THE EFFECTS OF AN EDUCATIONAL PROGRAM ON THE TEST PERFORMANCE OF CHILDREN WITH PSYCHONEUROLOGICAL LEARNING DISABILITIES

By

KAREN SUZANN BAUMANN

Bachelor of Music Education
Oklahoma State University
Stillwater, Oklahoma
1962

Master of Education
Boston University
Boston, Massachusetts
1966

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF EDUCATION
May, 1969

THE EFFECTS OF AN EDUCATIONAL PROGRAM

ON THE TEST PERFORMANCE OF CHILDREN

WITH PSYCHONEUROLOGICAL

LEARNING DISABILITIES

Thesis Approved:

Harry K. Brobst
Thesis Adviser

Norman E. Wilson

Dale D. Grosvenor

Kenneth St. Clair

John E. [illegible]

D. D. Durham
Dean of the Graduate College

PREFACE

In recent years, both professional and parental groups have demonstrated dissatisfaction with inadequate educational provisions for children with psychoneurological learning disabilities. Although there has been an increase in discourse concerning clinical observations, little research has been focused upon efficacy studies of the various existing educational programs. Furthermore, should an appropriate educational program be made available, so little regard has been given to systematic identification of these children, it is likely that children in need of treatment may be overlooked. Therefore, the principle aim of this study was to implement a systematic method of identifying these children, to develop a suitable educational program for them, and to assess its effects upon selected behavioral measures.

Words cannot adequately express my regard for Dr. H. K. Brobst who served as my graduate advisor and committee chairman. I am indebted to his thoughtful and perceptive criticism in the construction of this dissertation project. Working with him has been a unique experience.

Appreciation is also expressed to committee members Dr. John Egermeier, Dr. Dale Grosvenor, Dr. Kenneth St. Clair, and Dr. Norman Wilson for their full and complete cooperation, encouragement and understanding.

A very special thanks is extended to Dr. Norman Wilson who has given unselfishly of his time and wisdom to provide invaluable assistance in the programming of my statistical data. He has served as a source of encouragement throughout my entire program.

Without the enthusiasm and encouragement of Mrs. Margorie Shaw, implementation of this program would not have been possible. Her confidence in me has served to give me the courage to undertake and complete this task.

My deepest gratitude goes to Eldon Hardy for his assistance with the drawings for this project. The kindness and thoughtfulness of such a friend were greatly appreciated.

Indebtedness is acknowledged to Dr. K. Sandvold for his unfailing willingness to provide assistance and advice in just the proper proportions. To Mrs. Polly Harrison, my excellent assistant, I can only express my most heartfelt thanks for a job well done. To Mr. David Williams goes special recognition for the development of imaginative speech and language activities. Many thanks are due to

Dr. Don Culwell and Dr. Agnes Myers for their cooperation in the program. To Mrs. Mary Grimsley, a valued friend, goes my gratefulness for her ability to anticipate my needs. Sincere appreciation is due Miss Shirley Looper for her contributions of original training activities, and Mrs. Betty Vanice and Mrs. Elizabeth Herndon whose early efforts in the development of a training program marked the beginning of this research. A very special thanks goes to Mr. J. Johns, Mr. R. Lewis, Mr. J. Meacham, Miss J. Nall, Mrs. P. Kroger, Mrs. J. Moran, Miss M. Edwards, Miss B. Inglish, Mrs. M. Adair, Mrs. V. Beierschmitt, Mrs. A. Kimbrell, and Mrs. E. Suib, the volunteer teachers without whom this study would have been impossible.

Appreciation is extended to Mr. B. Brooks, Mrs. M. Carlton, Mr. P. Jones, Mr. J. Davis, Mr. J. Freemon, Mrs. P. Lehman, Miss P. Daubert, Mrs. I. Ford, and Miss S. Felible who provided invaluable assistance in the testing program.

Sincere appreciation is due to Stillwater Public School teachers for their cooperation and interest in this project.

To Mrs. Patty Tillerson, a very sincere thanks for special effort expended in readying this thesis for publication.

To my family goes my deepest love and appreciation for their unswerving loyalty, patience, and understanding. Their encouragement and pride in me have made this effort worthwhile.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

"Nonprogressive brain injury, which may occur at any time from the beginning of life in the uterus to old age and death, probably comprises the most devastating health problem in the United States today. Heart disease and cancer outrank it as a cause of death but not in the amount of productive time lost or the drain on social and economic resources." (LeWinn,et al, 1966, p. 56)

This rather startling statement exemplifies one reason for a current awareness of and concern for children with neurological impairments. However, the problem of nonprogressive brain injury is not one of health alone. Inevitably, difficulties in learning result from such neurological impairments. The concept of neurological impairment or central nervous system dysfunction as a primary cause of certain learning disabilities and their behavioral concomitants has received increasing attention in the past twenty years. This trend is demonstrated by the rapidly growing body of knowledge concerning these children.

Need for Study

As neurological impairments are represented by various combinations of learning disabilities, it can be seen that this particular segment of our population requires special resources for management and education. However, in spite of the high expectations for our educational system which seeks to realize the maximum development of every child in terms of his unique individual needs, this ideal is far from fulfillment in this key area.

> There is a sizable group of exceptional children for whom no adequate education facilities exist. These are children who have incurred a mild neurological impairment, and, as a result, may have severe learning disabilities, or may exhibit behavior deviations which make adjustment in the regular classroom difficult, even though their intelligence scores are within the range for "normal". (Leton, 1960)

Unlike educational programs which have been in existence in the United States for more than 100 years for mentally retarded children, educational programs for children with neurological impairments are just beginning to develop. In fact, it is rare that such an educational program is more than a few years old. (Cruickshank, 1967b)

With these considerations in mind, it can be seen that there is a definite need for treatment and educational programs geared to meet the specific needs of neurologically impaired children.

Increased activity in this field has, in part, become necessary due to the apparent rise in reports of the incidence of neurological impairments. This so-called rise may be explained on the basis of one or more of the following factors:

1. Diagnostic techniques and skills have become increasingly more sophisticated and refined. (Clements, 1966)
2. The current Diagnostic and Statistical Manual of the American Psychological Association (1952) which was developed primarily for the classification of adult disorders is unsatisfactory and, for the most part,inappropriate for the classification of the learning and behavioral disorders of children. This lack of an appropriate classification system is indicative of a need for more precise classification applicable to children. (Clements, 1966)
3. The habitual assumption of psychogenicity for any disorganized or poorly understood behavior, when no easily recognizable organic deviations can be found in the child, has become distasteful

to many medical workers. (Clements, 1966)

4. The change from an agrarian society to a highly evolved industrial urban organization has many implications for the family unit. Families must now make a deliberate effort if they are to maintain unity and involvement in constructive learning activities. The devastating effects of neurological impairments are more evident in children who lack stable structure in the home.

5. The technical nature of society itself appears to be placing restrictions on children's need for experimentation, due to the highly technical, complex, fragile, and expensive items which are being produced, as well as the actual physical danger involved in handling many of these items. Through technological advances we have become a nation of "Don't touch-ers!", and have in many ways decreased the potential experiential possibilities for the growing child. (Kephart, 1960)

6. Parents have become increasingly more sophisticated and outspoken in their demands that

the many problems which their children present be ameliorated. There is a growing awareness that neither the regular classroom nor the special classes for the retarded were providing satisfactory education for children with neurological impairments. (Dunn, 1967)

7. "Improvements in obstetrical techniques and prenatal care have decreased the incidence of birth mortalities. Many children are alive today who would not have survived under previous conditions." (Leton, 1960, p. 350) Many of these children are neurologically impaired.

This apparent rise in incidence rate has produced a flurry of statistical activity. Predicting educational needs and planning the development of educational resources require fairly accurate estimates of the proportion of the population presenting such problems. However, no accurate census exists, although incidence estimates ranging from 1% to 7% are often quoted. (Beck, 1961; Cruickshank, 1967a)

Nevertheless, Paine (1965) asserted, "Children with borderline impairments of functioning . . . without an overt disability . . . (although this is a matter of degree) are doubtless more numerous than those frankly mentally deficient or suffering from cerebral palsy, and probably number 4% or 5% of the general population of school age." (p. 4)

Therefore, although it is becoming apparent that there are many more neurologically impaired children than was previously suspected, the full extent of the problem remains to be realized. One author stated that in his opinion, "So common is the problem . . . that it is a problem of every elementary school in every American community and is undoubtedly to be found in almost every elementary classroom in every school." (Cruickshank, 1956a, p. 24)

Purpose of the Study

With the above considerations in mind, this study was specifically directed toward evaluating the effects of an educational program for neurologically impaired, primary-age children with learning disabilities. This involved several sub-problems:

1. By what behavioral criteria could children with psychological learning disabilities be identified?
2. What in-service procedures could acquaint teachers with these behaviors?
3. How could teachers be motivated to refer children for initial screening?

4. What administrative arrangements could be made to facilitate these referrals?
5. What instruments would be appropriate for initial screening?
6. How could the cooperation of parents be obtained for further diagnosis and treatment?
7. What diagnostic procedures would be most appropriate for further assessment of individual difficulties?
8. What educational procedures could be devised to meet the individual's indicated needs?
9. How could the effectiveness of such educational procedures be evaluated?

Clarification of the Problem

Answers to the question posed above form the basis for the subsequent chapters. However, prior to discussion of these subproblems, several basic issues must be clarified: (a) selection of appropriate terminology, (b) identification of symptom patterns, and (c) development of adequate diagnostic procedures.

Selection of Appropriate Terminology

One or more terms are needed to designate those patterns of neurological impairment which are not sufficiently specific or severe to warrent inclusion in established diagnostic categories, such as the cerebral palsies. A survey of the literature, however, revealed not a lack, but a veritable plethora of terms used to describe or distinguish the neurological conditions affecting the learning of children. Provided in Appendix A is a list of the various terms found in the literature which refer to conditions in which neurological impairment is considered to be a primary cause of learning disabilities.

Despite the multiplicity of terms, much remains to be done to clarify their meaning. There is no general agreement on operational definitions distinguishing these conditions from others. Furthermore, there appears to be a "war of words" designed to mask with a catch-all category an inability to diagnose accurately, and/or to preempt a potentially profitable problem area for a particular professional group.

More appropriately, the terminology itself should define a condition accurately, and, in doing so should distinguish clearly one condition from another. For example, the terms brain-injured and brain-damaged which appear most frequently in the literature have unfortunately become "waste-basket" categories for all problems in which etiology is unclear. Also, due to the implication of "mental retardation" conveyed by the terms, many feel that the terms are unfairly stigmatizing, for not all children with neurological impairments are retarded. Furthermore, the terms also connote specific demonstrable brain alterations. Yet the child with a subtle neurological impairment is more likely to be diagnosed behaviorally rather than neurologically. It is obvious that there is a need for more applicable and appropriate terminology than brain-injured or brain-damaged.

Minimal brain dysfunction is also prevalent in the literature. This is perhaps a more suitable term. It attempts to describe the child who is different in certain learning and behavioral patterns, but whose overall intellectual functioning has not been reduced to the subnormal ranges. However, applying the term "minimal" can complicate understanding, for the criteria for distinguishing between minimal and diffuse neurological involvement are difficult to establish. (Birch, 1964; Johnson and Myklebust, 1967)

The use of terms such as perceptually handicapped as general labels is also unsatisfactory, for not all children with neurological impairments have perceptual disabilities.

The term psychoneurological learning disability appears to meet the criteria of describing most accurately the condition under consideration. It clearly indicates that the learning processes have been altered and that this modification is due to neurological dysfunction. It is thus the neurology of learning which has been impaired; and the result of the impairment is a disability and not an incapacity in learning.

This term has found increasing use in the recent literature. (Benton, 1959; Luria, 1961; Myklebust and Boshes, 1960) "The root of the term, neurological, clearly discloses that the basic condition is organic and involves the central nervous system. The prefix psycho appropriately emphasizes that an important concomitant is behavioral. The designation psychoneurological, therefore, indicates that the disorder is in behavior and that the causation in neurological." (Johnson and Myklebust, 1967, p. 8)

This term also deals adequately with the important distinction between <u>disorder</u> and <u>disability</u>.

> <u>Learning disorder</u> might best designate a known impairment of the nervous system. The impairment may be the result of genetic variation, biochemical irregularity, perinatal brain insult, or injury sustained by the nervous system as a result of disease, accident, sensory deprivation, nutritional deficit, or other direct influences.
>
> <u>Learning disability</u> might best designate a demonstrated inability to perform a specific task normally within the capability range of individuals of comparable mental ability. (Frierson and Barbe, eds., 1967, p. 4)

> Psychoneurological, unlike terms such as 'brain damage', is applicable to all aberrations of behavior having a neurological basis, irrespective of age of onset or etiology. It is in this sense that we refer to children as having a Psychoneurological Learning Disability, meaning that behavior has been disturbed as a result of a dysfunction in the brain and that the problem is one of altered processes, not of a generalized incapacity to learn. (Johnson and Mykelbust, 1967, p. 8)

For these reasons, in this study, the term psychoneurological learning disability or PNLD was used to designate behaviors exhibited by children of average or above general intelligence manifesting certain learning or behavioral disabilities of varying degrees of severity which are associated with neurological impairments. The neurological impairment may be manifest by varying combinations of impairment in perception, conceptualization, perceptual-motor function, and control of attention, impulse, and motor function. (Clements, 1966)

Identification of Symptom Patterns

A broad range of symptoms in a wide variety of patterns are to be found among children with psychoneurological learning disabilities. An excellent summary of behavioral characteristics of children with psychoneurological learning disabilities has been provided by a Task Force co-sponsored by the National Society for Crippled Children and Adults, Inc., and the National Institute of Neurological

Diseases and Blindness. This tentative classification represents a review of over 100 recent publications. (Clements, 1966)

According to Clements, the ten characteristics most often cited by the various authors, in order of frequency are as follows:

1. Hyperactivity
2. Perceptual-motor impairment
3. Emotional lability
4. General coordination deficits
5. Disorders of attention (short attention span, distractability, perserveration)
6. Impulsivity
7. Disorders of memory and thinking
8. Specific learning disabilities
    a. Reading
    b. Arithmetic
    c. Writing
    d. Spelling
9. Disorders of speech and language
10. Equivocal neurological signs and electroencephalographic irregularities (Clements, 1966, p. 13)

Although the behavioral characteristics of children with psychoneurological learning disabilities differ from individual to individual, there appears to be one very noteworthy commonality. In varying degrees, all children with a psychoneurological learning disability are confronted with problems of adjusting to normal society. (Lewis, Strauss, and Lehtinen, 1960) These adjustment problems seem to stem from an inability to establish adequate and satisfactory compensatory behaviors. The resultant failure experiences often precipitate the development of an emotional overlay.

The ten characteristics cited previously (Clements, 1966) all contribute to the formation of this emotional overlay. Due to the resultant behavior which is variously described as anti-social, strange, nutty, childish, bratty, sociopathic, or stupid, the child with PNLD is denied the experience of satisfactory peer relationships, and invites punitive measures by his teachers and parents.

Those psychoanalytic theories which emphasize the importance of the ego in terms of the individual's total behavior seem to be especially applicable to the child with a psychoneurological learning disability. (Michal-Smith and Morgenstern, 1965) There appears to be some agreement in that there is a close relationship between cephalo-caudal maturation, opportunities for conditioning, subsequent learning, and ego development. If relative balance of this interrelationship is maintained, by school-age the child should possess the basic motor skills necessary for writing, the basic perceptual skills on which reading and number concepts will be developed, and the emotional experience which should make satisfactory adjustments with teachers and peers feasible. (Cruickshank, 1967b)

Rappaport (1966) reported that the child lacking neurological intactness is robbed of the inherent opportunity to develop ego functions in the usual course of growing up, since primary ego functions, such as motility and perception, can develop only with the maturation of the central nervous system. This struggle between self and environment in an attempt at mastery is often associated with failure and frustration for the child with a psychoneurological learning disability.

The devastating influence of such failure experiences cannot be overemphasized, since behavioral effects are cumulative, and serious adjustment problems often develop later in life. Most of these children have not experienced success as a reinforcer in learning and as a stimulator to more learning; and, therefore, have not responded to educational measures appealing to success motives. For these children, failure expectations often represent a style-of-life---a way of coping with their distorted and partial perceptions of their environment.

> Due to the subtle nature of their problems, they can neither function comfortably and securely in the world of the normal, nor expect the special treatment accorded the abnormal. They must live in a world whose demands they are unable to meet, through no fault of their own---and they must do so without understanding of the problems they face by their parents, teachers, or even themselves. (Ellingson, 1967, p. 5)

It can thus be seen that though the primary etiology of children with PNLD is neurological, accurate diagnosis and effective treatment are complicated when these secondary emotional difficulties arise. Due to the many deviant behaviors manifested, the primary neurological involvement is often overlooked. The resultant diagnosis more often than not reflects an emphasis upon personality factors.

Development of Adequate Diagnostic Procedures

The large number of symptoms which have been attributed to children with psychoneurological learning disabilities understandably complicates the diagnostic task. In spite of similarities of certain symptom patterns, each child will ultimately have his own distinctive cluster of symptoms. It has been pointed out that children with learning disabilities can only be characterized by their wide variability in behavior, for they do not represent a homogeneous group in terms of etiology or areas of deficiency. (Michal-Smith and Morgenstern, 1965)

The diagnostic problem is further complicated by the emotional overlay previously mentioned, for child guidance workers and child psychologists have emphasized the intrapsychic and interpersonal factors in the diagnosis of etiology for the behavioral and learning deviations seen in children.

> In many clinics, it has become habitual to assume psychogenicity when no easily recognizable organic deviation can be found in the child. Undoubtedly this has been due in part, to the difficulty in delineating the contribution to symptomology and personality structure of subtle organic and central nervous system deviations, and to the relatively greater accessibility of environmental data. (Clements and Peters, 1962)

Since a particular symptom-complex may involve only those symptoms which are less conspicuous, detection may be more difficult. "Many youngsters with only slight cerebral dysfunction learn to accommodate quite well, and this can hide the real difficulty enough to escape notice in a gross examination." (Crawford, 1966, p. 38)

Therefore, as a borderline or equivocal case of organicity and central nervous system deviation is difficult to detect, instruments sensitive to neurological impairments should be utilized routinely in diagnostic workups.

Differentiation between borderline or equivocal cases of organicity and functional disorders is seen as essential, for the children with this borderline deficit are those who are most often misdiagnosed and consequently not given the most effective treatment. Thus, possiblities of <u>subtle</u> organic causation must not be excluded from a diagnostic evaluation. This is critical, for indicated treatment of the organically impaired child may frequently differ in focus and emphasis from that indicated for the functionally impaired child. (Clemmens, 1961)

Too many clinicians are reluctant to diagnose organicity without assurance of specific etiology. As has been made clear, due to the emotional overlay and the subtlety and nature of the organic involvement, in many cases manifestations of the condition are behavioral, not neurological. Often overlooked, for example, is the significance of one very important diagnostic symptom--the central feature common to all children with a neurological impairment--the presence of a learning disability in spite of an average or above intelligence quotient. (Clements, 1966; Johnson and Myklebust, 1967)

Therefore, the development of adequate diagnostic procedures is seen as essential. Only then can children with PNLD be accurately identified, and appropriate educational treatment be administered.

An Educational Challenge

Due to a paucity of available educational programs it can be seen that often a diagnosis of psychoneurological learning disability meant no treatment would be available. Therefore, it often seemed more humane to focus diagnosis and treatment upon the concomitant emotional overlay, and hope for improvement in overall performance.

However, in spite of difficulties concerning terminology, symptomology, and diagnosis, it can be seen that ". . . educators and, in particular, the elementary teachers must provide programs for such individuals. . ." (Clements, 1966, p. 1) If the presence of these children in the classroom is as great as many investigators believe, the potential resources of a large segment of our population are not being realized.

Basic to the development of an educational program for this segment of our population are certain basic principles underlying treatment of children with learning disabilities:

1. Treatment must be based on a diagnosis.
2. The child's personal worth must be considered.
3. Corrective treatment must be individualized.
4. The program must be well motivated and encouraging to the child.
5. Materials and exercises must be carefully selected.
6. The entire environment of the child must be considered.
7. Continuous evaluations must be made.
8. Sound teaching procedures must be utilized in the treatment of learning difficulties. (Bruickner and Bond, 1955, p. 77)

Since this form of educational programming is not feasible for the large elementary classroom, we, as educators, are tempted to ignore our responsibilities to these children. We have passively accepted limitations as natural and actively deplored behavioral manifestations as willful, when we could have handled both more constructively.

What is needed is greater awareness on the part of classroom teachers of the existence of these conditions and the possibility of their detection and remediation. No other professional group has such an opportunity to observe learning difficulties, to recognize key symptoms, and to refer children for treatment at the most appropriate point in development.

In summary, there appears to be a large group of children manifesting various combinations of learning and behavioral disabilities, for whom no adequate plan for educational remediation exists. It is felt that if primary-age children with pyschoneurological learning disabilities can be routinely and accurately diagnosed and an educational training program be made available, treatment will ultimately be less costly (National Health Council, 1957) and more humanly beneficial than extensive rehabilitation programs for school dropouts, delinquents, and the emotionally and mentally handicapped.

In the subsequent chapters, the effects of efforts to identify children with PNLD, and develop and provide appropriate educational training for such children will be investigated.

CHAPTER II

REVIEW OF THE LITERATURE

This review of the literature includes the following areas: (a) a survey of behavioral criteria useful for identifying neurologically impaired children; (b) selection of diagnostic and evaluative instruments; (c) educational approaches recommended for treatment of neurologically impaired children, and (d) summary and synthesis.

Identification Criteria

Sound educational planning for children with psychoneurological learning disabilities depends upon accurate diagnosis. Prerequisite to accurate diagnosis is the establishment of criteria for identifying these children. These identification criteria would necessarily include symptcms commonly manifested by these children. A search for common symptoms attributed to neurological impairment revealed an overwhelming variety. However, in a young and rapidly developing field, where new professional organizations and publications have only been recently established, it is not surprising that the literature would include many works of vague and conflicting nature. It would appear that a practical description of symptoms or characteristics displayed by children with PNLD is difficult if not impossible. (Wortis, 1956; Clements, et al.,1964; Michal-Smith and Morgenstern, 1965) To this extent, the literature reflects the rather confused state of this field at its present stage of development. This being the case, reasons for this apparent confusion were sought.

Semantic differences are prevalent in this field, because each of the many disciplines involved in the study of children with psychoneurological learning disabilities uses its own terminology. As a result different terms are used to describe the same phenomenon. Confusion also results from differential emphases between fields. The characteristics given greatest attention will vary depending upon the discipline. In addition, disparity is found in the degree of specificity of terms. While some characteristics are described so broadly that diagnostic value is limited, others are so specific that relatively few of the total population of children with psychoneurological learning disabilities can be characterized by the use of these terms.

It can be seen that multiple difficulties arise when attempts are made to specify commonalities. Nevertheless, many authors have attempted to identify core characteristics manifested by most neurologically impaired children. (Gesell and Amatruda, 1947; Strauss and Lehtinen, 1947; Doll, 1953; Hanvik, et al., 1953; Carmichael, 1954; Goldstein, 1954; Bender, 1955; Bradley, 1955; Eisenberg, 1957; Laufer, et al., 1957; Thelander, et al., 1958; Levy, 1959; Burks, 1960; Denhoff, 1961; Clements, 1966) This persistent attempt to identify core characteristics suggests that there are a certain number of characteristics which will appear in the majority of groupings. Logically, these characteristics, though few in number, would tend to be more common among the majority of children suffering from psychoneurological learning disabilities. "Every affected child is in some way different from every other, yet certain threads run through the pattern and can be defined." (Paine, 1965, p. 4)

Most prevalent in the literature is the observation that almost all of these children exhibit difficulties in learning. "During the school years, a variety of learning disabilities is the most prominant manifestation of the condition." (Clements, 1966, p. 10)

"Together with deficits in the learning of arithmetic, deficiencies in acquiring spoken, read, and written language constitute the primary areas under the category of disabilities in verbal learning." (Johnson and Myklebust, 1967, p. 17) "Writing is also frequently affected." (Clements, 1965, p. 211)

As the focus of this study was upon skills basic to learning, such as visual-motor-perception, gross-motor coordination, and speech and language development, a detailed review of the extensive literature pertaining to specific learning disabilities, such as dyslexia and aphasia, was not considered relevant.

In considering the usefulness of a manifest learning disability in identifying children with PNLD, an important question arose. How large a discrepancy between estimated capacity for performance and actual achievement level must exist before it can be described as a learning disability?

Bateman (1965) indicated that this question should be ". . . answered by common sense and experience [rather] than by a formula or rigid rule." (p. 219) In practice, achievement scores one year below grade level provided a common index. Johnson and Myklebust (1967), however, suggested that a more accurate index of a learning disability is obtained when achievement is related to mental age rather than chronological age. "When the ratio of achievement to MA is computed, the result is a Learning Quotient--a quotient exhibiting the degree of learning achieved in relation to intellectual potential for learning." (Johnson and Myklebust, 1967, p. 19)

The above considerations, especially those suggested by Johnson and Myklebust, provided usable guidelines for assessing the severity or extensiveness of a learning disability in a given academic area. Therefore, the presence of a learning disability provided the first of several behavioral criteria useful in identifying children with PNLD.

Merely identifying and specifying the degree of a learning disability, however, is insufficient for identification of these children or for educational planning, because educational measures routinely applied appear to be relatively ineffective. For example, ". . . a learning disability persists and fails to yield to repetition of routine instruction or retention in the grades." (Michal-Smith and Morgenstern, 1965, p. 172)

Perhaps the essence of the remediation problem has been summarized best by Kephart who stated,

> Readiness for learning, then, is much more than a loosely-organized bunch of skills which a child must either possess or not possess. Rather it

> consists of a hierarchical buildup of generalizations which allows the child to deal increasingly effectively with his environment. Learning disabilities may be viewed in terms of difficulties in the developmental sequence. When such difficulties occur, then there are gaps in the sequence which will affect all future learning either by limiting or distorting it. (Kephart, 1963, quoted by Dunsing and Kephart, 1965, p. 81)

It can thus be seen that learning disabilities seem to stem from basic skill deficiencies resulting from various subtle impairments which interrupt the regular developmental sequence. Therefore, successful educational planning requires careful evaluation and assessment of the level of development of those specific skills basic to learning. Furthermore, the development of these various skills seem to be revealed most clearly by manifest behavioral characteristics, previously referred to as core characteristics.

Prior to a review of those characteristics which commonly appear to be associated with a neurological impairment, it should be pointed out that they are more often assessed behaviorally than neurologically. There is a notable lack of usable instruments capable of demonstrating physiologic, biochemical, or structural alterations of the brain. Thus, behavioral diagnosis appears to be more fruitful at this time. Clements (1966) presented a strong case for this pragmatic point of view by stating,

> With our limited validated knowledge concerning relationships between brain and behavior, we must accept certain categories of deviant behavior, developmental dyscrasias, learning disabilities, and visual-motor-perceptual irregularities as valid indices of brain dysfunctioning. They represent neurologic signs of a most meaningful kind, and reflect disorganized central nervous system functioning at the highest level. To consider learning and behavior as distinct and separate from other neurologic functions echoes a limited concept of the nervous system and of its various levels of influence and integration. (pp. 6-7)

Therefore, attention should be directed to a review of those characteristics, noted in Chapter I, which appear to relate more specifically to skill areas affected by a neurological impairment. These include: hyperactivity; disorders of attention; perceptual, conceptual, and perceptual-motor difficulties; impairments of gross-motor activity and fine-muscle movements; disorders of speech and language development; and emotional lability. For the purpose of this study, these characteristics, easily observed in the classroom, were considered more useful for identifying children with PNLD.

Hyperactivity, the characteristic most often cited by various authors, basically refers to an excess of energy or a lack of functional controls. The relationship between hyperactivity and brain impairment is not well-established. Research findings indicated that an increase in activity follows certain brain injuries in both animals and humans. For example, frontal lobe injury in animals appears to be followed by increased hyperactivity. (Smith, et al., 1941; Ruch and Shenkin, 1943; Blum, et al., 1948; Rosvold and Delgado, 1953) Kinder and Willenson (1952) studied humans who had undergone psychcsurgery. Foshee's (1958) ballistograph was used in a number of studies to measure activity levels in various types of subjects. (Gardner, et al., 1959; Spradlin, et al., 1959; Cromwell and Foshee, 1960)

As might be expected, experimental studies of humans are less numerous than studies dealing with animals. They have necessarily been limited as to the type of brain damage studied and the number of subjects within each category available for study.

Even though there are a limited number of relevant studies relating brain injury and hyperactivity, the observation of this characteristic in neurologically impaired children has been well documented in descriptive terms, and is included on almost every list of core characteristics. Although the term "hyperactivity" was not yet used, Cohen, (Kahn and Cohen, 1934) described this type of activity in detail over thirty years ago. Then, the term "organic-driven-ness" denoted the apparent surplus of inner compulsions.

Therefore, until the relationship of hyperactivity to organicity can be more clearly supported by empirical evidence, the observed incidence of hyperactivity in a great number of neurologically impaired children may be accepted as a certain type of deviant behavior which represents a valid index of brain dysfunctioning. It is obvious, especially in the regular classroom environment, that hyperactivity can be a debilitating deterrent to learning. Therefore, the presence of hyperactivity was included among the criteria for detecting PNLD.

Disorders of attention, including short attention span, distractibility, and perseveration are frequently observed in the neurologically impaired child.

Short attention span appears to be related to distractibility. S. R. Rappaport (1964) believed that disorders of attention result from the inability of impaired children to refrain from reacting to extraneous external or internal stimuli. Furthermore, disorders of attention can also result from the inability of impaired children to focus their attention selectively due to their inability to refrain from reacting to extraneous stimuli.

According to Strauss and Werner (1962), perseveration results from the impaired child's inability to shift readily from one stimulus to another. This inability to shift may be due to the prolonged aftereffect of a given stimulus. Perseveration would also appear to relate to the inability of impaired children to refrain from reacting to extraneous stimuli. Hence, perseveration and distractibility are not polar characteristics as might be assumed.

Unlike studies of hyperactivity, the experimental literature relating attention disorders to neurological impairment has primarily involved humans. Even though it has been difficult to design definitive studies capable of replication (Schulman, et al., 1965), several studies suggest that neurological impairment does increase distractibility. (Werner, 1949; Sheer, 1951; Rosvold, et al., 1956; Gallagher, 1957; Cruse, 1961) This relationship appears to vary with the type and complexity of the task employed, the age of the subjects involved, and the type and extensiveness of injury.

As with hyperactivity, the effects of attention disorders upon learning are obvious. Therefore, in line with the above studies, observations of various attention disorders were included among the criteria for detecting children with PNLD.

<u>Perceptual</u>, <u>perceptual-motor</u>, and <u>conceptual difficulties</u> form another broad category of characteristics relating

to skill areas often affected by a neurological impairment. These difficulties can perhaps best be described as inadequate integrative functions.

> Perceptual functioning may also be impaired, that is, the integrative function which enables the child to distinguish and interpret the meaning of sensory stimuli is faulty. Perceptual disturbances may also be seen in one or more of the sensory routes which distorts what is seen, heard, or touched. In general, perceptual problems refer to disturbed perceptions of form, shape, and depth." (Michal-Smith and Morgenstern, 1965, p. 186)

According to Klebanoff, et al. (1954), the most extensive and definitive studies of neurologically impaired children have been in the area of perception.

Studies have been conducted by a number of investigators dealing with sensory versus perceptual intactness as related to figure-ground problems. (Breakey, 1955; Solomons, 1957; Teuber, 1959-1960; Denhoff and Robinault, 1961) The effects of <u>intra</u>sensory variation on behavior has also been a topic of concern in a number of studies. (Cobrinik, 1959; Birch, et al., 1961a; Birch, et al., 1960b; Nelson and Bartley, 1962; Teuber and Rudel, 1962) In addition, the effects of <u>inter</u>sensory variations on behavior has been explored. (Shachtel, 1949; Teuber, 1959-60; Ram, 1962) These studies reflect the mounting clinical evidence that many neurologically impaired children tend to exhibit perceptual impairments. In spite of the increasing research activity in this area, there is a dearth of research studying sensation as an active system that controls its input. Most studies have dealt primarily with passive perception.

A child's inability to respond to a seemingly simple task may be related to a more fundamental impairment which influences or "causes" the many deviant behaviors associated with neurological impairments. For example, evidence points to a relationship between perceptual impairments and neurological impairments in children who are unable to read, whereas no such relationship has been proven to exist between perceptual impairments and emotional disturbance in children with reading difficulties. (Rabinovitch, et al., 1956; Denhoff and Laufer, 1959)

Visual-perceptual difficulties are closely related to motor difficulties. Werner and Strauss (1939) and Kephart (1960) have observed that as a group, neurologically impaired children cannot reproduce geometric figures or patterns on marble boards, even though a model board is present. Research has not clearly shown whether the child is unable to motorically reproduce an accurate perception, whether he dissociates and is thus unable to perceive things as a Gestalt, or whether the inability to reproduce an accurate figure is related to an inability to refrain from reacting to extraneous stimuli. Clearly, eye-hand coordination, dissociation, and distractibility are all involved in the development of adequate integrative functions.

"For many psychologists, the term 'perceptual disturbance' has become almost synonymous with brain-damage---to the point where such disturbance is regarded as a primary behavioral criterion for the existence of brain damage." (Diller and Birch, 1964, p. 28)

Conceptual difficulties have been studied by Dolphin and Cruickshank (1951) and Strauss and Werner (1962). Subjects were instructed to match pictures and objects for relatedness. Findings were significant in that neurologically impaired subjects compared to non-neurologically impaired subjects made more uncommon choices, more often emphasized secondary qualities of objects as the basis for association, tended more often to organize their objects into small subgroups in relation to each picture, and exhibited more formal compulsive behavior in the arrangement of their objects.

The abstract-concrete dimension of behavior has been significantly related to neurological impairments by several investigators. (Goldstein and Scheerer, 1941; Goldstein, 1948; Myklebust, 1965) Werner and Kaplan (1963) in their studies of abstract behavior and symbol formation have also contributed to the growing body of research linking conceptualization and neurological impairment.

In view of this body of evidence relating neurological impairments and learning to various disturbances in perception, perceptual-motor functioning, and conceptualization, these characteristics were included as criteria for identifying children with psychoneurological learning disabilities.

<u>Motor function disorders</u> are often exhibited by the neurologically impaired child. Both gross motor activity and fine muscle movements may be impaired. Fine motor skills, essential to efficient execution of paper and pencil tasks, for example, are refinements of gross motor activity. Both gross motor activity and fine muscle movements should be appraised in terms of developmental norms. (Piaget, 1937; Bender, 1938) Throughout the years motor efficiency has been related in some way to learning. Motor efficiency and learning have been topics of concern to people such as Periere, Itard, Seguin, Piaget, and Montessori. (Barsch, 1966)

Studies devoted to the assessment of relationships between motor disorders and neurological impairment have dealt primarily with issues of laterality and directionality in conjunction with reading, spelling reversals, or dyslexic children (Orton, 1937; Harris, 1957; Benton, 1959; Silver and Hagin, 1960), segmentation or inability to move one's body in a synchronized and integrated fashion (Kephart, 1960; Rappaport, 1964), and relationships between physiological movements and the development of adequate reading skills. (Getman, 1962)

The observance of various motor function disorders in neurologically impaired children, as well as considerable research, indicates that a relationship between motor function disorders and neurological impairments exists. Therefore, various motor function disorders were included as criteria useful for identifying children with psychoneurological learning disabilities.

Difficulties in speech and/or language development, in varying degrees of severity, are manifest by a large number of neurologically impaired children. (Cruickshank, 1967b) Impaired auditory functioning can precipitate these difficulties; because the neurologically impaired child with a generalized deficit in auditory functioning is able to hear, but he is unable to interpret what was heard. This description relates to the previous discussion concerning "perception", for this child is unable to perceive accurately the auditory stimuli. This faulty perception precludes successful mastery of tasks which depend upon accurate auditory perception, such as speech and language development.

Language and learning disabilities of this type have long been observed in the neurologically impaired child and were described by various authors as receptive aphasia, sensory aphasia, auditory verbal agnosia, or word deafness. (Goldstein, 1948; Wepman, 1951; Myklebust, 1954; McGinnis, 1963; Schuell, et al., 1964)

Language and learning disabilities of this type are more severe than are generally found in the child with a subtle psychoneurological learning disability. The milder forms of language and learning disabilities may be manifest as inconsistent auditory comprehension, mild articulation difficulties, or delayed attainment of reading skills. (Clements, 1961)

Several authors (Ingram, 1959; Myklebust and Boshes, 1960) relate language and learning disorders to neurological impairment by indicating that language and learning disorders ". . . represent specific disabilities which are related to high cortical functions." (Clemmens, 1961, p. 181)

The available literature concerning these disorders consists mostly of narrative descriptions based upon clinical experience, rather than controlled empirical study. Those studies cited in the literature have dealt primarily with the effects of brain injury upon severe language disorders as they relate to subtle neurological impairments.

> As a foundation for the knowledge of the relation between delayed and improper language acquisition and brain pathology, great effort must be exerted to obtain material for study. Although neurological and neuropathological studies most probably will not result in one to one correlations, such work must form the fundamental basis from which other, more subtle techniques can be rationally applied. (Cohn, 1964, p. 184)

Although there is a general lack of empirical evidence relating language disorders to subtle neurological impairments, this characteristic, observed in varying levels of severity in a majority of neurologically impaired children, may be accepted as a valid index of neurological impairment.

S. R. Rappaport (1964) referred to lability of affect as ". . . an emotional instability in which the child over-reacts to minimal stimuli either by an inordinately intense or mobile response." (p. 45)

Descriptive studies of neurologically impaired individuals suggest the common occurrence of emotional lability. (Strauss and Lehtinen, 1947; Klebanoff, et al., 1954) However, few objective studies relating brain damage and lability in humans have been conducted. Findings based upon animal studies are equivocal. The degree of the relationship seems to depend upon the area of the brain damaged, the intervening time period between injury and measurement, and the type of response measured. For example, several investigators (Kreig, 1938; Schreiner, et al., 1953) found that damage to the hypothalamus resulted in emotional lability. Nauta (1955) found persisting emotional lability in animals with lesions in the habenular complex of the thalamus, but a return to normalcy in animals with lesions in the septal forebrain area of the thalamus.

Again wide observance of this characteristic as evidenced by its inclusion in the majority of groupings which represent core characteristics of neurologically impaired children provided a reason for its inclusion as one criterion useful in identifying the neurologically impaired child.

A review of the literature pertaining to those characteristics related to basic skill areas affected by neurolofical impairments clearly demonstrated the need for more empirical evidence to support clinical descriptions. However, the undesirability of delaying action until such evidence is obtained was underlined by Clements (1966) who stated,

> We cannot afford the luxury of waiting until causes can be unquestionably established by techniques yet to be developed. We cannot postpone managing as effectively and honestly as possible the large number of children who present chronic differences we feel are more related to organicity variables than others. (pp. 6-7)

In summary, children with psychoneurological learning disabilities can be detected by observing such behavioral characteristics as hyperactivity; disorders of attention; perceptual, conceptual, and perceptual-motor difficulties; impairments of gross motor activity and fine muscle movements; disorders of speech and language; and emotional lability.

These characteristics formed the basis for the development of the Behavior Checklist utilized by classroom teachers in making referrals for the screening of children for possible inclusion in the training program evaluated in this study. A copy of the Behavior Checklist is included in Appendix B.

Selection of Diagnostic and Evaluative Instruments

Screening for Intellectual Level

Due to the large number of referrals of children with suspected psychneurological learning disabilities, screening procedures were utilized to identify those children who warrented a more extensive evaluation. The selection of a suitable screening instrument was based upon the following considerations.

1. A test which would provide an estimate of intellectual functioning was needed in order to eliminate mental defectives. Children with PNLD

were previously described as possessing normal intelligence.

2. Due to the large number of referrals, brevity of administration time was essential.

3. An individually administered test in which examiners were afforded opportunity to observe behavior was desirable.

4. Due to the possibility of speech and language impairments due to organic involvement, the need for a test which would be appropriate for nonverbal children was indicated.

Based upon the above considerations, the Peabody Picture Vocabulary Test (PPVT) (Dunn, 1959) was selected for utilization as a screening instrument. It was employed as an index of cognitive abilities as reflected by an estimate of verbal intelligence through a measure of hearing vocabulary.

The examination consists of 150 plates with four stimulus pictures per plate. A stimulus word is given by the examiner and the subject indicates the corresponding picture in any manner which communicates. The test may be administered in 10-20 minutes.

Due to the possibility of visual-perceptual handicaps, the possible inappropriateness of pictures for this population was of concern. However, Dunn (1965) stated, "With the drawings free of fine detail and figure-ground problems, the test is apparently appropriate for at least some perceptually impaired persons." (p. 25) An examination of the plates showed that the illustrations were seemingly of adequate size, well-illustrated, and of current design.

Some investigators have questioned the applicability of the PPVT as an individual test of intellectual functioning (i.e., Rice and Brown, 1967). However, for the Revised Stanford-Binet Scale (Binet)(Terman and Merrill, 1937b), it was stated, "We have found the vocabulary test to be the most valuable single test in the scale." (Terman and Merrill, 1937a, p. 302) For the Wechsler Intelligence Scale for Children (WISC) (Wechsler, 1949), Wechsler found the vocabulary subtest scores to correlate more highly with the Full-Scale IQ scores than any other subtest. (Wechsler, 1949, p. 10) Furthermore, Dale and Reichert (1957) reviewed numerous studies in which vocabulary was found to be the best single item for predicting school success. Dunn (1965) recognized that picture selection is not equivalent to defining words orally, as is done in the Binet and the Wechsler scales. The primary difference appears to be the two varied modes of decoding. He pointed out, however, that both tap comprehension of the spoken word.

The applicability of the PPVT as an individual test of intellectual functioning is further supported by significant correlations with other tests such as the Binet and the WISC. (Garrett, 1959; Dunn and Brooks, 1960; Himelstein and Herndon, 1962; Lindstrom, 1961; Moed, et al., 1963; Burnett, 1965; Koh and Madow, 1967) PPVT IQs have tended to exceed the 1937 Binet IQs by an average of six points and the Wechaler IQs by one or two points. (Dunn, 1965) Correlations of PPVT IQs with those obtained from these two tests seem to be running in the order of .70s and low .80s. (Piers, 1965)

One reviewer pointed out that the use of gross CA intervals is reflected in big "jumps" in the IQ table. (Lyman, 1965) This was of concern. Furthermore, the possible use of pictures of objects unfamiliar to children of lower socio-economic backgrounds was also of concern. To compensate for the possible effect that these two factors might have upon the IQ, PPVT IQ scores of 79 and up were included within the population to be evaluated in greater depth, if signs of neurological impairment and specific learning disabilities were also present.

In conclusion, ". . . in this reviewer's opinion, the PPVT is probably now the best of its kind." (Piers, 1965, p. 823)

Screening and Assessing Visual-Motor Efficiency

Among tests currently being utilized to evaluate perceptual-motor development are the Marianne Frostig Developmental Tests of Visual Perception (Frostig, et al., 1961), the Goodenough-Harris Drawing Test (1926-63), and the Visual Motor Gestalt Test (Bender-Gestalt)(L. Bender, 1938-1946).

The Frostig Tests are intended to measure the development and maturity of five areas of perception---position in space, horizontal spatial relationships, perceptual constancy, visual-motor coordination, and figure-ground perception. An initial perusal of the test indicated its appropriateness for measuring the development and maturity of perceptual skills. Upon further investigation, however, it was found that although norms were supposedly available for children between the ages of three and nine years, the ceilings on several of the subtests were in the seven year range. In a personal communication from Marianne Frostig, she indicated that norms for older children were being developed, but were not yet available for use. She reported that the test was being administered to older children, and if they fell below the given ceiling of a particular subtest, it could then be inferred that they were deficient in that area. However, it would appear that the differential effects of various intervening variables have not been taken into account. For example, older children may become bored and perform poorly on tasks more appropriate for younger children. In view of the lack of appropriate norms, use of this test was rejected.

For quite another reason, the Goodenough-Harris Drawing Test was also eliminated from consideration. Human figure drawings have been in use for many years. Observations of such abnormalities which have since been attibuted to neurological impairment date from the turn of the century. (Kerschensteiner, 1905; Lobsien, 1905) Goodenough (1926) was the first to evolve an objective scoring system for drawings of human figures. The test as it was originally designed was intended to estimate intelligence. It is still listed under this category in test classifications. The Goodenough-Harris Test is an extension of the Goodenough Intelligence Test. Many of the earlier studies have referred to it as the Draw-A-Person Test(DAP). However, as Urban (1963) has developed a test which he has entitled the Draw-a-Person Test, the term DAP can no longer be used in reference to the Goodenough-Harris Test without resulting confusion.

The literature reports a number of studies dealing with the effects of neurological impairment upon the reproductions of human figures. (Cohn, 1953; Gunzberg, 1955;

Vernier, 1952; Reznikoff and Tomblen, 1956)

> The evidence appears to suggest that while brain damage may reveal itself in human figure drawings, either in qualitative signs or in Goodenough scores lower than other intelligence test scores, other psychiatric disorders may also reveal themselves in similar and, therefore, undiscriminable fashion. (Schulman, 1965, p. 11)

The Bender Visual Motor Gestalt Test was selected for use as a measure of visual perception and visual motor coordination. Though Buros (1965) lists a number of modifications (Pascal and Suttell, 1951; Hutt and Briskin, 1944-1960; Clawson, 1962; Koppitz, 1964), as Bender's original plates and general administrative procedures were retained, Bender's 1946 edition of the test was utilized in this study. The Bender consists of nine figures which are presented to the subject one at a time. The subject is then asked to reproduce the designs on a blank sheet of paper. The procedure is designed to study visual-motor performance as represented by drawings.

Theoretically, the test is based upon Gestalt psychology. Those theories upon which the test is based stemmed from studies showing that the ability to accurately reproduce certain designs develops regularly with age in normal children. The accuracy of the reproduced designs is interpreted in terms of the Gestalt laws of perception and organization.

> The term Gestalt is best illustrated by taking the letter A, which, when taken apart is three straight lines---two slightly tilted from the vertical, the third horizontal. If a child is able to put the three straight lines together in proper position, he has formed a Gestalten. If he errs, the degree and type of errors are the basis for scoring this instrument. (Ellinson, 1967, p. 77)

> About one-fifth of all publications on the Bender Test. . . are exclusively concerned with children. Most of these studies were published since 1955 showing the growing awareness of the value of the Bender Test for this age group. (Koppitz, 1964, p. 3)

The Bender has been utilized or interpreted in a number of different ways. It has been utilized in studies to diagnose reading and learning problems (Koppitz, 1958; Lachman, 1960), to predict school achievement (Koopitz, 1962a, Koegh, 1965b), to evaluate emotional difficulties (Simpson, 1958; Clawson, 1959, 1962; Koppitz, 1960a, 1960b), to evaluate the need for psychotherapy (Byrd, 1956), to screen for school readiness (M.V. Baldwin, 1950; Keogh, 1965a), to study mental retardation (Halpin, 1955; Keller, 1955; Eber, 1958), and to diagnose brain injury (Bensberg, 1952; Feldman, 1953; Hanvik, 1953; Halpin, 1955; Shaw and Cruickshank, 1956; Wewetzer, 1956, 1959; Chorost, et al., 1959; Quast, 1961; Koppitz, 1962b; Schulman, 1965)

Focal to this study were those studies dealing primarily with brain damage. Various investigators agreed that if the subjects were not psychiatric patients, the Bender protocols of groups of neurologically impaired children differ significantly from groups of non-neurologically impaired children, regardless of age and intelligence. (Bensberg, 1952; Feldman, 1953; Hanvik, 1953; Niebuhr and Cohen, 1956; Shaw and Cruikshank, 1956; Wewetzer, 1959; McGuire, 1960).

The above specification---"not psychiatric patients"---identifies one problem which arises when analyzing a Bender protocol. The Bender does not adequately distinguish between functional and organic patients. (Halpern, 1951; Pascal and Suttell, 1951; Mehlman and Vatovec, 1956; Olin and Reznikoff, 1958; Goldberg, 1959; Nadler, et al., 1959) For this reason, children whose disturbances were adjudged to be primarily emotional were eliminated from this study.

Various investigators have indicated that certain deviations of behavior are diagnostically significant of neurological impairment. Among these are rotations (Fabian, 1945; Hanvik, 1953; Bensberg, 1952), distortion of figures (Baroff, 1957; Beck, 1959), fragmentation, poor integration (Feldman, 1953) and perseveration (Barnes, 1950; Bensberg, 1952; Feldman, 1953).

The above observations were utilized by Koppitz (1962b) who analyzed individual Bender scoring items to see how well each item could distinguish between brain-injured and non-brain-injured subjects. A table demonstrating the significance of Bender indicators of brain injury for children, five to ten years of age, was devised. (Koppitz, 1964, p. 189) These brain injury indicators appeared to be quite useful for the purposes of this study. In analyzing a Bender protocol, an acceptable Bender score may become significantly indicative of brain damage if a number of errors are made which occur almost exclusively in brain injured children.

Another point which must be considered is that a good Bender score does not necessarily eliminate the possibility of neurological impairment, for

> Good Bender scores may be found among brain injured youngsters who have difficulty primarily in auditory perception rather than in visual-motor perception, [or among those] who are able to compensate for malfunctioning in visual-motor perception. . . (Koppitz, 1964, p. 75)

Pascal and Suttell (1951) concluded that there may be present in adolescents, certain types of neurological impairments which cannot be diagnosed by means of a Bender. Shaw and Cruickshank (1956) found that epileptic children showed less deviation on their Bender protocol than did children with other kinds of brain pathology. Hirschenfang (1960) found that right hemiplegics performed better on the Bender than did left hemiplegics.

In summation, a Bender is useful in distinguishing between non-neurologically impaired children and children with visual-motor impairments who are not emotionally disturbed. However, it should be emphasized that ". . . a definite diagnosis of brain injury should never be made solely on the basis of a single Bender Test score, or for that matter, on the basis of any single psychological test score." (Koppitz, 1964, pp. 75, 77) Therefore, for the purposes of this study, the Bender provided one diagnostic criterion for identifying neurologically impaired children. The diagnostic capability of the Bender is greatly enhanced by a complete evaluation of the child's test performance, including ". . . the total test score, individual deviations on the protocol, observation of the child's behavior while taking the test, and the amount of time and space required by the child to complete the same." (Koppitz, 1964, p. 106)

Use of the Bender as a criterion for identifying neurological impairments requires an appropriate evaluation of the Bender protocols. General clinical impressions, however, appear to be highly subjective and show little reliability of agreement between clinicians. (Goldberg, 1959; Mehlman and Vatovec, 1956; Peek and Storms, 1958)

The apparent subjectivity of clinical evaluation and the growing popularity of the instrument clearly demonstrated a need for an objective scoring system. Various scoring systems were developed. (Billingslea, 1948; Kitay, 1950; Pascal and Suttell, 1951; Peek and Quast, 1951; Gobetz, 1953; Keller, 1955; Stewart and Cunningham, 1958) With the exception of the scoring system developed by Pascal and Suttell, the above scoring systems were designed for use with adult psychiatric patients or with retarded institutionalized children. The scoring system developed by Pascal and Suttell was designed for use with normal adults, 15-50 years old.

A scoring system appropriate for children with normal intelligence was unavailable. Consequently, other scoring systems had been adapted for use with this population---the Pascal and Suttell system being most widely used. (Koppitz, 1964)

Koppitz (1964) developed a scoring system designed for use with children five to ten years of age regardless of their intelligence or the type of problems presented. Due to the lack of any other appropriately normed scoring system, the Koppitz Developmental Scoring System was utilized in this study.

Diagnosing Intellectual Strengths and Weaknesses

Further evaluation of each child in both experimental and control groups required an individual intelligence test which could adequately differentiate problem areas specific to that child. Of the two most widely utilized intelligence tests, the Stanford-Binet Intelligence Scale (Terman and Merrill, 1916, 1937, 1960) and the Wechsler Intelligence Scale for Children WISC) (Wechsler, 1949), the WISC seemed to be most satisfactory because items have been grouped into subtests according to the underlying psychological functions, and the resultant scales yield weighted scores that allow intraindividual comparisons between skills. This grouping of items offers the following advantages:

1. The understanding of a given individual is enhanced by comparing his successes and failures on a given type of test item within each subtest.
2. An analysis of weighted score relationships between various subtests can facilitate a clearer understanding of a given individual's unique pattern of functioning.
3. The relationship of a given individual's verbal scores compared to his performance scores can lend insight into the make-up of the individual. (Rapaport, et al., 1968)

This information cannot be obtained from an analysis of the Binet, for the test items are distributed over mental age levels rather than grouped according to the underlying psychological functions. In fact,

> . . . many items are included more because, in the standardized population they reliably differentiated between successive age groups and were easily scorable [rather] than because the psychological functions underlying achievement on them were understood and considered sufficiently important to warrent their inclusion. (Rapaport, et al., 1968, p. 69)

Attempts to group Binet items (e.g. Roe and Shakow, 1942) with regard to the same underlying psychological function have not been successful. Instead, the interpretation of the Binet has dealt primarily with the number of age levels over which successes and failures were distributed. "The quality of the successes and failures has not yet been systematically investigated." (Rapaport, et al., 1968, p. 69) Attempts to quantify scatter of successes and failures have yielded contradictory results. (Harris and Shakow, 1937) For these reasons, the WISC appeared to have greater diagnostic cababilities than did the Binet.

As the practicality of any instrument depends upon the manner in which it is used and interpreted, various methods of interpreting WISC protocols have been considered. The use of only the Full-Scale IQ score is most prevalent, primarily because for many years it was believed that an IQ score was a permanent and immutable statistic that very rarely, if ever, changed. Various studies have shattered this concept. (Wellman, 1940; Sontag, et al., 1958; Moriarty, 1966) These studies clearly demonstrate that an IQ score merely represents the current operating level of the individual at the time of the test; and within reasonable limits, an individual's score can fluctuate up and down the scale on a test-retest situation.

The diagnostic capability of the instrument is sharply diminished when only the single IQ score is utilized. Dunsing and Kephart (1965) pointed out that although the IQ is the best single predictor for future performance for groups, the variability found in individual cases is not taken into account by the single IQ score. Michal-Smith and Morgenstern (1965) stated,

> The brain-injured child, may for example, show overall intellectual functioning grossly within normal limits as measured on an intelligence scale but his performance in some areas may be quite low so that test results show sharp inconsistencies in mental abilities. (p. 183)

This inconsistency of performance introduces a much disputed concept---scatter analysis. The concept of scatter analysis, strongly advocated by David Rapaport, embodies intra-individual comparisons in which the weighted subtest scores of each individual are compared intraindividually rather than interindividually as is done with IQ scores. Analysis of scatter represents diagnostic testing, in which the relative strengths and weaknesses of an individual are assessed. Rapaport, et al. (1945-46) and their successors (Griffith and Yamahiro, 1958) obtained significant results with scatter analysis. However, Holt (1968) said, "In a way, it could be argued that the results are better than they have any psychometric right to be." (p. 163)

Research on scatter patterns has been reviewed by a number of investigators. (Rabin, 1945; Watson, 1946; Rabin and Guertin, 1951; Guertin, et al., 1956; Guertin, et al., 1962, Guertin, et al., 1966) The findings appear to be predominantly negative and do not verify the Rapaport hypotheses. In explanation of these negative findings, Guertin, et al. (1962) indicated that the majority of the studies are poorly designed, lack homogeneity in their diagnostic groups, and tend toward oversimplified statistical designs. Furthermore, a perusal of these various reviews revealed that a majority of the studies which discredit the use of scatter analysis have dealt with the identification of functional disorders, such as chronic schizophrenia, hysteria, and depressive psychotics, rather than neurological disorders.

Of the considerable literature which deals specifically with brain damage, all but two studies deal exclusively with the Wechsler Adult Intelligence Scale. Though these studies with adults tend to support verbal and performance differences as being indicative of brain damage (Reed and Reitan, 1963), generalization of these findings to the WISC used with children would be inappropriate due to the lack of developmental norms. Therefore, this literature was not reviewed.

In one of the two studies dealing specifically with children, Beck and Lam (1955) found that the neurologically impaired subjects had a significantly lower mean IQ than did the non-neurologically impaired subjects. They found no distinguishable differences in subscore patterns for either the neurologically or the non-neurologically impaired subjects. It should be pointed out, however, that the subjects which these investigators selected to measure all had IQs below 80. Rapaport et al. (1968) stated, ". . . at either extreme of the weighted score continuum, the construction of the scale itself militates against great scatter." (p. 76) Therefore, it would appear that by delimiting the IQ range of their subjects, distinguishable differences in subscore patterns were much less likely to occur.

In the study conducted by Hanvik et al. (1961), a significant difference was demonstrated only on the Coding subtest, which was lower for the neurologically impaired children.

In light of the above, it is possible that certain types of scatter could be diagnostically significant of neurological impairment.

Furthermore, in spite of the lack of support from controlled studies, the use of scatter analysis in clinical settings has become prevalent. (Taylor, 1959; Clements and Peters, 1962; Frostig and Horne, 1965; Paine, 1965; Boder, 1966; Ellingson, 1967) Therefore, the use of scatter analysis was incorporated into this study. The following three patterns isolated by Clements and Peters (1962) seemed to be most usable.

Pattern I involves scatter in either or both the verbal and performance scales. Low scores, in relation to others, occur most frequently in Arithmetic and Digit Span in the Verbal Scale, and Block Design, Object Assembly, and Coding in the Performance Scale.

Clinical observations indicate that neurologically impaired children will generally experience difficulty with one or more skills involving

. . .visual-motor coordination, design reproduction by copying or from memory, duplication of block designs, coding, discriminations of any type, spatial concepts, abstractions, concept of body image, discrimination of figure versus ground or part from whole, and immediate short-term memory. A tendency toward concrete thought is noted and also a tendency to perseverate." (Paine, 1965, pp. 5-60

With regard to block design, Taylor (1959) stated,

Children with perceptual difficulties due to brain-injury. . . have considerable difficulty in these tests as they have in others involving form comprehension and analysis of form relationships. They may be able to copy from memory what has just been demonstrated to them, but be unable to apply it to the next card. (p. 409)

It would appear that the same variables or skill impairments which are operative when the child has difficulty in reproducing geometric designs on marble boards (Werner and Strauss, 1939; Kephart, 1960) would also be operative in reproductions of geometric figures with blocks.

Concerning Object Assembly, Rapaport, et al. (1968) said

. . .visual motor coordination is the underlying process of object assembly; it consists of a visual guidance of motor action which in turn, if of proper speed, gives an opportunity for restructuring the initial visual organization. Abortive forms of this coordination occur when the visual organization is fully crystallized at the beginning, and the motor activity appears to play the role of the executing servant; or when visual organization is extremely weak or absent, and trial motor activity and pattern coherence appear to determine the performance. (p. 146)

An observation which may be drawn from this quotation is that the manner in which individual items within a subtest are completed can be diagnostically significant.

Lloyd Silverman (1968) reported,

> The finding that Block Design and Object Assembly have the same factor loadings is in keeping with Rapaport's formulations that these subtests both tap visual organization, visual motor coordination, and motor speed. (p. 162)

Taylor (1959) pointed out that Digit Span is generally used for testing "rote memory". Children with PNLD generally have difficulty with this task due to impairments of memory. It has also been demonstrated that these children may perform better on digits forward than digits backwards. (Wells, 1927) Thus, in an analysis of Digit Span, it would again appear that individual items within the subtest merit consideration.

Rapaport (1968) indicated that both attention and concentration are involved in Digit Span and Arithmetic. "Attention and concentration usually vary together, the weighted scores on these two subtests are usually quite close." (Holt, 1968) Logically then, if differences do exist, they could be interpreted as differential impairments of attention (weighted more heavily in Digit Span) and concentration (weighted more heavily in Arithmetic).

An adequate performance on the Coding subtest demands a certain motor proficiency in handling paper and pencil tasks. (Taylor, 1959) Also, to some extent perception is involved in that the subject is required to match symbols. Memory for symbols is still another factor involved; for an individual's speed and thus his score are likely to be increased if he has memorized the symbols.

Pattern II, identified by Clements and Peters (1962), is that in which the Verbal IQ is 15 or more points higher than the Performance IQ. Often the exclusion of the Arithmetic subtest will make the difference more pronounced.

Pattern III, the most infrequent pattern, is characterized by a Performance IQ ten or more points higher than the Verbal IQ. "Such a child has difficulty in expressing himself verbally. He must actively search for the words necessary to express his usually concrete solution to a thought problem." (Clements and Peters, 1962, p. 190) A child exhibiting this pattern has been described as dyslexic. (Rabinovitch, et al., 1956)

In summation, with regard to the characteristics common to neurologically impaired children, reference was repeatedly made to their wide variability of behavior. (Wortis, 1956; Leton, 1960; Lewis, et al., 1960; Clements, et al., 1964; Michal-Smith and Morgenstern, 1965;

Boder, 1966) It is quite likely that this variability would be evident in measures of different skills. Logically, deficiencies in one or more of these skills would be revealed in a scatter analysis of the WISC subtests.

One additional concern arises when an intelligence score must be used for selection purposes. What constitutes a suitable selection criterion for average intelligence? This was of particular concern to this study, for due to the short time to be alloted for training, only subjects of average intelligence or above were included in the sample. As defined by Wechsler (1949), scores falling between 90 and 111 can be considered within the average range. However, in this study the total IQ was not used as a determining score due to the possible variability between verbal and performance measures. All subjects attaining an IQ of 90 on either a verbal or nonverbal measure, were included in the study as long as their Full-Scale IQ did not fall below 80. It was thereby assumed that the child's highest levels of performance represented his "potential" capability whereas the lowered scores represented areas of impairment. It was felt that these limits more accurately differentiated between the mentally retarded and those with psychoneurological learning disabilities.

Educational Approaches

Training Emphases

A search of the theoretical-clinical literature revealed various educational approaches which have been suggested for training the neurologically impaired child.

The approach which emphasizes motor development has probably received more impetus due to its potentiality for relatively greater adaptability to a variety of settings. Three major schools of thought each consider psychomotor development to be basic to a total educational program. The Philadelphia group under the direction of Doman and Delacato, Kephart's group at Purdue University, and the Bellevue group, which follows the Schilder-Bender-Freidus tradition, all stressed the need for systematic training to foster motor development. Kephart (1960, 1963) and Doman and Delacato (1960) believed that the neurologically impaired

> . . . need to be taken back and brought up through the different stages of motor development to establish the complex motor movements involving balance, coordination, and movement; otherwise the child is likely to develop splinter skills. (Dunn, 1967, p. 123)

Stressed in this approach are the development of laterality, body image, and the coordination of patterns of movement needed for complex activities. (Schilder, 1935; Bender, 1956; Freidus, undated) In this approach, if perceptual training is initiated, the shift in emphasis from motor to perceptual training occurs only after a neurologically impaired child has developed proficient motor skills.

The second approach which has been utilized involves an emphasis upon training in perceptual development. The emphasis may be narrowly defined, such as visual perception, or as comprehensive as sensory-motor training. Kephart's (1960) concept of perceptual organization is relevant to this approach. His construct, perceptual-motor match, involves matching perceptual data with motor activity through training. Proposed exercises focus upon integration of visual and auditory information with the tactual system. Probably the most widely known proponent of this approach is Marianne Frostig (1961) who emphasizes the development of visual perception through paper and pencil exercises.

The third major educational approach focuses upon the development of concept formation, including training in the various school subjects. Lehtinen pioneered this approach with recommended techniques for instruction. (Strauss and Lehtinen, 1947)

Other educational approaches include drug therapy (Clements and Peters, 1962; Paine, 1965) remediation of weaknesses unique to each child (Kirk and Bateman, 1962) speech and language remediation (Johnson and Myklebust, 1967), and the behavioristic approach (Skinner, 1953) which advocates a programming of instruction into small, sequential steps, and reinforcing appropriate behavioral modifications.

Well designed and controlled studies concerning the effectiveness of these various educational programs are almost nonexistent. Gallagher (1960) conducted a three-year tutoring program in a residential school for neurologically impaired children, ages 7-9 years. Emphasized were perceptual, conceptual, and language development exercises. The experimental subjects significantly surpassed the control group in improvement of intelligence, and attention span. Forgrone (1966) demonstrated that the Frostig approach was effective for increasing scores on the Frostig Developmental Test of Visual Perception. The subjects utilized, however, consisted of an undifferentiated group of special-class, educable retardates. Unfortunately, no research was found in the literature assessing the efficacy of the previously mentioned educational approaches emphasizing perceptual development for a population of neurologically impaired children with average intelligence.

Experimental research on the efficacy of the motor development techniques advocated by the Doman-Delacato, Kephart, or Schilder-Bender-Freidus groups for the population under consideration is also virtually nonexistent.

With reference to the widely publicized Doman-Delacato method, the American Academy of Pediatrics and the American Academy of Neurology issued a joint position statement urging careful assessment of its claims. They stated,

> To our knowledge, no controlled studies are available to support the greater value claimed for the program as compared with conventional treatment of the neurologically handicapped child. Without such studies, a medically acceptable evaluation is not thought possible. (1968, p. 368)

After this statement was issued, Kershner (1968) published a study supportive of several of the Doman-Delacato hypotheses. His subjects, however, were mental retardates; and thus, the results cannot be directly extrapolated to subjects with normal intelligence.

To date most of the studies pertaining to educational approaches have been case studies or have dealt with remediation of a specific skill such as reading or language. Appropriate experimental studies merely demonstrate the need for more research to establish and define the relationship between educational approaches and academic achievement. In view of the lack of studies supportive of any specific educational approach, a newly-developed educational approach was evaluated in this study.

The review of the literature revealed that in each educational approach, a different facet of training was emphasized. The reason for training only one skill at a time was not clear when applied to primary age children with average intellectual skills. Such children would of necessity possess some measurable amount of motor, perceptual, conceptual, perceptual-motor, and language skills. Why not provide a variety of experiences building upon and coordinating key skills, instead of focusing exclusively upon one skill at a time? In view of the short attention span and variety of social needs of these children, briefer exposure to a variety of experiences was considered more desirable. Within these various skill areas, activities could be adapted to the functional level of each child. The skill areas chosen for emphasis were those most basic to learning. The core characteristics previously specified were utilized to delineate the three basic areas to be emphasized in the educational treatment program evaluated by this study. Those areas chosen for emphasis included gross motor development, perceptual-motor development, and speech and language development. Conceptual development was incorporated into all three of these basic areas.

Exercises representative of each of the three training areas have been included in Appendix C.

Environmental Structuring

One principle underlying successful treatment of learning difficulties was felt to be pertinent to the educational approach proposed in this study. "In developing a program of training for the correction of a learning disability, consideration must be given to the entire learning environment of the child both in and out of school." (Brueckner and Bond, 1955, p. 95) The importance of this principle cannot be overemphasized, for the growth achieved through the training program could be destroyed if external expectations or demands either allow or force the child to use inappropriate or poorly developed coping mechanisms. Therefore, cooperation and exchange of information between public school teachers and training program teachers were deemed vital to this educational approach in order to encourage optimal development of the child in the classroom environment.

Furthermore, the home environment must be favorable for lasting improvement to accrue. (Brueckner and Bond, 1955) The benefits of parent counseling in this area have increasingly drawn professional attention. Barsch (1961) indicated that parents' concern for their neurologically impaired children is great and that "They require as much help as their child." (p. 1)

Despite considerable discourse on the merits of parent counseling, research is almost nonexistent. Probably the most significant effort in this particular field has been the contribution made by Lewis, Strauss, and Lehtinen (1960). The Child Development Division of the Jewish Vocational Service in Milwaukee has advocated working with parents in a counseling setting. Their focus is upon discussion of techniques for dealing with neurologically impaired children and the needs and daily problems of these children. Other writers confirmed the important role which parents play in the team which will work with the neurologically impaired child. (Clemens, 1961; Clements and Peters, 1962; Boder, 1966; Cruickshank, 1967a)

Thus, educational benefits may be maximized by recognizing and exerting influence upon the total learning environment of the child. Group counseling with parents can provide a medium for this aspect of treatment. The following objectives are suggested as suitable for counseling parents:

1. To provide an organic interpretation of the learning and behavior problems experienced by their children.

2. To provide a permissive group atmosphere conducive to open discussion of their successes and failures in coping with their neurologically impaired children.
3. To help parents accept their children by altering misperceptions of brain-injury and self-guilt.
4. To help parents set realistic goals and expectations for their children, enabling them in turn to help their children set realistic goals and self-expectations.
5. To acquaint parents with present knowledge regarding child growth and development.
6. To provide guidelines for managing their children effectively through structure and systematic and consistent methods of aiding the development of organized response patterns in their children.
7. To teach parents to be aware of their children and to recognize significant behavioral cues indicative of needs.

The importance of parent counseling to educational growth is perhaps best summarized by Cruickshank (1967a) who says,

> Parents. . .can be supportive of one another in their mutual attempts not only to understand the problems facing their child, but to bring into focus for themselves a meaningful plan for their personal and family adjustment. (p. 249)

Medical Intervention

For those subjects accepted for training, additional diagnostic information was obtained so that individual needs could be assessed more accurately.

As positive effects of educational training could be diminished by certain neurological deficits, a neurological examination, including an electroencephalogram (EEG) would seem appropriate. However, a review of the literature revealed that routine neurologicals and EEGs are not completely satisfactory. Clements and Peters (1962) reported that the usual neurological examination is sensitive to less than 50 per cent of brain function. And furthermore, as usually performed, the conventional neurological examination is more times than not reported as "non-contributory" in the type of child under consideration. This may prove critical when dealing with a child with psychoneurological learning disabilities, for a negative report ". . .may result in the parents' denial of a problem for whose presence they have been carefully prepared." (Paine, 1965, p. 6)

Also, as the EEG is often insensitive to brain abnormalities found in the child with subtle neurological impairments, ". . .we must infer that electroencephalography reveals certain, but not necessarily all, types of the brain dysfunction which might be present." (Johnson and Myklebust, 1967, p. 24)

For these reasons, a "routine" neurological examination was deemed unsuitable for the children to be evaluated in this particular training program. An examination, more appropriate for children with subtle neurological impairments, was sought.

A review of the literature revealed a type of examination which is currently attracting considerable professional attention, and is increasingly being given either in conjunction with or in lieu of a standard neurological examination. This examination focuses upon equivocal or "soft" neurological signs, and frankly borrows certain methods from the field of clinical psychology.

An attempt to specify items to be included in this type of examination was felt to be beyond the scope of this study. As some items may prove more or less useful than others, the reader is directed to a review of the existing literature from which those items considered more relevant can be drawn. (Tiecher, 1941; Strauss and Lehtinen, 1947;

M. B. Bender, 1952; Silver, 1952; Rabinovitch, et al., 1956; Kennard, 1960; Paine, 1966)

Common "soft" signs include, among others, awkwardness, mixed laterality, confused laterality, strabismus, speech defect, short attention span, and hyperactivity. (Clements and Peters, 1962)

Kennard (1960) concluded that these "signs" may be meaningful in relation to organic syndromes. The opposite point of view is expressed by Cohn (1964) who stated, "It has not been demonstrated neuropathologically that minimal clinical signs are in fact related to minimal brain pathology." (p. 180) Nevertheless, the value of "equivocal" or "soft" neurological signs to a more accurate diagnosis and thus more effective remediation was emphasized by a number of writers (Kennard, 1960; Anderson, 1963; Boshes and Myklebust, 1964; Paine, 1965; Boder, 1966)

Therefore, in view of the apparent dissatisfaction with the routine neurological examination and the increasing use of an examination which focuses upon "soft" signs, a "special" neurological examination was devised. This examination combined selected items from the "routine" neurological with items sensitive to the "soft" signs.

Working cooperatively with specialists in the field of neurology are specialists in the relatively new scientific field of psychopharmacology. There is increasing recognition that the use of medication has in many cases been effective in the control of behavior, often making it possible for children with psychoneurologic learning disabilities to profit more fully from their learning opportunities. (Cruickshank, 1967a) As revealed by the literature, prescribed and controlled medication has been used in conjunction with educational treatment; and, in fact, in some cases its use without educational treatment was advocated. (Clemmens, 1961; Clements and Peters, 1962; Paine, 1965; R. W. Baldwin and Kenny, 1966; Boder, 1966; Cruickshank, 1967b)

A perusal of the literature revealed that basically, studies have centered upon four groups of medications believed useful in controlling behaviors which arise as a result of neurological impairment: (1) Stimulants, (2) Anti-histamines, (3) Anti-convulsants, and (4) Tranquilizers. (Bradley, 1937; Lindsley and Henry, 1942; Walker and Kirkpatrick, 1947; Pasamanick, 1951; Effron and Freedman, 1953; Zimmerman, 1956; Low and Myers, 1958; Levy, 1959; Eisenberg, 1964; R. W. Baldwin and Kenny, 1966)

The relative merits of the various drugs were not felt to be within the scope of this study. When, in the judgment of the attending physician, a need for medication was indicated, appropriate drugs were prescribed. Medical cooperation of this kind was viewed as an integral part of the total educational program. It must be pointed out that the value of the prescribed medication can only be realized if a cooperative relationship between the physician and educator is maintained. The educator must be alert for expected behavior change. The physician needs feedback concerning behavior changes in order to make needed adjustments in medication. Only with such interdisciplinary cooperation and exchange of vital information can an appropriate pharmacological regimen be developed.

Age Levels Most Amenable to Training

One major variable to be considered in educational planning is the most appropriate age level for introducing a given learning activity. Considering the limited resources available for this project, it was important to seek information concerning the age levels at which training was most likely to be effective.

Cruickshank (1967a) stated,

> . . .the earlier the initiation of appropriate educational and parent counseling services the greater is the possibility of their being effective with a particular child. It is the author's considered opinion that services which are initiated with children before the chronological age of seven have much greater possibility

> in favorable adjustment than when the service is first brought to the child after this age. (p. 276)

> The older they get, the more difficult it becomes for them to change. The optimum age for any child with a learning disorder is between five and eight. He can absorb more at a faster rate than at any other time in his life. (Ellingson, 1967, p. 47)

"Education for the brain-injured child should start as early as possible." (Lewis, et al., 1960, p. 11)

Retraining of older children is generally more time consuming, more expensive, and often less effective. Therefore, this study focused upon primary age children.

Class Size Considerations

Another major variable influencing the effectiveness of training involves appropriate class size. Considering the attention disorders and hyperactive behavior characteristics of these children, how many children with PNLD can a teacher manage effectively? How much intensive individual supervision is needed? Strauss and Lehtinen (1947) recommended that the total class size not exceed 12 children. Cruickshank (1967b) stated,

> . . .if the group is relatively homogeneous regarding chronological age, mental age, and degree of severity of the problem, a full-time teacher with a full-time teacher's aid [aide] can adequately serve the needs of eight brain-injured children. Certain supportive personnel are also required. . . (p. 268)

In the light of these estimates, a class size of nine was specified.

Summary and Synthesis

A search was made of the literature for information relevant to this study. This review focused upon several areas: (a) behavioral criteria for identifying children with psychoneurological learning disabilities, (b) diagnostic and evaluative instruments suitable for identifying and assessing the behavioral characteristics manifested by these children, and (c) educational approaches and methods being utilized to meet indicated educational needs.

Accurate identification and diagnosis of children with PNLD is prerequisite to educational planning since the educational approach utilized must be appropriate for the children under consideration. This interrelationship of diagnostic information and educational treatment is illustrated in Figure 1 which elaborates upon the schematic representations of Hughes (1957) and Boder (1966). Psychoneurological learning disabilities, based upon subtle neurological impairment, are manifested in a triad of observable effects which coexist and interact, each serving as both cause and effect for each of the others.

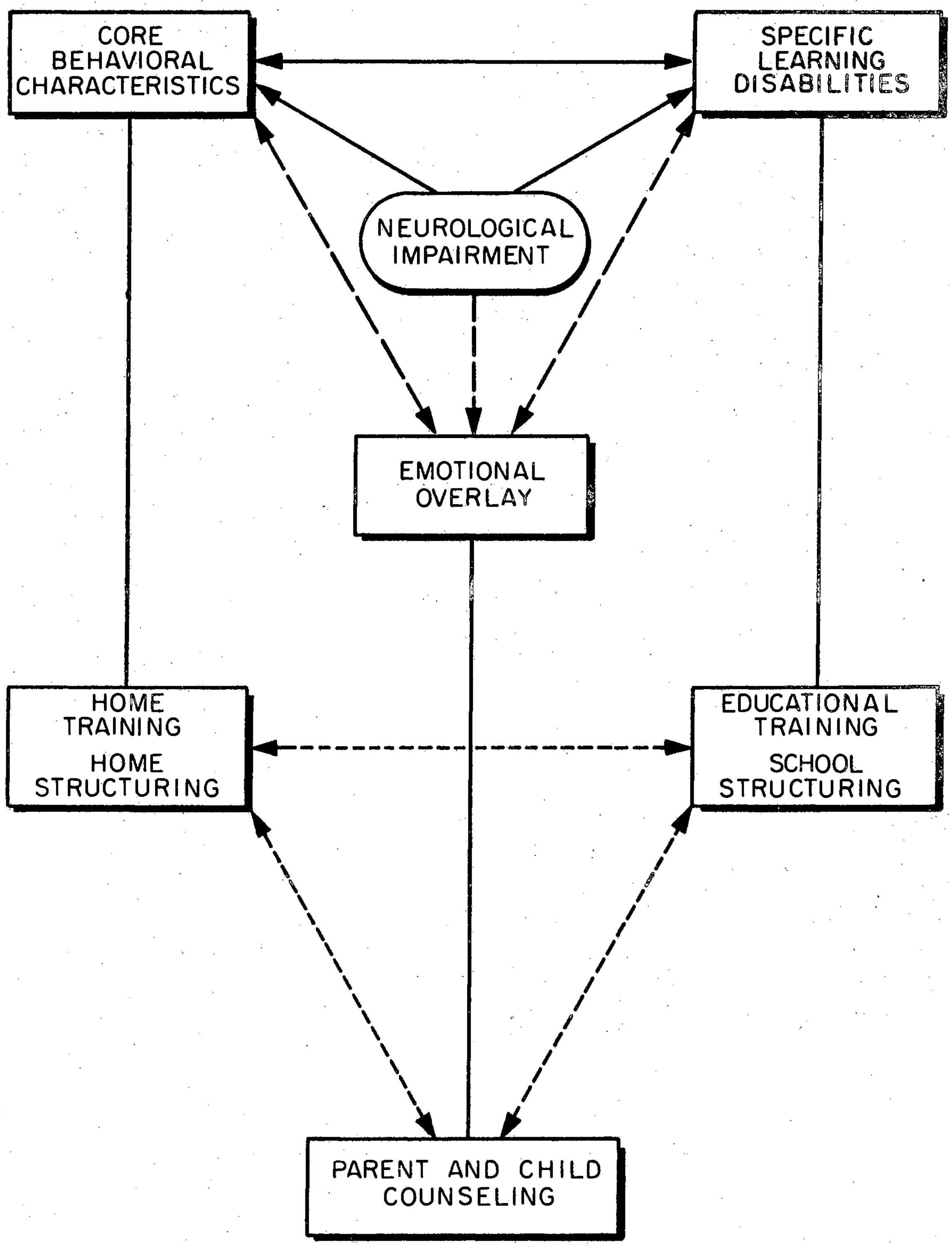

Figure 1. PNLD and Educational Treatment Triads

The two primary effects of PNLD, core behavioral characteristics and specific learning disabilities, are represented by the two upper angles of the PNLD Triad. The literature pertaining to behavioral criteria suitable for identifying PNLD reflects the rather confused state of this rapidly developing field of study. Nevertheless, a perusal of this literature revealed repeated observations of a small number of core characteristics which appear to be common to the majority of children suffering from PNLD. These include: (a) hyperactivity, (b) attention disorders, (c) perceptual, perceptual-motor, and conceptual difficulties, (d) motor function disorders, (e) difficulties in speech and language development, and (f) emotional lability. In addition to these core characteristics, learning disabilities in verbal as well as non-verbal areas, are manifested by children with PNLD.

These two primary effects of PNLD are often accompanied by emotional disturbances which might be extensive enough to mask the primary organic involvement. This secondary effect, frequently referred to as an emotional overlay, is represented by the third angle of the PNLD Triad. In this diagram, primary relationships are indicated by solid lines, and the secondary relationships are indicated by broken lines.

Core behavioral characteristics, specific learning disabilities, and manifestations of an emotional overlay are assessed first by subjective observation. An accurate assessment of the extensiveness and severity of the indicated neurological impairment, however, requires objective measurement.

In line with Diller and Birch (1962) who observed that perceptual disturbance was often used synonomously with neurological impairment, and in view of the observed frequency of motor dysfunctions; a measure of visual-perceptual-motor functioning was considered appropriate. The Bender Visual Motor Gestalt Test was selected for this purpose, since the findings of various studies confirmed the capability of this instrument to adequately discriminate between non-neurologically impaired children and neurologically impaired children with visual-perceptual-motor difficulties.

The literature reviewed supported the contention that the Peabody Picture Vocabulary Test could provide a usable estimate of verbal intellectual functioning. A review of the literature relating vocabulary intelligence to general intelligence indicated that a relatively high correlation exists between the two. The selection of this instrument for screening purposes was influenced by the need to discriminate between psychoneurologically impaired children with learning disabilities and mentally retarded children, since children with PNLD are described as possessing normal intelligence.

Necessary to efficient and effective educational planning for these children is an assessment of strengths and weaknesses in skill areas affected by the neurological impairment. A review of the literature describing differential effects of PNLD upon the psychological functions underlying learning indicated the need for a measure of intellectual functioning which provided meaningful groupings of items to allow for the differential evaluation of these functions. The WISC appeared to meet this specification more closely than any other established measure of intellectual functioning. Clements and Peters (1962) described scatter patterns of WISC subtest scores characteristic of children with PNLD. Therefore, guidelines were available for using the WISC profiles in assessing unique patterns of behavior deficits associated with PNLD.

The results of this evaluation of the three effects of PNLD provide a structure whereby a triad of educational strategies can be designed to focus the most appropriate treatment upon each of these three effects.

Of primary concern was the development of an appropriate educational program. However, a review of the literature revealed that well-designed and controlled studies concerning the effectiveness of the various educational approaches are almost nonexistent. In lieu of empirical studies, almost exclusive reference to descriptive literature was necessary. A review of this literature revealed that in each educational approach, a different facet of training was emphasized. Doman and Delacato (1960), Kephart (1960, 1963), and Schilder (1935), Bender (1960), and Freidus (undated) all stress psychomotor development. Frostig (1961) emphasizes perceptual development; and Lehtinen (Strauss and Lehtinen, 1947) advocates the development of concept formation. Approaches more recently recommended include drug therapy, parent counseling, remediation of weaknesses unique to each child, speech and language remediation, and the exclusive use of behavior modification techniques.

Although the argument has been advanced that developmental sequences dictate focusing upon each skill in order, the immediate needs of these children are multiple and interrelated. Therefore, instead of the segmented approaches advocated by some, the concurrent training, separately and in coordination, of several key skills seemed preferable. Due to memory and attention disorders, and hyperactive behaviors manifested by these children, and the variety of indicated social needs, this approach was considered more practical. Therefore, several of the skill areas reviewed above were incorporated into the training program evaluated by this study. These included: (a) gross motor functioning, (b) perceptual-motor functioning, including fine muscle coordination, and (c) speech and language functioning. Training in the ability to abstract and conceptual functioning was incorporated into each of these three basic areas.

A number of articles reviewed indicated the necessity of medical intervention as an adjunct to educational training. In some professional circles one hears a mounting crescendo of claims heralding the effectiveness of drug therapy used alone. Advocates of such an approach apparently accept as sufficient the mere maintainence of managability for children so treated. When overall developmental objectives are considered, however, it seems that ability gains will be minimal without specific remediation of poorly developed basic skills. With these considerations in mind, drug therapy appeared to be sometimes necessary but seldom sufficient.

Another prevalent theme in the literature stresses the importance of environmental management. Careful structuring of home and school situations and the adaptation of expectations to capabilities are necessary for developmental progress for these children, since they experience difficulty in structuring their own environment. Without external structure, tendencies toward hyperactivity and distractibility are intensified. Since insufficiently structured home or school situations can counteract the positive effects of training, it becomes obvious that the cooperation of parents and teachers must be enlisted, Therefore, following the trend indicated in the literature, consultations with parents and teachers can provide an effective medium for exerting influence on the total learning environment of the child. Only with their understanding of the conditions involved and their cooperation in maintaining consistent training efforts, can lasting developmental progress be achieved.

Based upon the rationale developed from this review of the literature, the selection, training, and evaluation of progress of children with PNLD were studied, using the procedures to be described in Chapter III.

CHAPTER III

DESIGN AND METHODOLOGY

The planned design and ultimate results of field research are often confounded by various intervening variables over which the experimentor has little or no control, such as the existence of administrative regulations outlining specific procedures to be followed when working cooperatively with a public school system, structured frameworks within which a program of study must be operated, specific interpretations of certain types of information considered to be an invasion of privacy, and stipulations which govern the delivery of services. Thus, in this study, as is often the case in action research, concern for sampling and clear differentiation of treatment effects was often overshadowed by concern for the services rendered and for maintaining the relationships essential to both the study and the services studied.

The following areas are discussed in Chapter III: (a) subjects, (b) procedure, including selection of subjects, consultation with referral agents and staff, training program structure, and test instruments and data collection, and (c) experimental design and statistical treatment of the data.

Subjects

The study involved pupils from five public schools in Stillwater and one nearby rural school. The population from which the treatment and control groups were selected consisted of public school children, grades 1-3. Figure 2 shows the distribution of subjects according to chronological age. The distribution of subjects by schools is presented in Figure 3.

The total population from which the sample was selected was characterized by normal intelligence and signs of a psychoneurological learning disability. Due to the small number of female subjects available, variations due to sex were not considered within the scope of this study.

Procedure

Selection of Subjects

The initial population consisted of public school children, grades 1-3, referred by their teachers as manifesting signs of a learning disability. The screening instruments were administered to this population. Those

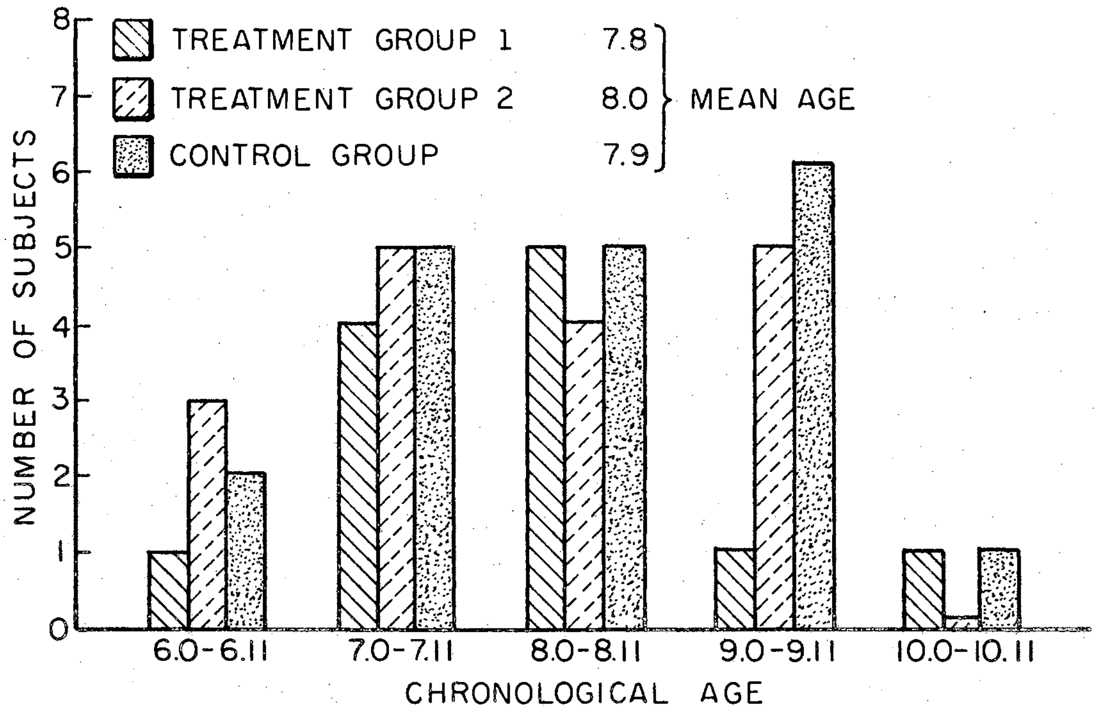

Figure 2. Distribution of Subjects by Chronological Age

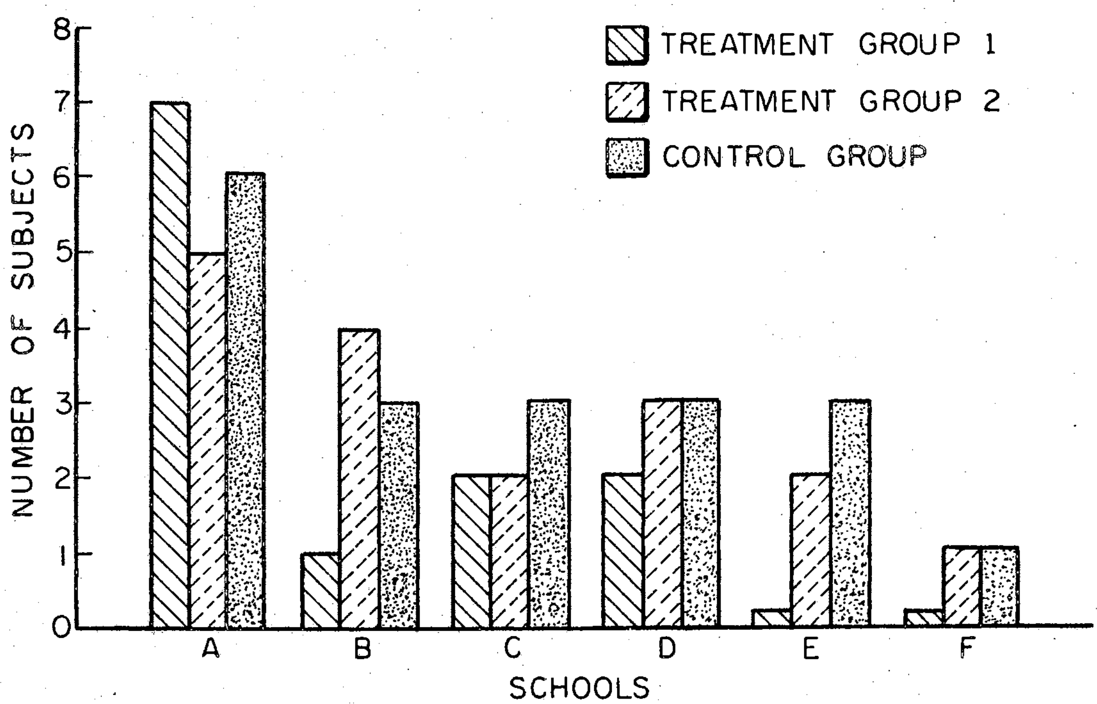

Figure 3. Distribution of Subjects by Schools

subjects not exhibiting normal intelligence and signs of neurological impairment were excluded from the study.

Subjects were randomly assigned to either treatment or control groups. The total sample consisted of 63 subjects. Treatment was administered to 36 subjects, while 27 subjects received no treatment.

As is common in field studies conducted over a substantial time period, attrition of the sample N was of concern in this study. However, for purposes of this study, it was necessary to evaluate as clearly as possible the effects of a specific treatment. Thus, a total of seven experimental subjects and eight control subjects were excluded from the study for various reasons. Six subjects who received treatment and seven who received no treatment were excluded from the study due to intervening variables, the effects of which could not be evaluated. In some cases, speech therapy, academic tutoring, and remedial reading services were offered through the public school system. The effects of these services could not be evaluated apart from the effects of the treatment under study. However, attempts at securing administrative restrictions on such services were considered unwise. In addition, one experimental subject and one control subject were excluded from the study due to serious emotional problems which became apparent after the study was underway.

Therefore, although 63 subjects received differential treatment, the effects of treatment were felt to be contaminated in 15 cases. Thus, the total N consisted of 48 subjects who could be evaluated for purposes of this study. A total of 29 subjects received treatment, and 19 subjects received no treatment.

Consultation with Referral Agents and Staff

In a preliminary briefing prior to the opening of the 1967-68 school year, public school teachers were acquainted with the characteristic behaviors manifested by children with psychoneurological learning disabilities, the criteria for identifying such children in their classrooms, referral procedures, and the kind of training program available for these children. During the pre-school briefing session various visual aids were used to illustrate some of the major characteristics exhibited by children with neurological impairments and some of the problems encountered by these children as a result of the impairments. At the conclusion of the briefing session, an open question and answer period was held. Reading materials containing additional information were then given to the teachers. Due to the communication difficulties often inherrent in a large group, teachers were individually contacted at a later date for a follow-up of this initial briefing.

As each public school in Stillwater has a reading specialist qualified to administer individual intelligence tests, the reading specialists were briefed separately, and given more detailed information regarding test indicators of psychoneurological learning disabilities. When, in the course of their regular duties, those reading specialists located children manifesting signs of psychoneurological learning disabilities, they conferred with the childrens' regular teachers to suggest referral.

A referral Checklist specifying behaviors useful in identifying the child with a psychoneurological learning disability was provided for the teachers' convenience. These referral checklists were sent by teachers to the principals' offices where they were collected.

Since many of these children have become classroom problems, teacher motivation to refer was instilled by offering consulting services to teachers and parents with suggestions for educational planning and home management. Consultation with parents was seen as motivating for teachers, because educational plans for these children are generally dependent upon the extent to which parental cooperation can be obtained.

Training program teachers were selected from advanced practicum students in the areas of physical education, speech and language, clinical psychology, and human development. A departmental supervisor was selected for each of these areas, and the teachers were closely supervised by both the departmental supervisor and the author, who served as director of the training program.

These teachers were briefed prior to the training program, and in-service training involved weekly meetings in which general principles of human development were discussed in relation to each of these specialization areas. During these meetings the individual progress of each child was carefully evaluated in terms of each area, and recommendations were made for dealing with individual problems.

A few of the teachers who worked with Treatment Group I were unable to work with Treatment Group II. However, the effect of personnel turnover was minimized by retaining the same departmental supervisors as well as continuing the careful supervision and in-service training. Perhaps variation due to personnel turnover is less important than variation due to experience. The inclusion of new teachers in each group, therefore, may have improved the over-all experimental design.

Prior to testing, qualified test administrators were given in-service training to control for differences between test administrators. Samples of each examiner's testing sessions were observed by the director. For screening, pre-testing, and post-testing, test administrators alternated daily between the six schools. They chose subjects randomly, and generally maintained an equal ratio of tested and untested children between the experimental and control groups. The examiners were instructed to discontinue testing if they felt that fatigue, illness, or a lack of rapport might effect the results of the test being administered. During the pre-testing period, the examiners were not told which subjects received treatment and which did not. Inferences drawn by the evaluators from communicating with the staffs of the respective schools and from the testing sessions themselves were not within the author's area of control.

The director of the training program administered the majority of the post-tests. In all cases the director was familiar to the children in both treatment and control groups, and an effort was made to ensure that performance measured by the post-test instruments was the best estimate of each child's present functioning level at the time of administration. This necessary administration factor introduces a variable difficult to assess, but extremely important to this study--a prior relationship variable. Differential test performances, under those conditions, can also be attributed to the fact that, in the course of treatment, subjects were taught to respond to educational measures appealing to success motives. On the other hand, hypothesized failure expectations in control subjects were not treated and were dealt with only in the normal procedure of providing encouragement during test administration. Thus, the differential effects of prior relationship with the examiner were inextricably intermingled with the effects of training.

Parents of those subjects randomly assigned to treatment groups were contacted individually and invited to a general meeting. At this meeting parents were acquainted with behavioral characteristics manifested by children with psychoneurological learning disabilities. Emphasis was placed on the fact that an educational plan designed for each child could be initiated by means of special training, but for change in behavior and performance to be more than temporary, continued parental involvement would be necessary. It was thus stressed that the parents themselves were an integral part of the training staff. Plans for educational treatment were outlined, and the parents were advised that their children would be accepted for training only if the parents themselves would attend group sessions designed to outline plans whereby treatment could be continued in the home. Most striking was the unanimous agreement to participate by all parents invited. No subjects were lost through parents' unwillingness to cooperate.

Parent meetings were scheduled once every two weeks. The director of the training program served as group leader, and was assisted by one or more of the training program teachers or departmental supervisors. Test results, educational difficulties, and training methods were communicated in the group. Procedures for home management were discussed and parent self-reports were utilized. Parents reported their successes and failures with various procedures for home management. Group discussion followed in which suggestions or recommendations were generated by other group members as well as the group leaders. Individual consultations were held as the need arose.

Classroom teachers were invited by the parents to one of their meetings in an attempt to indicate to teachers their willingness to cooperate and to become involved with the teachers in planning for educational management in the classroom. When special educational needs were indicated, individual consultative contacts with teachers were arranged at their request or at the initiative of the training program director. Thus, an effort was made to encourage the careful management of both home and school environments.

At the conclusion of the educational training program, evaluation and interpretation sessions were held with the parents of each child. Recommendations were made concerning continued treatment in the home and in the classroom, with special attention to the felt need for special help such as tutoring, remedial reading, language development, or supervised physical education. A summary report was sent to each child's classroom teacher.

Training Program Structure

The 29 subjects receiving training were divided into two different treatment groups for purposes of evaluating the effects of differential educational training. Each training session for both treatment groups was one hour and thirty minutes in length. Treatment I, administered in the fall to a total of 12 subjects, consisted of 24 training sessions, four times per week for six weeks. Treatment II was administered to a different sample of 17 subjects during the spring term. This consisted of 12 similar training sessions, two times per week for six weeks. Thus, a major variable in this study was the length and intensity of the training.

The two treatment groups were divided into four training groups with nine children in each training group. Two training groups received Treatment I, and two training groups received Treatment II. However, due to attrition of N, 12 children were reported as receiving Treatment I, while 17 children received Treatment II. Due to the manifest attention disorders, effective training could not exceed 20-25 minutes in any of the areas. Furthermore, it was felt that attention could be held for this time period only if individualized instruction were possible. With subgroups of three children, this criterion could be met.

Thus, the nine children in each training group were assigned to subgroups of three. In making subgroup assignments an attempt was made to group children homogeneously according to level of language development and speech pathology, since training tasks in other areas could be more easily adapted to greater individual differences.

As illustrated in Figure 4, the three subgroups of children were rotated through the various training activities. To avoid any possible effect that a particular sequence of tasks might have, the sequence followed by Treatment Group I subgroups was rotated after every eight sessions.

Treatment Group II followed the same daily schedule with the exception that the sequence of tasks which the

ROTATION PERIOD ONE

3:30-3:45

LARGE GROUP ACTIVITY

SUBGROUPS 1,2,3

SUBGROUP ACTIVITY	3:45-4:10	4:10-4:35	4:35-5:00
PERCEPTUAL MOTOR TASKS	1	3	2
GROSS MOTOR TASKS	2	1	3
SPEECH AND LANGUAGE DEVELOPMENT	3	2	1

ROTATION PERIOD TWO

3:30-3:45

LARGE GROUP ACTIVITY

SUBGROUPS 1,2,3

SUBGROUP ACTIVITY	3:45-4:10	4:10-4:35	4:35-5:00
PERCEPTUAL MOTOR TASKS	3	2	1
GROSS MOTOR TASKS	1	3	2
SPEECH AND LANGUAGE DEVELOPMENT	2	1	3

ROTATION PERIOD THREE

3:30-3:45

LARGE GROUP ACTIVITY

SUBGROUPS 1,2,3

SUBGROUP ACTIVITY	3:45-4:10	4:10-4:35	4:35-5:00
PERCEPTUAL MOTOR TASKS	2	1	3
GROSS MOTOR TASKS	3	2	1
SPEECH AND LANGUAGE DEVELOPMENT	1	3	2

Figure 4. Rotated Task Assignments of Subgroups

subgroups followed was rotated after every fourth session.

Within each training area activities were sequentially structured according to levels of development. Furthermore, the activities designed to develop a particular skill were group activities, although an individual program of treatment, based on specific evaluation of competency was prescribed for each child. Each child was taught to master a skill at his lowest functional level within each stage of development before going on to a skill requiring a higher functional level.

All activities were constructed to give a reason for the teacher to direct individual and group praise and encouragement. Praise was first given to effort, regardless of the quality of performance. As the level and quality of skill increased, the praise pattern was modified to fit the situation.

Activities were constructed in such a way that competitiveness was minimized, with each child trying to better his own previous performance, either by time, number of tasks completed, or increase in quality of skill.

In most cases two teachers worked with each three children. Should a child be experiencing unusual difficulty with a certain task, or should a particular child be expected to experience difficulty with a given task, he was taken from the room and given individual instruction prior to group participation. It was felt that the additional confidence generated by the individual help would allow the child to participate comfortably within the group in group activities. The cumulative effects of self-confidence within a group were observed.

The procedure for Treatment Group II was structurally the same. However, both the intensity of training contacts and the total number of contacts were reduced by half. The children were seen for six weeks, twice per week for a total of 12 contact sessions.

<u>Test Instruments and Data Collection</u>

The Peabody Picture Vocabulary Test and the Bender Visual-Motor Gestalt were administered as screening instruments to children whose teachers had completed a Behavior Checklist, indicating the presence of a learning disability. Thirty to forty-five minutes were spent in individual administration of the screening tests.

Those children screened who demonstrated normal intelligence, signs of neurological impairment, and indications of specific learning disabilities were included in the subject population to be sampled. A Wechsler Intelligence Scale for Children was then administered to this population. WISC results supportive of a diagnosis of psychoneurological learning disability further delimited the population to be studied.

Both the treatment and control groups received examinations for auditory and visual acuity to rule out the possibility of a physical handicap effecting performance on the test battery.

For the treatment group, additional procedures were used to obtain information relative to individual and group treatment, and included informal tests for lateral dominance, physical coordination, reading level, articulation, and language development. For each child a case history was compiled. In addition, a "special" nuerological examination was administered by the consulting pediatrician in order to check for the presence of "soft" neurological signs.

Finally, for both treatment and control subjects, informal pre-post teacher reports were obtained which described academic performance and social adjustment in the classroom.

For the treatment group, parent reports relative to their personal attitudes about their children as well as their perceptions of their children's behaviors were obtained.

Pre-post evaluation instruments included the Wechsler Intelligence Scale for Children and the Bender Visual-Motor Gestalt Test.

In summation, both treatment and control groups were given the pre-test battery. Subsequently, the treatment groups received training while the control groups did not. After treatment the post-test battery was administered to both treatment and control groups.

It was assumed that maturational changes and the effect of contemporaneous events operated equivalently for both treatment and control groups.

Experimental Design and Statistical Treatment

For purposes of evaluation, four groupings of subjects were utilized in the analysis. Treatment Group I with an N of 12 received training four days per week for six weeks. Treatment Group II with an N of 17 received training two times per week for six weeks. The Pooled Treatment Groups had an N of 29. The Control Group with an N of 19 received no treatment.

The major independent variable was participation versus nonparticipation in the educational training program developed for evaluation in this study. The second independent variable was the number and frequency of the training sessions.

The central question of this study was, "What effect did these independent variables have upon the following dependent variables?

1. Alertness to and memory for factual information as measured by the WISC Information subtest.
2. Practical reasoning in problem situations as measured by the WISC Comprehension subtest.
3. Concentration and reasoning in numerical problems as measured by the WISC Arithmetic subtest.
4. Ability to generalize and do abstract thinking as measured by the WISC Similarities subtest.
5. Ability to verbalize an understanding of words as measured by the WISC Vocabulary subtest.
6. Immediate recall of verbal stimuli as measured by the WISC Digit Span subtest.
7. Visual alertness and visual meanings as measured by the WISC Picture Completion subtest.
8. Ability to perceive and interpret social situations as measured by the WISC Picture Arrangement subtest.
9. Ability to reproduce abstract geometric designs as measured by the WISC Block Design subtest.

10. Ability to organize parts of pictures of familiar objects into a Gestalt as measured by the WISC Object Assembly subtest.
11. Speed and accuracy of learning and writing symbols as measured by the WISC Coding subtest.
12. Level of intellectual functioning in the verbal realm as measured by the WISC Verbal IQ.
13. Level of Intellectual functioning in the performance realm as measured by the WISC Performance IQ.
14. Level of overall intellectual functioning as measured by the WISC Full-Scale IQ.
15. Level of visual-perceptual-motor functioning as measured by the Koppitz Developmental Scoring System (Koppitz, 1964) for the Bender-Gestalt Test.

Statistical analysis of scores from such standardized tests as the WISC have historically utilized techniques which assume interval data. This assumption is open to question. An alternative assumption of ordinal scaling is much more tenable. In addition, the normality of the distribution of these scores was open to question, because nearly all of the subjects were drawn from the upper half of the IQ distribution. The Bender-Gestalt scores were clearly non-normal in their distribution. And (by no stretch of the imagination) could these scores be considered interval data. Therefore, nonparametric procedures, suitable for ranked data, were considered more appropriate.

In the absence of utility estimates, a probability of .05 or less was specified as the criterion for rejecting a null hypothesis. Since the directionality of differences between groups of scores could not be theoretically pre-determined, the two-tailed probabilities associated with given values were used in each case.

To assess the effects of the independent variables upon each of the 15 dependent variables, the following four <u>between</u> group comparisons were made:

1.	Treatment Group I	vs.	Control Group
2.	Treatment Group II	vs.	Control Group
3.	Pooled Treatment Gr.	vs.	Control Group
4.	Treatment Group I	vs.	Treatment Group II

<u>Hypotheses 1 - 60</u>

For each of the above four between group comparisons, the pre-test scores for each of the 15 dependent variables were analyzed to determine whether the groups of scores compared were statistically similar prior to differential treatment. For each of these 60 comparisons, the following set of null and alternative hypotheses was tested by the Mann-Whitney U Test (Siegel, 1956):

H_0 A: Pre-test scores for the dependent variable under consideration are distributed randomly among both groups being compared.

H_1 A: Pre-test scores for the dependent variable under consideration are stochastically higher in one group than in the other.

Hypotheses 61 - 105

Within each of three groups (Treatment Group I, Treatment Group II, and the Control Group), the significance of differences in pre-test and post-test scores was assessed for each of the 15 dependent variables. For each of these 48 assessments, the following set of null and alternative hypotheses was tested by the Wilcoxon Matched-Pairs Signed-Ranks Test (Siegel, 1956):

H_0 B: This set of post-test scores does not differ from the set of corresponding pre-test scores.

H_1 B: This set of post-test scores does differ from the corresponding pre-test scores.

Hypotheses 106 - 165

For each of the four between group comparisons listed above, pre-post gain scores for each of the 15 dependent variables were then analyzed to assess the effects of differential treatment. For each of these 60 comparisons, the following set of null and alternative hypotheses was tested by the Mann-Whitney U Test:

H_0 C: Gain scores for the dependent variable under consideration are distributed randomly among both groups being compared.

H_1 C: Gain scores for the dependent variable under consideration are stochastically higher in one group than in the other.

The results of these statistical tests are presented and discussed in detail in Chapter IV.

CHAPTER IV

RESULTS OF THE INVESTIGATION

In reporting and discussing the results of this study, the following comparisons are presented for each of the 15 dependent variables:

1. Between group comparisons were made of pre-test scores to assess the likelihood of similarity between groups of scores prior to treatment. Comparisons were made between:
   a) Treatment Group I (T_1) and the Control Group(C)
   b) Treatment Group II (T_2) and the Control Group (C)
   c) Pooled Treatment Groups (T_p) and the Control Group (C)
   d) Treatment Group I (T_1) and Treatment Group II (T_2)
2. Within group comparisons were made to determine the significance of differences between pre-test scores and post-test scores. Comparisons were made for T_1, T_2, and C.

3. Between group comparisons of pre-post gain scores were made to assess the effects of differential treatment upon the scores of the four pairs of groups listed under item 1 above.

Note that comparisons a, b, and c above pertain to the independent variable of treatment versus no treatment. The independent variable, length and intensity of training, was assessed by comparison d. In general, a lack of significant differences in the pre-test distributions followed by significant gain differences would be indicative of an effect related to the given independent variable.

For the purposes of this study a probability of .05 or less was required for rejection of null hypotheses. The two-tailed probabilities were utilized since, in no case could the directionality of differences be theoretically predetermined.

Test for Between Group Comparisons

Differences in pre-test scores and pre-post gain scores obtained from the WISC and the Bender-Gestalt, for each of the four between group comparisons were assessed by the Mann-Whitney U Test. (Siegel, 1956)

In each comparison, the null hypothesis stating that the two groups of scores were samples drawn from the same population was rejected when the obtained probability was equal to or less than the set .05 limit. When the null hypothesis was rejected, the alternative hypothesis of a stochastic difference was accepted. When the N of a group was less than 20, the Table of Critical Values from the sampling distribution of U was used.

Test for Within Group Pre-Post Differences

The Wilcoxon Matched-Pairs Signed-Ranks Test as described by Siegel (1956) was used to assess the significance of differences between the pre-test scores and the post-test scores obtained on the WISC and the Bender-Gestalt.

In each assessment, the null hypothesis stating that there are no significant differences within each of the three groups in corresponding pre and post scores was rejected when the obtained probability of a Type I error was .05 or less. Since the N of each group was less than 25, the Table of Critical Values from the sampling distribution of T was used.

Presentation and Discussion of Results

The results of this investigation are reported for each of the dependent variables, 1 - 15, in Tables I - XV. A summary of significant comparisons is presented in Table XVI.

Variable 1: WISC Information Subtest

The experimental findings concerning the WISC Information subtest scores are presented in Table I and discussed below.

Results. An Analysis of between group comparisons of the distributions of pre-test scores revealed no significant differences between the comparison groups prior to treatment.

In the analysis of within group pre-test and post-test differences, Treatment Group I (T_1)and Treatment Group II (T_2) made significant gains at the .02 and .01 levels respectively. Differences were not significant within the Control Group (C).

Between group comparisons showed that the distributions of gain scores of Treatment Groups I and II and the Pooled Treatment Groups (T_p) were all stochastically higher than those of the Control Group. All three differences

TABLE I

COMPARISONS OF WISC INFORMATION SUBTEST SCORES
(The symbol $\simeq$ is used to indicate no significant difference.)

Mann-Whitney U Tests of Between Group Comparison of Pre-test Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	92.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	128.5	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	220.5	$T_p \simeq C$	0.12144
T_1	12	T_2	17	102.0	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-test and Post-test Scores

Group	N	Decreases N	Decreases Σ Ranks	Increases N	Increases Σ Ranks	Indicated Relationship	Two-tailed Probability
T_1	12	1	-7.0	10	59.0	Post > Pre	$p = .02$
T_2	17	1	-2.5	11	75.5	Post > Pre	$p < .01$
C	19	9	-81.0	8	72.0	Post $\simeq$ Pre	NS

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	57.5	$T_1 > C$	$p < .05$
T_2	17	C	19	91.5	$T_2 > C$	$p < .05$
C	19	T_p	29	149.0	$T_p > C$	0.00355
T_1	12	T_2	17	83.0	$T_1 \simeq T_2$	$p > .10$

were significant at less than the .05 level. The distributions of gain scores of the two treatment groups were not significantly different from each other.

Therefore, there are statistically significant differences associated with treatment versus no treatment, but none associated with the length and intensity of training.

Discussion. The Information subtest requires responses which demonstrate a knowledge of factual information. Treatment did not emphasize activities involving factual information as such. Therefore, the above differential results might be accounted for by effects of treatment upon basic psychological functions underlying performance of this task. These could include increased alertness to and improved retention of such information, as well as increased ability to formulate and communicate adequate responses.

Variable 2: WISC Comprehension Subtest

Analyses concerning the WISC Comprehension subtest are summarized in Table II.

Results. Between group comparisons of pre-test scores demonstrated no significant differences between distributions except between the Control Group and the Pooled Treatment Groups. This difference was significant at the .01 level. Therefore, in comparing distributions of pre-post gain scores, the pre-existing stochastic difference

TABLE II

COMPARISONS OF WISC COMPREHENSONS
SUBTEST SCORES

Mann-Whitney U Tests of
Between Group Comparison of Pre-test Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	67.0	$T_1 \simeq C$	$P > .05$
T_2	17	C	19	105.0	$T_2 \simeq C$	$P > .05$
C	19	T_p	29	172.0	$T_p > C$	0.01336
T_1	12	T_2	17	89.5	$T_1 \simeq T_2$	$P > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within
Group Differences Between Pre-test and Post-test Scores

Group	N	Decreases N	Decreases Σ Ranks	Increases N	Increases Σ Ranks	Indicated Relationship	Two-tailed Probability
T_1	12	3	-10.5	9	67.5	Post > Pre	$p < .05$
T_2	17	3	-15.0	13	121.0	Post $\simeq$ Pre	$p < .01$
C	19	11	-115.5	6	37.5	Post $\simeq$ Pre	NS
					cv= 35.0		

Mann-Whitney U Tests of
Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	42.5	$T_1 > C$	$p < .02$
T_2	17	C	19	59.0	$T_2 > C$	$p < .002$
C	19	T_p	29	101.5	$T_p > C$	0.00011
T_1	12	T_2	17	83.0	$T_1 \simeq T_2$	$p > .10$

between these two groups of scores must be taken into account.

Significant pre-post differences were found only within Treatment Groups I and II, where the null hypotheses were rejected at the .05 and .01 levels respectively. The critical value for the .05 level for the Control Group has been included in Table II, for a trend toward a loss, significant at the .05 level, was apparent.

Gain score comparisons between groups showed that the distributions of scores for the treatment groups were not significantly different from each other. Singularly and in combination, the Treatment Groups made stochastically higher gain scores than did the Control Group. The probability that the gain scores of the various Treatment Groups were drawn from the same population as those of the Control Group was less than .02 in each case.

In summation, there are statistically significant differences associated with treatment versus no treatment.

Discussion. Successful performance on the Comprehension subtest calls for an ability to reason in problem situations. Training stressed verbalization skills and the formation of concepts.

Training appears to have increased the subjects' ability to conceptualize, organize, and communicate adequate responses. A subjective analysis of individual test items indicates that the subjects in both Treatment Groups tended to conceptualize at a higher level of abstraction, whereas the Control subjects responded more often with concrete solutions.

The loss trend apparent in the pre-post differences, within the Control Group will be discussed in connection with a similar relationship observed in Variable 5, the Vocabulary subtest.

Variable 3: WISC Arithmetic Subtest

Presented in Table III are comparisons involving the WISC Arithmetic subtest scores.

Results. No significant differences between the distributions of comparison group pre-test scores existed prior to treatment.

Within group comparisons of differences between pre-test and post-test scores showed that only Treatment Group I made a significant gain. The difference was significant at less than the .01 level.

An analysis of the distributions of the pre-post gain scores revealed that Treatment Group I was stochastically higher than the Control Group at less than the .05 level. The distributions of scores for Treatment Group II and the Pooled Treatment Groups did not differ

TABLE III

COMPARISONS OF WISC ARITHMETIC
SUBTEST SCORES

Mann-Whitney U Tests of
Between Group Comparison of Pre-test Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	87.5	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	141.5	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	229.0	$T_p \simeq C$	0.15874
T_1	12	T_2	17	94.0	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within
Group Differences Between Pre-test and Post-test Scores

Group	N	Decreases N	Decreases ΣRanks	Increases N	Increases ΣRanks	Indicated Relationship	Two-tailed Probability
T_1	12	1	-1.5	8	43.5	Post > Pre	$p < .01$
T_2	17	6	-32.5	7	58.5	Post $\simeq$ Pre	NS
C	19	7	-45.0	6	46.0	Post $\simeq$ Pre	NS

Mann-Whitney U Tests of
Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	64.0	$T_1 > C$	$p < .05$
T_2	17	C	19	144.0	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	208.0	$T_p \simeq C$	0.07453
T_1	12	T_2	17	64.0	$T_1 \simeq T_2$	$p = .10$

significantly from those of the Control Group; and Treatment Group I was not significantly different from Treatment Group II. Thus, for Treatment Group I there is a statistically significant difference associated with treatment versus no treatment.

Discussion. Adequate performance on the Arithmetic subtest requires an ability to attend, concentrate, and reason in numerical problems. Although training did not emphasize activities which focused upon numerical problem solving, training did stress the underlying psychological functions necessary for adequate performance of this task.

Within Treatment Group I, pre-post differences were significant. Even though the pre-post differences of Treatment Group II were not significant, the differences were slightly greater than those of the Control Group, as indicated by the sums of the signed ranks. This provides some basis for believing that had Treatment Group II received longer and more intensive training, pre-post differences might have been significant.

A significant difference was found between the distribution of gain scores for Treatment Group I and that of the Control Group. Although the corresponding difference between Treatment Groups was not significant, the probability that these were samples drawn from the same population equaled .10. These data tend to support the subjective observation that the longer and more intensive training received by Treatment Group I enabled those subjects to attend, concentrate, and reason more effectively in arithmetic problem solving. The probability of .07 observed in the comparisons between the Control Group and the Pooled Treatment Groups provides further support for this contention.

The results of this subtest will be discussed in relation to the results of the Digit Span subtest.

Variable 4: WISC Similarities Subtest

The experimental findings concerning the WISC Similarities subtest scores are reported in Table IV.

Results. In the analysis of between group comparisons of distributions of pre-test scores, no significant differences existed between the comparison groups prior to treatment.

In analyzing differences between pre-test and post-test scores within groups, the Control Group did not make significant gains, although the differences for both Treatment Groups were significant at less than the .02 level.

A comparison of gain score distributions showed that singularly the Treatment Groups did not differ significantly from the Control Group or from each other. However, the

TABLE IV

COMPARISONS OF WISC SIMILARITIES
SUBTEST SCORES

Mann-Whitney U Tests of
Between Group Comparison of Pre-test Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	89.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	144.0	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	233.0	$T_p \simeq C$	0.18406
T_1	12	T_2	17	91.0	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within
Group Differences Between Pre-test and Post-test Scores

Group	N	Decreases N	Decreases ΣRanks	Increases N	Increases ΣRanks	Indicated Relationship	Two-tailed Probability
T_1	12	3	-7.0	8	59.0	Post > Pre	$p = .02$
T_2	17	0	-0.0	13	91.0	Post > Pre	$p < .01$
C	19	8	-85.5	11	104.5	Post $\simeq$ Pre	NS

Mann-Whitney U Tests of
Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	79.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	117.0	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	196.0	$T_p > C$	0.04588
T_1	12	T_2	17	99.5	$T_1 \simeq T_2$	$p > .10$

Pooled Treatment Groups made stochastically higher gain scores than did the Control Group. This difference was significant at the .05 level. Therefore, for the Pooled Treatment Groups there is a statistically significant difference associated with treatment versus no treatment.

Discussion. The abilities to generalize and to reason abstractly underlie performance on the Similarities subtest. During training, subjects were encouraged to notice and talk about similarities and differences. An attempt was made to shape such responses in the direction of higher level abstractions which could then be applied to new situations.

Though there were significant gains between the pre-test and post-test scores within each of the treatment groups, these gains were not sufficient to show differences in the distributions of gain scores when compared singularly with the Control Group. However, distributions of Treatment Group gain scores became significantly different when they were pooled and compared to the Control Group. These marginal results indicate that although some gains were achieved, more effective training activities should be devised.

Variable 5: WISC Vocabulary Subtest

Analyses of the WISC Vccabulary subtest scores are presented in Table V.

TABLE V

COMPARISONS OF WISC VOCABULARY SUBTEST SCORES

Mann-Whitney U Tests of Between Group Comparison of Pre-test Score Distribution						
$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	109.5	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	155.0	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	264.5	$T_p \simeq C$	0.40768
T_1	12	T_2	17	101.5	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-test and Post-test Scores							
		Decreases		Increases			
Group	N	N	ΣRanks	N	ΣRanks	Indicated Relationship	Two-tailed Probability
T_1	12	0	-0.0	10	55.0	Post > Pre	$p < .01$
T_2	17	3	-13.5	11	91.5	Post > Pre	$p < .02$
C	19	10	-111.5	8	59.5 cv = 40.0	Post $\simeq$ Pre	NS

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions						
$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	57.5	$T_1 > C$	$p < .05$
T_2	17	C	19	95.5	$T_2 > C$	$p < .05$
C	19	T_p	29	153.0	$T_p > C$	0.00459
T_1	12	T_2	17	87.0	$T_1 \simeq T_2$	$p > .10$

Results. Between group comparisons of the distributions of pre-test scores revealed no significant differences in the scores of the four pairs of comparison groups prior to treatment.

Significant differences between pre-test and post-test scores were found within both Treatment Groups. The differences for both Treatment Groups were significant at less than the .02 level. The Critical Value for significance at the .05 level was included in the Table for comparison with the sum of positive ranks for the Control Group. Note that the smaller sum of positive ranks indicates a greater magnitude of losses over gains.

Between group comparisons showed that the gain score distributions of Treatment Groups I and II and the Pooled Treatment Groups were all stochastically higher than those of the Control Group. Differences were all significant at probabilities less than .05. The distributions of gain scores of the two treatment groups did not differ significantly from each other.

Thus, for this variable, statistically significant differences are associated with treatment versus no treatment, but there are no statistically significantly differences associated with length and intensity of training.

Discussion. The Vocabulary subtest taps the ability to verbalize an understanding of words. Well developed verbal skills are necessary in order to perform well on this subtest. Training emphasized the development of word concepts, concept formation, and verbal skills. Certain of the activities stressed development of an ability to describe. In addition, whenever possible, subjects were encouraged to describe and discuss what they were doing.

These results indicate that subjects who received training were more aware of word concepts, and were better able to organize their responses to communicate their understanding of these concepts.

The Control Group's indicated movement toward a loss appears to relate to a similar trend apparent in the Control Group's Comprehension subtest scores. These trends are likely to be related to influences occurring between pre-tests and post-tests. Comprehension and vocabulary are likely to be related to school experiences. A regular academic program increasingly emphasizes an understanding of verbal constructs and possession of verbal skills. Thus, the acquisition of knowledge becomes more verbally oriented and less performance oriented. Children with PNLD often have poorly developed basic verbal skills, coupled with a limited understanding of concepts and relationships. As academic progress requires an increasingly greater verbal proficiency, these children who lack the basic skills described above become even less capable of meeting academic expectations. Accumulated failure experiences, in the face of increasing expectations, undoubtedly affect both motivation and ability to respond adequately on these subtests. The cumulative effects of such loss trends over a period of years could have grave implications for society as well as the individual. Therefore, there is an obvious need for long-range studies to assess the possibility that decreasing IQ scores may be due to an increasingly greater need for skills which were never learned or only poorly developed at best.

These findings suggest that educational treatment apart from the regular academic program is highly desirable. Such treatment should emphasize basic learning skills which other children acquire with much less effort.

Variable 6: WISC Digit Span Subtest

Findings concerning the WISC Digit Span subtest are reported in Table VI.

Results. An analysis of the four pairs of between group comparisons of the distributions of pre-test scores demonstrated no significant differences between the populattions prior to treatment.

TABLE VI

COMPARISONS OF WISC DIGIT SPAN SUBTEST SCORES

Mann-Whitney U Tests of Between Group Comparison of Pre-test Score Distribution

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	8	C	9	28.5	$T_1 \simeq C$	$p > .10$
C	9	T_2	17	65.5	$T_2 \simeq C$	$p > .10$
C	9	T_p	25	94.0	$T_p \simeq C$	0.23273
T_1	8	T_2	17	62.5	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-test and Post-test Scores

Group	N	Decreases N	Decreases ΣRanks	Increases N	Increases ΣRanks	Indicated Relationship	Two-tailed Probability
T_1	8	3	-9.0	4	19.0	Post $\simeq$ Pre	NS
T_2	17	6	-43.5	9	76.5	Post $\simeq$ Pre	NS
C	9	3	-9.0	3	10.0	Post $\simeq$ Pre	NS

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	8	C	9	30.5	$T_1 \simeq C$	$p > .10$
C	9	T_2	17	71.0	$T_2 \simeq C$	$p > .10$
C	9	T_p	25	101.5	$T_p \simeq C$	0.37195
T_1	8	T_2	17	61.0	$T_1 \simeq T_2$	$p > .10$

Within group assessments of pre-post differences were not significant for any of the three groups.

Between group comparisons revealed that the distributions of gain scores were not significantly different in any of the four pairs of comparison groups.

Thus, there were no statistically significant differences associated with treatment versus no treatment, nor with length and intensity of training.

Discussion. Performance on the Digit Span subtest involves attention, concentration, and memory for recently learned material. Taylor (1959) observed that this subtest is usually given to test for "rote" memory.

The negative findings on this measure are supportive of observations made by Taylor (1959) and Michal-Smith and Morgenstern (1965), who indicated that due to memory impairments, children with PNLD have greater difficulty with tasks which require performance based upon rote memory. Furthermore, treatment emphasizing rote repetition is rarely effective. Hence, it would appear that a different method for training rote memory must be sought.

Regarding attention and concentration, the other psychological functions underlying performance of this task, Holt (1968) found that attention and concentration vary together. These functions underlie performance on both the Arithmetic and Digit Span subtests. (Rapaport and Schafer, 1968) On the Arithmetic subtest, the effect of pre-post differences was apparent only in the within group comparison for Treatment Group I, whereas there were no significant findings in the Digit Span subtest. The differential performance of Treatment Group I on the two subtests should be explained. It is possible that the more prolonged and intensive treatment received by Treatment Group I was effective in increasing the subjects' ability to concentrate, but ineffective in increasing the subjects' ability to attend. (Concentration is weighted more heavily in the Arithmetic subtest, whereas attention is weighted more heavily in the Digit Span subtest.)

Variable 7: WISC Picture Completion Subtest

The experimental findings relative to the WISC Picture Completion subtest scores are set forth in Table VII.

Results. Significant differences between the distributions of pre-test scores were not evident prior to treatment in any of the between group comparisons.

An analysis of differences between pre-test scores and post-test scores within groups disclosed that both Treatment Groups made significant gains, while the Control Group did not. For Treatment Group I there were no losses and no zeros. Therefore, the probability of the null

TABLE VII

COMPARISONS OF WISC PICTURE COMPLETION SUBTEST SCORES

Mann-Whitney U Tests of Between Group Comparison of Pre-test Score Distribution

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	88.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	159.0	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	252.0	$T_p \simeq C$	0.30849
T_1	12	T_2	17	82.0	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-test and Post-test Scores

Group	N	Decreases N	Decreases ΣRanks	Increases N	Increases ΣRanks	Indicated Relationship	Two-tailed Probability
T_1	12	0	0.0	12	78.0	Post > Pre	$p < .01$
T_2	17	5	-24.0	10	96.0	Post > Pre	$p < .02$
C	19	7	-58.5	11	112.5	Post $\simeq$ Pre	NS

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	49.0	$T_1 > C$	$p < .02$
T_2	17	C	19	142.5	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	191.5	$T_p > C$	0.03733
T_1	12	T_2	17	56.0	$T_1 > T_2$	$p < .05$

hypothesis being true was approximately zero. Gains within Treatment Group II were significant at less than the .02 level.

Between group comparisons of gain score distributions showed that Treatment Group I and the Pooled Treatment Groups made stochastically higher gain scores than the Control Group. A comparison of gain score distributions of Treatment Group II and the Control Group revealed no significant difference. Treatment Group I made stochastically higher gain scores than Treatment Group II, with less than a .05 probability level.

These observations indicate that statistically significant differences were associated with treatment versus no treatment, and with length and intensity of training.

Discussion. Performance on the Picture Completion subtest requires visual alertness in order to identify the missing part of the picture.

Many of the training activities were structured so as to encourage alertness to visual stimuli and the development of visual perception. The type of training activities utilized in training appears to be appropriate.

The significant difference between gain scores of the two Treatment Groups indicates that the longer and more intensive training was more effective.

Variable 8: WISC Picture Arrangement Subtest

The findings for the WISC Picture Arrangement subtest scores are presented in Table VIII.

Results. On this variable the between group comparisons for distributions of pre-test scores revealed two statistically significant differences. Pre-test scores for Treatment Group I and the Pooled Treatment Groups were stochastically higher than those of the Control Group. Significance levels were less than .002 and .008 respectively. Since pre-test scores for Treatment Group II were not significantly different from those of the Control Group, it appears that the significant differences of the Pooled Treatment Groups versus the Control are largely accounted for by Treatment Group I.

Differences between the pre-test and post-test scores were significantly positive at less than the .02 level within Treatment Group I. The critical values for the .05 level have been included in Table VIII for the other two groups. Note that the sum of negative ranks for Treatment Group II closely approximated the critical value, whereas there was no such trend toward significance within the Control Group.

For the populations of gain scores, between group comparisons revealed no significant differences.

TABLE VIII

COMPARISONS OF WISC PICTURE ARRANGEMENT SUBTEST SCORES

Mann-Whitney U Tests of Between Group Comparison of Pre-Test Score Distribution

Group$_1$	N_1	Group$_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	37.0	$T_1 > C$	$p < .002$
T_2	17	C	19	125.0	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	162.0	$T_p > C$	0.00797
T_1	12	T_2	17	65.0	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-test and Post-test Scores

Group	N	Decreases N	Decreases ΣRanks	Increases N	Increases ΣRanks	Indicated Relationship	Two-tailed Probability
T_1	12	1	-1.5	7	34.5	Post > Pre	$p < .02$
T_2	17	4	-23.0 c.v.= 21.0	10	82.0	Post $\simeq$ Pre	NS
C	19	8	-76.0 c.v.= 46.0	11	114.0	Post $\simeq$ Pre	NS

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions

Group$_1$	N_1	Group$_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	73.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	135.0	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	208.0	$T_p \simeq C$	0.07597
T_1	12	T_2	17	83.5	$T_1 \simeq T_2$	$p > .10$

Discussion. The Picture Arrangement subtest calls for an ability to perceive, interpret, and motorically sequence pictures depicting social situations.

For some unknown reason,Treatment Group I pre-scores were significantly different from those of the Control Group (and different from Treatment Group II at nearly the .05 level). Treatment Group I scores gained significantly from pre to post. It, therefore, seems surprising that the distribution of gain scores for this group was not significantly different from that of the Control Group. It would appear that the Control Group would have to make greater gains than Treatment Group I in order to be considered to be in the same population. However, this did not appear to be the case.

An examination of the original data indicated that the distribution of pre-test scores for Treatment Group I contained no score below 11 and that there were indeed gains between pre-test and post-test scores in seven of the 12 cases. In four cases, scores remained the same, and in only one case was there a loss. In the Control Group there were 11 gains and eight losses. The reason for the sampling anomaly on these pre-test scores is unknown. Even more puzzling is the lack of significant gain differences in comparison with the Control Group, although the Pooled Treatment

Groups approached a significant difference ($p. = .075$) in comparison with the Control Group.

Therefore, although it would appear that there were significant gains in Treatment Group I which was already higher in these skills, and a gain trend in Treatment Group II, the lack of significant differences between Treatment and Control Groups distributions casts doubt upon the effectiveness of the treatment in improving the skills described above.

Variable 9: WISC Block Design Subtest

Reported in Table IX are results concerning the WISC Block Design subtest.

Results. The distributions of pre-test scores for the paired comparison groups were not significantly different.

Within group comparisons of pre-test and post-test differences disclosed that both Treatment Groups made significant gains whereas the Control Group did not. The differences for both Treatment Groups were significant at less than the .02 level.

Between group comparisons of the distributions of gain scores revealed that Treatment Group I and the Pooled Treatment Groups made stochastically higher gain scores than did the Control Group. These differences were both significant at less than the .05 level. However, the distributions of

TABLE IX

COMPARISONS OF WISC BLOCK DESIGN SUBTEST SCORES

Mann-Whitney U Tests of Between Group Comparison of Pre-Test Score Distribution

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	112.5	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	150.5	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	263.0	$T_p \simeq C$	0.39531
T_1	12	T_2	17	96.0	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-Test and Post-Test Scores

Group	N	Decreases N	Decreases ΣRanks	Increases N	Increases ΣRanks	Indicated Relationship	Two-tailed Probability
T_1	12	3	-6.0	8	60.0	Post > Pre	$p < .02$
T_2	17	4	-18.0	11	102.0	Post > Pre	$p < .02$
C	19	7	-66.0	10	87.0	Post $\simeq$ Pre	NS

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	58.5	$T_1 > C$	$p < .05$
T_2	17	C	19	108.5	$T_2 \simeq C$	$p = .10$
C	19	T_p	29	167.0	$T_p > C$	0.01037
T_1	12	T_2	17	87.0	$T_1 \simeq T_2$	$p > .10$

gain scores were not significantly different for Treatment Group II versus the Control Group and Treatment Group I versus Treatment Group II. Therefore, there are statistically significant differences associated with treatment versus no treatment.

Discussion. Performance on the Block Design subtest requires an ability to reproduce abstract geometric designs.

Although pre-post difference scores were significant for both Treatment Groups, their gain score distribution when compared singularly with those of the Control Group, were significant only for Treatment Group I.

Many of the training activites utilized geometric figures to introduce concepts involving form comprehension. Subjects were encouraged to perform and practice tasks in which decisions about form relationships had to be made. It would appear that these activities were appropriate, and possibly more effective when applied more intensively for a greater period of time.

These results will be considered in relation to the results of the Object Assembly subtest.

Variable 10: WISC Object Assembly Subtest

The experimental findings concerning the WISC Object Assembly subtest scores are presented in Table X.

TABLE X

COMPARISONS OF WISC OBJECT ASSEMBLY SUBTEST SCORES

Mann-Whitney U Tests of
Between Group Comparison of Pre-Test Score Distribution

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	11	C	16	81.0	$T_1 \simeq C$	$p > .10$
C	16	T_2	17	112.5	$T_2 \simeq C$	$p > .10$
C	16	T_p	28	193.5	$T_p \simeq C$	0.22726
T_1	11	T_2	17	86.5	$T_1 \simeq T_2$	$p > .10$

Wilccxon Matched-Pairs Signed-Ranks Tests of Within
Group Differences Between Pre-Test and Post-Test Scores

Group	N	Decreases N	Decreases ΣRanks	Increases N	Increases ΣRanks	Indicated Relationship	Two-tailed Probability
T_1	12	1	-2.0	10	64.0	Post > Pre	$p < .01$
T_2	17	2	-12.0	12	93.0	Post > Pre	$p < .01$
C	19	5	-28.0	11	108.5	Post > Pre	$p < .05$

Mann-Whitney U Tests of
Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	11	C	16	57.0	$T_1 \simeq C$	$p > .10$
C	16	T_2	17	125.0	$T_2 \simeq C$	$p > .10$
C	16	T_p	28	182.0	$T_p \simeq C$	0.15023
T_1	11	T_2	17	67.5	$T_1 \simeq T_2$	$p > .10$

Results. An analysis of between group comparisons of the distributions of pre-test scores revealed no significant differences between the comparison groups prior to treatment.

In the analysis of comparisons or pre-test and post-test differences within groups, both Treatment Groups and the Control Group made significant gains. Differences were significant for both Treatment Groups at less than the .01 level, and significant at less than the .05 level for the Control Group.

Between group comparisons showed that the distributions of gain scores were not significantly different for any of the four pairs of comparison groups. There were no statistically significant differences associated with either treatment versus no treatment, or length and intensity of training.

Discussion. In the Object Assembly subtest, subjects are required to organize parts of familiar objects into a Gestalt.

Silverman (1968) found factors underlying both Block Design and Object Assembly to include visual organization, visual-motor coordination, and motor speed. Since these same psychological functions underlie performance on both subtests, the Control Group's differential performance on these two subtests must be explained. Children with PNLD are generally oriented to concrete solutions or ideas and possess impaired ability to abstract. (Clements and Peters, 1962; Paine, 1965) Both Object Assembly and Block Design require the organization of parts into a Gestalt. Items in the Object Assembly subtest are concrete, familiar objects, whereas Block Design items are geometric designs. The latter subtest requires a higher degree of abstract ability. The significant pre-post differences within each of the groups indicate that all children improved in ability to perform tasks dependent upon concrete orientation. However, training does appear to have increased the ability of Treatment Group subjects to recognize, organize, and motorically reproduce a geometric Gestalt which requires greater abstraction skills than does the recognition, organization, and assembly of a familiar object.

Variable 11: WISC Coding Subtest

Results concerning the WISC Coding subtest scores are summarized in Table XI.

Results. Between group comparisons of distributions of pre-test scores indicated no significant differences between the comparison groups prior to treatment.

Pre-test and post-test differences within groups were evident only in Treatment Group I, where a significance level of .05 was attained. Treatment Group II and the

TABLE XI

COMPARISONS OF WISC CODING SUBTEST SCORES

Mann-Whitney U Tests of Between Group Comparison of Pre-test Score Distribution

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	11	C	17	62.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	17	109.5	$T_2 \simeq C$	$p > .10$
C	17	T_p	28	171.5	$T_p \simeq C$	0.05817
T_1	11	T	17	90.0	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-Test and Post-Test Scores

Group	N	Decreases N	Decreases ΣRanks	Increases N	Increases ΣRanks	Indicated Relationship	Two-tailed Probability
T_1	12	1	-4.0	7	32.0	Post > Pre	$p = .05$
T_2	17	4	-33.0	12	103.0	Post > Pre	NS
		c.v.=30.0					
C	19	8	-81.5	9	71.5	Post $\simeq$ Pre	NS

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	11	C	17	63.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	17	121.0	$T_2 \simeq C$	$p > .10$
C	17	T_p	28	184.0	$T_p \simeq C$	0.10138
T_1	11	T_2	17	75.5	$T_1 \simeq T_2$	$p > .10$

Control Group did not make significant gains. The critical value for .05 for Treatment Group II has been included in Table XI. Note that Treatment Group II approached significance at the .05 level.

An analysis of between group comparisons showed that distributions of gain scores were not significantly different in any of the four pairs of comparisons.

Discussion. Speed and accuracy of learning and writing symbols is necessary for successful performance on the Coding subtest. In training, subjects were encouraged to study various drawings, then asked to reproduce them from memory. In addition, various activities stressed the development of fine-muscle coordination.

The only significance found was in the comparison of pre-test and post-test scores within Treatment Group I, although Treatment Group II showed a trend toward significance. These marginal results indicate that although some gains were achieved, more effective training activities should be devised and/or longer and more intensive training may be desirable.

In an effort to determine which of the underlying psychological functions (perception, visual memory, fine-muscle coordination and speed) were affected by treatment, each of these component functions were subjectively analyzed. The majority of Treatment subjects made fewer mistakes as a result of misperceiving than did the Control Group subjects. However, as was observed with auditory stimuli in the Digit Span subtest, many subjects in both Treatment and Control Goups had considerable difficulty in remembering the visual stimuli. Also, although the experimental subjects appeared to be more accurate in their reproductions than were the Control Subjects; in general, their motor speed was considerably reduced.

These observations seem to indicate the need for structuring more appropriate activities to stress visual memory and fine-muscle coordination. It is also possible that the greater accuracy demonstrated by the Treatment subjects was responsible for slower motor performance. From a developmental frame of reference, reduced speed is positive, as the development of greater accuracy is eventually incorporated into patterns of behavior, after which greater speed can be developed.

Perhaps a follow-up test at a later date will demonstrate the acquisition of greater speed as well as greater accuracy among Treatment Group subjects.

Variable 12: WISC Verbal IQ

Table XII contains the analyses of the WISC Verbal IQ scores.

TABLE XII

COMPARISONS OF WISC VERBAL IQ SCORES

Mann-Whitney U Tests of Between Group Comparisons of Pre-test Score Distribution

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	100.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	157.5	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	265.5	$T_p \simeq C$	0.41632
T_1	12	T_2	17	83.5	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-Test and Post-Test Scores

Group	N	Decreases N	Decreases ΣRates	Increases N	Increases ΣRates	Indicated Relationship	Two-tailed Probability
T_1	12	0	0.0	12	78.0	Post > Pre	$p < .01$
T_2	17	1	-2.5	16	150.5	Post > Pre	$p < .01$
C	19	12	-134.0	6	56.0	Post $\simeq$ Pre	NS
				c.v.=46.0			

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	21.0	$T_1 > C$	$p < .002$
T_2	17	C	19	43.0	$T_2 > C$	$p < .002$
C	19	T_p	29	64.0	$T_p > C$	0.00003
T_1	12	T_2	17	82.0	$T_1 \simeq T_2$	$p > .10$

Results. An analysis of between group comparisons of the distributions of pre-test scores revealed no significant differences between the comparison groups prior to treatment.

Within group comparisons of pre-post differences showed that both Treatment Group I and Treatment Group II made significant gains, whereas the Control Group did not. Differences for both Treatment Groups were significant at less than the .01 level. The Critical Value for .05 for the Control Group has been included in the Table for comparison with the sum of positive ranks of the Control Group. Note that the smaller sum of positive ranks indicates a greater magnitude of losses over gains.

Gain score comparisons between groups showed that the distribution of scores for the Treatment Groups were not significantly different from each other; but singularly and in combination, the Treatment Groups made stochastically higher gain scores than did the Control Group. All three differences were significant at less than the .002 level. Therefore, there are statistically significant differences associated with treatment versus no treatment; but none associated with length and intensity of treatment.

Discussion. The Verbal IQ represents the level of intelligence functioning in the verbal realm. Training appears to have been generally effective in increasing the subjects' ability to organize, conceptualize from auditory stimuli and reason abstractly, and communicate in this realm.

Variable 13: WISC Performance IQ

The analysis of the WISC Performance IQ scores appear in Table XIII.

Results. The distribution of pre-test scores were not significantly different in any of the between group comparisons.

In an analysis of within group comparisons of pre-test and post-test differences, the differences within both Treatment Groups were significant at less than the .01 level. Differences were not significant within the Control Group. The critical value for .05 for the Control Group has been included in Table XIII for comparison with the sum of negative ranks of the Control Group. Note that the smaller sum of negative ranks indicates a greater magnitude of gains over losses.

Between group comparisons showed that the distributions of gain scores of Treatment Groups I and II and the Pooled Treatment Groups were all stochastically higher than those of the Control Group. The gain score distributions of Treatment Group I were also stochastically higher than those

TABLE XIII

COMPARISONS OF WISC PERFORMANCE IQ SCORES

Mann-Whitney U Tests of Between Group Comparisons of Pre-test Score Distribution

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	108.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	146.0	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	254.0	$T_p \simeq C$	0.32493
T_1	12	T_2	17	89.5	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-Test and Post-Test Scores

Group	N	Decreases N	Decreases ΣRates	Increases N	Increases ΣRates	Indicated Relationship	Two-tailed Probability
T_1	12	0	0.0	11	66.0	Post > Pre	$p < .01$
T_2	17	2	-8.5	15	144.5	Post > Pre	$p < .01$
C	19	4	-42.0 c.v.=35.0	13	111.0	Post $\simeq$ Pre	NS

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	24.0	$T_1 > C$	$p < .002$
T_2	17	C	19	86.5	$T_2 > C$	$p < .02$
C	19	T_p	29	110.5	$T_p > C$	0.00025
T_1	12	T_2	17	48.5	$T_1 > T_2$	$p = .02$

of Treatment Group II. All four differences were significant at less than the .02 level.

Therefore, there are statistically significant differences associated with treatment versus no treatment, as well as differences associated with the length and intensity of treatment.

Discussion. The Performance IQ represents the level of intellectual functioning in the performance realm. Training appears to have been generally effective in increasing the subjects' ability to conceptualize from visual stimuli and reason abstractly, integrate visual-motor functions, and to respond in an organized manner.

The differential improvement shown by the two Treatment Groups appears to be related to training received by Treatment Group I. These findings suggest the need for longer exposure to and perhaps "massed" practice in activities designed to develop psychological functions underlying performance skills. These functions might include an awareness of visual stimuli, conceptualization from visual stimuli, abstract reasoning, visual-motor coordination, and motor accuracy and speed.

<u>Variable 14: WISC Full-Scale IQ</u>

The experimental findings concerning the WISC Full-Scale IQ scores are presented in Table XIV.

TABLE XIV

COMPARISONS OF WISC FULL-SCALE IQ SCORES

Mann-Whitney U Tests of Between Group Comparisons of Pre-test Score Distribution

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	114.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	142.0	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	256.0	$T_p \simeq C$	0.34025
T_1	12	T_2	17	93.0	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-Test and Post-Test Scores

Group	N	Decreases N	Decreases ΣRates	Increases N	Increases ΣRates	Indicated Relationship	Two-tailed Probability
T_1	12	0	0.0	12	78.0	Post > Pre	$p < .01$
T_2	17	0	0.0	17	153.0	Post > Pre	$p < .01$
C	19	8	-82.0	9	70.5	Post ≃ Pre	NS

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	11.0	$T_1 > C$	$p < .002$
T_2	17	C	19	38.5	$T_2 > C$	$p < .002$
C	19	T_p	29	49.5	$T_p > C$	0.00003
T_1	12	T_2	17	51.5	$T_1 > T_2$	$p < .05$

Results. An analysis of between group comparisons of the distributions of pre-test scores revealed no significant differences between the comparison groups prior to treatment.

In the analysis of within group pre-test and post-test differences, Treatment Group I and Treatment Group II both made significant gains at less than the .01 level. Differences were not significant within the Control Group.

Between group comparisons showed that the distributions of gain scores of Treatment Groups I and II and the Pooled Treatment Groups were all stochastically higher than those of the Control Group. Differences were all significant at less than the .02 level. The gain score distributions of Treatment Group I were also stochastically higher than those of Treatment Group II. The difference was significant at less than the .05 level.

There are statistically significant differences associated with treatment versus no treatment as well as the length and intensity of treatment.

Discussion. The WISC Full-Scale IQ represents the overall level of intellectual functioning. The full-Scale IQ score is a composite score representative of all the weighted verbal and performance subtest scores.

Findings indicate that training was generally effective in increasing the subjects' overall intellectual functioning.

The results also appear indicative of the greater benefits to be accrued from more prolonged and intensive treatment. This generalization may not hold, however, for an inspection of the separate findings for the Verbal and Performance IQ scores revealed a different picture. The effects of prolonged and intensive treatment did not have a significant influence upon verbal skills. Therefore, although the Full-Scale IQ findings indicate that longer and more intensive treatment has a significant effect upon overall intellectual functioning, a more accurate interpretation would note that most of this gain difference can be attributed to improvement in the Performance area.

In analyzing the Full-Scale IQ score findings, several separate findings merit further consideration. Although the comparisons of pre-post differences were not significant within the Control Group, note that the smaller sum of positive ranks indicates a slightly greater magnitude of of losses over gains. Again this finding should be analyzed in relation to the separate findings reported on the Verbal and Performance IQ scores. Even though none of the pre-post differences for the Control Group were significant, an analysis of the sums of the negative and positive ranks at least provides information useful for speculation. Some gain was evident in Performance IQ scores. However, a loss was demonstrated in Verbal IQ scores. Although this latter finding was not statistically significant, one might speculate that such a loss, continued over time, might be quite serious and indicate the desirability of early educational intervention focusing upon the development of basic verbal skills.

Variable 15: Bender-Gestalt Error Scores

Analyses concerning the Bender-Gestalt Error scores are summarized in Table XV.

Between group comparisons of pre-test scores demonstrated no significant differences between distributions for any of the four comparison groups.

Significant pre-post differences were found within Treatment Groups I and II. Gains for both groups were significant at less than the .01 level. Pre-post differences were not significant within the Control Group.

Gain score comparisons between groups revealed that the distributions of scores for the Treatment Groups were not significantly different from each other. Singularly and in combination, the Treatment Groups made stochastically higher gain scores than did the Control Group. The probability that the gain scores of the various Treatment Groups were drawn from the same sample as those of the Control Group was less than .02 in each case.

TABLE XV

COMPARISONS OF BENDER-GESTALT ERROR SCORES

Mann-Whitney U Tests of Between Group Comparisons of Pre-test Score Distribution

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	19	114.0	$T_1 \simeq C$	$p > .10$
T_2	17	C	19	160.0	$T_2 \simeq C$	$p > .10$
C	19	T_p	29	274.0	$T_p \simeq C$	0.48719
T_1	12	T_2	17	100.0	$T_1 \simeq T_2$	$p > .10$

Wilcoxon Matched-Pairs Signed-Ranks Tests of Within Group Differences Between Pre-Test and Post-Test Scores

Group	N	Decreases N	Decreases ΣRates	Increases N	Increases ΣRates	Indicated Relationship	Two-tailed Probability
T_1	12	10	-55.0	0	0.0	Post < Pre	$p < .01$
T_2	17	15	-131.5	1	4.5	Post < Pre	$p < .01$
C	17	10	-75.5	4	29.5 c.v.=21.0	Post ≃ Pre	NS

Mann-Whitney U Tests of Between Group Comparisons of Gain Score Distributions

$Group_1$	N_1	$Group_2$	N_2	U Value	Indicated Relationship	Two-tailed Probability
T_1	12	C	17	40.5	$T_1 > C$	$p < .02$
T_2	17	C	17	71.5	$T_2 > C$	$p < .02$
C	17	T_p	29	112.0	$T_p > C$	0.00104
T_1	12	T_2	17	84.0	$T_1 \simeq T_2$	$p > .10$

Thus, for this variable, statistically significant differences are associated with treatment versus no treatment; but there was no statistically significant differences associated with length and intensity of training.

Discussion. Performance on the Bender-Gestalt reflects the level of development of visual motor perception and involves both visual perception and motoric expression.

An evaluation of the protocols is expressed in error scores. Each mistake is recorded as an error score. Therefore, a favorable difference in pre-post scores is expressed as a loss or as fewer errors.

Treatment seems to have been generally effective in increasing the subjects' ability to translate an accurate perception into an appropriate motoric expression. Both receptive and expressive skills are involved, and unless gross difficulties are noted in one or the other, it is difficult to distinguish between them. As no such gross disturbance in one or the other was noted in any case, it may be assumed that training affected improvement in both reception and expressive skills.

One factor must be discussed in conjunction with the general improvement in visual-motor perception noted above. In many cases, the brain is able to compensate for malfunctioning areas through reorganization of its processes to utilize undamaged areas. Compensation may also involve a behavioral reorganization in which alternative or supplementary behaviors are utilized. For example, an impulsive child's performance on the Bender-Gestalt may reflect a behavioral reorganization if he demonstrates a compulsive counting and recounting of the dots and circles on the stimulus cards before reproducing the simulus figures. An analysis of individual performances showed that after treatment many of these subjects more often demonstrated compensatory behaviors such as tracing the stimulus design with their fingers before drawing, rotating the stimulus card and/or their paper, using their hands or the edge of their paper as a ruler, and checking and rechecking the number of dots and circles. Therefore, an improvement in perceptual-motor functions may be reflecting the acquisition of appropriate compensatory behaviors.

The possible interaction of one intervening variable (the effects of which cannot be measured) with training must be considered. Koppitz (1964) noted that with an average or above intelligence and sufficient motivation to succeed, the development of compensatory behaviors is likely. Training emphasized the development of success expectations, since a majority of children with PNLD have developed failure expectations due to repeated failures.

It is not known to what extent this training emphasis had upon motivation, and thus, test performance.

Improvements in execution of Bender-Gestalt designs may be related to similar improvements noted in WISC Block Design and Object Assembly subtests. Similar improvements were not noted in the WISC Coding subtest. However, not only does this particular subtest provide a measure of visual-motor coordination, but it also taps visual memory and motor speed skills, neither of which are required for successful performance on the Bender-Gestalt.

Summary

Presented in Table XVI is a summary of significant comparisons of the 15 dependent variables.

The analysis of pre-test score distributions revealed only three significant relationships out of a possible 60. Treatment Group I and the Pooled Treatment Groups were stochastically higher than the Control Group in Picture Arrangement subtest scores; and the Pooled Treatment Groups made stochastically higher scores than the Control Group on the Comprehension subtest.

TABLE XVI

SUMMARY OF COMPARISONS SIGNIFICANT AT THE .05 LEVEL

Variable	Between Pre-Test Score Distributions				Within T_1	T_2	C	Between Gain Score Distributions			
Information	--	--	--	--	Gain	Gain	--	$T_1 > C$	$T_2 > C$	$T_p > C$	--
Comprehension	--	--	$T_p > C$	--	Gain	Gain	--	$T_1 > C$	$T_2 > C$	$T_p > C$	--
Arithmetic	--	--	--	--	Gain	--	--	$T_1 > C$	--	--	--
Similarities	--	--	--	--	Gain	Gain	--	--	--	--	--
Vocabulary	--	--	--	--	Gain	Gain	--	$T_1 > C$	$T_2 > C$	$T_p > C$	--
Digit Span	--	--	--	--	--	--	--	--	--	--	--
Picture Completion	-	--	--	--	Gain	Gain	--	$T_1 > C$	--	$T_p > C$	$T_1 > T_2$
Picture Arrangemt.	$T_1 > C$	--	$T_p > C$	--	Gain	--	--	--	--	--	--
Block Design	--	--	--	--	Gain	--	--	--	--	--	--
Object Assembly	--	--	--	--	Gain	Gain	Gain	--	--	--	--
Coding	--	--	--	--	Gain	--	--	--	--	--	--
Verbal I.Q.	--	--	--	--	Gain	Gain	--	$T_1 > C$	$T_2 > C$	$T_p > C$	--
Performance I.Q.	--	--	--	--	Gain	Gain	--	$T_1 > C$	$T_2 > C$	$T_p > C$	$T_1 > T_2$
Full Scale I.Q.	--	--	--	--	Gain	Gain	--	$T_1 > C$	$T_2 > C$	$T_p > C$	$T_1 > T_2$
Bender Error Scores	--	--	--	--	Loss	Loss	--	$T_1 > C$	$T_2 > C$	$T_p > C$	--

With these three exceptions, the various comparison groups may be assumed to have been drawn from the same population prior to treatment.

In comparing pre-test and post-test scores within groups, changes in a favorable direction were noted in 14 out of 15 variables for Treatment Group I. Treatment Group II showed favorable changes in 11 of the 15 variables. The Control Group demonstrated only one favorable change.

None of the three groups showed significant changes in the Digit Span subtest scores. Only Treatment Group I showed changes in Arithmetic, Picture Arrangement, and Coding. In no case did Treatment Group II show a significant change for a variable in which Treatment Group I did not also show a significant change. All three groups showed significant gains in Object Assembly subtest scores, the only variable in which the Control Group demonstrated significant change.

The crucial tests in this study in relation to the independent variables were those comparing gain score distributions between groups. Comparisons of treatment versus no treatment involved comparisons of the Treatment Groups singularly and in combination with the Control Group. Differences related to length and intensity of treatment were assessed by comparing the distribution of the two treatment groups.

Gain scores for Treatment Group I were stochastically higher than those of the Control Group for 10 of the 15 variables, excluding Similarities, Digit Span, Picture Arrangement, Object Assembly, and Coding. Treatment Group II made stochastically higher gain scores than the Control Group on 7 of the 15 variables, excluding those listed for Treatment Group I above, plus Arithmetic, Picture Completion, and Block Design. The Pooled Treatment Groups made stochastically higher gain scores than the Control Group in 9 of the 15 variables, excluding those listed above for Treatment Group I, as well as Arithmetic.

Differences between the Treatment Groups were significant only for Picture Completion, Performance and Full-Scale IQ Scores. Differences between Treatment Group I and Treatment Group II are further suggested by the regularity with which significance levels within groups and between gain score distributions were significant for Treatment Group II only if they were also significant for Treatment Group I.

On the basis of the above findings, it may be said that there are differences associated with treatment versus no treatment for Information, Comprehension, Arithmetic, Vocabulary, Picture Completion, Block Design, Verbal, Performace, and Full-Scale IQs, and the Bender-Gestalt Error scores. There were significant differences related to intensity and length of treatment for Picture Completion, Performance and Full-Scale IQ scores. Indications of differences associated with prolonged and intensive treatment were also noted for Arithmetic and Block Design.

CHAPTER V

SUMMARY AND CONCLUSION

General Summary of the Investigation

Involved in this investigation were the development, operation, and evaluation of an educational program for primary children with psychoneurological learning disabilities (PNLD). Groups studied included Treatment Group I which consisted of 12 children who received training four times per week for six consecutive weeks, Treatment Group II composed of 17 children who received training two times per week for six consecutive weeks, and the Control Group which consisted of 19 children who received no treatment. For some analyses, the two Treatment Groups were pooled. The sample included pupils from six public schools.

The purposes of this study were to assess the effects of treatment versus no treatment, and to determine if there were significant differences associated with length and intensity of treatment.

In this investigation, screening procedures were utilized to eliminate mentally retarded children and children with primary emotional problems. A Behavioral Checklist was developed for use by public school teachers for initial identification of learning disabilities and behavioral manifestations characteristic of PNLD. Standardized screening instruments utilized were the Peabody Picture Vocabulary Test and the Bender Visual-Motor Gestalt Test (Bender-Gestalt). The Wechsler Intelligence Scale for Children (WISC) was utilized to assess intellectual strengths and weaknesses. Performance on each of the WISC subtests, IQ scores, and the Bender-Gestalt was analyzed.

The Mann-Whitney U Test was used to assess differences in distributions of pre-test scores and pre-post gain scores obtained from the WISC and the Bender-Gestalt, for each of the four following between-group comparisons: Treatment Group I (T_1) and the Control Group (C); Treatment Group II (T_2) and the Control Group (C); the Pooled Treatment Groups (T_p) and the Control Group (C); and Treatment Group I and Treatment Group II. The first three comparisons pertain to treatment versus no treatment. Length and intensity of training was assessed by the fourth comparison. Within each of three groups (T_1, T_2, and C), the Wilcoxon Matched-Pairs Signed-Ranks Test was used to assess the significance of differences between the pre and post-test scores obtained on the WISC and the Bender-Gestalt.

Summary of Results

An analysis of pre-test score distribution between groups revealed three significant relationships out of a possible 60. T_1 and T_2 were stochastically higher than C on the WISC Picture Arrangement subtest scores; and T_p was stochastically higher than C on the WISC Comprehension subtest scores. With these exceptions, the various comparison groups may be assumed to have been drawn from the same population prior to treatment.

Comparisons of pre-post differences within groups indicated favorable changes in 14 out of 15 variables for T_1 , 11 out of 15 for T_2 , and 1 out of 15 for C. None of the groups showed significant changes in Digit Span; and all three groups showed favorable changes in Object Assembly. Only T_1 showed significant changes in Arithmetic, Picture Arrangement, and Coding.

An analysis of gain score distributions between groups revealed that gain scores for T_1 were stochastically higher than those of C for 10 of the 15 variables, 7 out of 15 for T_2 , and 9 out of 15 for T_p. Differences between Treatment Groups were significant only for Picture Completion, Performance, and Full-Scale IQ scores.

In summary, there are significant differences associated with treatment versus no treatment for scores on the WISC Information, Comprehension, Arithmetic, Vocabulary, Picture Completion, and Block Design subtests, the Vocablulary, Performance, and Full-Scale IQ's, and the Bender-Gestalt Error Scores. Although significant gains were evident in within group assessments for one or both Treatment Group scores on the WISC similarities, Picture Arrangement, Object Assembly, and Coding subtests; between group comparisons of gain scores were not significant. There were significant differences related to intensity and length of treatment for the Picture Completion subtest and Performance and Full-Scale IQs. Indications of differences associated with this variable were also noted for the Arithmetic and Block Design subtests.

Favorable behavioral changes associated with treatment include: (a) greater alertness to factual information (as measured by the WISC Information subtest); (b) increased ability to reason in practical situations (Comprehension); (c) an improved ability to verbalize and communicate an understanding of word concepts (Vocabulary); and (d) an increased ability to organize, conceptualize from auditory and visual stimuli, and think abstractly in both verbal and performance realms (Verbal, Performance, and Full-Scale

IQs). Subjects receiving treatment also demonstrated better visual-motor coordination and motor accuracy. (Bender-Gestalt).

Associated with length and intensity of treatment were responses demonstrating greater ability to differentiate and integrate visual detail (Picture Completion), and an increased level of general intellectual functioning in the performance realm (Performance IQ). Significant gain scores within T_1 (but not T_2) suggest that increased comprehension and reasoning in numerical problem solving (Arithmetic), and an improved skill in reproducing abstract geometric designs (Block Design) are also related to the longer and more intensive treatment.

As both T and C groups demonstrated gain in an ability to recognize and assemble familiar, concrete objects (Object Assembly), treatment effects were not significant. Treatment did not significantly improve auditory and visual memory skills (Digit Span and Coding, respectively). Although pre-post differences within one or both Treatment Groups suggested improvements in generalization skills (Similarities), perception and interpretation of social situations (Picture Arrangement), and speed and accuracy in learning and writing symbols (Coding), gain score distributions were not significantly different from those of the

Control Group. In view of these marginal or negative findings, it is apparent that treatment more effective in developing these skills must be sought.

In conclusion, treatment utilizing the educational approach developed in this study was generally effective in producing favorable changes in selected behaviors and merits further developmental effort.

Limitations and Recommendations

One of the problems encountered in the course of this investigation was the extreme difficulty in controlling variables likely to affect the outcome in some way. For example, behavioral changes due to increased motivation were difficult to evaluate apart from actual changes in skill level. This is especially true of children with PNLD for due to the cumulative effects of repeated failure, success motives are generally poorly developed. Failure expectations and the accompanying negative emotional responses are common. Thus, plans for encouraging motivational changes were incorporated into the study by providing (a) individual attention, (b) the opportunity for positive teacher-pupil relationships to develop, and (c) parent and teacher counseling. Therefore, in an attempt to obtain optimal results, no effort was made to control for the "Hawthorne" effect. It is possible that significant changes in selected behaviors reflect changes in motivation as well as increased skills. Furthermore, it may be that increased ability to perform certain tasks became possible only after motivational changes occurred. Ideally, similarly selected subjects involved in a different type of remedial program would have been studied in relation to subjects receiving the educational training developed in this study. Likewise, additional control groups are needed in order to assess the effect of measurement.

These findings also indicate the need for more information regarding teacher personality variables and appropriate modes of reinforcement in relation to desired motivational changes. In addition, the importance of management through structure is stressed in much of the literature. Empirical evidence regarding the appropriateness of different types of classroom environments for children with PNLD might provide criteria for teacher selection.

Because of staff and budget limitations, and since volunteer help can be stretched only so far, much of the testing was conducted by the investigator who also served as teacher and parent group leader. This represents a degree of involvement that approaches a vested interest in the outcome of the study. Although every effort was made to equate testing conditions between experimental and control groups (for example, in the use of praise and other factors affecting test rapport), it is impossible to disregard the possible effects of prior relationships upon test performance. In future studies, adequate staffing for independent evaluation and possibly some version of the double-blind technique are recommended.

Also, in this study, due to the small number of available female subjects, variations related to sex differences were not investigated. Since fewer females than males are referred, the advantage of a larger initial population is apparent. As no studies were found which controlled for sex variation, such an evaluation is recommended.

Because children with PNLD exhibit diffuse and varied behavioral deficits, it would be desirable to include more measures tapping different kinds of behavior. If a wider variety of affected areas could be profiled, more effective educational planning could be undertaken.

Since there is no acceptable, standardized test for evaluating auditory perception, deficiencies in auditory perception must be inferred from observations of behavior on other tests. This specific deficiency is more easily observed on certain diagnostic reading or language tests.

Furthermore, as the development of speech and language skills and reading skills is often affected by neurological impairments, a careful assessment in each of these areas is recommended. Also, the need for an appropriate, standardized test designed to screen for deficits in auditory perception is great.

This investigation generated a number of ideas which seem to merit further consideration. For example, studies are needed which assess the relative feasibility of adapting such training to the regular classroom, including a separate training class within the school, or training outside the school, as was done in this study.

In considering the advantages and disadvantages of adapting the educational program proposed in this study to the regular classroom, it is impossible to disregard several important factors. First, with respect to the number of referrals received, there appears to be a large number of children who are unable to adequately adapt to the regular academic environment. Although speech and reading services are routinely made available, specialists in both fields maintain that perceptual-motor skills, visual and auditory perception, and motor proficiency, for example, are prerequisite to the development of adequate language and reading skills. Yet structured practice in these basic prerequisite skills is limited for primary age children. In some cases observed, primary children actually sat and passively watched television presentations of musical and physical education exercises. Furthermore, directed activities in physical education are not often initiated until the fourth or fifth grade, well after the critical periods for the development of these skills. How can these practices be reconciled with recommendations for early educational intervention? Many of the activities proposed in this educational program are suitable for large classrooms, and actually represent little more than an awareness of and an attempt to facilitate the maturation of regular developmental processes with appropriate sensitivity to extreme individual differences. The classroom teacher can and should be the most effective agent in influencing the development of these skills, for no other professional person has greater opportunity to recognize learning difficulties as they occur, and initiate appropriate educational measures at the proper point of development. All too often referrals represent several years of complacent assurance that the child will eventually "outgrow" manifest problems. Then, instead of educational intervention at critical points of development, extensive remedial unlearning and relearning are often necessary, and much less effective.

For children needing remedial training, regular classrooms are not equipped to meet the wide variety of educational and social needs manifest by these children. A separate training class in the school could, however, provide a more effective means for meeting these manifest needs. Another reason for including this service in the school relates to a parental cooperation factor. For those children whose parents cannot or will not become involved in educational programs designed to enhance the attainment of skills basic to learning, the need for considerable additional effort outside the regular class is indicated.

In weighing the advantages of a training program conducted outside the public school setting, one must necessarily consider the importance of parent involvement. Stressed in the literature is the key role which parent participation in training has upon the ultimate outcome of the educational treatment. Furthermore, parent attitudes pertaining to their neurologically impaired children often involve guilt, shame, and/or denial of difficulty. Often, parents need as much help as do their children. Neutral training territory removes evaluation threats and can be conducive to openness and frankness not always possible in the regular school setting. It is also possible that the clinic environment is better able than a public school to convey the seriousness of the problems involved.

It would appear that the greatest advantage of conducting training outside the school setting involves parent participation. However, a sensitive classroom teacher could provide equally well for many of the expressed needs of these parents. A counselor or school psychologist could also initiate group counseling for these parents.

Another area inviting investigation involves the effects of parental attitudes and involvement upon improvement noted in their children. Subjective observations made during this study suggest that the degree and kind of parent involvement are major factors in both the short-range and long-range effectiveness of training.

In assessing the empirical literature, it was found that many of the studies depended upon comparisons between neurologically impaired children, who had been referred for treatment, with non-neurologically impaired children, so defined because they had not been referred. As a result, measurements often demonstrated little or no significance. It appears that children designated as non-neurologically impaired should be diagnosed as such. A lack of referral, or even absence of gross symptoms does not guarantee a lack or impairment. What is needed are studies in which the subjects studied are appropriately defined.

Conclusion

In conclusion, the results of this investigation suggest that certain increases in basic skills underlying intellectual functioning can be attained through educational remediation. A number of significant findings suggest the efficacy of the educational approach designed for use in this study. Thus, it would appear that, on the basis of these data, there would be some utility in using this approach with primary age children with similar needs.

It should be pointed out, however, that this educational program requires further developmental effort. Immediate attention should be directed toward development of effective methods for training auditory and visual memory. In addition, methods designed to develop generalization skills, perception and interpretation of social situations, and motor speed merit further analysis.

Improvement in some skill areas, especially in the performance realm, were related to longer and more intensive treatment. Therefore, it would appear that certain types of expressive skills may require a longer period of concentrated practice.

Clinical impressions are supportive of significant findings which suggest a possible superiority of the longer and more intensive treatment in effecting favorable changes in certain selected behaviors. Parents of children who received this training and training program teachers more often reported more dramatic and observable changes. Although attitude changes, for example, were not evaluated in a systematic fashion, changes in behaviors related to personality factors were more apparent in children receiving the longer and more intensive treatment.

Further research conducted with similar subjects might provide some basis for assessing the relative merits of the various educational approaches suggested in the literature. In addition, consideration should be given to the applicability of these various educational approaches to different subject populations. Until additional research in these areas has been conducted, the generalized predictive value of these findings is necessarily limited.

A SELECTED BIBLIOGRAPHY

American Academy of Pediatrics and American Academy of Neurology. "Doman-Delacato Treatment of Neurologically Handicapped Children." Exceptional Children. (Jan., 1968), 365-366.

American Psychiatric Association. The Diagnostic and Statistical Manual: Mental Disorders. Washington, D. C.: Author, 1952.

Anderson, C. and Plymate, H. "Management of the Brain Damaged Adolescent." American Journal Orthopsychiatry, 32 (1962), 492-501.

Anderson, W. W. "The Hyperkinetic Child: A Neurological Appraisal." Neurology, 13 (1963), 168-973.

Bakwin, Harry. "Cerebral Damage and Behavior Damage in Children." Journal of Pediatrics, 34 (1949), 371-382.

Baldwin, M. V. "A Note Regarding the Suggested Use of the Bender Gestalt Test as a Measure of School Readiness." Journal of Clinical Psychology, 6 (1950), 412-415.

Baldwin, R. W. and Kenny, T. J. "Medical Treatment of Behavior Disorders." Learning Disorders, 2 (1966), 313-327.

Barnes, T. C. "Electroencephalographic Validation of Rorschach, Hunt, and Bender Gestalt Test." American Psychologist (Abstract), 5 (1950), 322.

Baroff, G. "Bender Gestalt Visuo-Motor Function in Mental Defectives." American Journal of Mental Deficiency, 61 (1957), 753-760.

Barsch, Ray H. "Counseling the Parent of the Brain-Damaged Child." Journal of Rehabilitation, XXVII (May-June, 1961), 1-3.

Barsch, Ray H. "Teacher Needs---Motor Training." *The Teacher of Brain-Injured Children: A Discussion of the Bases for Competency*. Ed. William M. Cruickshank. Syracuse: Syracuse University Press, 1966.

Bateman, Barbara. "An Educator's View of a Diagnostic Approach to Learning Disabilities." *Learning Disorders*, I (1965), 219-239.

Beck, H. S. "A Comparison of Convulsive, Non-Convulsive Organic and Non-Organic Public School Children." *American Journal Mental Deficiency*, 63 (1959), 866-875.

Beck, Harry S. "Detecting Psychological Symptoms of Brain Injury." *Exceptional Children*, 28-1 (Sept. 1961), 57-62.

Beck, H. S. and Lam, R. L. "Use of the WISC in Predicting Organicity." *Journal of Clinical Psychology*, 11 (1955), 154-158.

Bender, L. *A Visual Motor Gestalt Test and Its Clinical Use*. New York: American Orthospychiatric Assoc., Inc., 1938.

Bender, M. B. *Disorders in Perception*. Springfield, Ill.: Charles C. Thomas, 1952.

Bender, L. (ed). *Psychopathology of Children with Organic Brain Disorders*. Springfield, Ill.: Charles C. Thomas, 1956.

Bender, L. *Visual Motor Gestalt Test: Cards and Manual of Instructions*. New York: The American Orthopsychiatric Assoc., Inc., 1946.

Bensberg, G. J. "Performance of Brain Injured and Familial Mental Defectives on the Bender Gestalt Test." *Journal of Consulting Psychology*, 16 (1952), 61-64.

Benton, A. L. *Right-Left Discrimination and Finger Localization*. New York: Paul B. Hoeber-Harper & Row, 1959.

Billingslea, F. "The Bender-Gestalt: An Objective Scoring Method and Validating Data." *Journal of Clinical Psychology*, 4 (1948), 1-27.

Birch, H. G. (ed). Brain Damage in Children---The Biological and Social Aspects. Baltimore: Williams and Wilkins, 1964.

Birch, H. G., Proctor, F., Bortner, M. and Lowenthal, M. "Perception in Hemiplegia: I. Judgment of Vertical and Horizontal by Hemiplegic Patients." Archives of Physical Medicine and Rehabilitation, 14 (1960a), 19-25.

Birch, H. G., Proctor, F., Bortner, M. and Lowenthal, M. "Perception in Hemiplegia: II. Judgment of the Median Plane." Archives of Physical Medicine and Rehabilitation, 14 (1960b), 71-75.

Birch, H. G., Belmont, I., Reilly, T., and Belmont, L. "Visual Verticality in Hemiplegia." Archives of Neurology, 5 (1961), 444-453.

Blum, R. A.,Blum, J.S., and Chow, K. L. "The Production of Unilateral Epileptiform Convulsions from Otherwise Quiescent Foci by the Administration of Benzedrine." Science, 108 (1948), 560-561.

Boder, Elena. "A Neuropediatric Approach to the Diagnosis and Management of School Behavioral and Learning Disorders." Learning Disorders, 2 (1966), 15-44.

Boshes, B. and Myklebust, H. R. "A Neurological and Behavioral Study of Children with Learning Disorders." Neurology, 14 (1964), 7-12.

Bradley, C. "The Behavior of Children Receiving Benzedrine." American Jounral of Psychiatry, 94 (1937), 577-585.

Bradley, Charles. "Characteristics and Management of Children with Organic Brain Damage." Pediatrics Clinics of North America (Nov., 1957), 1049-1060.

Bradley, Charles. "Organic Factors in the Psychopathology of Childhood." Psychopathology of Childhood. Eds. Paul H. Hoch and Joseph Zubin. New York: Grune and Stratton, 1955, 80-104.

Breakey, A. S. "Ocular Findings in Cerebral Palsy." Archives of Ophthalmology, 53 (1955), 852-856.

Brueckner, Leo J. and Bond, Guy L. The Diagnosis and Treatment of Learning Difficulties. New York: Appleton-Century-Crofts, inc., 1955.

Burks, H. F. "The Effect on Learning of Brain Pathology." Exceptional Children, 24 (1957), 169-172.

Burks, H. F. "The Hyperkinetic Child." Exceptional Children, 27 (1960) 18-26.

Burnett, A. "Comparison of the PPVT, Wechsler-Bellevue, and Stanford-Binet on Educable Retardates." American Journal of Mental Deficiency, 69 (1965), 712-715.

Buros, O.K. (ed.) The Sixth Mental Measurements Yearbook. Highland Park, New Jersey: Gryphon Press, 1965.

Byrd, E. "The Clinical Validity of the Bender Gestalt Test With Children: A Developmental Comparison of Children in Need of Psychotherapy and Children Judged Well Adjusted." Journal of Projective Techniques, 20 (1956) 127-136.

Carmichael, L. Manual of Child Psychology. New York: Wiley, 1954.

Chorost, S. B., Spivack, G. and Levine, M. "Bender-Gestalt Rotations and EEG Abnormalities in Children." Journal of Consulting Psychology, 23 (1959), 559.

Clawson, A. "The Bender Visual Motor Gestalt Test as an Index of Emotional Disturbance in Children." Journal of Projective Techniques, 23 (1959), 198-206.

Clawson, A. The Bender Visual Motor Gestalt for Children: A Manual. Beverly Hills, Calif.: Western Psychological Services, 1962.

Clemmens, R. L. "Minimal Brain Damage in Children---An Interdisciplinary Problem." Children, 8-5 (Sept.-Oct., 1961), 179-183.

Clements, Sam D. "Minimal Brain Dysfunction in Children, Terminology and Identification: Phase One of a Three-Phase Project." National Institute of Neurological Diseases and Blindness Monograph, No. 3. Public Health Service Publication No. 1415. Washington D. C.:

U. S. Government Printing Office, 1966.

Clements, S. D., Lehtinen, L. E., and Lukens, J. E. Children with Minimal Brain Injury---a Symposium. National Society for Crippled Children and Adults, Inc., 1964.

Clements, S. D. and Peters, J. E. "Minimal Brain Dysfunctions in the School-Age Child: Diagnosis and Treatment." Archives of General Psychiatry, 6 (1962), 185-197.

Clements, S. D. and Peters, J. E. "Multiple Causality: Toward Clarification of the Diagnostic Dilemma in Child Guidance." Learning Disorders, 1 (1965), 197-218.

Cobrinik, L. "The Performance of Brain Injured Children on a Variety of Hidden Figure Tasks." American Journal of Psychology, 72 (1959), 566-571.

Cohn, Robert. "The Neurological Study of Children with Learning Disabilities." Exceptional Children, 31-4 (Dec., 1964), 179-185.

Cohn, R. "The Role of 'Body Concept' in Pattern of Ipsilateral Clinical Extinction." Archives of Neurology and Psychiatry, 70 (1953), 503-509.

Crawford, John E. Children with Subtle Perceptual-Motor Difficulties. Pittsburgh: Stanwix House, Inc., 1966.

Cruickshank, Willian M. The Brain-Injured Child in Home, School, and Community (1st ed). Syracuse: Syracuse University Press, 1967a.

Cruickshank, William M. "The Education of the Child with Brain Injury. Education of Exceptional Children and Youth. (1956b), 238-283.

Cruickshank, William M., and Johnson, G. Orville (eds). Education of Exceptional Children and Youth, 2nd ed. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1967.

Cruse, D. B. "Effects of Distraction Upon the Performance of Brain-Injured and Familial Retarded Children." American Journal of Mental Deficiency, 66 (1961), 86-92.

Dale, E.,and Reichert, D. Bibliography of Vocabulary Studies. Columbus, Ohio: Ohio State University, Bureau of Educational Research, 1957.

Daryn, E. "Problems of Children with Diffuse Brain Damage." Archives of General Psychiatry, 4 (1961), 299-306.

Denhoff, D. "Emotional and Psychological Background of the Neurologically Handicapped Child." Exceptional Children, 27 (1961), 347-349.

Denhoff, E., Laufer, M., and Holden, R. "The Syndromes of Cerebral Dysfunction." Journal of Oklahoma State Medical Association, 52 (1959), 360-366.

Denhoff, E., and Robinault, I. Cerebral Palsy and Related Disorders. New York: McGraw-Hill, 1961.

Diller, L., and Birch, H. G. "Psychological Evaluation of Children with Cerebral Damage." Brain Damage in Children. Ed H. G. Birch. (1964), 27-45.

Doll, E. A. "Behavior Syndromes of CNS Impairment." The Exceptional Child. eds. J. Magary and J. Eichorn. New York: Holt, Rinehart and Winston, Inc., 1960.

Doll, Edgar A. "Mental Deficiency versus Neurophrenia." American Journal of Mental Deficiency, 57 (1953), 477-480.

Dolphin, J. E., and Cruickshank, W. M. "Pathology of Concept Formation in Children with Cerebral Palsy." American Journal of Mental Deficiency, LVI (1951), 386-392.

Doman, R. J., Spitz, E. B., Zucman, E., Delacato, C. H., and Doman, G. "Children with Severe Brain Injuries." The Journal of the American Medical Association, 174 (1960), 257-262.

Dunn, Lloyd M. Expanded Manual for the Peabody Picture Vocabulary Test. Minneapolis: American Guidance Service, Inc., 1965.

Dunn, Lloyd M. "Minimal Brain Dysfunction: A Dilema for Educators." Educating Children with Learning Disabilities: Selected Readings. Eds. E. C. Frierson and

W. B. Barbe. New York: Appleton-Century-Crofts, 1967, 117-132.

Dunn, Lloyd M. Peabody Picture Vocabulary Test. Minneapolis: American Guidance Service, Inc., 1959.

Dunn, L. M. and Brooks, Sayde T. Training School Bulletin, 57 (1960), pp. 35-40.

Dunsing, Jack D. and Kephart, Newell C. "Motor Generalizations in Space and Time." Learning Disorders, 1 (1965).

Eber, M. "A Bender Gestalt Validity Study: The Performance of Mentally Retarded Children." Dissertation Abstracts, 18 (1958), 296.

Effron, A. and Freedman, A. "The Treatment of Behavior Disorders in Children with Benadryl." Journal of Pediatrics, 42 (1953), 261-266.

Eisenberg, L. "Behavioral Manifestation of Cerebral Damage in Childhood." Brain Damage in Children---The Biological and Social Aspects. (1964), 61-76.

Eisenberg, L. "Psychiatric Implications of Brain Damage in Children." Psychiatric Quarterly, 31 (1957), 72-92.

Ellingson, Gareth. The Shadow Children: A Book About Children's Learning Disorders. Chicago: Topaz Books, 1967.

Fabian, A. A. "Vertical Rotation in Visual-Motor Performance---Its Relationship to Reading Reversals." Journal of Educational Psychology, 36 (1945), 129-154.

Feldman, I. "Psychological Differences Among Moron and Borderline Mental Defectives as a Function of Etiology: I Visual-Motor Functioning." American Journal of Mental Deficiency, 57 (1953), 484-494.

Forgnone, C. "Effects of Group Training in Visual Perception and Language Development Upon the Abilities of Special Class Retardates." (unpub. Ph.D. dissertation, Peabody College, 1966).

Foshee, J. G. "Studies in Activity Level: I. Simple and Complex Task Performance in Defectives." American Journal of Mental Deficiency, 62 (1958), 882-886.

Freidus, E. S. New Approaches in Special Education of the Brain-Injured Child. New Jersey: Assoc. for Brain-Injured Children, undated.

Frierson, Edward C. and Barbe, Walter B. Educating Children with Learning Disabilities: Selected Readings. New York: Appleton-Century-Crofts, 1967.

Frosch, J. and Wortis, S. "A Contribution to the Impulse Disorders." American Journal of Psychiatry, 111 (1954), 132-138.

Frostig, M. and Horne, D. "An Approach to the Treatment of Children with Learning Disorders." Learning Disorders, 1 (1965), 293-305.

Frostig, M., Lefever, D. W. and Whittlesey, R. R. B. "A Developmental Test of Visual Perception for Evaluating Normal and Neurologically Handicapped Children." Perceptual and Motor Skills, 12 (1961), 383-394.

Frostig, M. Lefever, D. W., Whittlesey, J. R. B., and Maslow, P. Marianne Frostig Developmental Tests of Visual Perception, 3rd ed. Palo Alto: Consulting Psychologists Press, Inc., 1961-64.

Gallagher, J. J. "A Comparison of Brain-injured and Non-Brain-injured Mentally Retarded Children on Several Psychological Variables." Monographs of the Society for Research in Child Development, 22-2 (1957).

Gallagher, J. J. Tutoring of Brain-Injured Mentally Retarded Children. Springfield, Ill.: Charles C. Thomas, 1960.

Gardner, W. I., Cromwell, R. L. and Foshee, J. G. "Studies in Activity Level: II. Effects of Distal Visual Stimulation in Organics, Familials, Hyperactivites." American Journal of Mental Deficiency, 63 (1959), 1028-1033.

Garrett, Jane. "Comparison of the Peabody Picture Vocabulary Test and Wechsler Intelligence Scale for Children." (Master's thesis, George Peabody College for Teachers, Nashville, Tenn., 1959).

Gesell, A. L. and Amatruda, C. S. Developmental Diagnosis, 2nd ed. New York: Paul B. Hoeber, Inc., 1947.

Getman, G. How to Develop Your Child's Intelligence. Luverne, Minn.: The Announcer Press, 1962.

Gobetz, Wallace. "A Quantification, Standardization, and Validation of the Bender-Gestalt Test on Normal and Neurotic Adults." Psychological Monographs, 67(6)-356 (1953), 28.

Goldberg, L. R. "The Effectiveness of Clinician's Judgments: The Diagnosis of Organic Brain Damage from the Bender Gestalt Test." Journal of Consulting Psychology, 23 (1959), 25-33.

Goldstein, K. Language and Language Disturbances. New York: Grune and Stratton, 1948.

Goldstein, K. Pediatric Problems in Clinical Practice. New York: Grune and Stratton, 1954.

Goldstein, K. and Scheerer, M. "Abstract and Concrete Behavior: An Experimental Study With Special Tests." Psychological Monographs, 53-2 (1941), p. 151.

Goodenough, F. L. and Harris, D. B. Goodenough-Harris Drawing Test. New York: Harcourt, Brace, and World, Inc., 1926-1963.

Griffith, R. M. and Yamahiro, R. S. "Reliability-Stability of Subtest Scatter on the Wechsler-Bellevue Intelligence Scales." Journal of Clinical Psychology, 14 (1958), 317-318.

Guertin, W. H., Frank.,G. H., and Rabin, A. I. "Research with the Wechsler-Bellevue Intelligence Scale: 1950-1955." Psychological Bulletin, 53 (1956), 235-257.

Guertin, W. H., Ladd, C. E., Frank, G. H., Rabin, A. I., and Hiester, D. S. "Research with the Wechsler Intelligence Scales for Adults: 1960-1965." Psychological

Bulletin, 66 (1966), 385-409.

Guertin, W. H., Rabin, A. I., Frank, G. H., and Ladd, C. E. "Research with the Wechsler Intelligence Scales for Adults: 1955-1960." Psychological Bulletin, 59 (1962), 1-26.

Gunzberg, H. C. "Scope and Limitations of the Goodenough Drawing Test Method in Clinical Work with Mental Defectives." Journal of Clinical Psychology, 11 (1955), 8-15.

Halpern, F. "The Bender Gestalt Test." Eds. H. H. Anderson and G. L. Anderson. An Introduction to Projective Techniques. New York: Prentice-Hall, 1951, 324-340.

Halpin, V. G. 'Rotation Errors Made by Brain-Injured and Familial Children on Two Visual Motor Tests." American Journal of Mental Deficiency, 59 (1955), 485-489.

Hanvik, L. "A Note on Rotation in the Bender Gestalt Test as Predictors of EEG Abnormalities in Children." Journal of Clinical Psychology, 9 (1953), 399.

Hanvik, L. J., Nelson, S. E., Hanson, H. B., Anderson, A.S. Dressler, W. H., and Zarling, V. R. "Diagnosis of Cerebral Dysfunction in Children." American Journal of Diseases of Children, 101 (1961), 364-375.

Harris, A. J. "Lateral Dominance, Directional Confusion, and Reading Disability." Journal of Psychology, 44 (1957), 283-294.

Harris, A. J., and Shakow, D. "The Clinical Significance of Numerical Measures of Scatter on the Stanford-Binet." Psychological Bulletin, 34 (1937), 134-150.

Hellmuth, Jerome. Learning Disorders, 1. Seattle: Special Child Publications of the Seattle Seguin School, Inc., 1965.

Hellmuth, Jerome Learning Disorders, 2. Seattle: Special Child Publications of the Seattle Seguin School, Inc., 1966.

Herman, K. Reading Disability. Springfield, Ill.: Charles

C. Thomas, 1959.

Himelstein, P. and Herndon, J. S. "Comparison of the WISC and PPVT with Emotionally Disturbed Children." Journal of Clinical Psychology, 18 (1962), 82.

Hirschenfang, S. "A Comparison of Bender Gestalt Reproductions of Right and Left Hemiplegic Patients." Journal of Clinical Psychology, 16 (1960), 439.

Holt, R. R. (ed.) Diagnostic Psychological Testing by Rapaport, Gill and Schaffer. New York: International University Press, 1968.

Hughes, J. G. "Symposium on Brain Damage in Children." Pediatrics Clinics of North America. Pediatric Clinics of North America. Philadelphia: W. B. Saunders Co., 1957, 981-982.

Hutt, M. L. and Briskin, G J. Revised Bender Gestalt Test. New York: Grune and Stratton, Inc., 1944-1960.

Ingram, T. T. S. "Specific Developmental Disorders of Speech in Childhood." Brain: A Journal of Neurology, 82 (1959), 450.

Johnson, Doris J. and Myklebust, H. R. Learning Disabilities: Educational Principles and Practices. New York: Grune and Stratton, Inc., 1967.

Kahn, E., and Cohen, L. H. "Organic Drivenness: A Brain-Stem Syndrome and an Experience." New England Journal of Medicine, 210 (1934),748-756.

Keller, James E. "The Use of a Bender-Gestalt Maturation Level Scoring System with Mentally Handicapped Children." American Journal of Orthopsychiatry, 25 (1955), 563-573.

Kennard, M. A. "Value of Equivocal Signs in Neurological Diagnosis." Neurology, 10 (1960), 753-764.

Keogh, Barbara. "School Achievement Associated with Successful Performance on the Bender-Gestalt Test." Journal of School Psychology, 3 (1965b), 37-40.

Keogh, Barbara. "The Bender-Gestalt as a Predictive and Diagnostic Test of Reading Performance." Journal of Consulting Psychology, 29 (1965a), 83-84.

Kephart, N. C. The Brain-Injured Child in the Classroom. Chicago, Ill.: National Society of Crippled Children and Adults, 1963.

Kephart, N. C. The Slow Learner in the Classroom. Columbus, Ohio: Charles E. Merrill Books, Inc., 1960.

Kerschensteiner, D. G. Die Entwichelung der Zeichneriachen Begabung. Munich: Gerber, 1905.

Kershner, J. R. "Doman-Delacato's Theory of Neurological Organization Applied with Retarded Children." Exceptional Children, (Feb. 1968), 441-450.

Kinder, E. F., and Willenson, D. "Time Sampling Study of Behavior." Ed. F. A. Mettler. Psychosurgical Problems. New York: Blakiston, 1952, 239-253.

Kirk, S. A., and Bateman, B. "Diagnosis and Remediation of Learning Disabilities." Exceptional Children, 29 (1962) 73-78.

Kitay, J. "The Bender-Gestalt Test as a Projective Technique." Journal of Clinical Psychology, 6 (1950), 170-74.

Klebanoff, S. C., Singer, J. L. and Wilensky, H. "Psychological Consequences of Brain Lesions and Oblations." Psychological Bulletin, 51 (1954), 1-42.

Knobloch, H. and Pasamanick, B. "Syndrome of Minimal Cerebral Damage in Infancy." Journal of the American Medical Association, 170 (1959), 1384.

Kch, T., and Madow, A. A. "Relationship Between PPVT and Stanford-Binet Performance in Institutionalized Retardates." American Journal of Mental Deficiency, 72 (1967), 108-113.

Koppitz, E. M. "Diagnosing Brain Damage in Young Children with the Bender Gestalt Test." Journal of Consulting Psychology, 26 (1962), 541-546.

Koppitz, E. M. "Teacher's Attitudes and Children's

Performance on the Bender Gestalt Test and Human Figure Drawings." Journal of Clinical Psychology, 16 (1960b), 80-81.

Koppitz, E. M. "The Bender Gestalt Test for Children: A Normative Study." Journal of Clinical Psychology, 16 (1960a), 432-435.

Koppitz, E. M. The Bender Gestalt Test with the Human Figure Drawing Test for Young School Children. Columbus, Ohio: Department of Education, 1962a.

Koppitz, E. M. "The Bender Gestalt Test and Learning Disturbances in Young Children." Journal of Clinical Psychology, 14 (1958), 292-295.

Koppitz, E. M. The Bender Gestalt Test for Young Children. New York: Grune and Stratton, Inc., 1964.

Lachman, F. M. "Perceptual-Motor Development in Children Retarded in Reading." Journal of Consulting Psychology 24 (1960), 427-431.

Laufer, M. W. "Cerebral Dysfunction and Behavior Disorders in Adolescents." American Journal or Orthopsychiatry, 32 (1962), 501-507.

Laufer, M. W. and Denhoff, E. "Hyperkinetic Behavior Syndrone in Children." Journal of Pediatrics, 50 (1957), 463-474.

Laufer, M. W., Denhoff, E., and Solomons, G. "Hyperkinetic Impulse Disorder in Children's Behavior Problems." Psychosomatic Medicine, 19 (1957), 38-49.

Lawrence, M. M. "Minimal Brain Injury in Child Psychiatry." Comprehensive Psychiatry, 1 (1960), 360-369.

Leton, Donald A. "A New Frontier in Special Education." Education, 80-6 (1960), 349-353.

Levy, S. "Post-encephalitic Behavior Disorder---A Forgotten Entity: A Report of One Hundred Cases." American Journal of Psychiatry, 115 (1959), 1062-1067.

LeWinn, Edward B., Doman, G. J., Delacato, C., Doman, R. J., Spitz, E. B. and Thomas, E. "Neurological Organization: The Basis for Learning." Learning Disorders, 2 (1966), 51-93.

Lewis, Richard S., Strauss, Alfred A., and Lehtinen, Laura E. The Other Child, 2nd ed. New York: Grune and Stratton, Inc., 1960.

Lindsley, D. and Henry, C. "The Effect of Drugs on Behavior and the EEG of Children with Behavior Disorder." Psychomatic Medicine, 4 (1142), 140-149.

Lindstrom, A. E. "A Comparison of the Peabody Picture Vocabulary Test and the Wechsler Intelligence Scale for Children." Studies in Minnesota Education, 1961, 131-132.

Lobsien, M. "Kinderzeichnung und Kunst Kanon." Zeitschrift fur padagogische psychologie und jugendkunde, 7 (1905) 393-404.

Low, N. L. and Myers, G. G. "Suvren in Brain-Injured Children." Journal of Pediatrics, 52 (1958), 259-263.

Luria, A. The Role of Speech in the Regulation of Normal and Abnormal Behavior. New York: Liveright Publishing Corp., 1961.

Lyman, Howard B. "A Review of the Peabody Picture Vocabulary Test." The Sixth Mental Measurements Yearbook, ed. O. K. Buros. Highland Park, N. J.: Gryphon Press, 1965.

McGinnis, M. Aphasic Children. Washington, D. C.: Alexander Graham Bell Assoc. for the Deaf, Inc., 1963.

McGuire, F. "A Comparison of the Bender-Gestalt and Flicker Fusion as Indicators of Central Nervous System Involvement." Journal of Clinical Psychology, 16 (1960), 276-278.

MacKieth, R. and Bax, M. "Minimal Brain Damage---A Concept Discarded." Little Club Clinics in Developmental Medicine No. 10, Minimal Cerebral Dysfunction, ed. M. Bax and R. MacKeith. London: The National Spastics Society and Heinemann Medical Books, Ltd., 1963.

Mehlman, B. and Vatovec, E. "A Validation Study of the Bender-Gestalt Test." Journal of Consulting Psychology, 20 (1956), 71-74.

Michal-Smith, Harold, and Morgenstern, Murry. "Learning Disorders---An Overview." Learning Disorders, 1 (1965), 171-196.

Milman, D. "Organic Behavior Disorder: Behavior Characteristic of Brain-Damaged Children." American Medical Association, 91 (1956), 521-528.

Moed, G., Wright, B. W., and James, Patricia. "Interest Correlations of the Wechsler Intelligence Scale for Children and Two Picture Vocabulary Tests." Educational and Psychological Measurement, 23 (1963), 359-363.

Moriarty, A. E. Constancy and IQ Change. Springfield, Ill.: Charles C. Thomas, 1966.

Morris, H. Escoll, P., and Wexler, R. "Aggressive Behavior Disorders of Childhood: A Follow-up Study." American Journal of Psychiatry, 112 (1956), 991-997.

Myklebust, H. Auditory Disorders in Children: A Manual for Differential Diagnosis. New York: Grune and Stratton, 1954.

Myklebust, H. Development and Disorders of Written Language, 1, Picture Story Language Test. New York: Grune and Stratton, 1965.

Myklebust, H. and Boshes, B. "Psychoneurological Learning Disorders in Children." Archives of Pediatrics, 77 (1960), 247-256.

Nadler, E. B., Fink, S. L., Shantz, F. C., and Brink, R. W. "Objective versus Clinical Evaluation of the Bender Gestalt Test." Journal of Clinical Psychology, 15 (1959), 39-41.

National Health Council. Ten Million and One: Neurological Disability as a National Problem. (Proceedings of Arden House Conference. New York: Paul B. Hoeber, Inc. 1957.

Nelson, T. M. and Bartley, S. H. "Various Factors Playing a Role in Children's Responses to Flat Copy." Journal of Genetic Psychology, 100 (1962), 289-308.

Niebuhr, H. and Cohen, D. "The Effect of Psychopathology on Visual Discrimination." Journal of Abnormal and Social Psychology, 53 (1956), 173-177.

Olin, T. D., and Reznikoff, M. "The Effect of Psychopathology on Visual Discrimination." Journal of Abnormal and Social Psychology, 53 (1956), 173-177.

Orton, S. T. Reading, Writing and Speech Problems in Children. New York: Norton, 1957.

Ounsted, C. "The Hyperkinetic Syndrome in Epileptic Children." Lancet, 2 (1955), 303-311.

Paine, Richmond S. "Minimal Chronic Brain Syndromes in Children." Developmental Medicine 2nd Child Neurology, 4 (1962), 21-27.

Paine, Richmond S. "Organic Neurological Factors Related to Learning Disorders." Learning Disorders, 1 (1965).

Park, G. "Mirror and Reversed Reading." Journal of Pediatrics, 42 (1953), 120-128.

Pasamanick, B. "Anticonvulsant Drug Therapy of Behavior Problem Children with Abnormal Electroencephalograms." Archives of Neurology and Psychiatry, 65 (1951), 752-766.

Pascal, G. and Suttell, B. The Bender-Gestalt Test. New York: Grune and Stratton, 1951.

Peek, R. M., and Quast, W. A Scoring System for the Bender Gestalt Test. Minneapolis: 1951.

Peek, R. M., and Storms, L. "Judging Intellectual Status from the Bender Gestalt Test." Journal of Clinical Psychology, 14 (1958), 296-299.

Piaget, J. Principle Factors Determining Intellectual Evolution from Childhood to Adult Life. Cambridge, Mass.: Harvard University Press, 1937.

Piers, Ellen V. "A Review of the Peabody Picture Vocabulary Test." The Sixth Mental Measurements Yearbook, ed., O. K. Buros. Highland Park, N. J.: Gryphon Press, 1965.

Prechtl, H. F. R., and Stemmer, C. J. "The Choreiform Syndrome in Children." Developmental Medicine and Child Neurology, 4 (1962) 119- 127.

Quast, W. "The Bender Gestalt: A Clinical Study of Children's Records." Journal of Consulting Psychology, 25 (1961), 405-408.

Rabin, A. I. "The Use of the Wechsler-Bellevue Scales with Normal and Abnormal Persons." Psychological Bulletin, 42 (1945), 410-422.

Rabin, A. I. and Guertin, W. H. "Research with the Wechsler-Bellevue Test: 1945-1950." Psychological Bulletin, 48 (1951), 211-248.

Rabinovitch, R. D., Drew, A. L., DeJong, R., Ingram W., and Withey, L. "A Research Approach to Reading Retardation." Neurology and Psychiatry in Childhood, eds., R. McIntosh and C. Hare. Baltimore: Williams and Wilkins, 1956, 363-396.

Ram, M. J. "Some Educational Aspects of the Visuospatial Handicap in Cerebral Palsied Children." Spastics Quarterly, 11 (1962), 13-25.

Rapaport, D., Gill, M. M., and Schafer, R. Diagnostic Psychological Testing, 2 Vols. Chicago: Year Book Publishers, 1945-46.

Rapaport, D., Gill, M. M., and Schafer, R. Diagnostic Psychological Testing, Revised Edition. ed. Robert R. Holt. New York: International Universities Press, Inc., 1968.

Rappaport, S. R. (ed.) Childhood Aphasia and Brain Damage: A Definition. Narberth, Pa.: Livingston Publishing Co., 1964.

Rappaport, S. R. Proceedings of the 1965 Pathway School Institute. Narberth, Pa.: Livingston Publishing Co., 1966.

Reed, H. B. C., and Reitan, R. M. "Intelligence Test Performance of Brain Damaged Subjects with Lateralized Motor Deficit." _Journal of Consulting Psychology_, 27 (1963), 102-106.

Reznikoff, M. and Tomblen, R. M. "The Use of Human Figure Drawings in the Diagnosis of Organic Pathology." _Journal of Consulting Psychology_, 20 (1956), 467-470.

Rice, J. A. and Brown, L. F. "Validity of the Peabody Picture Vocabulary Test in a Sample of Low IQ Children." _American Journal of Mental Deficiency_, 71 (1967), 602-603.

Roe, A. and Shakow, D. "Intelligence in Mental Disorder." _Annals New York Academy of Science_, 42 (1942), 361-490.

Rosvold, H. E., and Delgado, J.M.R. "The Effect on the Behavior of Monkeys of Electrically Stimulating or Destroying Small Areas Within the Frontal Lobes." _American Psychologist_, 8 (1953), 425-426.

Rosvold, H. E., Mirsky, A. F., Sarason, I., Bransome, E. D., Jr., and Beck, L. H. "A Continuous Performance Test of Brain Damage." _Journal of Consulting Psychology_, 20 (1956), 343-350.

Ruch, T. C., and Shenkin, H. A. "The Relation of Area 13 on Orbital Surface of Frontal Lobes to Hyperactivity and Hyperphagia in Monkeys." _Journal of Neurophysiology_, 6 (1943), 349-360.

Schilder, P. _The Image and Appearance of the Human Body_. New York: International University Press, 1935.

Schuell, H., Jenkins, J., and Jimenez-Pabon, E. _Aphasia in Adults_. New York: Paul B. Hoeber, 1964.

Schulman, J. L., Kaspar, J. C., and Throne, F. M. _Brain Damage and Behavior: A Clinical-Experimental Study_. Springfield, Ill.: Charles C. Thomas, 1965.

Shachtel, E. G. "On Memory and Childhood Amnesia." _A Study of Interpersonal Relations: New Contributions to Psychiatry_, 1st ed. Ed. P. Mullahy. New York: Hermitage Press, 1949.

Shaw, M. C., and Cruickshank, W. M. "The Use of the Bender Gestalt Test with Epileptic Children." Journal of Clinical Psychology, 12 (1956), 192-193.

Sheer, D. E. "The Effect of Frontal Lobe Operations on the Attention Process." American Psychologist, 6 (1951), 261.

Siegel, Sidney. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill Book Co., Inc., 1956.

Silver, A. A. "Diagnosis and Prognosis of Behavior Disorder Associated with Organic Brain Disease in Children." Journal of Insurance Medicine, 6 (1951), 38-42.

Silver, A. A. "Psychologic Aspects of Pediatrics, Postural and Righting Responses in Children." Journal of Pediatrics, 41 (1952), 493-498.

Silver, A. A., and Hagin, Rosa. "Specific Reading Disability: Delineation of the Syndrome and Relationship to Cerebral Dominance." Comprehensive Psychiatry I (April 1960), 126-134.

Silverman, Lloyd. Diagnostic Psychological Testing. (Quoted by R. R. Holt), 1968.

Simpson, W. H. "A Study of Some Factors in the Bender Gestalt Reproduction of Normal and Disturbed Children." Dissertation Abstracts, 19 (1958), 1120.

Skinner, B. F. Science and Human Behavior. New York: MacMillan, 1953.

Smith, K. U., Peterson, B. M., and Rayson, G. G. "Spontaneous Activity in Guinea Pigs Following Removal of the Frontal Areas of the Cortex." Journal of Genetic Psychology, 24 (1941), 439-445.

Solomons, H. C. "A Developmental Study of Tactual Perception in Normal and Brain Damaged Children." (Ph.D. dissertation, Boston University, 1957).

Sontag, L. W., Baker, C. T., and Nelson, V. L. "Mental Growth and Personality Development: A Longitudinal Study." Monographs of the Society for Research in Child Development, 23-2 (1958).

Spradlin, J. E., Cromwell, R. L., and Foshee, J. G. "Studies in Activity Level: III. Effects of Auditory Stimulation in Organics, Familials, Hyperactives and Hypoactives." American Journal of Mental Deficiency, 64 (1959), 754-757.

Steward, H., and Cunningham, S. "A Note on Scoring Recalled Figures of the Bender Gestalt Test Using Psychotic, Non-Psychotoc, and Controls." Journal of Clinical Psychology, 14 (1958), 207-208.

Strauss, Alfred A., and Lehtinen, Laura E. Psychopathology and Education of the Brain-Injured Child. New York City: Grune and Stratton, Inc., 1947.

Strauss, A. A. and Werner, H. "Disorders of Conceptual Thinking in the Brain-Injured Child." Journal of Nervous and Mental Diseases, XCVI (1962), 153-172.

Taylor, Edith Meyer. Psychological Appraisal of Children with Cerebral Defects. Cambridge: Harvard University Press, 1959.

Teicher, J. D. "Preliminary Survey of Motility in Children." Journal of Nervous and Mental Diseases, 94(1941), 277-304.

Terman, L. M. The Measurement of Intelligence: An Explanation of and Complete Guide for the Use of the Standford Revision and Extension of the Binet-Simon Intelligence Scale. Boston: Houghton Mifflin, 1916.

Terman, L. M. and Merrill, M. A. Measuring Intelligence. Boston: Houghton Mifflin, 1937a.

Terman, L. M. and Merrill, M. A. Revised Stanford-Binet Scale, 2nd Revision. Boston: HoughtonMifflin, 1937b.

Terman, L. M., Merrill, M, Pinneau, S. P. Stanford-Binet Intelligence Scale, 3rd Revision, 1960. Boston: Houghton Mifflin Co., 1960.

Teuber, H. L. "Perception." Handbook of Physiology, 3. ed. J. Field. Washington: American Physiological Society, 1959-1960.

Teuber, H. L. and Rudel, R. G. "Behavior After Cerebral Lesions in Children and Adults." Developmental Medicine and Child Neurology, 4 (1962), 3-20.

Thelander, H. E., Phelps, J. K., and Kirk, E. W. "Learning Disabilities Associated with Lesser Brain Damage." Journal of Pediatrics, 53 (1958), 405-409.

Urban, William H. The Draw-A-Person Test. Beverly Hills: Western Psychological Services, 1963.

Vernier, Clare M. Projective Test Productions: 1. Projective Drawings. New York: Grune and Stratton, 1952.

Walker, C., and Kirkpatrick, B. "Dilantin Treatment for Behavior Problem Children with Abnormal Electroencephalograms." American Journal of Psychiatry, 103 (1947), 484-492.

Walton, J., Ellis, E., and Court, S. "Clumsy Children: A Study of Developmental Apraxia and Agnosia." Brain: A Journal of Neurology, 85 (1962), 603-612.

Wechsler, David. Wechsler Intelligence Scale for Children Manual. New York: Psychological Corp., 1949.

Wellman, B. "Iowa Studies on the Effects of Schooling." Intelligence: Its Nature and Nurture, The Thirty-Ninth Yearbook of the National Society for the Study of Education, Part 2. Bloomington, Ill.: Public School Publ. Co., 1940, 377-399.

Wells, F. L. Mental Tests in Clinical Practice. Yonkers, New York: World Book Co., VIII, 1927.

Wepman, J. Recovery from Aphasia. New York: W. W. Norton, 1951.

Werner, H. "Thought Disturbance with Reference to Figure-Background Impairment in Brain Injured Children." Confinia Neurologicia, 9 (1949), 255-263.

Werner, H. and Kaplan, B. Symbol Formation. New York: John Wiley and Sons, 1963.

Werner, H. and Strauss, A. A. "Types of Visuo-Motor Activity in Their Relation to Low and High Performance Ages." Proceedings of American Association on Mental Deficiciency, XLIV (1939), 163-169.

Wewetzer, K. H. "Bender-Gestalt Test bei Kindern: Auswertungsmethode und Differential Diagnostische Moglichkeiten." Zeitschrift fur diagnostische Psychologie und Personlichkeitsforshung, 4 (1956), 174.

Wewetzer, K. H. Das Hirngeschadigte Kind. Stuttgart, Georg Thieme Verlag, 1959.

Wigglesworth, R. "Minimal Cerebral Palsy." Cerebral Palsy Bulletin, 3 (1961), 293.

Witty, Paul. Reading in Modern Education. Boston: D. C. Heath and Co., 1949, v.

Wortis, Joseph. "A Note on the Concept of the 'Brain-Injured' Child." American Journal of Mental Deficiency, 61-1 (July 1956), 204-206.

APPENDIX A

TERMINOLOGY USED TO DESCRIBE NEUROLOGICAL IMPAIRMENT

1. Aggressive Behavior Disorder (Morris, Escoll, and Wexler, 1956)
2. Aphasoid Syndrone
3. Association Deficit Pathology (Anderson and Plymate, 1962)
4. Attention Disorders
5. Brain-injured (Strauss and Lehtinen, 1947)
6. Central Nervous System Developmental Lag (Bender, 1956)
7. Central Nervous System Deviation
8. Central Nervous System Dysfunction
9. Central Nervous System Maturational Lag (Bender, 1956)
10. Cerebral Dysfunction (Laufer, 1962)
11. Cerebral Dys-synchronization Syndrome
12. Character Impulse Disorder (Frosch and Wortis, 1954)
13. Choreiform Syndrone (Laufer, 1962)
14. Clumsy Child Syndrone (Walton, Ellis, and Court, 1962)
15. Conceptually Handicapped
16. Diffuse Brain Damage (Daryn, 1961)
17. Dyslexia (Park, 1953)
18. Dysmaturation
19. Exceptional

20. Exogenous (Strauss and Lehtinen, 1947)

21. Functionally Impaired

22. Hyperexcitability Syndrome (Prechtl and Stemmer, 1962)

23. Hyperkinetic Behavior Syndrome (Denoff, Laufer, and Holden, 1959)

24. Hyperkinetic Impulse Disorder (Laufer and Denhoff, 1957)

25. Hyperkinetic Syndrome (Ounsted, 1955)

26. Hypokinetic Syndrome (Clements, 1966)

27. Imperceptive (Dunn, 1967)

28. Interjacent

29. Learning Disabilities

30. Major Learning Disorders

31. Minimal Brain Damage (Clemmens, 1961)

32. Minimal Brain Injury (Strauss and Lehtinen, 1947; Eisenberg, 1957)

33. Minimal Cerebral Damage (Knobloch and Fasamanick, 1959)

34. Minimal Cerebral Dysfunction (Clements and Peters, 1962; MacKeith and Bax, 1963)

35. Minimal Cerebral Injury (Gesell and Amatruda, 1941)

36. Minimal Cerebral Palsy (Wigglesworth, 1961)

37. Minimal Chronic Brain Syndrone (Paine, 1962)

38. Minor Brain Damage (Strauss and Lehtinen, 1947)

39. Neurological Handicap

40. Neurophrenia (Doll, 1960)

41. Neurosensory Disorder

42. Organic Behavior Disorder (Milman, 1956)

43. Organic Brain Damage (Bradley, 1957)

44. Organic Brain Disease (Silver, 1951; Bender, 1956)

45. Organic Brain Dysfunction (Burks, 1957)

46. Organic Drivenness

47. Organic Impairment

48. Perceptual Cripple (Silver, 1951)

49. Perceptually Handicapped

50. Perceptual-Motor Impairment

51. Psychoneurological Learning Disabilities (Myklebust and Boshes, 1960)

52. Specific Reading Disability (Hermann, 1959)

APPENDIX B

HELP IDENTIFY THE CHILD
WITH PSYCHONEUROLOGICAL
LEARNING DISABILITIES

The Payne County Guidance Center and the Stillwater Public Schools are cooperating in an effort to identify children with a special kind of problem. These are children who often exhibit difficulties in learning, especially reading and arithmetic and who are frequently a behavior problem in the classroom. At the same time these children are average or above in measured intelligence, even though their performance in the classroom may not reflect this level of intelligence.

On the basis of these children's behavior, you may have understandably labeled them behavior problems, underachievers, slow learners, non-readers, lazy, immature, undisciplined or emotionally blocked.

These children have psychoneurological learning disabilities and it is not unlikely that you have several in your classroom. National statistics show that one out of every ten children born have some neurological impairment ranging from very mild to more severe.

If identified in the primary grades, it has been shown that with a special kind of training, many of these children can function adequately in the normal classroom. Without help many of these children become additional figures in the dropout statistics.

The primary teacher is invaluable in helping to identify these children. The following checklist will help you to identify the children you feel might have such a problem. Upon completion of the Checklist, the Guidance Center will administer a battery of tests designed to screen for neurological impairment.

The parents will then be contacted by the Guidance Center. The child will be given additional tests and will be seen by the pediatrician before he is admitted to one of the

Educational Training Classes made available by the Payne County Guidance Center.

After a child has been accepted for training, the teacher will be informed and communication with the clinic will be maintained.

In completing the following Checklist it is important to remember that since each child has his own pattern of symptoms, any given child may not have symptoms in all, or even many, of these areas.

For additional information, please contact:

Miss Karen Baumann
Payne County Guidance Center
Office: FR2-1979
Home: FR2-3064

BEHAVIOR CHECKLIST

Child's Name: ____________ Teacher: ____________

Birthdate: ____________ School: ____________

Sex: ____________ Grade: ____________

Does this child have:

	Yes	No	Some-times
1. The ability to put thoughts into words	___	___	___
2. Speech problems	___	___	___
3. Distorted speech under stress	___	___	___
4. Voluble, uninhibited speech	___	___	___
5. Learning disabilities in one or more of the following areas:			
a. Reading	___	___	___
b. Arithmetic	___	___	___
c. Drawing	___	___	___
d. Copying geometric figures	___	___	___
e. Printing or writing	___	___	___
6. Coordination difficulties in one or more of the following areas:			
a. Visual-motor	___	___	___
b. Fine-muscle	___	___	___
c. Gross-motor	___	___	___
7. The ability to distinguish between right and left			
8. Mixed laterality in use of hands, feet, and eyes	___	___	___
9. A short attention span	___	___	___
10. Difficulty in concentrating on one thing for very long	___	___	___
11. Difficulty in thinking in an organized fashion	___	___	___

Can this child be described as:

	Yes	No	Some-times
1. Hyperactive	___	___	___
2. Highly distractible	___	___	___
3. Emotionally unstable	___	___	___
4. Characterized by abrupt mood changes	___	___	___
5. Easily moved to tears	___	___	___
6. Impulsive	___	___	___
7. Antisocial	___	___	___

APPENDIX C

SAMPLE OBJECTIVES AND PROCEDURES FOR THE TRAINING PROGRAM

Introduction

The educational program proposed in this study was developed for children with psychoneurological learning disabilities (PNLD). These children are often unable to adequately adjust to the regular academic environment due to their various learning disabilities and socially unacceptable behaviors. Teacher and peer responses to behavioral manifestations characteristic of children with PNLD are often based upon misunderstanding of the origins of such behavior. Behaviors commonly manifested by these children include, among others: (a) hyperactivity, (b) attention disorders, (c) perceptual, conceptual, and perceptual-motor difficulties, (d) poor overall coordination, (e) speech and language disorders, and (f) emotional lability. Due to the neurological origin, control of these unacceptable behaviors may be difficult, if not impossible, for these children. It can be seen then, that peer and teacher expectations, evaluations, and sanctions, appropriate for normal children, may have devastating developmental consequences for children with PNLD. When these negative social responses are added to the intrinsic task frustrations experienced by these children, an overlay of failure expectations develops, accompanied by maladaptive compensatory behavior and negative emotional responses.

Included in the following subsections of this Appendix are sample objectives and procedures for the development of skills basic to (a) effective group interaction, (b) gross motor coordination, (c) perceptual-motor functioning, and (d) appropriate language usage.

Activities for remediation of specific skills basic to learning were devised; and representative activities have been included in this Appendix. They do not constitute an entire training program. Instead, they merely serve to illustrate suggested procedures for developing the skills specified by the objectives.

Sample Objectives and Procedures for Large Group Participation

Children with PNLD often experience school failure due to their inability to function in group activities. Basic to successful group participation is the ability to compete with at least a reasonable degree of assurance that success in group interaction is possible. Hence, children whose failure expectations are constantly reinforced by peers, teachers, and parents have not experienced success as a reinforcer or a motivator for participation in group activities.

The above considerations must be kept in mind when constructing group activities for these children. Activities should first be structured so that group participation, rather than the quality of performance, will be reinforced.

The following sample objectives for developing skills prerequisite to group participation should serve as guidelines for the construction of appropriate activities.

1. Development of verbal skills.
2. Development of relationship concepts.
3. Development of time sense and concepts of time.
4. Development of the ability to organize and integrate abstract ideas and concepts.
5. Development of self-confidence in group participation.

Many of the following activities are equally appropriate for the development of gross motor, perceptual-motor, and speech and language skills. Nevertheless, they were included in this section because of their greater applicability to a large group, and their potential for encouraging group participation.

Developing Verbal Skills and Concepts Involving Emotions

Have the children discuss and relate the meanings of happiness, love, sadness, anger, etc. to facial expressions and their personal experiences with each.

Developing Relationships and Time Concepts

A calendar may be used to discuss the days of the week, month and year in relation to the weather and the seasons. Time concepts may be introduced by allowing the children to time their own performance in the various activities with a stop watch. Also discussing plans for future activities can be utilized to develop concepts of future time.

Developing the Ability to Organize and Integrate Abstract Ideas

The ability to ask meaningful questions depends to a great extent upon organizational and integrative skills. Children can be taught to ask meaningful questions by such games as "What am I?" or "Who am I?" To introduce these games ask a child to pantomime an animal, for example. Then have the children ask questions. Emphasis should be placed upon the asking of broad, general questions, before asking questions of a more specific nature. As children become more adept at questioning, pantomime should be omitted. Clues to the correct answer should be given in the same manner recommended for questioning---general to more specific.

Developing Multiple Skills While Developing Self-Confidence in Group Participation

Letter Bingo materials can be prepared by substituting alphabetic characters for numbers. Letters such as b and d, m and w, which require discrimination ability should be used. The concept of rows and columns may be introduced by varying the location of the free space. Allow the children to experience both playing and calling letters. Cards should be traded after each game. This activity provides equal opportunity for all children within the group to experience success.

Developing Self-Confidence in Group Participation

1. Emphasis upon the development of general coordination and left-right discrimination may provide an excellent means for instigating group interaction. One such game appropriate for these purposes is egg racing. Hardboiled eggs and large spoons are the only materials needed. Divide the children into equal teams. Then ask the first child on each team to place an egg on a spoon held in his dominant hand, placing his nondominant hand behind his back. Instructions can include alternating the hand holding the spoon. Ask the child to walk as rapidly as possible without

dropping his egg, toward a set goal, touch it, then return it to his team. After each race the team composition should be varied to break up patterns of competition. The task may be made more difficult by blindfolding the children and asking the next child in line to give left and right directions to the blindfolded racer.

2. Volleyball provides an excellent medium for developing cooperative interactive skills. Children may be positioned where strong players must help weaker players in order to score. Also, strong players may be placed far enough from the net so that they are unlikely to score independently. Reinforcement or praise should be given only for behaviors demonstrating cooperation.

3. Rhythm and memory for number concepts may be practiced in a group setting. Tapping sequences (11 111 1, 1 1111 11) may be used for this purpose. By tapping rhythms into a child' hand, the tactual and kinesthetic senses as well as the auditory senses are stimulated. When learning this activity, the children should be asked to count aloud. Sequences may become longer or rhythms made more difficult when children become increasingly able to perform the simple sequences.

Large group activities should capitalize upon the fact that nearly all children possess one or more areas of strength. Therefore, it is possible for most children to experience teaching as well as learning.

Sample Objectives and Procedures for Gross Motor Development

Motor development begins in the uterus before birth. Unilateral movement develops first, then bilateral movement, essential for the development of integrated functions of the various segments of the body. Coordination of the motor system is prerequisite to the development of the higher skills of directionality and spatial relationships, as well as the refinement of fine-muscle movements.

The following activities represent procedures which emphasize the development of bilateral gross motor skills.

Developing Independent and Integrated Coordination

A volleyball may be adapted to a variety of appropriate exercises. To develop correct arm movements, ask the children to stand and squat slightly. Then ask them to push the ball to another child, using both hands. The pushing movement can then be performed using alternate hands. The child can learn to judge from a strip of masking tape placed on the floor how far his pushed ball deviated from a straight line. To develop appropriate leg movements, ask the children to sit with legs spread apart. Have them push and trap the pushed ball with their legs, singularly and in combinations, without using their hands. As hand position and posture are important in learning how to throw a ball, correct positions should be taught before teaching them to throw a ball, correct positions should be taught before teaching them to throw at anything more specific than the side of a building. After rudimental positions are mastered, a large waste basket may be utilized. A waste basket is preferable to a basketball goal until necessary techniques are mastered. Work on balance and posture. An understanding of number concepts can be reinforced by asking children to catch a ball only after it has bounced a given number of times. In catching a ball above the head, children should be instructed to place their thumbs together whereas a ball caught below the waist is caught with the little fingers together. As many of these children are frightened by a thrown ball; a large, soft rubber ball should initially be used, gradually decreasing the size of the ball as the children show less fear and become more adept at catching a thrown ball.

Developing Rhythm of Movement

Have the children use exaggerated movements in walking on two lines drawn approximately six inches apart. Combine arm and leg movements, using principles of opposition.

Music with definite rhythm can be used after the child becomes confident of his movements. Similarly, jumping, hopping, skipping, and galloping can be practiced. Correct movements should be taught before presentation of music.

Developing Balance

A 2 X 4 board raised six inches from the floor may be used. Have the children practice walking without their shoes on the flat side of the beam, one foot in front of the other with toes pointed straight ahead. There should be no space between the feet. Arms should be extended straight from the shoulders to give additional balance. Walking can be practiced forward, backward, and sideways. A book may even be placed on a child's head. After children have become confident of their balance on the walking board, ask two children to balance themselves, one at each end, while tossing the ball back and forth. The ball may then be bounced on the board to each other. This activity requires well-developed visual-motor coordination, and thus may be difficult for many of the children. The thin side of the board may be used when walking the flat side becomes less difficult.

Developing Motor Patterns and Rhythm

Before introducing a jump rope, give each child a stick (yardstick or broomstick). Ask them to hold it with both hands and step through it, first with their right foot, then their left. The stick may then be lifted over their head. This same motor pattern is repeated with an individual jump rope.

Developing Handedness and Footedness

Place cut-out hand prints on the wall. Have the children fit their hands to the prints, identifying them as right or left. Place cut-out footprints on the floor around the room. Between regular left-right footprints give directions to jump over a yardstick, crawl, hop, etc. Make certain that the child puts his right foot on a right footprint. For example, two right footprints, one following the other, would indicate that the child must hop on his right foot.

Developing Balance

A balancing board may be used. The child must first be taught how to get on the board. The teacher may hold his hands until he gets the feel of proper feet placement and knee action necessary to keep the board balanced.

Developing General Coordination

Using a basketball, teach the children to dribble a ball with both hands. Ask them first to lock their thumbs and practice flexing their fingers before handing them the ball. After they can maintain an even dribble with both hands, then instruct them to use alternate hands. An obstacle course requiring directional changes may be constructed using common objects such as chairs. To make the task more difficult, the teacher can give directions for alternating hands as they navigate the obstacle course.

Developing Visual-Motor and Fine-Muscle Coordination

A small rubber ball the size of a golf ball and a set of jacks are required. Have the children sit on the floor with their legs spread apart. Teach them how to throw the ball into the air, letting it bounce once before catching it. Then hand them one jack and teach them the basic rudiments of jacks.

Developing Visual-Motor and Gross Motor Coordination

Children may be taught to use a bat by allowing them to try to hit a large rubber ball. As the child becomes better able to hit this ball, the size of the ball used may be decreased. Similarly, when teaching children how to use baseball gloves, begin with large rubber balls.

The following activities may be adapted to serve a variety of purposes or objectives:

1. Standard games such as ring toss, horseshoes, frisbe, and darts are all excellent for coordination work.
2. The physical exercises porposed by Getman (1962)

are also appropriate for development of general coordination.

3. Rhythm band instruments and appropriate music can be adapted to a variety of purposes. For example, marching music in 4/4 time can be used to coordinate regular physical movement such as marching in time with playing an instrument on only one of the four accented beats. According to the capability of the children, this task can be simplified or made more complex.

The above activities should serve to illustrate the endless variety of tasks appropriate to aid the development of gross-motor skills. Inescapably, fine-muscle movement and perceptual motor skills are also being trained. As should be evident, expensive or even extensive equipment is unnecessary. Ingenuity and resourcefulness, however, are essential, for there are a multitide of appropriate activities enjoyable to and educationally beneficial for children. Training must be fun in order to be effective, especially since motivation must be maintained through many repetitions. Repeated practice of performance skills is necessary in order to attain desired behaviors.

Sample Objectives and Procedures for Perceptual-Motor Development

When a hierarchy of experience is developed, the most primitive level of experience is sensation. "By gradation it evolves to perception, imagery, symbolization, and lastly to conceptualization." (Johnson and Myklebust, 1967) It can be seen that nonverbal disabilities involving perception constitute a fundamental distortion of a child's total experience. In training perceptual skills, various modalities of the more primitive experience of sensation are utilized.

Due to the interrelatedness of the various skills which contribute to the development of adequate perceptual-motor coordination, objectives and procedures for training perceptual-motor skills have not been developed in an isolated fashion. Instead, the activities selected are structured to serve multiple objectives or purposes.

The following sample objectives for perceptual-motor development should serve as guidelines for the construction of learning tasks:

1. Improvement of visual skills
2. Development of visual memory

3. Development of body image

4. Development of left-right orientation

5. Development of consistent use of dominant hand

6. Development of spatial orientation

7. Development of kinesthetic and tactual senses

8. Development of fine-muscle coordination

9. Development of eye-hand coordination

10. Development of skill in matching according to shape, size and color

11. Development of the concept of size constancy

12. Development of time sense and concepts of time measurement

13. Development of ability to organize and integrate patterns of behavior utilizing various perceptual modalities

Each of the following activities were selected because they are representative of procedures which emphasize the development of the skill areas suggested by the obejctives listed above.

Developing Bilateral Counterbalancing Mechanisms

The child marks an X on the chalkboard directly opposite the tip of his nose. The X serves as his working center. With a piece of chalk in each hand he makes two large circles, moving his arms first in the same direction, then in opposite directions.

Developing Visual Discrimination and Person Perception

Have the children match faces with different expressions, indentifying the affect portrayed. Ask them to describe how they are alike and how they are different.

Developing Visual-Sensory-Motor Patterns and Spatial Relationships

Form templates can be used at the chalkboard to build a better visual-sensory-motor pattern and increase the effectiveness of directional movements in space. The child marks an X opposite the tip of his nose on the chalkboard to serve as the center of the template form. He then holds the template with his non-dominant hand, and traces with his dominant hand around the outline 20 times without lifting his chalk. Care must be taken that he learns a consistent starting point and the correct direction of tracing movements. Removing the template, he then traces his outline 20 more times trying to stay on the lines. Finally on a clear portion of the board, he attempts to match his first figure with a free-hand drawing. The template drawings must be learned in the following sequence: circle, square, triangle, rectangle, and horizontal diamond. This exercise may be varied by using pegboards. Only corner cues are given, and the child fills in the rest of the design. Eventually cues are unnecessary.

Developing Matching Skills

Variations on the Leiter Scale may be used. Have the child match the blocks to the corresponding pictures, and then have him explain the basis for matching. To make the task more difficult, the directions for matching can be varied. For example, the teacher might ask the child to match the numbers but to vary the color, or match the numbers, but vary the shape.

Developing Eye-Hand Coordination and Visual-Tactual Memory

Puzzles and Parquetry blocks may be used. After the child has mastered the assembly of simple five piece puzzles, he may be blindfolded. He should be encouraged to feel the shape of the puzzle piece and the hole into which it fits.

Developing Tactual Skills in Order to Match and Sequence

By seeing and feeling different textures of materials which have been glued to square boards, children should learn the names of the textures and the words which describe how these textures feel (e.g., rough-smooth, coarse - fine). After they can do this accurately, they can be blindfolded and told to match the two sets of textures by feel. To make the task more difficult, have the children sequence the textures from the roughest texture to the smoothest texture.

Developing Size Discriminations Through Tactual and Kinesthetic Senses

Blindfold the children and hand them like objects of varying sizes (e.g., sticks of different lengths, cylinders of different circumferences). Ask the children to arrange the objects according to size or length.

Developing Visual Imagary Through the Tactual Sense

Alphabetic characters may be cut from sandpaper and glued to wooden boards. Blindfold the children and have them feel and name each of the letters. Make certain that each child traces each letter as though he were printing or writing it. Letters formed from strips of clay may be used.

Perceiving and Remembering Detail

Give the child two copies of a simple design. Tell him that one part is missing in one of the designs, and ask him to draw in the missing part. As the child more readily sees the missing part, give him one design to look at for 10-15 seconds. Then remove the design and ask him to reproduce it from memory. According to the capability of the child, try different exposure times, delay times, and intervening activities.

Developing Visual Motor Patterning

Paper and pencil dot-to-dot patterns may be used. Spatial concepts (e.g., up-down) may be introduced with sewing cards which have holes numbered or lettered in sequence.

Developing Visual Discrimination and Visual-Motor Patterning

Prepare and suplicate pencil and paper mazes of varying degrees of complexity. Have the children trace the pathways without letting their lines touch the sides.

Developing Visual-Motor Patterning and Fine Muscle Coordination

In cutting out pictures, following the outline of the picture should be emphasized. In peeling apples, have a contest to see who can get the thinnest peelings. Dull knives are recommended. In both activities adherence to usage of correct hand movements should be maintained. If a child has difficulty with these tasks, hand movements should be taught before giving them the scissors or knife.

Integrating Size Discrimination, Perceptual Memory, and Visual-Motor Coordination

Have the children place cylinders of varying sizes in corresponding holes. To avoid trial and error behavior, ask the child to arrange the cylinders according to height or circumference; then to determine by feel the size of the hole before attempting to place the cylinder in the hole.

The difficulty of this task can be increased by blindfolding the children.

Developing Multiple Skills

Pinning clothespins on a clothesline is an excellent activity for the development of eye-hand coordination, fine-muscle coordination, spatial-orientation, and kinesthetic and tactual senses. String the line at eye-level, and have the child stand at arms' length from it. Give him eight pins, and have him first pin them on with his dominant hand, then with his nondominant hand. This activity may be done blindfolded. Color and number concepts can be developed with elaborations on this task. Integration of rhythms and visual motor skills are also possible.

Developing Multiple Skills

Creating pictures on a tile board with tiles of varying geometric shapes affords an excellent opportunity for the development of number-concepts, visual-memory, matching skills, fine-muscle coordination, eye-hand coordination, and tactual and kinesthetic senses. Select large pictures which clearly show the tiles to be used in the construction of the picture. While building the design, have the child talk about the shape of the tiles, directionality of the geometric shapes, color, and number of tiles needed.

In almost every activity in this section, consistent use of the dominant hand and consistent left to right progression were emphasized. Children were also encouraged to verbalize about what they were doing.

The above activities exemplify the types of tasks appropriate for the development of perceptual motor skills. They do not constitute a complete training program. Furthermore, each of the above activities may be elaborated to serve a variety of purposes. Once aware of the perceptual motor training needs of individual pupils, a creative teacher will find that an endless variety of common toys and tasks can be adapted to these purposes.

Sample Objectives and Procedures for Speech and Language Development

<u>Development of the Listening Skill</u>

Listening involves hearing, recognizing and interpretating through previous experience. In working toward this goal, the following activities were felt to be helpful in developing the listening skill:

1. Echo game. The teacher whispers a sentence to the first child who whispers it to the next and so on until the last child repeats aloud what he heard. This activity is suitable for a large group.
2. Identification of sounds. The children close their

eyes while the teacher makes various sounds. Then they identify the sounds.

3. Use of recordings which emphasize sounds or stories. Ask the children to identify or relate what they heard.

4. Find the absurdity. Have the children answer true or false to statements such as, "Most balls are square." Then have them tell which word or words do not belong in the sentence. For example, "Mother mixed the flour, sugar, nails, and butter for the cookies. Then she put the cookies in the refrigerator to bake." This activity is excellent for training the child to react to ideas and to evaluate what he hears.

5. The use of games and stories which require specific responses to key words. Secretly, give each child a key word, and ask him to respond to the word by a particular gesture such as scratching his nose. Ask the children to identify the key words given to each child by associating gestures and key words.

Improvement of Auditory Discrimination Skills

Auditory discrimination involves the ability to differentiate sounds and to relate them to the proper unit of experience. Children with auditory receptive deficits often behave more like the deaf, becoming more visually and tactually oriented to their environment. Emphasis upon auditory discrimination is essential in almost any program of remediation. The following excercises were considered to be appropriate for auditory discrimination training:

1. Sound and word discrimination. The teacher first pronounces a sound. The child must then find an object in the room that starts or ends with that sound. The teacher then pronounces a group of words, saying some incorrectly. The children are then asked to identify the incorrect words. If children experience difficulty in performing this task, a more elementary activity may be utilized. For example, hand an object to a child, pronouncing its name simultaneously. In some cases, comprehension is established only when the meaningful sounds or words are structured, isolated, and timed with the presentation of the symbol. As soon as the sound or word is understood in isolation, it can then be reintroduced into context or short sentences.

2. Comparison of word sounds. Two words are said, and then the child must tell whether the two words are the same at the first of the words, the last of the words, or at both the first and last of the words. For example, "show-shop" (first), "seat-meat"(last), "Peach-patch (both).
3. Use of subtle differences in sounds. Two words are pronounced in which only one consonant differs. The child is then asked to describe the difference in the words. The use of similar sounding words requires a high degree of auditory discrimination. Therefore, this activity should not be utilized until basic auditory discrimination skills have been established.

Development of Categorization Skills

Categorization skills include the ability to form a category or recognize category membership, to symbolize categories, and perceive and symbolize relationships be tween categories. The following exercises are typically used to develop categorization skills:

1. Identifying and symbolizing categories. Have the child sort groups of pictures, and then supply the word for him. For example, give the child pictures of toys and food. Ask him to place the

things we eat on one page and the things we play with on the other page. After he finishes, the teacher can say, "We eat these; they are food.", emphasizing the name of the category. Eventually the children can identify the category without prompting from the teacher.

2. Naming and describing objects. A "feely" box may be used. Placed in the box are objects which the child may feel, but not see. The child must then describe the object, name it, and indicate its use. Real objects should be used, for children with PNLD sometimes do not understand that an object can be represented in pictorial form. This activity is excellent for children who are able to give a functional definition of an object, but are unable to name the symbols representing categories. As the child becomes more adept at this game, the activity may move to a more abstract level. Pictures instead of objects may be used. In this case, the teacher gives one clue and lets the child guess what the object might be. Additional clues are given until the child guesses correctly. For example, if the object were an elephant, the clues might be, "It is an animal. It

lives in the jungle. It is a large animal. It is grey. It has tusks." This activity may be reversed, whereby the child gives clues to the teacher.

3. Asking meaningful questions. Children may be taught to ask broad, general questions which will lead them to one specific idea or object. This can be accomplished with guessing games such as, "What am I? What is in the sack? or What am I thinking?" General questions such as, "Is it alive? Is it large? Does it make a noise? or Can you eat it?" should be encouraged.

Development of Sequencing Skills

Basic to the ability to relate thoughts and ideas in sequential order is the ability to remember and understand a given sequence of simple items. Listening, auditory perception, and auditory memory skills are involved. The following activities are structured so that more basic sequencing skills are trained before moving to more complex types of sequencing.

1. Touching objects sequentially. The teacher names the objects to be touched. The children must then touch the objects in the order given. If a child appears to be having difficulty in remembering

the verbal directions, the teacher may have him reauditorize the directions before undertaking the task.

2. Sequencing objects. Place four objects, for example, animals, in front of the child. Then mix them up and ask him to put them in the original order.

3. Training auditory memory by verbally sequencing numbers and names of objects. All the words in a given set or sequence should be in the same category, such as orange, lemon, peach, and apple. This activity can be made more interesting to the children by asking each child to say a word. The next child must repeat the first word said, and add a word of his own. For example, if the category were animals, the first child might say "cow". The second child will then say "cow" and add "chicken". This activity can be structured so that the basic principles of association are taught. This activity is equally appropriate for the development of categorization skills.

4. Hunting objects such as Easter eggs in order of color.

5. Integrating meaningful sequences. Tell a short

story that has three or four parts to it. Then have the child review it, giving a beginning, middle and end. The child must be able to listen for a longer period of time, store more information, understand the meaning of the words used in the story, and relate ideas meaningfully.

6. Integrating information from several sensory channels to combine visual and auditory sequencing. Use stimulus objects such as sequence stories and language pictures. Ask the children to explain what they had seen or to make up a story in their own words. Individual comic strip frames, which will tell a story, when arranged in correct sequence might be used. Present the pictures in an incorrect sequence. Then have the child put the pictures in the correct order and tell the story portrayed by the pictures.

7. Following directions---integrating auditory perception and memory with motor skills. The children are first given directions in very simple form. A series of instructions are more difficult for children to remember than a series of words, because the physical act of executing the commands often interferes with recall. Paper and pencil

activities should be utilized first before activities which involve excessive physical movement are attempted. As the children become increasingly capable of remembering the directions given, the verbal directions become more complex. Using a mimeographed sheet of circles, directions for the execution of performance may be as follows: "Go to the third row, the second column, and color the top half of that circle red." This exercise can be made more difficult by recording the directions. Emphasis upon directions is appropriate for activities in all areas of training.

Development of Structurally and Grammatically Correct Sentences

The development of initiative and logical structure in the use of language involves more complex verbal skills in which word relationships must be understood. The following activities were found to be useful in developing this skill.

1. Sentence construction. Give the child an object and ask him to make up a sentence about the object.
2. Story construction. Have the children make up a story in which each child adds one sentence to the story. To make the activity more interesting to

the children, commercial games may be used in conjunction with this activity. If games are used, before a child takes his turn in the game, he must add a sentence to the story.

Development of Language Skills

Even though specific deficits are isolated, the fundamental approach to speech and language remediation is one of language development broadly conceived. It includes the following concepts: (a) receptive language must be developed before expressive language, otherwise comprehension of the spoken word will remain incomplete; lacking comprehension , the child will be forced to rely upon poorly developed memory skills, (b) concrete language must be taught before progressing to abstract language, and (c) the naturalness of the development from simple to more complex verbalization must be recognized. The significance of these general principles of languages development should be recognized in the construction of activities for children with PNLD. These principles should serve as guidelines for the structuring of learning tasks. Furthermore, the value of visual, kinesthetic and tactual cues for teaching children with PNLD cannot be over-emphasized, because the use of various senses in learning can aid recall.

VITA

Karen Suzann Baumann

Candidate for the Degree of

Doctor of Education

Thesis: THE EFFECTS OF AN EDUCATIONAL PROGRAM ON THE TEST PERFORMANCE OF CHILDREN WITH PSYCHONEUROLOGICAL LEARNING DISABILITIES

Major Field: Student Personnel and Guidance

Biographical:

Personal Data: Born in Fort Worth, Texas, July 24, 1940, the daughter of Betty M. and W. Elmo Baumann.

Education: Graduated from Stillwater High School, Stillwater, Oklahoma, 1958; received the Bachelor of Music Education degree from Oklahoma State University, Stillwater, Oklahoma, in August, 1962; attended Oklahoma City University and majored in marketing, Oklahoma City, Oklahoma, 1963-64; attended Oklahoma State University and majored in distributive education, 1963-65; attended Central State College and majored in counseling and guidance, Edmond, Oklahoma, 1965; received the Master of Education degree with a major in counseling and guidance from Boston University, Boston, Massachusetts, in June, 1966; completed requirements for the Doctor of Education degree in May, 1969.

Professional Experience: Served as secondary public school Distributive Education Coordinator in Oklahoma City, Oklahoma, 1962-65; served as staff assistant for NDEA Counseling and Guidance Institute at Oklahoma State University, Stillwater, Oklahoma, Summer of 1966; served as Vocational Counselor for the Veterans Administration at Oklahoma State University, 1966-67; served as teacher of group processes and T-Group leader for U. S. Employment Service Training Institute at Oklahoma State University, Summer of 1967; served as Child Development Specialist and Director of Perceptual Training for the Payne County Guidance Center, Stillwater, Oklahoma, 1968.

Professional Organizations: American Personnel and Guidance Association, American College Personnel Association, Phi Kappa Phi.