increase the width and strength of explanatory concepts and therapeutic interventions without sacrific-

ing methodological efficiency (Hollon & Kendall, 1979).

Metacognition

Douglas (1980) discussed investigations which have shown that hyperactive children demonstrate certain kinds of attentional problems much more frequently than other kinds. These findings suggest that the impact of their attentional problems extends far beyond the relatively simple tasks that were used in the early attentional studies. Research which taps more complex cognitive and problem-solving skills has been limited; but newer evidence points to serious impairments in the higher-order mental functioning of hyperactive children. Deficits in these and other closely related mechanisms have serious long-term implications for the children's intellectual, cognitive, and social development. Moreover, although drug treatment and the more traditional behavioral approaches have been used successfully to decrease disruptive behaviors and to improve the children's performance on simple attentional measures, these methods have not yet shown their effectiveness in helping hyperactive children cope with more complex problem-solving tasks. Douglas (1980) maintained that the cognitive training approach, used in combination with contingency management and possibly, drug treatment, provides the most promise for improving these higher-order skills. She hypothesizes that if hyperactive children exam-

ine their experiences less reflectively than their companions, then it must be assumed that the schemas (or higher-order cell assemblies, or contingency organizations) resulting from their previous learning will be less well elaborated and less organized. Thus, the poverty of stored experiences would set limits on future learning.

Douglas suggested that possible effects of early deficits include diminution in the quality and quantity of higher-order schemas that are developed by these children and a failure to learn sophisticated search strategies. This could result in severe problem-solving limitations.

Investigators interested in the "metacognitive" development of children place a good deal of emphasis on the difference between knowledge that can be acquired automatically and unselfconsciously and that which can be acquired only by exercising self-conscious, deliberate, and strategically-applied effort. Douglas quoted Brown (1975) in terms of "executive" operations which must be performed by one who attempts to solve a problem that requires knowledge of the second kind. These include: (1) analyzing and characterizing the problem at hand (2) reflecting upon what one already knows or needs to know in order to solve the problem (3) devising a plan for attacking the problem and (4) monitoring one's own progress. Deficits in hyperactive children in turn damage development of their intrinsic

sis motivation. Douglas presents a schematic representation of the way in which the defective functioning of a hyperactive child's attentional, inhibitory, and arousal modulation mechanisms are hypothesized to influence his potential for successful problem solving and other complex intellectual processes. It is suggested that the original deficits result from a constitutional predisposition, possibly neurological in nature. The three closely-related defective mechanisms then lead to impairment or limitations in the development of higher-order schemas, meta processes (including search strategies), and effectance motivation. These deficiencies result in a higher-than-normal rate of failure for the child which, in turn, leads to avoidance behaviors, which result in even greater decreases in concentration. This further impairs the child's ability and motivation to undertake effective problem-solving and a snowball cycle is in motion.

Douglas recommends employment of the cognitive training approach supplemented by contingency management techniques and, perhaps, stimulant medication. She believes the essential ingredients of cognitive training, self-verbalization, modeling, self-monitoring, and self-reinforcement are particularly well suited for dealing with the primary and secondary deficits described above. Major training goals are: (1) help the child understand the nature of his/her deficits (2) strengthen motivation and

capacity to cope with the problem-solving role, and (3) teach the child specific problem-solving strategies.

Locus of Control

Perception of control has been defined as a generalized expectancy for internal versus external control over reinforcement (Lefcourt, 1976). According to Rotter's (1966) theory, internal locus of control refers to the perception that events, both pleasant and unpleasant, are consequences of one's own actions and are thus potentially under personal control. Contrarily, external locus of control is the perception that such events are unrelated to one's own behavior and thereby beyond personal control.

Beginning with the initial work of Phares (1957) and James and Rotter (1958), research has demonstrated that perceptions of internal-external control can be assessed with paper and pencil instruments. This finding led to the development of numerous locus of control scales, and to a plethora of research probing the behavioral and cognitive correlates of locus of control. Among the many reported findings, studies have shown that children having an internal perception of control are more perceptive, inquisitive, curious, and efficient in processing information (Lefcourt, 1976); are better able to delay gratification (Erikson & Roberts, 1971; Mischel, Zeiss & Zeiss, 1974); are superior in intentional and incidental learning (Wolk & DuCette,

1973): and obtain higher scores on measures of academic achievement (Lefcourt, 1976).

These findings suggest that internally-oriented children enjoy a great advantage in the classroom. Their inclination towards delayed gratification could well underly their apparently greater attentiveness and their more efficient information processing abilities. Consequently, internally-oriented children are more likely to perform at a higher scholastic level and thus earn higher grades. Not surprisingly, some authors have contended that, with the exception of IQ, locus of control orientation is the most powerful predictor of academic success (Coleman, Campbell, Hobson, McPartland, Mood, Weinfield & York, 1966).

Recent research indicates that an external orientation to locus of control may be associated with the hyperactive syndrome. Because much of the hyperactive child's physical activity seems to be beyond his/her control (Freedman, 1971), it is likely that he/she perceives an external locus of control. Research conducted by Omizo, Denkowski, and Wilson (1983) demonstrates that hyperactive boys score about one standard deviation above normals on the Nowicki-Strickland Scale (Nowicki & Strickland, 1973). Additionally, studies have indicated that significantly higher external scores can be expected for children with learning disabilities (Gardner, Warren & Gardner, 1977) and those

with learning disorders (Finch & Pezzuti, 1975). Because there tends to be an overlap in the behaviors exhibited by these groups, these findings provide tentative evidence that hyperactive children are more externally oriented.

Quite likely, this external perception of control discourages hyperactive children from efforts toward gaining greater self-control, which thus may assure that their disruptive behavior will continue to interfere with learning, and that their academic achievement will be poor. Accordingly, it would appear that any proposed treatment for hyperactivity should incorporate some means of attempting to shift locus of control internally.

Development of Relaxation Training

The use of relaxation has an extensive history in medicine, clinical psychology, and psychiatry (Goldfried & Davison, 1976). Jacobson (1938) was concerned principally with the exploration of the Watsonian notion that thoughts and feelings were located in the peripheral musculature. Jacobson, a physician, also reported clients benefited when relaxation training was practiced. He systematically studied the powerful effects of muscles on various mental processes such as imagining, paying attention and becoming aware, and demonstrated experimentally that energy is expended in the act of imagining. The mental review of tension-producing situations or even the subconscious image or sensation

of the experience sets the muscles into particular patterns of tension.

This scientist's contribution lies on his major thesis that anxiety and relaxation are mutually exclusive. He demonstrated that learned relaxation of the muscles can generalize to smooth (involuntary) muscles and can effect relaxation of muscles of the gastrointestinal and cardiovascular systems (Brown, 1977).

Independent of Jacobson, two Europeans, Schultz and Luthe (1959), were studying "autogenic training," a method of reducing anxiety while promoting a sense of well-being. Progressive relaxation is practiced chiefly in the United States, autogenic training is popular in Europe and in various medical centers around the world (Brown, 1977).

Training phases are focused primarily on the physiologic aspect along with general suggestions for relaxation. Each phrase is said slowly, allowing time for the client to experience some awareness of the effect of suggestion. Some therapists employ a slow-paced, soothing voice similar to that used in hypnotic induction and some further encourage the use of imagery or memories accompanying states of heaviness, warmth and relaxation.

Goldfried and Davison (1976) trace the development. In this country Haugen, Dixon and Dickel (1963) outlined a complete therapy based on deep-muscle relaxation. Mothers

who have experienced natural childbirth may be also familiar with relaxation exercises, not only to reduce anxiety but also to facilitate movement of the baby through the cervix (Lamaze, 1958).

Wolpe's technique of systematic desensitization lies in the assumed need for the anxiety-inhibiting effects of striate muscle relaxation. Recently, psychologists and others interested in meditation and other Eastern practices have seen a connection between muscle relaxation and yoga exercises (Pfeiffer, 1967; Stoyva, 1968). The interest in transcendental meditation seems also to be a part of the long-standing efforts of people to control their anxieties and generate feelings of well-being via relaxation or quiet contemplation. For the clinician, available data support the usefulness of teaching certain clients how to relax (Bernstein & Borkovec, 1973; Goldfried & Trier, 1974). The mechanics of relaxation training are so straightforward that they can be put on tapes for practice at home. Goldfried and Davison (1976) describe the procedure used in systematic desensitization and detail eleven points ancillary to the method.

Systematic desensitization, the anxiety reduction procedure developed by Salter (1949) and by Wolpe (1958), has proven itself markedly effective in reducing unrealistic anxiety. The technique itself entails having a deeply-re-

laxed person imagine a graded series of increasingly aversive situations. The person imagines each situation under conditions of deep-muscle relaxation, so that he is able to tolerate greater and greater levels of anxiety. Considerable clinical (Paul, 1969) evidence supports the conclusion that the procedure can significantly reduce unrealistic tensions.

There are numerous theoretical explanations for the efficacy of systematic desensitization (Davison & Wilson, 1973; Wilkins, 1971; Wilson & Davison, 1971) the substitution of relaxation for anxiety (basically Wolpe's counterconditioning hypothesis), the gradual exposure to anxiety-eliciting stimuli (the so-called extinction hypothesis, Wilson & Davison, 1971), the contingent reinforcement of increasingly bold approach responses of Goldfried (1971), the cognitive relabeling view (Valins & Ray, 1967) and the "maximal habituation" hypothesis of Mathews (1971). The issue is far from settled. In fact, Goldfried and Davison (1976) have stated that more confusion exists today than it did ten years ago.

It is important to emphasize that this behavior therapy technique relies a great deal on the client's imagery. In a sense, whatever relearning or reconditioning is taking place occurs while the client is silently visualizing scenes. The assumption is that an imaginary aversive scene is a

functional equivalent of the real situation, enabling one to confront a fantasied representation of the thing of which he is afraid. This is assumed to be analogous to his learning to face the situation in real life (Grossberg & Wilson, 1968).

Miller did much of the pioneering work in biofeedback (Miller, 1961; 1969). In recent years, physicians and psychologists have become very interested in biofeedback experiments with human subjects to try and deal more effectively with psychosomatic illnesses, including migraine headaches, asthma, ulcers, etc. (Budzynski, Stoyva & Adler, 1973; Miller, 1974; Shapiro, 1970; Weiss & Engel, 1971).

There has been a strong traditional belief in the inferiority of the autonomic nervous system and the visceral responses that it controls. Recent experiments opposing this notion have deep implications for theories of learning, for individual differences in autonomic responses, for the cause and cure of abnormal psychosomatic symptoms, and possibly also for the understanding of normal homeostasis. Since ancient times, reason and the voluntary responses of the skeletal muscles have been considered to be superior, while emotions and the presumably involuntary glandular and visceral responses have been considered to be inferior. Students of learning have made a distinction between a lower form, called classical conditioning and thought to be

involuntary, and a superior form variously called trial-and-error learning, operant conditioning, type II conditioning or instrumental learning and believed to be responsible for voluntary behavior.

The distinctions have coalesced into the strong traditional belief that the superior type of instrumental learning involved in the superior voluntary behavior is possible only for skeletal responses mediated by the superior cerebrospinal nervous system. While, conversely, the inferior classical conditioning is the only kind possible for the inferior, presumably involuntary, visceral and emotional responses mediated by the inferior nervous system.

The belief that instrumental learning is possible only for the cerebrospinal system and, conversely, that the autonomic nervous system can be modified only by classical conditioning has been used as one of the strongest arguments for the notion that instrumental learning and classical conditioning are two basically different phenomena rather than different manifestations of the same phenomenon under different conditions. For many years Miller (1971) was impressed with the similarity between the laws of classical conditioning and those of instrumental learning and with the fact that, in each of the two situations, some of the specific details of learning vary with the specific conditions of learning. Failing to see any clear-cut dichotomy, he has

assumed that there is only one kind of learning. That assumption logically required that instrumental training procedures be able to produce the learning of any visceral responses that could be acquired through classical conditioning procedures.

The instrumental learning of visceral responses suggests a new possible homeostatic mechanism and demonstrates that the autonomic nervous system is not as inferior as has been so widely and firmly believed. It removes one of the strongest arguments for the hypothesis that there are two fundamentally different mechanisms of learning, involving parts of the nervous system.

Similarly, evidence of the instrumental learning of visceral responses removes the main basis for assuming the psychosomatic symptoms that involve the autonomic nervous system are fundamentally different from those functional systems, such as hysterical ones, that involve the cerebrospinal nervous system. Such information allows one to extend to psychosomatic symptoms that type of learning-theory analysis that Dollard and Miller (1941, 1950) have applied to other symptoms (Miller, 1971).

Biofeedback

Lubar and Shouse (1979) explain the essence and utilization of biofeedback. Biofeedback is operant conditioning of autonomic, electrophysiological, and neuromuscular responses. The procedure usually involves making an exteroceptive stimulus such as a light or a tone contingent upon some clearly defined change of an internal response, resulting in control of the delineated response. This process may take place with or without the awareness on the part of the organism as to exactly what manipulations must be performed to effect such control. The exteroceptive stimulus informs the subject that the internal response has taken place and may even provide information in terms of the magnitude of the response; i.e., its amplitude or frequency or some other parameter. The exteroceptive stimulus can also function as a primary or secondary reinforcer in that its contingent presentation can change the probability that the internal response will occur.

Whereas psychophysiology is primarily concerned with the problem of how autonomic, electrophysiological, or neuromuscular responses are learned; biofeedback in clinical practice is aimed at utilization of mediating responses in terms of increasing the rate of learning. It is possible to train a person to think "relaxing thoughts" and to allow his/her body to remain resting in order to lower his/her

electromyographic (EMG) activity and blood pressure, to decrease his heart rate, to increase his gastrointestinal motility, or to bring about a variety of other autonomic responses that are part of the general parasympathetic profile.

A major problem in current biofeedback research is that of controlling for the possibility of placebo effects which may account for desirable outcomes. One of the most potent control procedures is the use of ABA design, in which data are collected systematically over several conditions. First, there is a baseline or pretreatment condition, then treatment intervention and finally, a return to the baseline condition. If changes in the target symptom happen in moving from A to B and then reverse when going from B to A, it appears to be very strong evidence that B is the variable causing changes in that symptom.

Other control methods employ the introduction of non-contingent reinforcement either before treatment is started or at some time during the treatment period. It is important that the subject not be aware that any change in contingencies has taken place. Other methods may utilize yoked controls of nofeedback subjects, who are observed throughout the regimen of treatment, along with the experimental group and compared on the symptom of concern.

There are a number of areas in which clinical applica-

tions of biofeedback are being explored. These include the management of systolic and diastolic blood pressures (Schwartz & Shapiro, 1973), cardiac arrhythmias (Bleecker & Engel, 1973), and the control of many stress-related conditions (Lubar & Lubar, 1984).

Biofeedback has been utilized in the rehabilitation of patients suffering from neuromuscular disease, stroke, and spinal-cord injury (Basmajin, 1972; Brudny, Lorein, Levitow, Grynbaum, Liberman & Friedmann, 1974). Many physical therapists have learned to intergrate electromyographic-feedback techniques as part of their treatment for the rehabilitation of patients with neuromuscular dysfunction.

A recent area of feedback research and application centers on the control of the gastrointestinal tract. Engel, Nikoomanesh, and Schuster (1974) have demonstrated that it is possible to condition operantly the rectosphincteric response for the control of fecal incontinence. Another application is the use of biofeedback for the management of ulcerative conditions in several parts of the intestinal tract (Welgan, 1974).

Many physiological systems can also be monitored from the control of brain-wave (EEG) activity. For instance, there has been much interest in the behavioral control of alpha rhythms. Kamiya (1969), Lynch and Paskewitz (1971)

and Beatty(1973) have shown that alpha rhythms (8-13 hz, recorded from the occipital regions of the human scalp) can be controlled when feedback or reward is provided for changes in the density of this activity. Although the evidence is unclear, alpha-feedback training has been associated with states of relaxation which may also be connected with low levels of arousal.

In some potentially promising research, Lubar and Shouse (1979) placed emphasis on the behavioral control of a rhythm (sensorimotor rhythm) that is recorded over the sensorimotor cortical regions of the human or mammalian brain. The activity of 12-15 hz is associated with the inhibition of motor responses and perhaps the generation of spindles during sleep. Current applications of sensorimotor-rhythm (SMR) conditioning include epilepsy and specific types of insomnia in which cerebral mechanisms involved with the generation of Stage 2 sleep spindles might be deficient (Hauri, 1976). The newest application of SMR conditioning is the management of the hyperkinetic syndrome in children.

Lubar and Shouse (1979) indicated it is important to leave the impression that there is not a specific biofeedback treatment for every type of functional, psychosomatic, or medical disorder for which biofeedback has attempted. Possibly, the most powerful effects can be evidenced when

several feedback modalities are combined in a treatment regimen which may also include traditional psychotherapy. Schwartz (1975) effectively argued that many autonomic and electrophysiological responses that are highly correlated are also involved in a particular altered state. For instance, the state of deep relaxation seems to be correlated with theta brain-wave activity (4-7 hz) or the alpha rhythm (8-13 hz) and also decreased levels of frontalis muscle EMG and EMG recorded from limb flexors. Moreover, increased peripheral skin temperature, slow and even respiration, and perhaps lowered heart rate and blood pressure occur in deep relaxation. This is what Gelhorn (1968) called the "state of parasympathetic dominance". In those psychogenic or physiological conditions for which stress levels are elevated, it appears to be desirable to shift the balance toward the parasympathetic. In order that a patient learn this and be able to maintain control of the flight/fight response in stressful situations, the combination of multiple feedback for several modalities plus desensitization techniques seems to offer the most promising approach.

Lubar and Shouse (1979) consider CNS arousal as an integrative mechanism in the hyperactive disorder. Evidence accumulated in the past decade which suggests two subgroups of hyperactive subjects, one having reduced CNS arousal and the other heightened CNS arousal (Satterfield,

Cantwell, Lesser & Podosin, 1972). Excessive overactivity in low arousal subjects is hypothesized to reflect over-compensatory behavior of an otherwise sluggish organism. The selective effectiveness of stimulant medication in reducing these subjects' overactivity may therefore be explained by drugs' enhancing their physiological arousal level. On the other hand, high arousal subjects, whose excessive motor activity is presumably commensurate with the excitable state of the nervous system, should respond most favorably to CNS depressants. Establishing CNS arousal level as a moderating influence in the disorder may explain the paradoxical calming effects connected with stimulant-drug treatment in some hyperactive children and may allow more reliable predictions about the successful clinical applications of both stimulants and depressants.

Low and high-arousal children have been separated on the basis of three CNS-arousal indices taken individually or together. Generally, low-arousal children exhibit excessive synchronized slow-wave activity in the waking EEG, suggesting low arousal because alertness is typified by a faster, low-amplitude EEG; reduced galvanic skin response (GSR) conductance, which indicates reduced sympathetic and reticular arousal; and enhanced auditory evoked-response amplitudes which indicate relaxation, reduced alertness and perhaps abbreviated attention span. Subjects

differing from controls in the low-arousal direction also evidenced more severe disruptive behavior. Medication produced moderate changes toward increased arousal in conjunction with substantial decreases in behavior difficulties.

High-arousal subjects displayed less slow-wave activity, higher GSR conductance, and lower-amplitude evoked cortical responses. They also showed the fewest behavior problems. Moreover, these subjects responded less well, if not unfavorably, to stimulants. These data are consistent with the dependency findings in human and animal subjects in demonstrating that stimulant medication may affect motor systems concurrently (Millichap, 1968). Lubar and Shouse (1979) obtained an even more conclusive assessment by the conditioning of increases in SMR, which is an EEG activity associated first with enhanced peripheral motor inhibition and second with changes in CNS arousal measures. Because of its association with these two characteristics of hyperkinetic children, additional research was planned. They hypothesized that SMR biofeedback training should provide a convenient test of the arousal hypothesis. Contingent increases in SMR should result in reduced motor activity in all hyperactive subjects, increased physiological arousal in low-arousal subjects and decreased physiological arousal in high-arousal subjects. Such an outcome would

strengthen the arousal hypothesis; conversely, the exclusive display of training effects in either arousal level or motor activity would contraindicate the relevance of arousal as a primary factor in the dysfunction. In either case, a favorable outcome would provide a set of therapeutic methods independent of the drug issue and perhaps of independent value when use of drugs is contraindicated.

Upon completion of their research, Lubar and Shouse (1979) found that the effectiveness of the biofeedback technique in treating hyperkineses is supported by the fact that the combined effects of drug administration and SMR resulted in some improvement above and beyond the effects of drugs alone. Further support comes from the maintenance of positive treatment effects with SMR training after the withdrawal of the medication. The loss of improvement following SMR counterconditioning tends to minimize the role of extraneous influences, such as maturation, on treatment outcomes. The subject who failed to acquire the SMR task also failed to develop associated physiological and behavioral changes, which in fact lends some credence to these claims. These findings clearly involve both CNS arousal level and central motor system functions in the hyperkinesis syndrome and its treatment. However, since SMR acquisition, normalization of CNS arousal indices, and behavioral improvement seem to have occurred concurrently; it is difficult to know

whether the observed behavioral outcomes reflect primary changes in CNS arousal or whether the arousal changes represent a secondary effect from better motor control. An analysis of individual differences in laboratory and classroom suggests a greater relative role for enhanced motor control than for arousal level in training success.

Pretreatment levels of SMR reliably indexed both the severity of the original motor deficits and the subsequent success of both treatments in alleviating symptoms. These findings not only reconfirm the relationship between SMR and behavioral immobility but also suggest that EEG rhythm's potential value as a diagnostic and prognostic tool in the disorder, especially when overactivity is a central symptom.

In spite of these promising findings, these researchers urge caution in view of the heterogenous symptom profiles typically included in diagnoses, the specificity of the physiological and behavioral symptom profiles examined in their research and the inability to produce feedback-related changes in one of the four subjects. It may be that short attention span, although partially controlled by medication, may have interfered with successful training in one negative case. This result could restrict the method's therapeutic utility on a larger scale since some reduced attention span is symptomatic with hyperactivity.

EMG Biofeedback Training

The control of emotional stress and the physiological results it brings about have been investigated for many years. As early as the 1920's and 1930's Jacobson, one of the pioneers of relaxation therapy, utilized a primitive form of electromyographic (EMG) equipment to monitor tension levels in the muscles of his patients (in Basmajian, 1979). Through progressive relaxation, which he monitored with his biofeedback apparatus, Jacobson developed methods for dealing with a variety of psychoneurotic syndromes.

Feedback is one of the most profound and unifying concepts in all the behavioral sciences (Lazarus, 1975). Feedback from the environment about the consequences of one's acts provides the rewards and punishments that are in part responsible for learning. Science has long been familiar with the ability of the body to communicate important information about itself (Brown, 1977). However, without a physiological monitoring device it would be difficult to determine whether or not the relaxation was actually having any effect.

Due to Alexander's (1975) finding that frontalis relaxation does not generalize to other muscle groups, consensus is lacking that EMG training actually reduces baseline levels of arousal. However, a well-controlled study by Schandler and Grings (1976) tends to support the belief that EMG

training facilitates arousal reduction. Using a large sample of college undergraduates (N=100), it was determined that EMG relaxation of the frontalis muscle correlates with a generalized relaxation of other muscle groups. Possibly, Alexander's original finding was a chance effect due to a small sample size, or it is possible that the effectiveness of biofeedback paradigms are related to specific applications.

The use of biofeedback training with hyperactive children is a very useful and expedient method for learning. The need for developing and implementing behavioral interventions, without relying on the action of an external agent--in this case, medication--to alter inefficient or undesirable behavior, was recognized; and preliminary work was begun in that area.

The major proposition of biofeedback, EMG, was only one facet of the field in providing individuals with information regarding the physiological responses needed to assist them in learning to emit immediate, feedback-contingent, self-regulatory responses; and thus, it was reasonable to assume that hyperactive children benefitted from appropriate training procedures. Finley (1976) indicated that, in ongoing case studies in his laboratory utilizing EMG feedback training with hyperkinetic children, the response was excellent; after 6 months, four out of five of the original subjects were no longer dependent upon medication to

control their undesirable behavior. Additionally, as Yates (1975) indicated, another of the most important aspects of biofeedback training was that it was a serious attempt to allow the individual to assume responsibility for the control of his/her own behavior. This concept was utilized in the use of the central nervous stimulants, i.e., that the medication facilitated individual acquisition of learned habits of self-control which remained after the medication was discontinued. Unfortunately, the child using the medication seldom internalized this concept; on the other hand, EMG feedback facilitated the assumption of responsibility for behavior and habit formation in a direct, non-contaminated manner.

EMG biofeedback as a tool for reduction of muscular tension has been explored for treatment of hyperactivity. Long (1974) selected educationally maladjusted adolescents who had high frontalis tension. He reported that standard relaxation techniques, taped relaxation procedures, and EMG biofeedback were all successful in decreasing tension; but the mean change was greatest for the EMG trained group. Short-term memory increased and behavior problems decreased in the biofeedback subjects more than in any other standard relaxation technique.

Laufer (1974) found that EMG biofeedback reduced test anxiety in hyperkinetic children. Significant reduction in

frontalis tension and improvement on tasks requiring fine visual-motor functioning were found by Hunter (1974). In a comparative study utilizing the previous techniques, Braud (1975) found that both modalities, drug treatment and biofeedback, reduced defined muscle tension, with biofeedback producing significantly larger decreases. As a result, the biofeedback subjects scored greater decreases on a behavioral rating measure than the subjects treated by stimulant drugs.

Braud, Lupin, and Braud (1975) reported the results of a pilot study on a single subject. EMG assisted relaxation training was conducted to demonstrate the usefulness of the procedures with children demonstrating the symptomatology of hyperkinesis at an early age. Pretraining assessment yielded overall dull normal abilities on the Wechsler Intelligence Scale for Children in addition to auditory and visual association on deficits on the Illinois Test of Psycholinguistic Abilities. In general, there was no clearly identifiable disability pattern noted. The subject was described as being very distractable, easily frustrated, and not cohesive in his train of thought. He had never utilized any type of medication to control these deficits. The results of the study indicated that recorded muscle tension, with the number of tension seconds above the individual norm being the dependent variable, declined dramatically

within and between sessions. A follow-up session seven months later indicated that the subject continued to be able to control his activity and attention. The subjective behavioral rating indicated that considerable improvement was noted in these areas immediately after the training sessions and seemed to be maintained by the self-paced relaxation exercises. The gains noted in the post-training period indicated that the subject's pre-training scores had been depressed by the hyperactivity and a poor attention span. The laboratory control over a short period of time showed some generalization to the everyday environment. As long as the subject received encouragement to practice on his own between sessions, the socially acceptable behavior was maintained.

Subsequently, Haight, Irvine, and Jampolski (1976) studied the effects of nine biweekly 30-minute EMG training sessions on eight hyperactive boys. Compared to the control group, these subjects evidenced significant improvements on the Conners Parent-Teacher Hyperkinesis Questionnaire (Conners, 1973) and on an attention span subscale of the Detroit Test of Learning Aptitude (Baker & Leland, 1967). Interestingly, it was reported that no significant change between each group's pre- and post-treatment EMG tension levels had been observed. However, this seems to be a spurious finding which resulted from a failure to test

for differences between each group's gain scores.

The same shortcoming plagues Jeffery's (1978) investigation of the effects of EMG training on frontalis tension level. He reported that ten 30-minute sessions failed to produce significant decreases in EMG tension. But again, the experimental group's gain scores were not tested for significance against those of the control group.

Baldwin, Benjamins, Meyer, and Grant (1978) were unable to demonstrate reductions in EMG tension level in four hyperactive children using a reversal design. However, they reported that hyperactive behavior steadily increased during the reversal phase, but this increase in hyperactivity did not generalize beyond the experimental setting. It should be noted that the experimental design included an administration of false EMG biofeedback which may have been extremely frustrating for the subjects. As such, this finding seems to document a failure to exercise adequate control rather than the ineffectiveness of EMG training with this population.

More recently, Braud (1978) replicated her initial findings using a control-group design. In this study, significant reductions in muscle tension, hyperactivity, and "emotionality-destructiveness" were noted. While these results are more convincing than those of Braud's previous study, their generalization must remain cautious due to the

small size of the two comparison groups.

In addition to its influence upon arousal level, Stern and Berrenberg (1977) demonstrated that EMG training also correlates with a shift towards internal locus of control as measured by the Rotter I-E Scale (Rotter, 1966). Those authors speculated that this relationship derived from the continuous knowledge of results which the subject receives regarding the success of his self-initiated behavior. It was proposed that such contingent feedback enhances perceptions of self-control, and that these cognitions endure beyond the experimental period. While these results were demonstrated with adults, recent research suggests that EMG treatment will also induce shifts towards a more internal locus of control in hyperactive children (Omizo, Denkowski & Wilson, 1983).

Overall, existent literature seems to indicate that EMG biofeedback training is a viable technique for reducing the correlates of physiological arousal, that it promotes a perception of internal locus of control, and that such improvements can be induced in hyperactive children. However, it may be that the effectiveness of EMG training cannot be demonstrated across all its current applications.

EMG Biofeedback Relaxation Technique

Because there has always been a constant search for effective methods of training and teaching children in special education to improve both their cognitive functions and behavioral control over their actions, many researchers began looking at electromyographic biofeedback relaxation technique as an alternative to solve this problem. The theory of relaxation technique involved the idea that learning was most effective when the child was physically relaxed and mentally attentive to the material being presented.

This application of biofeedback in education depended upon the researcher's results, the practitioner's interest, and the social milieu. With changes in the social climate from the late 1960s to 1970s, biofeedback, which was only a means for self-exploration and achievement of altered states of consciousness, came to be considered a tool to develop a psychophysiological language of consciousness (Kamiya, 1974; Peper, 1971); feedback was used to achieve an altered state of consciousness, a short cut for meditation.

Then the main focus of the biofeedback shifted from investigating altered states of consciousness, and clinical application became the main concern. This type of research was started in the late 1960s and expanded rapidly. Clinical applications ranged from the treatment of a variety of

conditions including headaches, Raynaud's disease, and backaches.

Biofeedback was used to test research hypotheses from a cybernetic point of view (Muholland, 1968). This point of view was based on the close relationship between internal control and communication in animals and/or machines. Both biofeedback and cybernetics showed the value of feedback. No matter what caused the stimulus, if a missile was off course, or if a person's temperature was too high or too low, the information was fed back to the controlling device, which corrected the problem. Muholland showed that the physiological system from which the feedback signal was generated to an established positive or negative feedback loop.

During the past 10 years, biofeedback training was developed as a means of teaching individuals control over their psychophysiological responses to the stresses which they encountered. Exploratory work has shown that children learned control of their bodies with immediate applications in academic learning. Peper (1971) found that feedback control was achieved through passive attention and not through striving or anticipation. Control was learned by attending to the process, not the outcome or end goal.

When an individual was physically or psychologically threatened, a characteristic pattern of arousal occurred to

prepare for dealing with the threat. This pattern included muscle tension, rapid breathing, increased heart rate, increased cerebral and large muscle blood flow, decreased peripheral blood flow, decreased stomach flow, and a decrease of digestive action. This autonomic arousal pattern prepared the body to respond to the perceived threat (Carter & Russell, 1978). Combs and Taylor (1959) found that a mild degree of threat impaired academic performance by increasing anxiety. Further, McMillan (1969) indicated that many behavioral traits such as impulsivity, disorganization, and distractibility were commonly attributed to the learning disabled child and, also, were reactions to perceived threatening instructional situations.

Sheer (1976) reported that learning disabled children showed much more autonomic lability and inability to focus attention on relevant stimuli than on normal controls. When threat or stress persisted (such as the individual's perception of his/her continual failure to learn) then a high and fluctuating internal activity level was maintained, usually accompanied by a high level of anxiety. This feeling of failure was characterized by generalized muscular tension. Benson (1975), described this muscular tension anxiety, and Braud (1975) showed how some individuals lived their lives boxed in a state of muscular tension with a rigidity of postural tone and facial expression.

Most learning of the disabled students was nonverbal. Although most activities were, therefore, nonverbal activities, language was used to tell the students how to do them. Words described the action, but the person learning the experience had to analyze the phenomena involved, and then develop a learning approach (Peper & Robertson, 1976). The feedback translated authenticated the verbal command into actual physiological experiences.

This concept, in which the teacher gave demonstration rather than repeating verbal instructions (Hunter, 1976), assured the effects of thermal biofeedback training in learning disabled children with normal and controls. Learning was demonstrated only for those normal and control children who had previously had a fluctuating and heightened internal environment. The learning disabled children made gains in functioning on visual-ground tasks.

Connolly, Besserman, and Kirschink (1974) were among the first to integrate progressive relaxation with EMG biofeedback training. The purpose of this combination was to facilitate a transfer of the relaxation state beyond the laboratory setting. This technique consisted of eight EMG training sessions based on Jacobson's (1965) format. Significant improvements in EMG tension levels and on the Sprague Teacher and Parent Rating Scale (Sprague & Sleator, 1973) were found for all six hyperactive children.

Rivera and Omizo (1980) subsequently combined EMG biofeedback and audio cassette relaxation training into a treatment for hyperactivity. Their rationale for merging these two procedures was twofold: to expedite biofeedback training through relaxation exercises and to prevent habituation via the variable audio stimulus.

Their format utilizes Lupin's (1977) taped relaxation program for children, which is presented simultaneous to EMG biofeedback signal through headphones. Six studies have been completed to date using this treatment. Each used hyperactive school-age males who were randomly assigned to control and experimental conditions. All of these studies demonstrated significant reductions in the measure of arousal, frontalis EMG, and specific improvements on affective and cognitive measures. In Rivera and Omizo's (1980) study, the Matching Familiar Figures Test (Kagan, 1965) was administered pre- and post treatment. After three sessions, significant changes were noted in terms of increased attention to task and decreased impulsivity.

Omizo (1980) used the progressive relaxation EMG training to assess its affect on the Dimensions of Self Concept (Michael & Smith, 1977). After three sessions, significant improvements were found on the "level of aspiration", "anxiety", and "identification versus alienation"

factors; however, the "academic interest and satisfaction" factor remained unchanged. Using another sample, Omizo also assessed the effects of this treatment on memory tasks. His results indicated that improvements in paired word association was significant, while picture recall was not facilitated.

The foregoing research tends to suggest that a combined treatment of progressive relaxation and EMG biofeedback training is effective in lowering the hyperactive child's level of arousal, and that such reductions correlate with improvements on academic tasks and with an increase in internal locus of control orientation. Accordingly, it appears that EMG biofeedback training which includes an audio cassette relaxation program is a viable treatment for the hyperactivity syndrome.

CHAPTER III

METHOD

This chapter contains the descriptions of the independent and dependent variables; hypotheses; descriptions of participants in the study; descriptions of apparatus and instruments used in the investigation; and procedures for treatment, data collection, and statistical analysis.

Definitions

In this study, the independent and dependent variables were operationally defined in the following manner:

Independent Variables

Relaxation Training: Relaxation training implemented through the use of three cassette tapes selected from the Personal Enrichment Through Imagery (Lazarus, 1982) relaxation program.

Biofeedback Training: Relaxation implemented through the use of visual EMG biofeedback and the cassette tapes (Lazarus, 1982).

Dependent Variables

Reading Achievement: The child's scores on the Gilmore Oral Reading Test (Gilmore & Gilmore, 1968)

and the Durrell Analysis of Reading Difficulty (Durrell & Catterson, 1980).

Attention/Concentration: The child's scores on the Freedom from Distractibility triad (Kaufman, 1975) from the WISC-R, and the Cancellation of Rapidly Recurring Target Figures Test (Rudel, Denckla, & Broman, 1978).

Locus of Control: The child's scores on the Nowicki-Strickland Scale (Nowicki & Strickland, 1973).

Rule-Governed Behavior: The child's degree of self-control as measured by the Self-Control Rating Scale (Kendall & Wilcox, 1979), and the Teacher Rating of Impulsivity Scale and the, Self-Rating of Impulsivity Scale (Wynne, 1979).

On-Task Behavior: The percentage of time spent on tasks measured by direct behavioral observation.

Hypotheses

The following hypotheses were tested:

Ho: There is no significant difference across time for any group.

If there is a significant difference then:

He: Both treatment groups will be more effective than the control group.

He: EMG biofeedback training group will be more effective than the relaxation group.

Subjects

Because hyperactivity is about six times more prevalent among boys than girls (Sandoval, 1977), only male subjects were chosen due to their greater availability. Seventy-five hyperactive males, aged 8 through 12, were carefully selected from two suburban elementary school systems. None of the participants were receiving medical or other treatment for hyperactivity during the period of the investigation. Individuals whose IQ scores were below the average range were excluded from the study.

Potential subjects (n = 783) were initially identified by their teachers through the Conners' Teacher Rating Scale, Abbreviated Form (Conners, 1973), which is the most widely used selection instrument for recruiting research groups of hyperactive children (Barkley, 1981; Conners, 1973; Gadow & Loney, 1982; Sandoval, 1977; Zins & Ponti, 1982). Using the procedures developed by various researchers (Barkley, 1981; Gadow & Loney, 1982; Werry, Sprague, & Cohen, 1975) only those students scoring 2.0 standard deviations above their normative population's mean were used in the study.

After the children with the above scores were identified, their teachers and parents were interviewed. Then

these children were observed in various classroom situations to further determine that these children were appropriate for the investigation i.e., their behavior was not due to being expected to perform academic tasks at an inappropriate level of difficulty or the result of inappropriate teaching techniques.

During the parental interview the research project was explained to the children's parents. Then parental consent was acquired along with developmental, medical, social, and environmental information to further aid in assessing each child's appropriateness for the investigation. After parental consent was obtained, each child was individually screened in an effort to determine the existence of a possible deficit in their attention skills. The Visual Closure subtest of The Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy, Kirk, 1968) was used to screen for the possibility of an attention deficit. Students who scored at least 9 points below the mean scaled score of 36 were considered for the study (this score is over 1 1/2 standard deviations below the mean). Upon the completion of the above, those subjects selected for inclusion in the present study were then observed to gather baseline (pretest) information regarding their performances on the dependent measures. Subjects were matched in terms of their behavioral rating scores, and these resultant triads were then

ranked on the basis of those scores. That is to say that beginning with the highest triad, each member was then randomly assigned to one of these groups by flipping a coin. Then, these three groups were randomly assigned to either one of two experimental treatments or the control situation. The subjects' teachers were "blind" regarding their students' group assignment.

Description of Biofeedback Apparatus

In this study, relaxation was inferred from a decrease in frontalis (forehead) muscle tension, because low frontalis tension has been reported to be a reliable index of overall relaxation (Stoyva & Budzynski, 1975). For the sixteen 30 minute twice a week biofeedback training sessions (EMG training group only), a Bio-Logic Devices, Inc. (Myosone 405) electromyometer was utilized in assisting the reduction of muscle tension levels, as monitored over the central forehead area. This unit is able to provide visual feedback in the form of a meter needle deflection. The position of the pointer of the peak-to-peak microvolt meter provides one mode of visual feedback. A higher EMG level produces a meter pointer movement to the right. Additional visual feedback was provided by a light bar display, 15 lights turn on in sequence, forming an indication of the level of muscle tension; five green lights for the lowest levels; five yellow lights for the mid-range, and five additional red

lights indicating the highest levels of feedback. A lower EMG causes the lights to change sequentially from right to left (i.e., from red to green). The higher EMG level causes the lights to change from green to yellow and finally to red at the higher levels.

A digital integrator was also connected to facilitate data collections. This unit was programmed to display mean readings every 30 seconds.

Procedure

This study spanned a total of 20 weeks, and was initiated with pretest measures of academic achievement, locus of control, EMG baseline levels, rule-governed behavior, on-task behavior, and attention/concentration measures. One week later, the first treatment session was held with the remaining sessions scheduled at twice a week intervals for a total of 16 treatment sessions. Delayed post-treatment data were collected 10 weeks after the first post-treatment observations had been made.

One week after the last treatment session, each participant's teacher again completed the Self-Control Rating Scale and Teacher Rating of Impulsivity Scale. The subjects were also observed regarding post-measures of on-task behaviors.

All subjects were seen individually to determine their baseline EMG levels, achievement, attention/concentration,

and locus of control score. Post-treatment and delayed-post treatment data were collected in the same manner.

Group 1 Relaxation Training

Twenty-five children in Group 1 were randomly assigned into two groups which met for 16 relaxation training sessions, twice a week for approximately 25-30 minutes. Subjects were told that the group's purpose was to help them learn to control and relax their bodies, which would enable them to study better.

Relaxation training was administered through the use of the Personal Enrichment Through Imagery (Lazarus, 1982) taped relaxation program. This series consists of six 25-minute tapes designed to teach imagery and relaxation and to increase self-confidence.

To begin each group session, the trainer briefly explained novel terms and techniques which were presented on the scheduled tapes. After the introduction, the children listened to the tape and followed its instructions. At the end of the tape, the trainer summarized its major points. The purpose of the summary was to reinforce the importance of the techniques and strategies covered in the tape.

Group 2 EMG Biofeedback Training

The 25 subjects in this group were treated individually during the 16 sessions, held twice a week for eight weeks. All sessions were approximately 25 to 30 minutes in length, with the exception of the first, during which the biofeedback equipment was introduced. As with the relaxation training group, subjects were told that the purpose of their meetings is to help them learn to control and relax their bodies, enabling them to study better.

In this study, EMG biofeedback training incorporated the use of biofeedback equipment and the three relaxation tapes used with the relaxation only group. During each session, the subject listened to the relaxation tape while simultaneously observing the visual feedback provided by the EMG instrument. The rationale for combining these two modalities is that any post-treatment differences observed between the relaxation training and the biofeedback training groups could be attributed to the biofeedback equipment and/or the individualization of treatment. However, if no between-group differences were found on the post measures, it could be concluded that it is unnecessary to augment relaxation with biofeedback training.

Group 3 Control Group

The 25 control subjects were randomly assigned into two groups which met for 16 sessions, twice a week for about 25 minutes. Subjects were told that their groups' purpose is to "give them a break" during the day so that they would be able to study better.

Each session consisted of listening to two taped children's stories, marketed by Disney Productions (1968). Some examples of the titles selected were: "Alice in Wonderland", "Brer Rabbit", "Wizard of Oz", "Dumbo", "Robin Hood", "The Hobbit", for a total of 32 tapes. Because the length of these stories is about one-half that of the relaxation tape, two stories were played during the control group's meetings. The trainer briefly introduced and summarized each story in a manner similar to that used with the relaxation and biofeedback training groups.

Instrumentation

Pre-, post, and delayed-post treatment data collection for each subject on achievement, locus of control, attention/concentration, rule-governed behavior, on-task behavior; was accomplished by administering respectively, the Gilmore Oral Reading Test, the Durrell Analysis of Reading Difficulty, the Nowicki-Strickland Scale, the Self-Rating Scale of Impulsivity, the Freedom from Distractibility Triad, the Cancellation of Rapidly Recurring Target Figures Test, the

Teacher-Pupil Interaction Scale, the Self-Control Rating Scale, and the Teacher Rating of Impulsivity Scale.

The Gilmore Oral Reading Test (Gilmore & Gilmore, 1968) was used to assess reading skills. This test is used for the analysis of individual performance in accuracy, comprehension, and rate of oral reading, and for comparison of this performance with a national norm. Retest reliability of the accuracy score is .94 in third grade and .84 in sixth grade. Alternate-forms correlations of second, fifth, and seventh grade pupils indicate high reliability for the accuracy score (.89, .85, and .84), and lower reliability for comprehension (.68, .67, and .52). Kuder-Richardson coefficients are approximately the same for accuracy (.88, .78, and .89) and somewhat higher for comprehension (.82, .78, and .78). Analysis of the results of a fifth grade sample on the Gilmore Test and similar tests by Gray and Durrell indicates that the accuracy scores on these several tests are quite comparable (correlations of .77, .80 and .73 are reported).

The Durrell Analysis of Reading Difficulty (Durrell & Catterson, 1980) was also used to assess reading skills. This test provides a detailed analysis of the phases of reading difficulty: silent and oral reading, listening comprehension, word analysis, phonetics, faulty pronunciation, writing and spelling. It provides spiralbound reading

paragraphs, a quick exposure device (tachistoscope) with accompanying cards, and an organized individual record booklet for recording results systematically. However, no reliability or validity information could be found in the manual or *Buros Mental Measurement Yearbooks*. The only reference to this test has been noted in the paragraph concerning the Gilmore Oral Reading Test.

The Freedom from Distractibility Triad (Kaufman, 1975) was used as one measure of the attention/concentration variable. This factor score (triad) consists of three subtests from the Wechsler Intelligence Test for Children - Revised (WISC-R) (Wechsler, 1974) which are the Arithmetic, Digit Span, and Coding. The Freedom from Distractibility triad measures the child's ability to remain undistracted which assists in evaluating the students' ability to attend and concentrate (Kaufman, 1979). In the WISC-R manual test-retest or stability coefficients only are reported for Digit Span, and Coding as the split-half procedure is not appropriate for these measures (Wechsler, 1974); These are averaged as .78 and .72 respectively. Reliability coefficients for Arithmetic are averaged at .77.

The Cancellation of Rapidly Recurring Target Figures Test (Rudel, Denkla, & Broman, 1978) was also utilized to assess the child's attention and concentration. This test originally was devised as a method for differentiating

dyslexic children from children with other types of learning disabilities. Gardner (1979) found it an "excellent way of detecting concentration impairment"(p.68). No reliability or validity data are provided in the original article however, normative data are provided (means, sd. for errors and means, s.d. for time) for age levels 4 through 13.

The Nowicki-Strickland Scale (Nowicki & Strickland, 1973) was used to measure locus of control. This scale is based on Rotter's (1966) internal-external locus of control of reinforcement dimension assessing attitudes regarding affiliation, achievement, and dependency. It consists of forty questions which describe various reinforcement situations asking the tester to evaluate each positively or negatively by answering "yes" or "no". High scores on the Nowicki-Strickland Scale indicate a more external locus of control which has been found to correlate negatively with measures of achievement. The authors reported a split-half reliability coefficient of .63 for scores of third graders and .74 for scores of sixth through eighth graders. Test-retest reliability was found to be .66 when the interval was three weeks. The authors cited that construct validity was established through significantly high correlations between the Nowicki-Strickland Scale and other measures of locus of control including the Strickland Scale (Strickland, 1961), The Rotter Scale (Rotter, 1966), the Bialer-Cromwell

(Bialer, 1961), and the Intellectual Achievement Responsibility Scale (Crandall, Katkovsky, & Crandall, 1965).

The Teacher Rating Scale, Abbreviated Form (Conners, 1973) was used to select subjects for the study. Teachers rated the child's degree of activity on each behavior using a four-point scale (not at all, just a little, pretty much, very much). Test-retest reliabilities (one month) for the hyperactivity factor were reported to range between .72 and .91 (Conners, 1973). The author also asserts that this scale's validity and sensitivity have been established through drug research: however, no coefficients were presented (Conners, 1973).

The Self-Control Rating Scale (Kendall & Wilcox, 1979) was also used to measure the degree of self-control exhibited before and after participation in the study. The authors report that this instrument is useful for assessing cognitive-behavioral self-control in children. One of the reasons for the development of this scale was the need for a dependent measure that could be used to assess the generalization of treatment effects to extratherapy settings (Kendall & Wilcox, 1979). The internal reliability of this scale was .98, as indicated by Cronbach's (1951) Alpha. Test-retest reliability over 3 to 4 weeks was .84. The scale consists of 33 items dealing with problems of self-con-

trol. The scale was standardized using only teacher ratings. Each item is rated on a 7-point continuum, and the total score is based on the sum of these ratings. Norms for children in grades 3 to 6 for males and females are provided. The construct validity is the scale as evaluated by correlating teacher ratings on the scale with behavioral observations in the classroom of off-task verbal and physical behavior, off-task attention, out of seat behavior, and interruptions, as well as the Matching Familiar Figures Test, the Porteus Mazes, and a delay of gratification task. The SCRS failed to correlate with measures of mental age or intelligence; a necessary finding for establishing discriminant validity of the scale. Studies with clinic-referred children find that it discriminates them from normal children to a useful degree (Kendall & Wilcox, 1979).

The Self-Rating of Implusivity Scale (Wynne, 1979) was used by the subjects to measure their own perceptions of rule-governed behavior. This scale was designed to measure implusivity in normal and deviant populations (Barratt, 1965). It consists of 22 items which are descriptive of impulse control problems. However, the statements do not appear related to conduct difficulties. For example, items such as "I like to do crossword puzzles" and "I like work requiring patience" were rated using a five-point Likert-type scale with responses such as "never describes

me" (scored 1), to "always describes me" (scored 5). This scale was revised into its present form by Wynne (1979) and was used to measure impulsivity in adolescent females. Recent research (Brown & Wynne, 1984) indicates that this scale is successful in discriminating children with impulse control problems from their normal developing peers. The internal reliability of this scale ranged from .76 to .84 as indicated by Cronbach's Alpha (Wynne, 1979).

The Teacher Rating of Impulsivity Scale (Wynne, 1979) was used by the teachers to rate impulsivity, another measure of rule-governed behavior. The descriptive statements contained in this scale have been demonstrated to measure impulse control difficulties in students with behavior problems (Wynne, 1979). The items on this scale are the same as found on the Self-Rating of Impulsivity Scale (SRIS) with the exception that they are changed to the third person. Instead of using a five-point Likert-type scale as with the SRIS another category indicating insufficient information was provided. Thus, the items ranged from "always describes this child" (scored 5) to "Insufficient information" (scored 0). The internal consistency of the scale measured by a Cronbach alpha was .85 when used by teachers rating behavior disordered children (Wynne, 1979).

A portion of the Teacher-Pupil Interaction Scale

(Goodwin & Coates, 1977) was used in gathering the percentage of time spent on-task. This scale was designed to measure the sequential verbal and nonverbal interactions between pupils and teachers across the entire range of classroom activities. Observations of on-task behavior were made at the end of 10-second intervals. The observation time was kept consistent each time, lasting one hour. The observer's role within the classroom was a neutral one, the observer never had worked in the room taking care not to interact with the children while observing. Interrater reliabilities of .80 or better were attained.

Design and Statistical Analysis

A variation of the pretest-posttest control group and longitudinal time design was used. As modified for this study, two treatments and a control group were compared across time. Then the two treatment groups were compared to the control group, and finally the two treatment groups were compared to each other.

Multivariate analysis of variance (MANOVA) repeated measures procedures were used to test for differences on the two experimental and control groups across time on the dependent variables of academic achievement, locus of control, rule-governed behavior, attention/concentration, and on-task behavior. Due to the non-additivity of treatment effects, (i.e., they are independent rather than levels

of the same variable) data were analyzed using separate multivariate analyses of variance to determine differences in the effectiveness of treatment as well as to determine the persistence of each of the treatments at follow-up testing (Kirk, 1982). To investigate further group differences, post hoc univariate analysis of variance techniques as discussed by Kerlinger and Peduzur (1973) were utilized to determine:

1. Which variables independently were significant, and
2. which variables after controlling for the effect of all other variables contributed to the significant effect.

CHAPTER IV

RESULTS

This study investigated the effects of relaxation training on measures of EMG, attention/concentration, locus of control, on-task behavior, "rule-governed" behavior and reading achievement among three groups of hyperactive children. Its purpose was to determine whether group-administered relaxation training would improve those scores as effectively as individually-conducted EMG biofeedback relaxation training.

Specifically, it was hypothesized that subjects who received either type of relaxation training would not achieve significantly different posttreatment scores on the dependent variables when compared to subjects in the control group. Additionally, EMG biofeedback training would not be found to be significantly superior to group-administered relaxation training treatment.

To test these hypotheses, posttreatment and follow-up scores on EMG levels (EMG), Freedom from Distractibility Triad (FFD), Cancellation of Rapidly Recurring Target Figures Test (CRRTF), Locus of Control (LC), Self-Rating of Impulsivity Scale (SIS), Self-Control Rating Scale (SRS),

Teacher Rating of Impulsivity Scale (TRIS), On-task Behavior (OT), Gilmore Oral Reading Test (GORT), and The Durrell Analysis of Reading Difficulty (DARD) were compared. The means and standard deviations for the two treatment groups and the control group are presented in Table 2. No significant pretreatment differences were revealed by MANOVA tests among the three groups on any of the dependent variables. Due to the non-additivity of treatment effects, (i.e., they are independent rather than levels of the same variable) data were analyzed using separate multivariate analyses of variance to determine differences in the effectiveness of treatment as well as to determine the persistence of each of the treatments at follow-up testing (Kirk, 1982). The ten dependent scores were analyzed for each treatment group across time using a multivariate repeated measures design (SPSS, 1983).

For the EMG group, MANOVA results indicated significant post- and follow-up-treatment differences when all dependent variables are considered simultaneously, ($F(2,72) = 71.79, p < .001$) across the three levels of time (i.e., Pre, post, & Follow-up). For the relaxation group, the results across time were significant ($F(2,72) = 45.63, p < .001$). For the control group, the difference was also significant but in the opposite direction, i.e., the subjects' scores tended to deteriorate across time ($F = 3.67, p <$

.001). Post hoc univariate analysis and separate univariate analyses of variance were conducted to locate the significant effects for time, and examine the differences of the dependent variables independently for each group. These results are summarized in Tables 3, 4, 5.

TABLE 2

Means and Standard Deviations

EMG Training (N=25)

Variable	Pretest		Posttest		Follow-up	
	M	SD	M	SD	M	SD
EMG ↓	11.00	1.74	4.56	1.60	5.54	1.53
FFD ↓	22.72	5.47	24.04	4.39	24.20	4.17
CRRTF ↓	42.76	9.71	22.60	12.22	21.16	11.71
LC ↓	17.04	3.01	15.12	2.45	14.84	2.91
SIS ↓	68.56	5.92	67.00	4.30	67.86	5.27
SRS ↓	173.00	17.29	151.56	8.27	139.60	6.88
TRIS ↓	55.84	8.04	53.92	7.42	55.56	7.44
OT ↓	16.12	3.89	9.16	4.42	9.32	4.38
GORT ↑	3.85	1.70	4.78	1.64	4.91	1.68
DARD ↑	2.76	1.42	3.60	1.47	3.60	1.50

Relaxation Group (N=25)

Variable	Pretest		Posttest		Follow-up	
	M	SD	M	SD	M	SD
EMG ↓	11.70	1.73	7.56	1.82	8.58	1.50
FFD ↓	22.28	4.56	23.36	3.85	23.08	3.53
CRRTF ↓	44.32	9.22	23.64	13.11	21.48	10.46
LC ↓	16.36	2.99	13.32	2.14	13.48	1.69
SIS ↓	68.20	6.54	64.72	6.44	65.04	5.90
SRS ↓	169.00	18.01	150.36	6.33	142.68	7.54
TRIS ↓	55.52	9.27	53.36	7.95	55.00	8.23
OT ↓	17.00	2.94	12.24	2.98	9.96	4.47
GORT ↑	4.25	1.57	4.62	1.63	4.72	1.56
DARD ↑	2.84	1.30	5.52	1.58	3.64	1.38

Control Group (N=25)

Variable	Pretest		Posttest		Follow-up	
	M	SD	M	SD	M	SD
EMG ↓	10.94	1.60	10.54	1.75	11.32	1.73
FFD ↑	23.36	5.06	22.68	3.94	22.52	3.58
CRRTF ↓	40.08	10.54	40.68	9.98	44.92	10.85
LC ↓	17.40	2.87	17.60	2.89	18.84	4.05
SIS ↓	69.72	5.56	69.56	5.24	70.40	6.93
SRS ↓	170.44	15.99	169.16	16.32	171.68	15.66
TRIS ↓	54.64	8.47	53.76	8.89	55.92	8.04
OT ↓	17.52	2.93	17.40	3.07	19.20	2.67
GORT ↑	4.48	1.68	4.55	1.67	4.43	1.54
DARD ↑	2.92	1.20	4.55	1.35	2.88	1.39

TABLE 3
EMG Training Group

Univariate F Values, for Total, Pre-Posttest and Post-Follow-up Time Intervals for the Ten Dependent Variables

Variables	Total across groups**		Pre-Posttest*		Post-Follow-up*	
	F	p	F	p	F	p
EMG	278.36	.000	397.16	.000	17.73	.000
FFD	7.81	.001	10.59	.002	.28	.597
CRRTF	89.36	.000	142.66	.000	.85	.361
LC	8.25	.000	12.83	.001	.31	.580
SIS	2.76	.067	3.85	.053	.89	.348
SRS	90.75	.000	98.94	.000	57.44	.000
TRIS	4.33	.015	9.52	.003	.39	.536
OT	53.63	.000	110.84	.000	.04	.838
GORT	95.01	.000	174.71	.000	2.53	.116
DARD	27.54	.000	57.57	.000	.00	1.000

df = 2,72**

df = 1,72*

The univariate analysis for the EMG group revealed that all variables except SIS contributed significantly to the multivariate F ($p < .003$ level). From pretest to posttest, all variables were significantly different in the direction of improved functioning. Comparing post-test to follow-up time period only, EMG and SRS scores were significantly different at a $p < .001$ level. EMG exhibited an increase in tension level (i.e., a significant return to pretreatment levels), and SRS continued to show a decrease in impulsivity. A t-test was performed to compare pretest to follow-up time periods on EMG. Despite the return to more tension, EMG at follow-up remained significantly improved

over the initial level ($t = 8.84$ (48) $p < .001$). All other dependent variables were found to be not significant at follow-up.

TABLE 4
Relaxation Group

Univariate F Values, for Total, Pre-Posttest and Post-Follow-up Time Intervals for the Ten Dependent Variables

Variables	Total across groups**		Pre-Posttest*		Post-Follow-up*	
	F	p	F	p	F	p
EMG	107.55	.000	147.82	.000	19.20	.000
FFD	3.72	.027	4.77	.032	.86	.356
CRRTF	97.43	.000	154.94	.000	1.90	.172
LC	16.85	.000	26.48	.000	.10	.752
SIS	8.27	.000	13.03	.001	.13	.720
SRS	58.05	.000	66.50	.000	23.68	.000
TRIS	6.49	.002	11.69	.001	2.53	.116
OT	43.84	.000	81.51	.000	8.55	.005
GORT	16.19	.000	25.64	.000	5.23	.025
DARD	27.54	.000	44.68	.000	.81	.372

df = 2,72**

df = 1,72*

The univariate analysis for the Relaxation Group revealed all dependent variables contributed significantly to the multivariate F. From pretest to posttest all variables were significantly different in the direction of improved functioning as found in the EMG group. However, comparing posttest to the follow-up time interval which was performed to measure the stability of the treatment effects, only EMG, SRS, OT and GORT were significantly different at a $p < .003$ level. EMG showed an increase in tension level (i.e., a return to pretreatment levels as found in the EMG group). SRS, OT, and GORT continued to exhibit improvement in functioning (see Table 2). A separate

t-test was completed to compare pretest to follow-up time periods on EMG. Despite the return to an increased tension level, EMG at follow-up remained significantly improved over the initial level ($t = 7.92$ (48) $p < .001$). All other dependent variables were found not to be significant at follow-up indicating persistence of treatment over twenty weeks.

TABLE 5
Control Group

Univariate F Values, for Total, Pre-Posttest and Post-Follow-up Time Intervals for the Ten Dependent Variables

Variables	Total across groups**		Pre-Posttest*		Post-Follow-up*	
	F	p	F	p	F	p
EMG	3.52	.032	.01	.973	11.23	.001
FFD	.30	.739	.31	.579	.78	.597
CRRTF	4.27	.016	2.42	.124	7.33	.008
LC	3.50	.033	2.03	.158	6.06	.016
SIS	.37	.691	.07	.797	.89	.348
SRS	.57	.606	.00	.994	2.55	.115
TRIS	2.53	.084	.07	.798	4.39	.040
OT	3.44	.035	1.42	.237	5.33	.024
GORT	1.11	.333	.02	.894	2.37	.128
DARD	3.56	.031	1.74	.282	5.74	.019

df = 2,72**

df = 1,72*

Univariate analysis for the Control Group demonstrated that the variables contributing to the significant multivariate F were EMG, CRRTF, LC, OT and DARD. In each case the difference was in the direction of decreased functioning. It is important to note that from pretest to posttest (when control group experiences were provided) no significant differences were found on any variable and it was differences from post to follow-up which contributed to the significant multivariate F.

To determine which of the treatments was superior,

canonical correlation coefficients for each multivariate analysis were examined. The canonical correlation squared (R^2) may be interpreted in a similar fashion to R^2 in multiple regression. For the EMG group, the R^2 was .982; for the relaxation group the R^2 was .972. This indicates that the amount of variance in the dependent measures across pre-, post and follow-up testing sessions accounted for by differences in the two treatment programs (EMG training and the relaxation group) was virtually the same. In both cases, treatment accounted for a very large proportion of the variance obtained in the dependent measures.

CHAPTER V

DISCUSSION

Previous research with hyperactive children indicated that both progressive relaxation and EMG biofeedback relaxation training effect significant decreases in muscle tension, decreased impulsivity, increased attention to task, and enhance performance on cognitive tasks (Braud, 1978; Carter & Russell, 1980; Denkowski, Denkowski, & Omizo, 1983; Omizo & Michael, 1982). These results have been observed when either progressive relaxation or biofeedback was the mode of treatment (Braud, 1978; Braud et al., 1976) and when the two approaches were combined into one program (Rivera & Omizo, 1980). However, the relative effectiveness of these treatments for hyperactivity had not yet been compared. Additionally, no evaluation of group-treatment in comparison to individual treatment had been reported.

The present study was designed to determine whether group-administered progressive relaxation could be as effective as individually-conducted biofeedback combined with relaxation training in improving attention/concentration, increasing rule governed behavior (self-control), increasing

reading achievement, and shifting locus of control internally.

The overall outcome of this investigation indicated that significant differences existed between the two treatment groups and the control group relative to the scores on the ten dependent measures. Both the EMG group subjects and the relaxation group subjects exhibited improved functioning from pretest to the posttest time interval. The control group subjects demonstrated no significant change from pretest to posttest time. Examination of the canonical correlation coefficients indicated that neither the EMG group subjects or the relaxation group subjects were superior in treatment effects.

Following treatments, significant differences existed on the EMG levels. The means of the EMG training and relaxation training groups were significantly lower at both posttreatment and at the follow-up time intervals of data collection. Both the relaxation group and the EMG group demonstrated a return to pretreatment (baseline) levels, but despite this increase, the muscle tension levels remained significantly improved over the initial level. The return toward the baseline level usually found in reversal type designs would be expected when treatment is terminated. The control group subjects demonstrated no significant change from pretest to posttest time interval on EMG.

However, from posttest to follow-up, EMG tension levels indicated a significant increase indicating higher muscle tension. It is believed that the changes for the control group on the EMG levels, as well as changes on CRRTF, LC, OT and DARD were affected by the circumstances (i.e., follow-up measures were taken at the end of the school year). This group received no treatment to deal with their behavior, and inability to control their impulsive behavior possibly resulted in a significant deterioration in performance on these measures.

The attention/concentration dimension was measured by the Freedom from Distractibility Triad (FFD)(Kaufman, 1975) and the Cancellation of Rapidly Recurring Target Figures Test (CRRTF)(Rudel, Denckla & Broman, 1978). Both EMG training and relaxation training groups demonstrated significant differences across time on this dimension. FFD was significantly increased from pretest time to posttest time and was maintained at that level to the follow-up time interval (i.e., no significant increase or decrease from posttreatment to the follow-up time period on this measure). The control group scores remained constant; no significant change was noted across time. The CRRTF demonstrated significant decreases from pretest to posttest and like FFD remained stable from posttest to follow-up. Overall, the resultant findings on these two

measures suggest that relaxation training and EMG Training both positively affect the hyperactive child's attention/concentration skills. The control group revealed no significant changes from pretest to posttest on the attention/concentration dimension. However, from posttest to follow-up a significant increase was noted in the CRRTF score (i.e., their ability to correctly indentify errors became worse as explained earlier with EMG tension levels).

Following treatment, both treatment groups demonstrated a significant shift of locus of control towards a more internal orientation and this difference was maintained through the follow-up time period indicating the relative stability of the shift in locus of control (LC). For the control group no difference was noted from pretest to posttest, however, locus of control (LC) did increase significantly toward a more external orientation at follow-up time period as was the case with CRRTF. Biofeedback and/or relaxation training offers students something they may never have had before--attainment of success through immediate feedback of success either visually (i.e., lowering EMG reading) and/or kinesthetically (i.e., lowering of actual tension levels). This training may demonstrate to students that they have control over previously "involuntary" functions. These feelings of success may make students more aware than previously of the fact that

academic goals are attainable through their own efforts. This new awareness and accompanying new thought processes may carry over to the classroom, gradually allowing changes in behavior patterns. Although the significance of this variable over time lends support to a similar study by Omizo (1980), further study is needed to determine whether a shift toward internal locus of control actually leads to an increase in academic achievement. At this time, however, an introduction of progressively designed incremental academic goals could be introduced by the teacher as further reinforcement.

"Rule-governed" behavior was measured by the Self-Rating of Impulsivity Scale (SIS), Self-Control Rating Scale (SRS) and the Teacher Rating of Impulsivity Scale (TRIS). These measures were used to assess the degree of impulsivity. The SRS and TRIS are teacher ratings of the child's impulsive behaviors, whereas the SIS is the child's self-rating of impulsivity. On all three scales, a decreased score indicates less impulsivity and an increase in self-control is therefore inferred. In the experimental groups across all three time intervals, SRS and TRIS moved significantly toward less impulsivity. In the EMG group, the pattern of change was similar but SIS only approached significance ($p < .07$). When considering the pre-post time interval (during which treatment occurred) all impulsivity measures

were significantly improved. From post to follow-up SRS continued to show significant improvement in both treatment groups. These measures did not change significantly across all time intervals for the control group.

Rivera and Omizo (1980) reported that a combination of biofeedback and relaxation training improved physiological self-control over muscle tension, reduced impulsive behavior, and increased attention to task. They suggested that biofeedback and relaxation training facilitates academic performance because it teaches the child to control physiological responses, which enhances the ability to exhibit appropriate classroom behavior. Indices measured in the present study reflected this trend of greater self-control and improved academic achievement. Thus, together, these two studies indicate that increased ability to control responses per se may be sufficient to foster improved academic performance. However, because Rivera and Omizo (1980) did not measure academic achievement, these findings must be stated cautiously. Replication studies should incorporate diagnostic achievement tests so that academic gains can be appropriately attributed to qualitative/quantitative changes in existent skills versus new learning, and actual school performance should be measured.

Further support are the data obtained in this study with regard to on-task behavior. This advances the

hypothesis that self-control is enhanced by relaxation training and/or biofeedback-assisted relaxation training. Both treatment groups significantly reduced incidents of off-task behavior across both posttreatment and follow-up time periods. The positive relation between academic performance and self-control suggests that the latter may have generalized to promote improved functioning of the former. Within the context, these data support Douglas' (1974) theory that hyperactive children must acquire inhibitory control before their attentional gains can derive educational benefits. Also, these findings tend to confirm the conviction of others that external interventions, such as environmental manipulations, chemotherapy, and extrinsic reinforcement paradigms, are insufficient treatments for hyperactivity because they do not teach self-control (Ballard & Glynn, 1975; Masters & Mokokros, 1974; Varni, 1976).

Reading achievement in this study was found to increase significantly for the two treatment groups (i.e., EMG training and group relaxation training) at posttreatment. Reading achievement was measured using the Gilmore Oral Reading Test (GORT) and the Durrell Analysis of Reading Difficulty (DARD). Reading scores remained stable at follow-up for the EMG training group, however, a significant increase was attained for the relaxation group on the

GORT at follow-up. The control group demonstrated a significant decrease in achievement scores at follow-up. Again, it is believed that what is occurring here, is, as discussed earlier with the other variables (EMG, CRRTF, LC, OT and DARD).

As conceived by Meichenbaum (1976), biofeedback and relaxation training provides an increased awareness of one's maladaptive physical responses and elicits the recognition that these can be controlled voluntarily. Transposing this thesis into the context of the present study that such training may demonstrate to hyperactive children that they have control over their physical behavior, and this perception of self-control then generalizes to enable more selective socioeducational behavior. Possibly, through those processes, both EMG-relaxation and group relaxation training enables the generalization of tension-reduction effects to academic achievement. Research is clearly needed to assess systematically the interactive relationship between self-control and academic competency.

Results from the present investigation suggest that EMG Biofeedback and/or Relaxation training warrants consideration for inclusion in the educational curriculum of special education where most hyperactive children are placed. The findings support those of other researchers (Braud, 1978; Braud et al., 1976; Carter & Russell, 1980;

Dunn & Howell, 1982; Rivera & Omizo, 1980), who indicated that biofeedback and relaxation training decreased impulsivity and increased attention to task among hyperactive students. Research has indicated the importance of increasing attention to task (Brown & Wynne, 1983; Werry & Sprague, 1969) and of controlling impulsivity (Kagan et al., 1964) in the learning process. Hyperactive children tend not to reach their educational potentials partially because they are not able to control their impulsive behaviors and because they are easily distractible by circumstances that keep them from focusing on tasks. Given the findings reported above, the inclusion of relaxation training and/or biofeedback-assisted relaxation programs could increase the chances for hyperactive children to improve their performance in the academic subjects.

The outcome of this study tends to support the contention that tension reduction effects obtained with both group relaxation and individual EMG-assisted relaxation training generalize to promote scholastic performance. Because no previous data on the relationship of relaxation training and academic outcomes exist, comparison of the present findings must suffice to those obtained with cognitive therapy procedures, which are also self-control induction models. From that perspective, the obtained gain in reading proficiency is congruent with those found by Doug-

las et al., (1976) and Varni (1976) with hyperactive children. Because language skill had not been used previously as a dependent measure, improvements on that scholastic dimension must be ascribed more cautiously to relaxation training.

Overall, the results of this investigation indicate that both EMG-assisted relaxation and group relaxation training may be effective augmentations to the treatment of hyperactivity. Given the minimal restrictiveness of relaxation training, the availability of low-cost myometers and audio cassette relaxation programs, and the seeming suitability of these applications by paraprofessionals, both EMG training or group relaxation training merits concerted investigation as broad-spectrum treatments for hyperactive school children.

Recommendations for Future Research

Relaxation research with hyperactive children is a relatively new field in which few well-controlled studies have been reported. Quite expectedly, published articles in the area abound with contradictory findings.

Aside from spurious findings due to poor methodology, incongruent results tend to be attributable mostly to variations in treatments, sampling, and dependent variables measured. Accordingly, future research probing the efficacy of relaxation training with hyperactive children should

be directed more rigorously to these potential intervening variables. This section will discuss possible causes for the inconsistent results which have been reported with the intent of providing some guidelines for further research.

Variations in the format and intensity of treatments cited in the literature seem to be the major source of incongruent findings. The treatments include EMG biofeedback (Braud, 1978), EEG biofeedback (Tansey & Bruner, 1983), taped relaxation programs (Lupin et al., 1976), and combined biofeedback and relaxation training (Long, 1975; Rivera & Omizo, 1980). Moreover, treatment duration has encompassed anywhere from three (Rivera & Omizo, 1980) to ninety (Lupin et al., 1976) sessions, with sessions being conducted daily (Lupin et al., 1976), weekly (Long, 1974; Tansey & Bruner, 1983), or biweekly (Denkowski et al., 1983; Lubar & Lubar, 1984).

Several studies (Braud, 1978; Dobbins, 1979; Klein & Deffenbacher, 1977), have been unsuccessful in determining conclusively the relative effectiveness of various relaxation treatments. It is likely that variations, such as the one elaborated above, accounted for the divergent results. For example, Denkowski et al. (1983) collected posttreatment data two weeks after subjects received six biweekly biofeedback and relaxation sessions. Klein & Deffenbacher (1977) administered treatment weekly and posttest data were

collected one week after the eighth session. The differences in the duration and frequency of treatment might be responsible for the discrepant findings between the two studies. Perhaps a period longer than six weeks is necessary before significant changes in academic achievement and self-control are to occur. The present investigation used a treatment period of ten weeks with treatment occurring biweekly. It seems advisable that future research be designed to investigate the effect of variables such as duration and frequency of treatment on relaxation outcomes.

Other variables which appear to confound research findings in this field seem to arise from characteristics of the sample selected. Variables such as age, sex, ethnic group, and medication could interact with the treatment effects. For example, in the Omizo, Wilson and Denkowski (1982) study, subjects were selected from a group of male students, 11 to 14 years of age, who scored 1.9 standard deviations above the normative mean on a hyperactivity scale. The Denkowski et al. (1983) study included both males and females, aged eight through ten, who scored 1.2 standard deviations above the normative means on a similar scale. While Omizo et al. found a significant improvement in academic achievement and self-control, Denkowski et al. did not. However, because the results of this investigation support those of Omizo et al. (1982), it may be that relax-

ation training is most effective with extremely hyperactive male students.

Another subject characteristic, not discussed in the biofeedback literature, is the child's motivation to implement newly-acquired relaxation techniques outside the treatment session. Though the hyperactive child may enjoy participating in relaxation training, competing reinforcers could prevent the transfer of skills learned in that process. For instance, parents and/or teachers could maintain the child's hyperactivity inadvertently by attending only to disruptive activities while ignoring appropriate behavior. Thus, for some children, teacher and/or parental involvement in the treatment program might be necessary to promote its effectiveness. As part of the treatment program, they may assist the child in gaining self-control by ignoring inappropriate, hyperactive behaviors and actively reinforcing calmness and relaxation. Future research needs to assess the extent of parental and teacher influences upon the treatment of hyperactive children.

In sum, little or no data exist which describe the relationship between subject characteristics such as age, sex, motivation, and types of relaxation treatments. Therefore, research results must be generalized with extreme caution until more tightly controlled studies are able to isolate possible relationships. It is possible that

data from such research will disclose which specific forms of relaxation training are more effective with certain types of subjects. Ultimately, it may be possible to describe the type of relaxation program which will be most effective for a given child.

A variety of dependent variables have been used to assess the effects of relaxation training format, including measures of cognitive performance (Lupin et al., 1976), disruptive behavior (Braud, 1978), and personality factors such as locus of control (Omizo et al., 1982) and self-concept (Long, 1974). However, studies measuring the same dependent criterion have not yielded consistent results. For example, Lupin et al. (1976) administered a taped relaxation program and noted significant improvements on the WISC-R Digit Span subscale. Yet Braud (1978) implemented a similar relaxation program but was unable to replicate this Digit Span gain. Lupin et al.'s treatment encompassed three months of daily sessions, while Braud administered only two sessions per week for six weeks, it may be that the brief duration of the latter treatments resulted in changes which were too small to register significantly on that scale. Further, these disparate findings possibly were due to the fact that Digit Span is not very reliable when used alone and is a more stable measure when used as part of the Freedom from Distractibility triad

(FFD). The FFD triad was used in the present investigation because it appears sensitive to the treatment effects under study.

To date, only the Matching Familiar Figures Test (MFFT) (Kagan, 1965) appears to reflect consistent significant improvements following relaxation training (Klein & Deffenbacher, 1977; Rivera & Omizo, 1980). This finding indicates that the choice of instrumentation seems very critical in assessing the effects of relaxation treatment. Accordingly, researchers must be careful to select a measuring instrument which will be sufficiently sensitive to the extent of change which can be anticipated from the type and duration of their treatment as well as reliable and valid for the purposes of the study.

Discrepancies in results also can arise when studies attempt to replicate previous findings on the same dependent variable but employ different instruments. For example, Omizo et al. (1982) found significant increases in academic achievement as measured by the Iowa Tests of Basic Skills (Hieronymous & Lindquist, 1971). However, Denkowski (1983) found no significant changes when the Wide Range Achievement Test (Jastak & Jastak, 1978) was used to assess academic achievement. The Iowa tests tap a wider range of skills than the WRAT so it is not terribly surprising that the WRAT might be insensitive to changes

which the IOWA would detect. Such fluctuations indicate that researchers should anticipate negative outcomes on the same dependent variable when insensitive measures are used. For that reason, the most suitable instrument should be used even in studies which seek to corroborate previous treatment results.

Due to the inconsistent findings which comprise the relaxation training literature, it appears that a major thrust of future research should be the verification of existent data. Its challenge will be to generate consistent results which are immune from multiple interpretations. It seems that the surest path to that goal is rigorous research methodology.

Several basic procedures should be incorporated in such replication efforts to assure better control over the many intervening variables which have confounded the interpretation of previous findings. First of all, it appears necessary to "match" experimental and control groups adequately since random assignment with small samples does not guarantee that the resultant groups will be equal on all variables. Thus, subjects should be carefully matched for sex, age, etc., or the effects of these attributes should be nullified through covariance techniques. Secondly, treatments should be replicated exactly, especially in terms of frequency and duration. To facilitate this objective, train-

ing formats must be detailed in the literature. Lastly, the appropriateness of instruments chosen to assess changes in dependent variables must be evaluated carefully. This implies that the cognitive, personality, or behavioral dimension(s) tapped by each instrument must be analyzed and explicated, and the unreliability of its measurements must not exceed the anticipated magnitude of experimental effect.

Concomitant with the replication of previous investigations, researchers need to address questions such as:

1. To what extent, either independently or interactively, do attributes such as age, sex, ethnicity, and socioeconomic status affect the outcome of relaxation training?
2. What modifications in training formats yield the most significant changes in disruptive behavior or self-control?
3. What reactive arrangements (e.g., parent and teacher influences, subject's motivation to participate, and time during school semester treatment commences or ends) impede or potentiate the effects of relaxation treatment?

During the course of these investigative efforts, it seems that the applicability of relaxation training to group settings should remain the focus of concern. Considering the significant percentage of children who are reported to be hyperactive, in tandem with the budgetary difficulties faced by most school boards, a group approach seems to

offer the most viable prospect for training a school system's population of hyperactive children. Accordingly, the most important task is a careful exploration of the effectiveness of group relaxation treatments of hyperactivity.

REFERENCES

- Achenbach, T. M. (1978). Psychopathology of childhood: Research problems and issues. Journal of Consulting and Clinical Psychology, 46, 759-776.
- Achenbach, T. M. (1982). Developmental psychology (2nd ed.). New York: Wiley.
- Alexander, A. B. (1975). An experimental test of assumptions relating to the use of electromyographic feedback as a general relaxation training technique. Psychophysiology, 12, 656-662.
- Allen, E. K., Henkel, L. B., Harris, F. R., Baer, D. M., & Reynolds, N. J. (1967). Control of hyperactivity by social reinforcement of attending behavior. Journal of Educational Psychology, 58, 231-237.
- American Psychiatric Association. (1980). Diagnostic and statistical manual of mental disorders (3rd.). Washington, DC: Author.
- Ayllon, T., & Roberts, M. D. (1974). Eliminating discipline problems by strengthening academic performance. Journal of Applied Behavior Analysis, 8, 137-146.
- Ayllon, T., & Rosenbaum, J. S. (1977). The behavioral treatment of disruption and hyperactivity in school settings. In B. B. Lahey & A. E. Kazdin (Eds.), Advances in clinical child psychology. New York: Plenum.
- Baker, H. J., & Leland, B. (1967). Detroit Test of Learning Aptitude: revised examiner's handbook. Indianapolis: Bobbs-Merrill.
- Baldwin, B. G., Benjamins, J. K., Meyer, R. M., & Grant, C. W. (1978). EMG biofeedback with hyperactive children: A time series analysis. Proceedings of the Biofeedback Society of America, Ninth Annual Meeting, 184-187.

- Ballard, K. D., & Glynn, T. (1975). Behavioral self-management in story writing with elementary school children. Journal of Applied Behavior Analysis, 8, 387-398.
- Bandura, A. (1969). Principles of behavior modification. New York: Holt, Rinehart, & Winston.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84, 191-215.
- Bandura, A. (1978). The self system in reciprocal determinism. American Psychologist, 33, 344-358.
- Bandura, A., & Walters, R. H. (1963). Social learning and personality development. New York: Holt, Rinehart, & Winston.
- Barkley, R. A. (1976). Predicting the response of hyperkinetic children to stimulant drugs: A review. Journal of Abnormal Child Psychology, 4(4), 327-348.
- Barkley, R. A. (1977). A review of stimulant drug research with hyperactive children. Journal of Child Psychology and Psychiatry, 18, 137-165.
- Barkley, R. A. (1981). Hyperactivity. In E. J. Mash & L. G. Terdal (Eds.), Behavioral assessment of childhood disorders. New York: Guilford.
- Barkley, R. A. (1981). Hyperactive children: A handbook for diagnosis and treatment. New York: Guilford.
- Barkley, R. A., Copeland, A. P., & Sivage, C. (1978). A self-control classroom for hyperactive and impulsive children. Unpublished manuscript, University of Oregon Health Sciences Center.
- Barkley, R. A., & Cunningham, C. E. (1978). Do stimulant drugs improve the academic performance of hyperactive children? A review of outcome research. Clinical Pediatrics, 17, 85-92.
- Barratt, E. (1965). Factor analysis of some psychometric measures of impulsiveness and anxiety. Psychological Bulletin, 16, 547-555.
- Basmajian, J. V. (1972). Electromyography comes of age. Science, 176, 603-609.

- Basmajian, J. V. (1979). Introduction: Principles and background. In J. V. Basmajian (Ed.), Biofeedback: Principles and practice for clinicians. Baltimore, Maryland: Williams & Wilkins.
- Bassuk, E. L., Schoonover, S. C., & Galenberg, A. J. (Eds.). (1983). The practitioner's guide to psychoactive drugs. (2nd ed.). New York: Plenum.
- Bateman, B. (1965). An educator's view of a diagnostic approach to learning disorders. In J. Hellmuth (Ed.). Learning Disorders, Vol. 1. Seattle: Special Child Publications, 210-236.
- Battle, E., & Lacey, B. (1972). A context for hyperactivity in children over time. Child Development, 43, 757-773.
- Bax, M. (1978). Who is hyperactive? Developmental Medicine and Child Neurology, 20, 277-278.
- Beatty, J. (1973). Similar effects of feedback signals and instructional information on EEG activity. Physiology and Behavior, 9, 151-154.
- Beck, A. T. (1976). Cognitive therapy and the emotional disorders. New York: International Universities Press.
- Benson, H. (1975). The relaxation response. New York: Morrow.
- Bernstein, D. A., & Borkovec, T. D. (1973). Progressive relaxation training. Champaign, IL: Research Press.
- Bijou, S. W. (1965). Experimental studies of child behavior, normal and deviant. In L. Krasner & L. P. Ullman (Eds.), Research in behavior modification. New York: Holt, Reinhart, & Winston.
- Bleecker, E. R., & Engel, B. T. (1973). Learned control of ventricular rate in patients with atrial fibrillation. Psychosomatic Medicine, 35, 161-170.
- Borland, B. L., & Heckman, H. K. (1976). Hyperactive boys and their brothers. Archives of General Psychiatry, 33, 369-375.

- Braud, L. W. (1975). The effects of EMG biofeedback and progressive relaxation upon hyperactivity and its behavioral concomitants. Paper presented at a meeting of the Association for Humanistic Psychology, Estes Park, August.
- Braud, L. W. (1978). The effects of frontal EMG biofeedback and progressive relaxation upon hyperactivity and its behavioral concomitants. Biofeedback and Self-Regulation, 3, 69-89.
- Braud, L. W., & Holiday, E. E. (1971). The effects of EMG reinforcement on sitting behavior in a hyperactive girl. Unpublished manuscript.
- Braud, L. W., Lupin, M. N., & Braud, W. G. (1974). The use of EMG (electromyographic) biofeedback in the control of hyperactivity. Paper presented at the 11th Annual International Convention for Learning Disabilities, Houston, February.
- Braud, L. W., Lupin, M. N., & Braud, W. G. (1975). The use of electromyographic biofeedback in the control of hyperactivity. Journal of Learning Disabilities, 8, (7), 21-26.
- Brown, A. L. (1975). The development of memory, knowing, knowing about knowing and knowing how to know. In H. W. Reese (Ed.), Advances in child development and behavior, Vol. 10. New York: Academic Press.
- Brown, B. B. (1977). Stress and the art of biofeedback. New York: Harper & Row.
- Brown, R. T., & Wynne, M. E. (1984). An analysis of attentional components in hyperactive and normal boys. Journal of Learning Disabilities, 17(3), 162-166.
- Brudny, J., Lorein, J., Levidow, L., Grynbaum, B. B., Leiberman, A., & Friedmann, L. W. (1974). Sensory feedback therapy as a modality of treatment in central nervous system disorders of voluntary movement. Neurology, 24, 925-932.
- Brundage-Aguar, D., Forehand, R., & Ciminero, A. R. (1977). A review of treatment approaches for hyperactive behavior. Journal of Clinical Child Psychology, 3, 3-10.

- Budzynski, T. H. (1974). Relaxation training program. New York: BMA Audio Cassettes. (Audio Cassette)
- Budzynski, T. H., & Stoyva, J. M. (1972). Biofeedback techniques in behavior therapy. In N. Birnbaumer (Ed.) Die Bewältigung Von Angst. Beiträge der Neuropsychologie zur Angstforschung. (The making of anxiety. Contributions of neuropsychology to anxiety research). Reihe Fortschritte Der Klinischen Psychologie, Bd. 4, München/Wien: Verlag Urban & Schwarzenberg.
- Budzynski, T. H., Stoyva, J. M., & Adler, S. C. (1973). EMG biofeedback and tension headache: A controlled outcome study. Psychosomatic Medicine, 35, 484-496.
- Campbell, D. T., & Stanley, J. C. (1963). Experimental and quasiexperimental designs for research. Chicago: Rand McNally & Co.
- Campbell, S. B. (1976). Hyperactivity: Its course and treatment. In A. Davids (Ed.), Child Personality and Psychopathology. New York: Wiley Interscience.
- Cantwell, D. (1972). Psychiatric illness in families of hyperactive children. Archives of General Psychiatry, 27, 414-417.
- Cantwell, D. P. (1975). Familial-genetic research with hyperactive children. In D. P. Cantwell (Ed.), The hyperactive child: Diagnosis, management and current research
- Cantwell, D. P. (1977). Psychopharmacological treatment of the minimal brain dysfunction syndrome. In J. M. Wiener (Ed.), Psychopharmacology in childhood and adolescence. New York: Basic Books.
- Cantwell, D. P. (1980). Drugs and medical intervention. In H. H. Rie & E. D. Rie (Eds.), Handbook of minimal brain dysfunctions: A critical view. New York: Wiley.
- Carlson, J. G. (1977). Locus of control and frontal electromyographic response training. Biofeedback and Self-Regulation, 2, 259-271.
- Carlson, J. G. (1982). Some concepts of perceived control and their relationship to bodily self-control. Biofeedback and Self-Regulation, 7(3), 341-375.

- Carter, J. L., & Russell, H. L. (1978). Effect of biofeedback training on academic ability of four language/learning disabled boys. ACA Therapy.
- Carter, J. L., & Russell, H. L. (1980). Biofeedback and academic attainment of LD children. Academic Therapy, 16(3), 311-316.
- Cautela, J. R. (1967). Covert sensitization. Psychological Reports, 20, 459-468.
- Chess, S. (1960). Diagnosis and treatment of the hyperactive child. New York State Journal of Medicine, 60, 2379-2385.
- Clements, S. D., & Peters, J. E. (1972). Minimal brain dysfunction in the school age child. Archives of General Psychology, 6, 185-197.
- Coleman, J. S., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A.M., Weinfield, F. D., & York, R. L. (1966). Equality of Educational Opportunity. Washington, D. C.: United States Government Printing Office.
- Colpaert, F. C. (1977). Drug-produced cues and states: Some theoretical and methodological inferences. In H. Lal (Ed.), Discriminative Stimulus Properties of Drugs. New York: Plenum.
- Combs, A. W., & Taylor, C. (1959). Effect of perception of mild degrees of threats on performance. Journal of Abnormal and Social Psychology, 47,
- Conners, C. K. (1969). A teacher rating scale for use in drug studies with children. American Journal of Psychiatry, 126, 152-156.
- Conners, C. K. (1970). Symptom patterns in hyperkinetic, neurotic, and normal children. Child Development, 41, 667-682.
- Conners, C. K. (1972). Psychological effects of stimulant drugs in children with minimal brain dysfunction. Symposium: Behavior modification by drugs. Pediatrics, 49, 702-708.
- Conners, C. K. (1973). Rating Scale for use in drug studies with children. Psychopharmacology Bulletin, 24-84.

- Conners, C. K. (1980). Food additives and hyperactive children. New York: Plenum Press.
- Conners, C. K., Eisenberg, L., & Barcai, A. (1967). Effect of dextroamphetamine in children. Archives of General Psychiatry, 17, 478-485.
- Conners, C. K., Goyette, C. H., Southwick, D., Lees, J. M., & Andrulonis, P. A. (1976). Food additives and hyperkinesis: A controlled double-blind experiment. Pediatrics, 58, 154-166.
- Conners, C. K., Taylor, E., Meo, G., Kurtz, M. A., & Fournier, M. (1972). Magnesium pemoline and dextroamphetamine: A controlled study in children with minimal brain dysfunction. Psychopharmacologia, 26, 321-331.
- Conners, C. (1974). Drug and cognition studies in disturbed children. Psychopharmacology Bulletin, 65(2), 60-61.
- Conrad, P. (1976). Identifying hyperactive children. Lexington, Mass.: Plenum Press.
- Cott, A. (1972). Megavitamins: The orthomolecular approach to behavioral disorders and learning disabilities. Academic Therapy, 7, 245-258.
- Cunningham, C. E., & Barkley, R. A. (1978). The effects of Ritalin on the mother-child interactions of hyperactive identical twins. Developmental Medicine and Child Neurology, 20, 634-642.
- Crandall, V. C., Katkovsky, W., & Crandall, V. J. (1965). Children's beliefs in their control of reinforcements in intellectual academic achievement behaviors. Child Development, 36, 91-109.
- David, O. J. (1974). Association between lower level lead concentrations and hyperactivity. Environmental Health Perspectives, 7, 17-25.
- Davidson, R., & Krippner, S. (1971). Biofeedback research: The data and their implications. In T. Barber, L. V. Dicara, J. Kamiya, N. E. Miller, D. Shapiro, & J. Stoyva (Eds.), Biofeedback and self-control. Chicago: Aldine-Atherton.

- Davidson, R., & Krippner, S. (1972). Biofeedback research: The data and their implications. In Johann Stoyva et al. (Eds.), Biofeedback and self-control. Chicago: Aldine-Atherton.
- Davison, G. C., & Wilson, G. T. (1976). Processes of fear reduction in systematic desensitization: Cognitive and social reinforcement factors in humans. Behavior Therapy, 4, 1-21.
- Denkowski, K. M., Denkowski, G. C., & Omizo, M. M. (1983). The effects of EMG-assisted relaxation training on the academic performance, locus of control, and self-esteem of hyperactive boys. Biofeedback and Self-Regulation, 8,(3) 363-375.
- Disney Productions. (1968). Children's Stories. Hollywood: Producer, (Audio Cassette).
- Dollard, J., & Miller, N. E. (1941). Social learning and imitation New Haven CT: Yale University Press.
- Dollard, J., & Miller, N. E. (1950). Personality and psychotherapy. New York: McGraw Hill.
- Douglas, V. I. (1972). Stop, look, and listen: The problem of sustained attention and impulse control in hyperactive and normal children. Canadian Journal of Behavioral Science, 4, 259-282.
- Douglas, V. I. (1974). Sustained attention and impulse control: Implications for the handicapped child. J. A. Swets & L. L. Elliot (Eds.), Psychology and the handicapped child. Washington, D. C.: Office of Education.
- Douglas, V. I. (1975). Are drugs enough? To treat the hyperactive child. International Journal of Mental Health, 4(1-2), 199-212.
- Douglas, V. I. (1980). Treatment and training approaches to hyperactivity: Establishing internal or external control. In C. Whalen & B. Henker (Eds.), Hyperactive children: The social ecology of identification and treatment. New York: Academic Press.

- Douglas, V. I., & Peters, K. G. (1979). Toward a clearer definition of the attentional deficit of hyperactive children. In G. A. Hale & M. Lewis (Eds.), Attention and the development of cognitive skills. New York: Plenum.
- Dunn, F. M., & Howell, R. J. (1982). Relaxation training and its relationship to hyperactivity in boys. Journal of Clinical Psychology, 38(1), 92-100.
- Durrell, D. D., & Catterson, J. H. (1980). Durrell Analysis of Reading Difficulty, Third edition. New York: The Psychological Corporation.
- Dykman, R. A., Peters, J., & Ackerman, P. (1973). Experimental approaches to the study of minimal brain dysfunction: A follow-up study. Annals of the New York Academy of Sciences, 205, 93-108.
- Engel, G. L. (1977). The need for a new medical model: A challenge for bio-medicine. Science, 196, 129-136.
- Engel, B. T., Nikoomanesh, P., & Schuster, M. M. (1974). Operant conditioning of rectosphincteric responses in the treatment of fecal incontinence. New England Journal of Medicine, 290, 646-649.
- Erikson, R. V., & Roberts, A. H. (1971). Some ego functions associated with delay of gratification in male delinquents. Journal of Consulting and Clinical Psychology, 36, 378-382.
- Eysenck, H. J. (1960). (Ed.), Behavior therapy and the neuroses. New York: Pergamon Press.
- Eysenck, H. T., & Rachman, S. T. (1971). The application of learning theory to child psychiatry. In T. C. Howells (Ed.), Modern perspectives in child psychiatry. New York: Brunner/Mazel.
- Feingold, B. F. (1973). Introduction to clinical allergy. Springfield: Charles C. Thomas.
- Feingold, B. F. (1975). Why is your child hyperactive? New York: Random House. (a)
- Feingold, B. F. (1975). Hyperkinesis and learning disabilities linked to artificial food flavors and colors. American Journal of Nursing, 75, 793-803.

- Ferguson, H. B., & Pappas, B. C. (1979). Evaluation of psychophysiological, neurochemical, and animal models of hyperactivity. In R. L. Trites (Ed.), Hyperactivity in children. Baltimore, MD: University Park Press.
- Fernald, G. (1943). Remedial Techniques in basic school subjects. New York: McGraw Hill.
- Finch, A. J., & Pezzuti, K. A. (1975). Locus of control and academic achievement in emotionally disturbed children. Journal of Consulting and Clinical Psychology, 43, 103-112.
- Finely, W. W., Niman, C., Standly, J., & Ender, P. (1976). Frontal EMG biofeedback training of athetoid cerebral palsy patients: A report on six cases. Biofeedback and Self-Regulation, 1, 139-143.
- Firestone, P., & Douglas, V. (1975). The effects of reward and punishment on reaction times and autonomic activity in hyperactive and normal children. Journal of Abnormal Child Psychology, 3, 201-215.
- Freedman, D. X. (1971). Report on 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.
- Food and Drug Administration. (1975). Proceedings presented at the meeting for formation of the interagency collaborative group on hyperkinesis. Washington, D. C.
- Food and Drug Administration. (1976). First report of the preliminary findings and recommendations of the interagency collaborative group on hyperkinesis, Washington, D. C.
- Frostig, M., & Horne, D. (1964). The Frostig program for the development of visual perception. Chicago: Follett Educational Corp.
- Gadow, K. D., & Loney, J. (Eds.). (1981). Psychosocial aspects of drug treatment for hyperactivity. Series: American Association for the Advancement of Science. AAAS selected Symposium; 44. Boulder, Colo.: Frederick Praeger, Publisher. Westview Press.

- Gardner, C. L., Warren, E. R., & Gardner, B. L. (1977). Locus of control and law Knowledge: A comparison of normal, retarded, and learning disabled adolescents. Adolescence, 12, 103-109.
- Gardner, R. A. (1979). The objective diagnosis of minimal brain dysfunction. Cresskill, NJ: Creative Therapeutics.
- Gellhorn, E. (1968). Central nervous system tuning and its implications for neuropsychiatry. Journal of Nervous and Mental Disease, 147, 148-162.
- Gellhorn, E., & Loofburrow, G. N. (1963). Emotions and emotional disorders: A neurophysiological study. New York: Hoeber.
- Getman, G. N., & Kane, E. R. (1964). The physiology of readiness: An action program for the development of perception for children. Minneapolis, MN: Programs to Accelerate School Success.
- Gilmore, J. V., & Gilmore, E. C. (1968). Gilmore Oral Reading Test. New York: Harcourt Brace Jovanovich.
- Gittelman, R., Abikoff, H., Pollack, E., Klein, D. F., Katz, S., & Mattes, J. (1980). A controlled trial of behavior modifications and methylphenidate in hyperactive children. In C. K. Whalen & B. Henker (Eds.), Hyperactive children: The social ecology of identification and treatment. New York: Academic Press.
- Glow, P. H., & Glow, R. A. (1979). Hyperkinetic impulse disorder: A developmental defect of motivation. Genetic Psychology Monographs, 100, 159-231.
- Goldfried, M. R. (1971). Systematic desensitization as training in self-control. Journal of Consulting and Clinical Psychology, 37, 228-234.
- Goldfried, M. R., & Davison, G. C. (1976). Clinical behavior therapy. New York: Holt, Reinhart & Winston.
- Goldfried, M. R., & Trier, C. S. (1974). Effectiveness of relaxation training as an active coping skill. Journal of Abnormal Psychology, 83, 348-355.

- Grinspoon, L., & Singer, S.B. (1973). Amphetamines in the treatment of hyperactive children. Havard Educational Review, 43(4), 515-555.
- Grossberg, J. M., & Wilson, H. (1968). Physiological changes accompanying the visualization of fearful and neutral situations. Journal of Personality and Social Psychology, 10, 123-133.
- Group for the Advancement of Psychiatry. (1966). Psychopathological disorders in childhood: Theoretical considerations and a proposed classification. New York: Author.
- Haight, M. J., Irvine, A. B., & Jampolski, G. G. (1976). The response of hyperkinesis to EMG feedback. Proceedings of the Seventh Annual Meeting of the Biofeedback Research Society, Colorado Springs, Colorado.
- Hampstead, W. J. (1979). The effects of EMG-assisted relaxation training with hyperkinetic children: A behavioral alternative. Biofeedback & Self-Regulation, 4(2), 113-125.
- Harley, J., & Matthews, C. G. (1980). Food additives and hyperactivity in children. In R. Knights & D. Barker (Eds.), Treatment of hyperactive and learning disabled children. Baltimore, MD: University Park Press.
- Harley, J., Matthews, C. G., & Eichman, P. (1978). Synthetic food colors and hyperactivity in children: A double blind challenge study. Pediatrics, 62, 975-983.
- Harley, J., Ray, R. S., Tomasi, L., Eichman, P., Matthews, C. G., Chun, R., Cleeland, C., & Traisman, B. (1978). Hyperkinesis and food additives: Testing the Feingold hypothesis. Pediatrics, 61, 818-828.
- Hastings, J. E., & Barkley, R. A. (1978). A review of psychophysiological research with hyperactive children. Journal of Abnormal Child Psychology, 7, 413-447.
- Haugen, G. B., Dixon, H. H., & Dickel, H. A. (1963). A therapy for anxiety tension reactions. New York: Macmillan.

- Hauri, P. (1976). Biofeedback as a treatment for insomnia. Proceedings of the Biofeedback Research Society, Seventh Annual Meeting, Colorado Springs.
- Henker, B., & Whalen, C. K. (1980). The changing faces of hyperactivity: Retrospect and Prospect. In C. K. Whalen & B. Henker (Eds.), Hyperactive children: The social ecology of identification and treatment. New York: Academic Press.
- Hieronymous, D., & Lindquist, R. (1964). Manual for administrators, supervisors, and counselors. Iowa Test of Basic Skills. Boston: Houghton Mifflin.
- Homme, L. E. (1965). Perspectives in psychology: XXIV. Control of coverants, the operants of the mind. Psychological Record, 15, 501-511.
- Hunter, S. A., Russell, H. L., Russell, E. G., & Simmerman, T. K. (1976). Control of fingertip temperature increases via biofeedback in learning disabled children. Perception and Motor Skills, 7, 743-755.
- Jacobs, A., & Felton, G. S. (1969). Visual feedback of myoelectric output to facilitate muscle relaxation in normal persons and patients with neck injuries. Archives of Physician Medicine and Rehabilitation, 50,34-39.
- Jacobson, E. (1938). Progressive relaxation. Chicago: University of Chicago Press.
- Jacobson, E. (1965). Anxiety and tension control: A physiological approach. Philadelphia: Lippincott.
- James, W. H., & Rotter, J. B. (1958). Partial and 100 percent reinforcement under change and skill conditions. Journal of Experimental Psychology, 55, 397-403.
- Jeffrey, T. B. (1978). The effects of operant conditioning and electromyographic biofeedback on the relaxed behavior of hyperkinetic children. Proceedings of the Biofeedback Society of America, Ninth Annual Meeting.
- Kagan, J. (1965). Impulsive and reflective children. In J. D. Krumboltz (Ed.), Learning and the educational process. Chicago: Rand McNally.

- Kamiya, J. (1962). Conditioned discrimination of EEG alpha rhythm in humans. Paper presented at the meeting of the Western Psychological Association, San Francisco.
- Kamiya, J. (1967). EEG operant conditioning and the study of states of consciousness. In D. X. Freedman (Chm.), Laboratory studies of altered psychological states. Symposium at the American Psychological Association, Washington, D. C.
- Kamiya, J. (1969). Operant control of the EEG alpha rhythm of some of its reported effects on consciousness. New York: Wiley.
- Kamiya, J. (1974). Autoregulation of the EEG alpha rhythm: A program for the study of conscienceness. Operant Control of Brain Activity, Los Angeles Brain Research Institute (UCLA).
- Kanfer, F. H. (1970). Self-regulation: Research, issues, and speculations. In C. Neuringer & J. L. Micheal (Eds.), Behavior modification in clinical psychology. New York: Appleton-Century-Crofts.
- Kanfer, F. H. (1980). Self-management methods. In F. H. Kanfer & A. P. Goldstein (Eds.), Helping people change. New York: Pergamon Press.
- Katz, S., Saraf, K., Gittelman-Klein, R., & Klein, D. F. (1975). Clinical pharmacological management of hyperkinetic children. In R. Gittelman-Klein (Ed.), Recent advances in child psychopharmacology. New York: Human Sciences Press.
- Kaufman, A. S. (1975). Factor analysis of the WISC-R at elevenage levels between 6 1/2 and 16 1/2 years. Journal of Consulting and Clinical Psychology, 43, 135-147.
- Kendall, P. C., & Finch, A. J. (1978). A cognitive-behavioral treatment for impulsivity: A group comparison study. Journal of Consulting and Clinical Psychology, 46, 110-118.
- Kendall, P. C., & Hollon, S. D. (1979). Cognitive-behavioral interventions: Overview and current status. In P. D. Kendall & S. D. Hollon (Eds.), Cognitive-behavioral interventions: Theory, research, and procedures. New York: Academic Press.

- Kendall, P. C., & Wilcox, L. E. (1979). Self-control in children: Development of a rating scale. Journal of Consulting and Clinical Psychology, 47(6), 1020-1029.
- Kenny, T. J. (1980). Hyperactivity. In H. E. Rie & E. D. Rie (Eds.), Handbook of minimal brain dysfunctions: A critical view. New York: Wiley.
- Keough, B., & Barkett, C. (1980). An educational analysis of hyperactive children's achievement problems. In C. Whalen & B. Henker (Eds.), Hyperactive children: The social ecology of identification and treatment. New York: Academic Press.
- Kephart, N. (1971). The slow learner in the classroom. Columbus, Ohio: Merrill.
- Kerlinger, R. N., & Pedhazur, E. J. (1973). Multiple regression in behavioral research. New York: Holt, Rinehart & Winston.
- Kinsbourne, M., & Caplan, P. J. (1980). Children's learning and attention problems. Boston: Little, Brown & Co.
- Kirk, S. A., McCarthy, J. J., & Kirk, W. D. (1968). The Illinois Test of Psycholinguistic Abilities, rev. edit. Urbana, IL: University of Illinois Press.
- Klein, S. A., & Deffenbacher, J. L. (1977). Relaxation and exercise for hyperactive impulsive children. Perceptual and Motor Skills, 45, 1159-1162.
- Kuhn, T. S. (1962). The structure of scientific revolutions. Chicago: University of Chicago Press.
- Lahey, B. B. (1976). Behavior modification with learning disabilities and related problems. In M. Hersen, R. Eisler, & P. Miller (Eds.), Progress in behavior modification (Vol. 3). New York: Academic Press.
- Lahey, B. B. (1977). Research on the role of reinforcement in reading instruction: Some measurement and methodological deficiencies. Corrective and Social Psychiatry, 23, 27-32.

- Lahey, B. B., Hobbs, S. A., Kupfer, D. L., & Delamater, A. (1979). Current perspectives on hyperactivity and learning disabilities. In B. B. Lahey (Ed.), Behavior therapy with hyperactive and learning disabled children. New York: Oxford University Press.
- Lamaze, F. (1958). Painless childbirth: Psychoprophylactic method. London: Burke.
- Laufer, M. W., & Denhoff, E. (1957). Hyperkinetic behavior syndrome in children. Journal of Pediatrics, 50, 463-474.
- Lazarus, A. A. (1965). A preliminary report on the use of directed muscular activity in counter-conditioning. Behaviour research and therapy, 2, 301-304.
- Lazarus, A. A. (1971). Behavior therapy and beyond. New York: McGraw-Hill.
- Lazarus, A. A. (1976). Multimodal therapy. New York: Springer.
- Lazarus, A. A. (1981). The practice of multimodal therapy. New York: McGraw-Hill
- Lazarus, A. A. (1982). Personal enrichment through imagery. New York: BMA Audio Cassettes.
- Lazarus, A. A., & Abramovitz, A. (1962). The use of "emotive imagery" in the treatment of children's phobias. Journal of Mental Science, 108, 191-195.
- Lazarus, R. S. (1975). A cognitively oriented psychologist looks at biofeedback. American Psychologist, 31(5), 553-561.
- Lefcourt, H. M. (1976). Locus of control. New York: John Wiley & Sons.
- Leviton, H., & Kiraly, J., Jr. (1979). Intervention strategies for promoting self-concept. Academic Therapy, 15(5), 535-546.
- Loney, J. (1974). The intellectual functioning of hyperactive elementary school boys: A cross-sectional investigation. American Journal of Orthopsychiatry, 44, 754-762.

- Long, A. (1974). Muscle relaxation training with male adolescents using EMG biofeedback training vs. recorded relaxation instructions. Paper presented at the Midwest Psychological Association annual meeting, Chicago.
- Lubar, J. F., & Deering, W. M. (1981). Behavioral approaches to neurology. New York: Academic Press
- Lubar, J. F., & Shouse, M. (1979). Use of biofeedback in the treatment of hyperactivity. In B. B. Lahey (ED.), Behavior therapy with hyperactive and learning disabled children. New York: Oxford University Press.
- Lupin, M. (1977). Peace, Harmony, Awareness. San Antonio, TX: Learning Concepts.
- Lupin, M.N., Braud, L. W., Braud, W. G., & Duer, W. F. (1976). Children parents and relaxation tapes. Academic Therapy, 12(1), 106-113.
- Lynch, J. J., & Paskewitz, D. A. (1971). On the mechanisms of the feedback control of human brain activity. Journal of Nervous and Mental Disease, 153, 205-217.
- Mahoney, M. J. (1974). Cognition and behavior modification. Cambridge, Massachusetts: Ballinger.
- Mahoney, M. J. (1977). Reflections on the cognitive-learning trend in psychotherapy. American Psychologist, 32, 5-13.
- Marholin, D., & Steinman, W. M. (1977). Stimulus control in the classroom as a function of the behavior reinforced. Journal of Applied Behavior Analysis, 10, 465-478.
- Marinacci, A. A., & Horande, M. (1960). Electromyogram in neuromuscular re-education. Bulletin of the Los Angeles Neurological Society, 25, 57-71.
- Mash, D. J., & Dalby, J. T. (1979). Behavioral interventions for hyperactivity. In R. L. Trites (Ed.), Hyperactivity in children: Etiology, measurement, and treatment implications. Baltimore: University Park Press.

- Masters, J. C., & Mokolos, J. R. (1974). Self-reinforcement processes in children. In H. Reese (Ed.), Advances in child development and behavior (Vol. 9). New York: Academic Press.
- Matheny, A., Dolan, A., & Wilson, R. (1976). Twins with academic rearing problems: Antecedent characteristics. American Journal of Orthopsychiatry, 46, 464-469.
- Mathews, A. M. (1971). Psychophysiological approaches to the investigation of desensitization and related procedures. Psychological Bulletin, 76, 73-91.
- McMahon, R. C. (1980). Genetic etiology in the hyperactive child syndrome: A critical review. American Journal of Orthopsychiatry, 50, 145-149.
- McMillan, S. L. (1969). The problem of motivation in the education of the mentally retarded. Exceptional Children, 40-42. Meichenbaum, D. H. (1976). Cognitive factors in biofeedback therapy. Biofeedback and Self-Regulation, 2, 201-216.
- Meichenbaum, D. H. (1977). Cognitive-behavior modification: An integrative approach. New York: Plenum.
- Mendelson, W., Johnson, J., & Stewart, M. (1971). Hyperactive children as teenagers: A follow-up study. Journal of Nervous and Mental Disorders, 153, 273-279.
- Michael, W. B., & Smith, R. A. (1977). Dimensions of Self-Concept. Los Angeles: Los Angeles Unified School District.
- Mischel, W., Zeiss, R., & Zeiss, A. (1974). Internal-external control and persistence: Validation and implications of the Stanford preschool Internal-external scale. Journal of Personality and Social Psychology, 29, 265-278.
- Miller, N. E. (1961). Integration of neurophysiological and behavioral research. Annals of the New York Academy of Sciences, 92, 830-839.
- Miller, N. E. (1969). Learning of viseral and glandular responses. Science, 163, 434-445.

- Miller, N. E. (1971). Learning of visceral and glandular responses. In T. Barber, L. V. Dicara, J. Kamiya, N. E. Miller, D. Shapiro, & J. Stoyva (Eds.), Biofeedback & self-control. Chicago: Aldine-Atherton.
- Miller, N. E. (1974). Biofeedback: Evaluation of a new technique. New England Journal of Medicine, 290(12), 684-685.
- Miller, N. E., & Dollard, J. (1941). Social learning and imitation. New Haven: Yale University Press.
- Miller, N. E., & Dollard, J. (1950). Personality and psychotherapy. New York: McGraw-Hill.
- Millichap, J. G. (1968). Drugs in the management of hyperkinetic and perceptually handicapped children: Council on drugs. Journal of the American Medical Association, 206, 1527-1530.
- Millichap, J. G. (1973). Drugs in management of minimal dysfunction. Annals of the New York Academy of Sciences, 205, 321-334.
- Minde, K., Lewin, D., Weiss, G., Laviguer, H., Douglas, V., & Sykes, E. (1971). The hyperactive child in elementary school: A five-year, controlled follow-up. Exceptional Child, 38, 215-221.
- Minde, K., Weiss, G., & Mendelson, M. (1972). A five-year follow-up study of 91 hyperactive school children. Journal of the American Academy of Child Psychiatry, 11, 595-610.
- Mulholland, T. B. (1968). Feedback electroencephalography. Antivitas Nervosa Superior, 410-438.
- Mulholland, T. B. (1971). Can you really turn on alpha? Paper presented at a meeting for the Massachusetts Psychological Association, Boston College.
- Nowicki, S., & Strickland, B. (1973). A locus of control scale for children. Journal of Consulting and Clinical Psychology, 40, 148-154.
- O'Leary, K. D., & O'Leary, S. G. (1972). Classroom management: The successful use of behavior modification. New York: Pergamon Press.

- O'Leary, K. D., Pelham, W. E., Rosenbaum, M. A., & Price, G. H. (1976). Behavioral treatment of hyperkinetic children: An experimental evaluation of its usefulness. Clinical Pediatrics, 15(6), 274-279.
- Paul, G. L. (1969). Outcome of systematic desensitization. I: Background procedures, and uncontrolled reports of individual treatment. In C. M. Franks (Ed.), Behavior therapy: Appraisal and status. New York: McGraw-Hill.
- Omizo, M. M. (1980). The effects of biofeedback-induced relaxation on hyperactive adolescent boys. Journal of Psychology, 105, 131-138.
- Omizo, M., Denkowski, K. M., & Wilson, P. (1980). The effects of biofeedback-induced relaxation training on hyperactive boys. Paper presented at the meeting of the American Psychological Association, Montreal.
- Omizo, M. M., & Michael, W. B. (1982). Biofeedback-induced relaxation training and impulsivity, attention to task, and locus of control among hyperactive boys. Journal of Learning Disabilities, 15(7), 414-416.
- Palmer, S., Rapoport, J., & Quinn, P. (1975). Food additives and hyperactivity. Clinical Pediatrics, 14, 956-959.
- Pauling, L. (1968). Orthomolecular psychiatry. Science, 160, 265-271.
- Peper, E. (1971). Reduction of different motor commands during alpha feedback as a facilitator of EEG alpha and precondition for changes in consciousness. Kybernetik, 226-231.
- Peper, E., & Robertson, J. A. (1976). Biofeedback use of common objects; the bathroom scale in physical therapy. Biofeedback and Self-Regulation,
- Pfeiffer, W. M. (1967). Konzentrative Selbstentspannung durch Uebungen, die sich aus der buddhistischen Atemmeditation und aus der Atemtherapie herleiten. Zeitschrift fuer Psychotherapie und medizinische Psychologie, 46, 172-181.

- Pigeon, G., & Enger, A. (1972). Increasing assignment completion and accuracy in a hyperactive first grade student. School Application of Learning Theory, 4, 421-423.
- Pihl, R. (1967). Conditioning procedures with hyperactive children. Neurology, 17, 421-423.
- Phares, E. J. (1957). Expectancy changes in skill and chance situations. Journal of Abnormal and Social Psychology, 54, 339-342.
- Porges, S. W., & Smith, K. M. (1980). Defining hyperactivity: Physiological and behavioral strategies. In C. K. Whalen & B. Henker (Eds.), Hyperactive children: The social ecology of identification and treatment. New York: Academic Press.
- Raskin, M., Johnson, G., & Rondestvedt, J. (1973). Chronic anxiety treated by feedback-induced muscle relaxation. Archives of General Psychiatry, 28, 263-267.
- Reed, M., & Saslow, C. (1980). The effects of relaxation instructions and EMG biofeedback on test anxiety, general anxiety, and locus of control. Journal of Clinical Psychology, 36(3), 683-690.
- Rivera, E., & Omizo, M. M. (1980). An investigation of the effects of relaxation training on attention to task and impulsivity among male hyperactive children. The Exceptional Child, 27, 21-31.
- Rose, S. P., & Rose, H. (1974). Do not adjust the mind, there is a fault in reality. Cognition, 2(4), 499-502.
- Ross, A. O. (1980). Psychological disorders of children (2nd ed.). New York: McGraw-Hill.
- Ross, D. M., & Ross, S. A. (1976). Hyperactivity: Research, theory, and action. New York: Wiley.
- Ross, D. M., & Ross, S. A. (1982). Hyperactivity: Research, theory, and action (2nd ed.). New York: Wiley.
- Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, 80, Whole no. 609.

- Rotter, J. B., & Hochreich, D. J. (1975). Personality. Glenview, IL: Scott, Foresman.
- Routh, D. K. (1980). Developmental and social aspects of hyperactivity. In C. K. Whalen & B. Henker (Eds.), Hyperactive children: The social ecology of identification and treatment. New York: Academic Press.
- Rudel, R. G., Denckla, M. B., & Broman, M. (1978). Rapid silent response to repeated target symbols by dyslexic and non-dyslexic children. Brain and Language, 6, 52-62.
- Rutter, M. (1977). Brain syndromes in childhood: Concepts and findings. Journal of Child Psychology and Psychiatry, 18, 1-21.
- Rutter, M., Lebovici, S., Eisenberg, L., Sneznevskij, A., Sadoun, R., Brooke, D., & Lin, T. (1969). A tri-axial classification of mental disorders in childhood. Journal of Child Psychology and Psychiatry, 10, 41-61.
- Safer, D. (1973). A familial factor in minimal brain dysfunction. Behavior Genetics, 3, 175-187.
- Safer, D., & Allen, R. (1976). Hyperactive children: Diagnosis and management. Baltimore: University Park Press.
- Saletu, B., Saletu, M., Simeon, J., Viamontes, G., & Itil, T. M. (1975). Comparative studies with d-amphetamine, thioridazine, and placebo in hyperkinetic children. Biological Psychiatry, 10(3), 253-273.
- Salter, A. (1949). Conditioned reflex therapy. New York: Creative Age.
- Sandberg, S., Rutter, M., & Taylor, E. (1978). Hyperkinetic disorder in psychiatric clinic attenders. Developmental Medicine and Child Neurology, 20, 279-299.
- Sandoval, J., Lambert, N. M., & Sassone, D. (1980). The identification and labelling of hyperactivity in children: An interactional model. In C. K. Whalen & B. Henker (Eds.), Hyperactive children. New York: Academic Press.

- Satterfield, J. H. (1973). EEG issues in children with minimal brain dysfunction. Seminars in Psychiatry, 5, 35-46.
- Satterfield, J. H. (1975). Neurologic studies with hyperactive children. In D. P. Cantwell (Ed.), The hyperactive child. New York: Spectrum Publications, Inc.
- Satterfield, J. H., & Cantwell, D. P. (1974). CNS function and response in methylphenidate in hyperactive children. Psychopharmacology Bulletin, 10(4), 35-38.
- Satterfield, J. H., Cantwell, D., Lesser, L., & Podosin, R. (1972). Physiological studies of the hyperkinetic child. I. American Journal of Psychiatry, 128, 102-108.
- Satterfield, J. H., Cantwell, D. D., Saul, R. E., & Yustin, A. (1974). Intelligence, academic achievement, and EEG abnormalities in hyperactive children. American Journal of Psychiatry, 3, 391-395.
- Saxon, S. A., Magee, J. T., & Siegel, D. S. (1977). Activity level patterns in the hyperactive ritalin responder and nonresponder. Journal of Clinical Child Psychology, 6, 27-29.
- Schandler, S. L., & Grings, W. W. (1976). An examination of methods for producing relaxation during short-term laboratory sessions. Behavior Research and Therapy, 14, 419-426.
- Schultz, J. H., & Luthe, W. (1959). Autogenic training. New York: Grune & Stratton.
- Schwartz, G. E. (1975). Biofeedback self regulations and patterning of physiological processes. American Scientist, 63, 314-324.
- Schwartz, G. E., & Shapiro, D. (1973). Biofeedback and essential hypertension: Current findings and theoretical concerns. Seminars in Psychiatry, 5, 493-503.
- Schwartz, S., & Johnson, J. H. (1981). Psychopathology of Childhood. New York: Pergamon.

- Sheer, D. (1973). Biofeedback of 40 hz EEG in behavior. In R. Burch, & G. Altshular (Eds.), Behavior in brain and electrical activities. New York: Plenum Press.
- Skinner, B. F. (1953). Science and human behavior. New York: Macmillan.
- Sprague, R. L., & Sleator, E. K. (1973). Effects of psycho-pharmacological agents on learning disabilities. Pediatric Clinics of North America, 20, 719-735.
- Sprague, R. L., & Werry, J. S. (1971). Methodology of psychopharmacological studies with the retarded. IN N. R. Ellis (Ed.), International review of research in mental retardation. New York: Academic Press.
- Spring, C., & Sandoval, J. (1976). Food additives and hyperkinesis: A critical evaluation of the evidence. Journal of Learning Disabilities, 9, 28-37.
- Sroufe, L. A. (1975). Drug treatment of children with behavior problems. In F. A. Horowitz (Ed.), Review of child development research, Vol. 4. Chicago: University of Chicago Press.
- Stephens, R. S., Pelham, W. E., & Skinner, R. (1984). State-dependent and main effects of Methylphenidate and Pemoline on paired-associate learning and spelling in hyperactive children. Journal of Consulting and Clinical Psychology, 52(1), 104-113.
- Stern, G. S., & Berrenberg, J. L. (1977). Biofeedback training in frontalis muscle relaxation and enhancement of belief in personal control. Biofeedback and Self-Regulation, 2, 173-182.
- Stewart, M. A., & Olds, J. W. (1973). Rasing a hyperactive child. New York: Harper & Row.
- Stewart, M., Pitts, F., Craig, A., & Dieruf, A. (1966). The hyperactive child syndrome. American Journal of Orthopsychiatry, 36, 861-867.
- Stoyva, J. (1968). Skinnerian Zen or control of physiological responses through information feedback. Paper read at Denver University Symposium on Behavior Modification.

- Stoyva, J., & Budzynski, T. (1975). Cultivated low arousal--an antistress response? In L. V. DiCara (Ed.), Limbic and Autonomic Nervous System Research. New York: Plenum.
- Strauss, A. A., & Lehtinen, L. E. (1947). Psychopathology and education of the brain-injured child. New York: Grune & Stratton.
- Tansey, M. A., & Bruner, R. L. (1983). EMG and EEG biofeedback training in the treatment of a 10-year-old hyperactive boy with a developmental reading disorder. Biofeedback and Self-Regulation, 8(1), 25-37.
- Toffler, A. E. (1972). The effect of intervention on children classified as minimal brain damaged by psychological testing which has been confirmed or disconfirmed by EEG evaluation. Dissertation Abstracts International, 32(10-B), 6062-6063.
- Trites, R. L. (1979). Prevalence of hyperactivity in Ottawa Canada. In R. L. Trites (Ed.), Hyperactivity in children. Baltimore, MD: University Park Press.
- Trites, R. L., Tryphonas, H., & Ferguson, H. B. (1980). Diet treatment for hyperactive children with food allergies. In R. Knights & D. Bakker (Eds.), Treatment of hyperactive and learning disabled children. Baltimore, MD: University Park Press.
- Twardoz, S., & Sojiraj, T. (1972). Multiple effects of a procedure to increase sitting in a hyperactive boy. Journal of Applied Behavioral Analysis, 5, 73-78.
- Ullman, L. P. (1970). On cognitions and behavior therapy. Behavior Therapy, 1, 201-204.
- Ullman, L. P., & Krasner, L. (1969). A psychological approach to abnormal behavior. Engelwood Cliffs, NJ: Prentice-Hall.
- Urban, H. B., & Ford, D. H. (1981). Some historical and conceptual perspectives on psychotherapy and behavior change. In A. E. Bergin & S. L. Garfield (Eds.), Handbook of psychotherapy and behavior change: An empirical analysis. New York: Wiley.
- Valins, S., & Ray, A. A. (1967). Effects of cognitive desensitization on avoidance behavior. Journal of Personality and Social Psychology, 7, 345-350.

- Varni, J. W. (1976). A cognitive-behavior self-regulation approach to the treatment of the hyperactive child. Unpublished doctoral dissertation, University of California, Los Angeles.
- Wechsler, D. (1974). Wechsler Intelligence Scale for Children -- Revised. New York: The Psychological Corporation.
- Weiss, G. (1975). Effects of long-term treatment of hyperactive children with methylphenidate. Canadian Medical Association Journal, 112, 159-165.
- Weiss, G., & Engel, B. T. (1971). Operant conditioning of heart rate in patients with premature ventricular contractions. Psychosomatic Medicine, 33, 302-321.
- Weiss, G., & Minde, K. (1974). Follow-up studies of children who present with symptoms of hyperactivity. In C. K. Conners (Ed.), Clinical use of stimulant drugs in children. Amsterdam, Netherlands: Excerpta Medica.
- Weiss, G., Minde, K., Werry, J., Douglas, V., & Nemeth, E. (1971). Studies on the hyperactive child. VIII. Five year follow-up. Archives of General Psychiatry, 24, 409-414.
- Welgan, P. R. (1974). Learned control of gastric acid secretions in ulcer patients. Psychosomatic Medicine, 36, 411-419.
- Wender, P., & Wender, E. (1978). The hyperactive child and the learning The hyperactive child and the learning disabled child: A handbook for parents. New York: Crown.
- Werry, J. S. (1968). Developmental hyperactivity. Pediatric Clinics of North America, 15, 581-597.
- Werry, J. S. (1972). Organic factors in childhood psychopathology. In H. C. Quay and J. S. Werry (Eds.), Psychopathological disorders of childhood. New York: Wiley.
- Werry, J. S., & Aman, M. A. (1975). Methylphenidate and Haloperidol in children: Effects on attention, memory and activity. Archives of General Psychiatry, 32, 790-795.

- Werry, J. S., Minde, K., Guzman, A., Weiss, G., Dogan, K., & Hoy, E. (1972). Studies on the hyperactive child. VII. Neurological status compared with neurotic and normal children. American Journal of Orthopsychiatry, 42, 441-451.
- Werry, J. S., Sprague, R. L., & Cohen, M. N. (1975). Conners' teacher rating scale for use in drug studies with children: An empirical study. Journal of Abnormal Child Psychology, 3, 217-229.
- Whalen, C. K., & Henker, B. (1976). Psychostimulants and children: A review and analysis. Psychological Bulletin, 83, 1113-1130.
- Wilkins, W. (1971). Desensitization: Social and cognitive factors underlying the effectiveness of Wolpe's procedure. Psychological Bulletin, 76, 311-317.
- Wilson, G. T., & Davison, G. C. (1971). Processes of fear reduction in systematic desensitization: Animal studies. Psychological Bulletin, 76, 1-14.
- Wolk, S., & DuCette, J. (1973). The moderating effect of locus of control in relation to achievement-motivation variables. Journal of Personality, 41, 59-70.
- Wolpe, J. (1958). Psychotherapy by reciprocal inhibition. Stanford: Stanford University Press.
- Wynne, M. E. (1979). Time estimation as a measure of impulsivity in emotionally disturbed adolescent females. Dissertation Abstracts International, 40/05A, p2618. (University Microfilms No. DEL 79-25250).
- Yates, A. J. (1975). Theory and practice in behavior therapy. New York: Wiley Interscience.
- Zental, S. (1975). Optimal stimulations as theoretical basis of hyperactivity. American Journal of Orthopsychiatry, 45, 549-563.

APPROVAL SHEET

The dissertation submitted by John T. Tomassetti has been read and approved by the following committee:

Dr. Martha Ellen Wynne, Director
Assistant Professor, Educational Foundations, Loyola
University of Chicago

Dr. Joy J. Rogers
Associate Professor, Educational Foundations, Loyola
University of Chicago

Dr. Ronald R. Morgan
Associate Professor, Educational Foundations, Loyola
University of Chicago

Dr. Stanford L. McDonald
Clinical Psychologist, Independent Practice

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

February 14, 1985
Date

Martha Ellen Wynne
Director's Signature