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A SCREENING BATTERY OF AUDITORY PERCEPTUAL ABILITIES OF KINDERGARTEN CHILDREN

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A SCREENING BATTERY OF AUDITORY PERCEPTUAL ABILITIES OF KINDERGARTEN CHILDREN

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CHAPTER I

INTRODUCTION

Today's children are expected to absorb greater quantities of information and to comprehend more abstract concepts earlier and more quickly than ever. Within the United States there are a large number of children who are unable to achieve at the level expected for their age and apparent abilities. The child who is not achieving as expected is not only frustrated but puzzling to those adults responsible for his welfare. The effects on the child of continuing failure, especially when it is recognized by the child himself, has been well documented in psychiatry, psychology, and educational psychology. The young child reacts by developing behavioral or emotional symptoms, including early school drop-out, delinquency, neuroses and psychoses. Estimates of this most pervasive problem range from 2 to 15 percent of the nonretarded child population, depending upon how learning disabilities are defined (see Appendix A, Definition of Learning Disability; Ellingson, 1967; Rappaport, 1969; Tarnopol, 1971). All authorities agree, moreover, that these underachieving children

will be an increasing problem unless their handicap is recognized early and the deficits are diagnosed correctly in order that specialized educational services can be provided.

Children with specific learning problems who are not classified under the categories of deafness, blindness, mental retardation, etc., have been labeled by their aberrations in behavior, development, and learning. In general, the terms used to describe these aberrations fall into two broad categories: (a) etiological and (b) behavioral. Medical terminology tends to label learning disorders in terms of etiology and generally relates them to deficits in the brain (Masland, 1969). Terms such as brain injury, brain damage, minimal cerebral dysfunction, etc. are terms which imply a neurological etiology as an explanation for the deviation in development (see Appendix A, Definition of Minimal Brain Dysfunction). The behavioral terms attempt to label the disordered function according to behavioral manifestations. These behavioral terms include: perceptual handicap, conceptual disorders, and learning disability. The term "learning disability" is more specific to educational development and is concerned primarily with disorders of the communication process (see Appendix A, Definition of Learning Disability). It is primarily an educational concept whose focus is on behavioral diagnosis and remediation rather than on biological etiology.

In the past fifteen years, an explosion of interest in the area of learning disabilities has developed, though

concern has been mounting steadily since Strauss and Lehtinen set forth their educational principles in 1947. Both private and public programs are growing in number. At the state level there has been statutory implementation of special classroom instruction for children with learning disabilities. Federal and private sources have sponsored grants for research studies and teacher education. Parents and professionals, as individuals and organizations, search for the best ways to educate these children. Because of the variety of symptoms and needs presented by such children, the concept of a multidisciplinary approach to identification and remediation has assumed increasing importance.

The locating and identifying of children with specific learning disabilities must be accomplished as early as possible. The success of a special school program in helping these children develop compensatory learning methods and to remediate developmental delays in the perceptual areas is partially determined by the time between onset of the problem, its diagnosis and the application of special teaching methods. Appropriate assessments provide the teacher with a baseline for training the child in the areas of language (reading) and learning. If early assessments are not made, the child may attempt to protect himself from his inadequacies. To work through the resulting compensatory mechanisms is a much more difficult diagnostic and training task than it would have been at an earlier age.

Because of the need to identify learning disabilities early, research in the auditory modality, heretofore neglected, is vital. The present study, using professional literature on perceptual and mental development, concentrated on the need for testing as early as kindergarten. Various studies were drawn upon to survey the relationships between perception and intelligence, to classify learning disabilities, and to show that learning is contingent upon auditory perceptual abilities. Clearly, early assessment of auditory perception for diagnosis is essential.

Heretofore, a large majority of research studies have centered on the visual modality, perhaps because of the ease in observing and sampling data. However, recent studies indicate that auditory dysfunctions comparatively are more debilitating to the total well-being of the child than the visual disturbances (Bannatyne, 1968; Bateman, 1968; Flower, 1968; Morency, 1967; Myklebust, 1954; Zigmond, 1969; in Tarnopol, Ed.). For this reason, it is critical that attention is given to auditory disorders. These affect the child early in life and present major handicaps in learning.

The first task is of a diagnostic nature: to identify children with specific learning disabilities. Group administered standardized tests used in most public school kindergartens exclude auditory measures of perceptual abilities. The present study proposed a battery of auditory tasks to offset this limitation. The following aspects of the perceptual

level of the student and relationships among them were considered: the areas of auditory reception, association, sequential memory, discrimination, attention span for words, attention span for sentences, as well as the academic achievement, measured intellectual level, and sexual differences.

Background of the Problem

The review of the literature for this study was divided into three major areas: first, the basic studies of the relationship between perception and intelligence; second, an historical review of learning disabilities; third, research into auditory perception.

The work of neuropsychologists such as Luria (1966) tends to support the viewpoint that the brain functions on several levels: the sensory, perceptual and conceptual. Luria made an extensive study of the higher cortical functions in man and identified the neurological areas which, when damaged, seem to impair central language functioning. The sensory level includes hearing, seeing, movement sensing, and touch, as well as the activity of the cortical areas where the sensory signals are first received and identified as having primary physical attributes, e.g., shapes, sounds, colors. However, there is no recognition and no understanding on this level. This direct experiential material is built up selectively from birth, coming in through the senses to a main memory storage area. There, in some way which is not understood,

it seems to become integrated with other cognitive processes. This integration includes cross-indexing and the hierarchical arrangement of received images and ongoing cognitions and the assignment of meanings to them. Thus, perception, the second level, combines "identified" sensory input data with nonverbal meanings. The perceptual level involves an immediate sensing of the environment.

The third level, the conceptual, can be defined as an enduring and almost invariably progressing coalescence of related images, usually in the form of a classification. Whereas a percept almost always involves an immediate meaningful interpretation of the environment, a concept may be manipulated internally without reference to the immediate non-verbal physical environment.

The spoken word may facilitate conceptualizing but it is not itself conceptualizing. In the written form of languages, we have a system of secondary (visual) symbols which represent the primary (auditory/vocal) signs, which, in their turn, represent the perceived objects or coalesced concepts. Therefore, an auditory/vocal and written phonetic language itself expresses a sensory, perceptual and conceptual system.

The developmental progression through these levels, although it may sometimes appear to operate on a continuum from sensing to thought, probably does not do so. It is highly likely (and at the sensory level fairly certain) that specific areas of the brain may take care of each of the psychological

functions: sensing, memorizing (as an aspect of perceiving and simple conceptualizing) and thinking (Penfield and Roberts, 1959). It is also probable that the two symbol systems, one auditory/vocal and the other visual, being of sensory origin, also each have their specific neurological territory, although they must have extensive interface as well. Psychologically, these are the association, control and feedback processes through which the functioning of the parts is integrated.

Kephart (1968) proposed a theory concerning intellectual development. He described the major developmental stages and the operations found in each.

1. Motor Stage. It is during this stage that the child develops the tools for environmental encounters. He learns what the parts of his body are, what responses they can make, how to produce these movement responses, and how to recognize what response has occurred. When the human moves, certain perceptual information is automatically generated. However, the human is organized neurologically so that, at the conscious level, any perceptual information can be suppressed. By virtue of the fact that it is not attended to, it has no effect.

2. Motor-Perceptual Stage. Perceptual information is being received by the child. This perceptual information is initially meaningless. However, it soon is apparent that certain of the motor responses which he had previously learned are closely associated with certain perceptual patterns or

with alternations in perceptual patterns. Since the body of motor information is already beginning to be systematized, these closely correlated perceptual data could be put together according to the same system and thereby become meaningful to the child. The child then begins the long process of matching perceptual data to motor data. At this stage the motor information is the controlling factor. Perceptual information is manipulated against these motor data until consistency between the two sources of information is achieved.

3. Perceptual-Motor Stage. Perceptual exploration is more efficient than motor exploration and becomes the primary source of information.

4. Perceptual Stage. Perceptions can be manipulated against each other. The perception of one object can be compared with that of another object. From this comparison similarities and differences can be noted and relationships between the two objects can be deduced. The child identifies characteristics of objects through perception and manipulates these characteristics to elaborate an extensive systematized body of information.

5. As perceptions are compared with each other, certain similarities appear. These similarities can be collected together and integrated into a new whole. It would appear that the initial concepts formed by the child are the result of these abstracted similarities among perceptions. Many perceptual experiences can be combined and can be dealt with

simultaneoulsy in a single psychological act by using the abstracted concept rather than the initial perceptions.

6. Conceptual Stage. In this stage, the child manipulates one concept against another. He observes the relationships between concepts as he previously observed the relationships between percepts. The concept involves not only immediate perceptual information but past perceptual information as well. Since the basis of the concept is an abstraction, it follows that all such information both past and present is integrated and systematized.

7. Conceptual-Perceptual Stage. As the child develops an increasing number of concepts, he comes to depend more and more extensively on conceptual manipulations of information. He uses perception as a confirming function. Thus, perceptions which are incomplete or meager will be distorted or altered to fit the demands of the concepts. At this stage, organization is imposed upon the perceptual world prior to the completion of the sensory stimulus. We are able to manipulate via conception such an extensive mass of information that we can predict what will happen.

Kephart (1968) emphasized that the developmental stages are hierarchical. Each stage is essential to the next stage. A child may experience developmental breakdown at any stage in the developmental progression. The child finds himself pressured for performance at the next higher level of development even though the present stage has not been completed. He

begins to deal with the activities and generalizations of the next stage even though the foundation has not been laid in development of the present stage. Since the learnings of each stage are essential to and assumed in the learnings of subsequent stages, confusion develops and difficulties arise which are compounded as time goes on.

Studies of Learning Disabilities

The problems of the great majority of children described as "learning disabled" are based in neurological function or dysfunction. Perception, memory, reasoning, and comprehension are all dependent upon the operation of a complex neurophysiological system. A complicating factor is the common observation that many children possess all or most of the behavioral characteristics of psychopathology recognized as being related to neurological dysfunction, even though neurological findings are negative. Careful differential diagnosis should isolate children whose learning problems are caused by environmental factors from those whose learning disorders are based on perceptual psychopathology, which in turn is embedded in neurological dysfunction.

Quite early in the history of working with children with severe learning difficulties, neurologists, psychologists, and educators began to develop the concept that some sort of brain damage or neurological impairment was the basis of the children's learning difficulties. However, the realization

grew that such injury or impairment could not be proved but rather was being inferred from the symptoms. Moreover, there were just too many children with severe learning problems that didn't fit the pattern. Thus, working with children with learning problems were specialists from many fields, each with his own professional orientation. Professionals began to search for ways to coordinate findings from more than one field. It was then that the term "learning disabilities" began to be heard. Kirk (1963) presented the term "learning disabilities" for the first time to parents at a conference organized by parents to explore the problems of the perceptually handicapped on April 6, 1963. Educators adopted the term learning disability, which indicated that the problem is educational in scope. Its rapid acceptance reflected its usefulness in focusing on the problem rather than in attempting explanations, and recognized the growing interaction of the various concerned groups. Physicians tend to prefer a term such as minimal brain dysfunction, which points to the medical nature of the problem. Many of the original labels remain in use, usually referring to the same children.

In 1966 a group sponsored by the National Institute of Neurological Diseases and Blindness of the National Institutes of Health, and the National Society for Crippled Children and Adults, Inc. organized a review of the literature dealing with brain dysfunction in children (Clements, 1966). Its first task was the identification of the variety of behavioral

characteristics, medical indicators and suggestions as to natural history which had shared the common label of "minimal brain dysfunction." No less than ninety-nine signs and symptoms were compiled. The National Project on Minimal Brain Dysfunction in Children was organized to produce a series of position papers dealing with learning and behavioral disorders in children based on current knowledge and thinking. The Task Force One Document set forth the working definition of minimal brain dysfunction (Clements, 1966; see Appendix A). Its purpose was to establish the category and to make specific the group of children with which the National Project would be concerned. Task Force Two Document reported on the extent of the need both for medical diagnosis and treatment and for identification of educational capabilities and methods of educating afflicted children (Charing, 1969). Task Force Three Document reported on research aspects of the problem (Chalfant and Scheffelin, 1969).

Gearheart (1972) reviewed the historical literature on minimal brain dysfunction and learning disabilities. One of the specific disabilities currently included as part of the total grouping of learning disabilities we would recognize in studies in the very early Nineteenth Century relating to visual perception. A book entitled Visual Perception: The Nineteenth Century was dedicated entirely to contributions in this field commencing as early as 1801 (Dember, 1964).

However, prior to 1920, studies in this area were limited largely to reports of case studies of individuals.

The origins of the term "minimal brain dysfunction" came from the efforts in the 1920's and 1930's to better classify different types of intellectual aberration. It was during this period that it became necessary for administrative, clinical, and research purposes to develop meaningful sub-groupings to differentiate institutional populations of children. The designated spectrum of disorders ranged from relatively circumscribed, specific disabilities in motor, sensory and behavioral organization to profound disturbances in behavior and intellect.

As early as the late 1920's and early 1930's, a few professional leaders were concerned with children who demonstrated unique learning characteristics. They were working in isolation from one another, and, as the result, the impact of their efforts was not to be felt until thirty years later. The study of learning disabilities sprang largely from the work by individuals within the area of mental retardation.

During the early 1920's a number of universities developed Clinic Schools dedicated to the study of children with special problems in learning. One such school was established in 1921, at the University of California at Los Angeles. From the initial mixture of children who were delinquents, epileptics, children who had normal intelligence but severe reading problems, and those children with limited mental abilities, a

program involving mainly those children with normal intelligence but with extreme educational disabilities evolved. This program, and a few others similar in nature, were the nearest approach to early learning disabilities programs in the United States. The program was well documented by an early educational classic text written by Fernald (1934). Her studies on cases of word blindness demonstrated the effectiveness of her "tracing" approach to remediation of reading problems. The major thrust of Fernald's work was the need to investigate and attempt to utilize the kinesthetic approach, in addition to the visual and auditory channels.

Orton (Tarnopol, 1971), an American neurologist and psychiatrist, made important contributions to this field from 1925 until his accidental death in 1948. The Orton Society, devoted to the study and treatment of children with specific language disabilities, was founded in his honor.

Pioneer research studies began to make an impact on the educational scene with the work of Strauss, Heinz, Lehtinen, and Kephart. Werner and Strauss (1939) advocated functional analysis which insists that each child must be assessed in terms of his particular abilities and disabilities. The bequest of Werner and Strauss to the fundamental principles of learning disability theory included maximum concern for (a) specific individual disabilities and techniques to deal with them; (b) perceptual-motor difficulties and training to modify them; and (c) the psychological characteristics of hyperactivity

and distractibility and educational procedures to minimize them.

Strauss and Lehtinen (1947) summarized the previous work in this field and made the first comprehensive presentation of the learning problems of brain-injured children. Studies of the learning problems of brain-injured children revealed basic information about how all children learn and led to the hypothesis that some children are afflicted with minimal brain dysfunction. Strauss and Kephart (1955), in describing the problems of brain-injured children, reported the lack of meaning associated with the child's verbalization.

In addition to the work of Strauss and Werner, other researchers and educators have published tests concerned with information on research, rationale, assessment, and management of children with learning disabilities (Bannatyne, 1971; Bortner, 1968; Clements, Lehtinen, and Lukens, 1964; Cruickshank, Bentzen, Ratzeburg, and Tannhauser, 1961; Hallahan and Cruickshank, 1973; Hammell and Barterl, 1971; Johnson and Myklebust, 1967; Kephart, 1960; Kirk and Kirk, 1971; Koppitz, 1964; Myklebust, 1954, 1965, 1968, 1971; Tarnopol, 1971; Waugh and Bush, 1971).

In recent years several extensive studies have been compiled examining the periodical literature concerning the various facets of learning disabilities in children (Chalfant and Scheffelin, 1969; Elkind and Semeroff, 1970; Flavell and Hill, 1969; Tymchuk and Knights, 1969; Yates, 1966). A review of periodical literature subsequent to Elkind and Semeroff's

work required the reading of a large number of articles published since 1970. Further, the study of learning disabilities is multidisciplinary: medicine, sociology, psychology, as well as education, are engaged in work with the child with learning disabilities. It was not until 1968 that the Journal of Learning Disabilities, a periodical devoted entirely to this area, was first published.

Immediate Context of Auditory Perception

When the activity of listening becomes integrated with the sensation of hearing, auditory perception takes place. If the auditory image in the child's brain does not match the auditory stimulus, he is said to have an auditory perceptual disorder. Most studies on auditory perception have limited their focus to the relationship of reading skills to audition. However, some studies have noted that audition is related to the total learning experience (Baker and Leland, 1967; Johnson and Myklebust, 1967; Zigmond, in Tarnopol, 1969). In light of such research, it is the contention of this investigator that early assessment is imperative to diagnose the auditory modality deficits before the child enters first grade. The earlier the diagnosis the better the prognosis for adequate educational progress. Generally the diagnosis of learning disabilities is not made until the child is presented with the need to interpret such geometric symbols as words and numbers. The usual age of referral is seven to ten years. By that time the auditory deficits may be well entrenched.

Perceptual studies in all sensory modalities indicated developmental patterning (Bangs, 1968; Birch and Belmont, 1965). A dysfunction in the brain can inhibit auditory learning and at times impede all aspects of auditory functioning.

Audition is the child's primary distance scanning sense. It is the primary channel for language acquisition and inter-personal communication. Generalized deficits in sensory processes comprise one of the most complex problems encountered by educators and psychologists. The child with a generalized deficit in auditory learning hears, but he does not interpret what he hears. He is unable to structure his auditory world, to sort out and associate sounds with particular objects or experiences. Johnson and Myklebust (1967) found that auditory involvements of this type were considerably more debilitating than those where only verbal comprehension was affected.

Children who have auditory verbal comprehension disabilities can comprehend non-verbal social sounds, but they are unable to relate the spoken word to the appropriate unit of experience. The degree of involvement varies. When the condition is less severe, they have trouble only with abstract language or certain parts of speech. Language disabilities of this type have been designated as receptive aphasia, sensory aphasia, or word deafness (Myklebust, 1954; Orton, 1937; Wepman, 1951).

An inability to understand words must be differentiated from disorders related to distractibility, listening, or

auditory memory. Inasmuch as any one of these problems can affect the child's comprehension, the specific deficit should be determined. Auditory memory span refers to the amount of information an individual can retain in proper sequence, particularly for purposes of immediate action or recall. Many children with neurogenic learning disorders are limited in the amount of information they can remember. The role of memory in learning a language should be emphasized. A child must retain certain linguistic patterns in mind and store them to make the abstractions necessary for correctly generating sentences of his own.

The efficiency of a human system in receiving and storing information depends upon the intactness and appropriate integration of sensation, perception, and memory. In recent years investigators have found evidence that there is a mechanism in the brain with a basic function called attention (Broadbent, 1954, 1958; Norman, 1969; Treisman, 1966, 1969). Birch, et al., (1965) hypothesized that attention-span derives from altered patterns of relation between the processes of excitation and inhibition. Attention may vary from intermittent to fixated. They theorized that short attention span may be viewed as the result of relatively weak excitation and/or weak surrounding inhibition, perseveration as the result of excessively strong or persistent excitation and/or strong surrounding inhibition, and distractability as the product

of relatively short-lived excitation and/or weak surrounding inhibition resulting in ineffective insulation.

Many children with language disorders have no problem in understanding the spoken word but are deficient in using it to express themselves. The person's primary difficulty is in the evocation of certain types of words, such as names, qualities, or relationships (Johnson and Myklebust, 1967). Children with reauditorization deficits experience great frustration in communicating. They try to relate happenings but give up in desperation because they cannot remember how to say what they have in mind. Eisenson (1963) referred to this disorder as an amnestic type of aphasia. When the child is unable to recall a word, he may substitute one from within the same general category or one similar in meaning.

One striking and subtle speech development symptom which may continue even into adult life is the inability to discriminate between vowels which sound alike, particularly the short or neutral vowels. To test this symptom effectively, auditory discrimination tests should present the vowels in similar sounding words, preferably using the same consonants, e.g., pen and pin. In a paper on auditory discrimination and articulation, Weiner (1967) has thoroughly reviewed the field. His one major finding was that there was a positive relationship between poor auditory discrimination and the more severe articulatory difficulties at the age levels below nine years. Wepman (1960) stated that there is a positive relationship

between poor discrimination and poor reading. He found that the ability to discriminate frequently matures as late as the end of the child's eighth year. Wepman and Weiner apparently agreed that there is a strong positive relation between slow development of auditory discrimination and inaccurate pronunciation.

One aspect of learning disability research which has not been conclusively investigated is the relationship of sex difference to learning performances. It has been consistently observed that more boys than girls experience difficulty in learning to read (Katz and Deutsch, 1963). Further, boys are over-represented in the learning disability populations as a whole; in various studies, the ratio of male children to females in the learning disability population ran from 3:1 to 8:1 (Bannatyne, 1971; Gearheart, 1972; Hallahan and Cruickshank, 1973; Silver, 1971). This difference in the learning performance of boys as compared with girls was considered by some investigators to suggest a genetic trait (Crosby and Liston, 1969; Ellingson, 1967). However, it is worth noting that most studies in the literature used only male subjects in their experimental and control populations, apparently because of the preponderance of problems among boys. And in those studies using both boys and girls no attempt was made to investigate differences in performances between boys and girls.

To complicate the problem, few auditory tests were administered to either sex, leaving a gap in information about

sex differences in relation to audition. Three studies reported that the pupil's sex did not enhance perceptual performance (McNinch, 1970; McNinch and Richmond, 1972; Snyder and Pope, 1972). These findings of no differences by sex were reported when individual tests of perceptual nature were used in first grade population, administered early in the school year.

In summary of the preceding review of the literature some basic concepts can be formulated. One of the major causes for failure to achieve academically among children with average intelligence is perceptual dysfunction. Children who are in this category have been designated as having a learning disability.

It is important to diagnose these dysfunctions at an early age so correct placement and remediation can be started before the child begins to experience failure. Auditory perceptual development is crucial to the ability to learn and a deficit in this area may be one of the primary reasons children of average intelligence fail to achieve academic success.

It is apparent that there is a need to view the problem of auditory disorders in children as one requiring differential diagnosis. Assessing of specific rather than general factors would be more informative in obtaining information to be used in training and education.

Observation of the body of literature concerning learning disability research reveals the auditory modality has been

relatively ignored in comparison to the visual modality. Obviously what is necessary is (1) further research into sex differences in relation to learning disabilities and (2) early testing in auditory perception in order to remediate handicaps before the student begins to have difficulty in school.

The present study focused on auditory perceptual development in kindergarten children. The remaining review of the literature concentrates on the instruments used in the present study. The instruments were the Vane Kindergarten Test, the Metropolitan Readiness Tests, the auditory subtests from the Detroit Tests of Learning Aptitude, the auditory subtests from the Illinois Test of Psycholinguistic Abilities, and the auditory discrimination subtest from the Gates-MacGinitie Readiness Skills Test (see Appendix B).

Vane Kindergarten Test

The Vane Kindergarten Test (VKT) was developed in order to evaluate the intellectual and academic potential and behavior adjustment of young children. Vane (1968) stated that the underlying assumption of the VKT is that samples of behavior taken at kindergarten age will give clues to the child's ability to function adequately in areas related to success in school. It permits an individual evaluation of each child which makes it possible to determine the influence of attention, perceptual motor skills or non-conforming behavior upon the test results. The VKT consists of three parts, a

perceptual motor subtest, a man drawing subtest, and a vocabulary subtest.

Perceptual Motor Subtest.--Abilities measured by this subtest are related to basic perceptual motor skills which are developmental in nature (Epstein, 1967; Koppitz, 1963). Skills needed for success on this type of test were shown to be related to mastery of reading and writing in the primary grades (Book, 1971; Kephart, 1960). Poor performance on the subtest frequently is indicative of a developmental lag in motor or perceptual development. Very poor performance may be suggestive of central nervous system dysfunction (Diller and Birch, 1964).

Vocabulary.--Abilities measured by this subtest are related to intelligence and ability to succeed with academic work (Terman and Merrill, 1960). The responses to the beginning words measure knowledge and as such function as a general information test. Responses to the more difficult words require language facility as well as knowledge of the meaning of the words.

Man Drawing.--This subtest is similar to the Drawing Test of Intelligence developed by Goodenough (1926) and the Goodenough-Harris Drawing Test developed by Harris (1963), but the directions, scoring and standardization are different. Such tests were shown to be a measure of both intelligence and adjustment at the preschool and primary level (Harris, 1963; Koppitz, 1966; Vane and Eisen, 1962; Vane and Kessler, 1964).

Metropolitan Readiness Tests (MRT)

This battery was devised to measure the extent to which school beginners have developed in the several skills and abilities that contribute to readiness for first grade instruction (Hildreth, Griffiths, and McGauvran, 1969). Designed for group testing, these tests are administered by the kindergarten teachers in the late spring. Six tests are included in the MRT battery: Word Meaning, Listening, Matching, Alphabet, Numbers, and Copying.

A total readiness score is composed of the sum of the points earned on the six tests. The extent to which the six tests go together to form a meaningful composite readiness measure is indicated by the intercorrelations among the tests (Hildreth, Griffiths, and McGauvran, 1969). All are positive and would be considered moderate. None is so large as to suggest that any two of the tests are measuring identical or nearly identical functions. The most closely correlated subtests ($r = .64$) are Alphabet and Numbers. This is as would be expected, since these two contain the most directly taught material. The predictive validity data for the MRT involve the correlation between pupils' readiness scores and scores on the Stanford Achievement Test: Primary I (1964 Revision) the following May, for 9497 cases in the standardization population for the Readiness tests. The range of these correlations for the six Stanford subtests is .57 to .67, providing evidence

that a fall test entirely devoid of reading can give a good prediction of both reading and arithmetic achievement at the end of the year. Since these observed correlations are with single subtests of achievement, Hildreth, et al., (1969) concluded that the correlation with total overall achievement, were there such a measure, would be at a level of at least .65.

In a study of early identification of learning disabilities, Ferinden and Jacobson (1970) found that the MRT was an effective predictor only if the total test scores fell below the thirtieth percentile. Bougere (1969) searched for ways of specifying those factors of oral language which are related to beginning reading achievement and for evidence that selected language measures could add significantly to the predictive value of a standardized readiness test. The children were tested on the Metropolitan Readiness Test and on selected language measures. The Gray Oral and Stanford Primary I reading tests were used for criterion data. Major results showed that the MRT predicted reading success more accurately than any of the language measures, but the predictive validity of the MRT for comprehension and word recognition could be significantly increased by the addition of three language factors. Book (1971) found significant differences in the performance of average and failing readers in the first grade on the Metropolitan Readiness Test. Book and deHirsch (1966) both suggested the use of a predictive battery for the early identification

and program planning for children with perceptual, intellectual, and readiness deficits.

Detroit Tests of Learning Aptitude (DTLA)

This battery of tests was developed to meet the needs of a differential diagnostic instrument to assess the strengths and weaknesses of specific mental faculties. It was developed in 1935 by Baker and Leland (1967). The second revised edition, published in 1967, has nineteen subtests which yield a general mental age as well as a series of subtest mental ages. This instrument is very flexible, adapted to examining preschool children and to the higher mental processes of high school students. The standardization was made on pupils from the Detroit Public Schools. Subtests were correlated with each other on 100 children ages eight to twelve years and the great majority of correlations fell from .2 to .4 indicating a fairly low yet positive correlation. The highest correlation was .679 between subtests verbal absurdities and verbal opposites.

Two of the DTLA subtests were administered in the present investigation as part of the Auditory Screening Battery. These were Auditory Attention Span for Unrelated Words and the Auditory Attention Span for Related Sentences. An investigation was made by Myklebust (1971) to critically evaluate a battery of psychoeducational tests in terms of their usefulness in assessment of learning disability children. Both the recall of words and sentences as measured by the DTLA were

found to be significant at the $p < .01$ level in discriminating between the severe learning disability and control groups.

Johnson and Myklebust (1967) observed that the performance of dyslexic and aphasic children fell substantially below the norm on the two DTLA tests of auditory memory span, although some of the children with formulation difficulties performed better on memory for unrelated words than on memory for sentences. It seems that those who had syntactical deficits could more successfully remember a list of unrelated words than sentences where both meaning and structure must be held in mind.

Flower (1968) proposed a model of auditory perceptual skills that were necessarily mastered prior to reading instruction. Auditory memory was one of the essential perceptual skills. Rizzo (1963), Cabrini (1963) and Morency (1968) found that auditory memory span discriminated between good and poor readers or predicted first grade achievement to a significant degree within normal populations.

Illinois Test of Psycholinguistic Abilities (ITPA)

The concept of "intraindividual differences" (discrepancies in growth within a single child) necessitated the development of diagnostic psychoeducational tests (Kirk and McCarthy, 1961). The ITPA was developed as a test battery that assesses specific abilities, disabilities, and achievements of a child in such a way that remediation of defects can logically follow.

The ITPA was developed by Kirk and published in experimental form in 1961. It originally contained nine subtests and later was expanded to include twelve. The revised edition of the ITPA was published in the fall of 1968 (Kirk, McCarthy and Kirk, 1968).

The ITPA, adapted from the communications model of Osgood (1957), includes those major processes involved in the use of language--reception, organization, and expression. The routes of communications included in the tests are the auditory-vocal channel and the visual-motor channel.

The ITPA is one test that is invariably used at the Marianne Frostig Center of Educational Therapy as a basis for planning the educational program (Frostig, in Myklebust, Ed., 1967). A vast amount of research has focused on the ITPA and it has become an extraordinarily popular clinical and research tool (Hallihan and Cruickshank, 1973). Most of the reported studies were performed on the 1961 experimental edition rather than on the newer revised edition.

In terms of reliability, both internal consistency and stability coefficients were calculated on the revised edition (Paraskevopoulos and Kirk, 1969). For the most part, the coefficients were quite adequate, occurring predominantly in the high .80's or .90's. The stability of the ITPA was determined by retesting three age groups from the standardization sample. Some six months after the original assessment, 198 of the children were relocated and tested. Those selected for

this reliability study did not differ significantly from the larger group on their scores for the first testing. The coefficients obtained were generally of a moderately high nature, falling for most part in the .60's and .70's.

Three subtests from the ITPA were given to each subject, auditory reception, auditory association, and auditory sequential memory. The tests were administered by a certified school psychometrist.

Gates-MacGinitie Readiness Skills Test (G-MRST)

This test was designed for kindergarteners and early first graders (Gates and MacGinitie, 1968). Two separate standardization samples were tested and separate norms for each group were prepared. The norms were developed by administering the test to a nationwide sample of approximately 4500 children in thirty-five communities. Only one of the eight subtests was included in the auditory screening battery given by the investigator. The Auditory Discrimination subtest on the G-MRST was chosen because the testing procedures were easily understood and followed by the young child. The subtest measures the child's skill in distinguishing between two words of similar sound. It includes twenty-one pairs of pictures that correspond to twenty-one pairs of words. Each pair differs in only one sound. After naming both pictures in a pair, the examiner pronounces the name of one of the pictures again. The child marks the corresponding picture.

Wepman studied auditory perception and the relation it holds to speech and reading in young children. In discussing the implications of his research and the findings of others, Wepman (1968) argued that children should be studied as they reach school age to determine whether their auditory abilities have developed to the level that they can benefit from phonic instruction. The Wepman focus was on the significant fact that children who have inadequate auditory discrimination are more likely to be poor readers than the total group.

Flower (1968) proposed a hierarchy of auditory perceptual skills that must be mastered prior to successful reading instruction. The model by Flower proposed that auditory discrimination is the basic and least complex of the skills.

The following conclusions were drawn from the review of literature: (1) normal perceptual development is considered prerequisite to adequate learning; (2) auditory perceptual ability is an essential component in this learning; (3) it is important to detect auditory perceptual dysfunctions early in a child's school career; (4) standardized measures of various facets of auditory perceptual ability exist in the Detroit Tests of Learning Aptitude, Illinois Test of Psycholinguistic Abilities, and the Gates-MacGinitie Readiness Skills Test; (5) research is limited in the area of auditory perceptual abilities of kindergarten children; and (6) because of contradictory findings, no conclusive statements can be made as to sex superiority on test performance.

Problem to Be Investigated

The major problem in the area of learning disabilities to be investigated was that of selecting a battery of tests which would adequately measure auditory perceptual skills of kindergarten children. Further, it was necessary to identify those auditory factors which were not being assessed by a reading readiness battery. Rude (1973) noted in his study of five major reading readiness batteries that three purported to measure listening ability and only one assessed auditory discrimination skills. None of the five readiness tests had measures to assess auditory reception or association abilities.

The present study, therefore, focused on the differentiation of auditory factors in the perceptual development of kindergarten children. The following aspects of the perceptual level of the student were considered: auditory reception, association, sequential memory for digits, discrimination, attention span for words, and attention span for sentences.

The specific purpose of this study was to (1) investigate the differences in auditory perceptual abilities between boys and girls, and (2) examine the correlations between the auditory perceptual measures and other tests regularly administered at the kindergarten level.

For that purpose, it was decided to use standardized auditory perceptual measures to investigate the relationships between the auditory measures and the scores obtained from an

intelligence test and readiness test battery commonly administered at this level. Based upon the review of the literature, the following hypotheses were formulated:

1. There are no significant differences in mean scores between boys and girls in auditory attention span for words.
2. There are no significant differences in mean scores between boys and girls in auditory attention span for sentences.
3. There are no significant differences in mean scores between boys and girls in auditory reception.
4. There are no significant differences in mean scores between boys and girls in auditory association.
5. There are no significant differences in mean scores between boys and girls in auditory sequential memory for digits.
6. There are no significant differences in mean scores between boys and girls in auditory discrimination.
7. There are no significant differences in mean scores on prereading measures between boys and girls.
8. There are no significant correlations among the six auditory measures and the prereading test battery.

CHAPTER II

METHOD

Testing Program

Many public schools screen their kindergarten children each spring to aid in determining correct placement for first grade in the following year. One hundred and eighty kindergarten students from two Oklahoma towns were selected for this study. An Auditory Screening Battery (ASB), consisting of six auditory perceptual measures, was administered by certified school psychometrists. The data from the ASB were scored by the investigator, a certified school psychologist. The spring test data from measures of readiness and intellectual factors (VKT and MRT) were obtained from school records of the sample population.

Subjects

The subjects (Ss) used in this study were chosen from public school kindergartens in Oklahoma. The sample came from two school systems in different geographic locations. The kindergarten programs in both towns have had supplementary funds from the ESEA, Title III Program.

One group of subjects, from a small western town, Elk City, was comprised of all kindergarten pupils--sixty boys and

thirty girls--who attended the full year and were not retainees from the previous school year. These children were tested during the first three weeks of school by the school psychometrist. The test data were used to determine if a child had specific developmental imbalances in perception, conceptual development, language or motoric development that would cause him to be high risk for learning. All children identified by the team as high risk remained in the regular kindergarten classroom and were serviced daily by a specialist with early childhood training. The specialist worked with the high risk children in perceptual motor development, language development, and in the area of math either individually or in small groups.

The second group of students, located in the northeastern section of Oklahoma, came from two schools in the larger school system of Sapulpa, randomly chosen from nine schools offering the kindergarten program. The Sapulpa students were randomly selected to match the proportions of boys and girls in the group of students from Elk City, constituting a proportional stratified sample. See Table 1 for the distribution of subjects by town and sex. The Sapulpa kindergarten classes used programmed materials from the DISTAR Reading Program published by Science Research Associates. Each teacher had the services of a trained paid teacher's aide who assisted her in all aspects of the program. The Sapulpa kindergarten program was classified as an innovative program by the ESEA, Title III Project.

TABLE 1

DISTRIBUTION OF SUBJECTS BY TOWN AND SEX

Town	Males		Females	
	N	%	N	%
Elk City	60	66.7	30	33.3
Sapulpa	60	66.7	30	33.3
Total	120	66.7	60	33.3

Instruments

The Vane Kindergarten Test (VKT) and the Metropolitan Readiness Tests (MRT) were administered to all subjects early in the fall and again in late spring. The VKT was administered by the school psychometrist, and the MRT was given by the kindergarten teacher. For the purposes of this study, only the spring test data was used. The descriptions of these instruments are given in Appendix B.

The Auditory Screening Battery (ASB) was administered in the late spring, within two weeks of the school testing program (VKT and the MRT). The ASB was comprised of six standardized instruments. These measures were administered in the following order: (1) Detroit Tests of Learning Aptitude Auditory Attention Span for Words (DTLA AAW); (2) Detroit Tests of Learning Aptitude Auditory Attention Span for Sentences (DTLA AAS); (3) Illinois Tests of Psycholinguistic Abilities Auditory Perception (ITPA AR); (4) Illinois Test

of Psycholinguistic Abilities Auditory Association (ITPA AA); (5) Illinois Test of Psycholinguistic Abilities Auditory Sequential Memory (ITPA ASM); and (6) Gates-MacGinitie Readiness Skills Test Auditory Discrimination (G-MRST AD).

Certified psychometrists who were experienced in giving the above tests administered the battery of six auditory measures. Two psychometrists assisted in Elk City and one in Sapulpa. The testing was administered to each child invidually in a testing room. Each battery took from twenty to thirty minutes. All testing at both locations was done within a two-week period. The various tests were administered according to standard test instructions. All tests were composed of objective items and all were scored by the investigator, who is a certified school psychologist.

Design

This study examined the intercorrelations among the six auditory measures and the measures obtained from the intelligence test and the readiness test battery. The major comparison variable was the sex of the subjects. The dependent variables were the number of correct responses on the auditory measures and the scores on the spring test data of intelligence test and the readiness test battery.

The primary data used in testing of the hypotheses were the scores from the auditory test battery, the subtest scores and total score from the MRT. The probability level

for testing the null hypotheses is reported at the .10 and the .05 level of confidence. The .10 level is used to reduce the probability of mistakenly accepting the null hypotheses. The statistical technique employed in analyzing the data was the analysis of variance for hypotheses one through seven. Correlational analysis was used in analyzing the data for hypothesis eight.

CHAPTER III

RESULTS AND DISCUSSION

One hundred and eighty kindergarten students from two Oklahoma towns were selected for this study. Each group was given the Vane Kindergarten Test, the Metropolitan Readiness Tests, two auditory subtests from Detroit Tests of Learning Aptitude, three auditory subtests from the Illinois Test of Psycholinguistic Abilities, and the auditory discrimination subtest from the Gates-MacGinitie Readiness Skills Test. Additional biographical data were collected on each subject such as sex and town. The distribution of subjects by town and sex is presented in Table 1.

Comparison of Performance by Sex

Six null hypotheses were formulated concerning the differences in performances of boys and girls on six auditory perceptual abilities. The seventh null hypothesis was formulated to investigate the differences in performance of boys and girls on prereading measures (VKT and MRT). The application of analysis of variance was used in comparing the performance by sex on the various measures. The means and standard deviations by town and sex for the various measures are given in Table 2. When comparison of performance by sex was

TABLE 2

MEANS AND STANDARD DEVIATIONS BY TOWN AND SEX FOR THE VARIOUS MEASURES

Boys (n = 60)				Girls (n = 30)			
	Test	Mean	S.D.		Test	Mean	S.D.
Elk City							
1	VKT PM	7.32	2.29	1	VKT PM	7.40	2.22
2	VKT V	6.02	1.73	2	VKT V	5.73	1.86
3	VKT MD	13.10	2.96	3	VKT MD	14.23	3.10
4	MRT WM	8.48	2.78	4	MRT WM	8.30	2.65
5	MRT L	11.48	2.33	5	MRT L	11.73	2.15
6	MRT M	8.75	3.37	6	MRT M	8.97	3.50
7	MRT A	10.95	3.94	7	MRT A	11.90	4.08
8	MRT N	13.53	4.58	8	MRT N	14.87	4.26
9	MRT C	8.22	3.66	9	MRT C	8.93	3.32
10	MRT TOTAL	61.48	15.72	10	MRT TOTAL	64.83	15.74
11	DTLA AAW	30.95	6.98	11	DTLA AAW	29.97	8.21
12	DTLA AAS	36.57	11.13	12	DTLA AAS	35.27	13.01
13	ITPA AR	24.97	7.39	13	ITPA AR	22.37	8.79
14	ITPA AA	19.67	5.40	14	ITPA AA	19.07	5.35
15	ITPA ASM	21.35	7.85	15	ITPA ASM	22.07	7.91
16	G-MRST AD	18.60	2.89	16	G-MRST AD	19.23	2.31
Sapulpa							
1	VKT PM	5.92	2.36	1	VKT PM	5.80	1.81
2	VKT V	5.28	1.79	2	VKT V	5.27	1.80
3	VKT MD	13.78	4.12	3	VKT MD	15.00	3.79
4	MRT WM	9.33	2.78	4	MRT WM	9.03	2.24
5	MRT L	10.35	2.74	5	MRT L	10.50	2.54
6	MRT M	9.22	3.27	6	MRT M	8.80	2.86
7	MRT A	13.72	2.95	7	MRT A	13.93	2.35
8	MRT N	13.67	4.66	8	MRT N	13.07	3.92
9	MRT C	8.03	3.44	9	MRT C	9.07	3.22
10	MRT TOTAL	64.53	15.65	10	MRT TOTAL	64.40	12.85
11	DTLA AAW	34.07	8.11	11	DTLA AAW	31.80	7.06
12	DTLA AAS	36.10	13.16	12	DTLA AAS	36.00	11.06
13	ITPA AR	25.90	7.19	13	ITPA AR	25.73	7.87
14	ITPA AA	20.65	4.90	14	ITPA AA	20.80	4.33
15	ITPA ASM	23.12	7.91	15	ITPA ASM	24.53	9.91
16	G-MRST AD	19.38	1.49	16	G-MRST AD	19.70	1.34

investigated, no statistically significant differences were noted between Elk City Boys and Elk City Girls or between Sapulpa Boys and Sapulpa Girls. The means and standard deviations for the combined sample for the various measures are shown in Table 3.

TABLE 3

MEANS AND STANDARD DEVIATIONS FOR THE COMBINED SAMPLE FOR THE VARIOUS MEASURES

	Test	Mean	S.D.
1	VKT PM	6.61	2.33
2	VKT V	5.60	1.80
3	VKT MD	13.83	3.58
4	MRT WM	8.83	2.69
5	MRT L	10.98	2.53
6	MRT M	8.95	3.26
7	MRT A	12.53	3.64
8	MRT N	13.72	4.45
9	MRT C	8.42	3.46
10	MRT TOTAL	63.54	15.20
11	DTLA AAW	31.97	7.70
12	DTLA AAS	36.10	12.05
13	ITPA AR	24.97	7.69
14	ITPA AA	20.08	5.06
15	ITPA ASM	22.59	8.26
16	G-MRST AD	19.15	2.19

One way analyses of variance comparing boys and girls on each of the subtests and the MRT total were performed which yielded F values that ranged from 0.00 to 19.63. Observation of the F values indicated that on all auditory perceptual measures, and on all prereading measures, with the one exception of the VKT Man Drawing measure, there were no significant

TABLE 4

SUMMARY OF THE UNEQUAL N'S ANALYSES OF VARIANCE COMPARING SEX AND TOWN VARIABLES ON EACH DEPENDENT VARIABLE

	Test***	Elk Boys vs Elk Girls (df=1/88) F	Sp Boys vs Sp Girls (df=1/88) F	Elk Boys vs Sp Boys (df=1/118) F	Elk Girls vs Sp Girls (df=1/58) F	Elk City vs Sapulpa (df=1/178) F	Boys vs Girls (df=1/178) F
1	VKT PM	0.03-	0.06	**10.90	** 9.36	**18.29	0.00
2	VKT V	0.51	0.00	** 5.22	0.98	** 4.57	0.28
3	VKT MD	*2.84-	1.84-	1.09-	0.74-	1.65-	** 4.40-
4	MRT WM	0.24	0.26	* 2.81-	1.34-	* 3.54-	0.32
5	MRT L	0.24-	0.01-	** 5.33	** 4.12	** 9.18	0.25-
6	MRT M	0.08-	0.35	0.59-	0.04	0.08-	0.04
7	MRT A	1.14-	0.12-	**18.98-	** 5.60-	**19.63-	1.05-
8	MRT N	1.78-	0.51	0.09-	* 2.90	1.40	0.27-
9	MRT C	0.82-	1.89-	0.08	0.03-	0.00-	2.59-
10	MRT TOTAL	0.91-	0.00	1.14-	0.01	0.30-	0.45-
11	DTLA AAW	0.35	1.70	** 5.10-	0.86-	** 4.24-	1.81
12	DTLA AAS	0.24	0.00	0.04	0.06-	0.00-	0.13
13	ITPA AR	2.17	0.01	0.49-	2.44-	* 3.15-	1.29
14	ITPA AA	0.29	0.02-	1.09-	1.90-	* 2.91-	0.08
15	ITPA ASM	0.17-	0.54-	1.51-	1.13-	2.65-	0.67-
16	G-MRST AD	0.09-	0.97-	* 3.49-	0.91-	* 3.31-	1.90-

Negative sign (-) indicates favor of second group
* Significant at or beyond the .10
** Significant at or beyond the .05 level
*** See Appendix B for Description of Instruments

differences in mean scores between boys and girls at the .05 level and at the .10 level. On the VKT Man Drawing measure the girls surpassed the boys in performance. Research studies have shown that social intelligence and awareness of environment, reflected in figure drawings are developed earlier in girls than in boys (Harris, 1963; Koppitz, 1966). The Elk City girls' mean score on the VKT MD was 14.23 with a standard deviation of 3.10. The Sapulpa girls' mean score on the VKT MD was 15.00 with the standard deviation of 3.79. For the total group of girls from both towns the mean score was 14.62. The Elk City boys' mean score on the VKT MD was 13.10 with a standard deviation of 2.96. The Sapulpa boys' mean score on the VKT MD was 13.78 with a standard deviation of 4.12. For the total group of boys from both towns, the mean score was 13.44. The difference in the mean scores between boys and girls is 1.18. Although this difference is significant in a statistical sense, it does not seem large enough to have any practical significance.

Null hypotheses one through six (concerning the auditory perceptual measures) were not rejected. The analyses of variance tests revealed no significant differences in mean scores between boys and girls in auditory attention span for words, auditory attention span for sentences, auditory reception, auditory association, auditory sequential memory for digits, and in auditory discrimination. The seventh null hypothesis (there are no significant differences noted on

prereading measures between boys and girls) was accepted with the one exception that girls score significantly higher than boys on figure drawing tasks (VKT MD).

Evaluation of Intercorrelation of Subtest Scores

Hypothesis eight stated that there will be no significant correlations among the six auditory measures and the prereading test battery. Hypothesis eight was tested by correlating the scores of each of the instruments which resulted in a 15 x 15 correlation matrix. Only the correlations between tests 1-9, on the one hand, and 11-16 on the other, are relevant to this hypothesis. Significant correlations among tests 11-16 are expected, since they all pertain to auditory perception. On a post hoc basis, this matrix was factor analyzed. The primary data used in the matrix combined data from sex and town variables. The rationale for this procedure was, first, that the size of sample, varied by sex and town, was not large enough to obtain stability of factors for factor analysis; and second, that there was no significant statistical difference in the total readiness score (MRT TOTAL) between sexes or between towns and further that only one auditory measure, auditory attention span for words (DTLA AAW), showed a significant difference in mean scores between towns but not between sexes (see Table 4). The combined data from the 180 subjects are presented in Table 5. A correlation matrix from which multiple correlation coefficients could be obtained was computed.

TABLE 5

CORRELATION MATRIX WITH MEANS AND STANDARD DEVIATIONS
(N = 180)

	Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Mean	S.D.
1	VKT PM	.49																6.61	2.33
2	VKT V	.33	.29															5.60	1.80
3	VKT MD	.44	.23	.31														13.83	3.58
4	MRT WM	.28	.36	.22	.48													8.83	2.69
5	MRT L	.44	.32	.21	.38	.37												10.98	2.53
6	MRT M	.45	.32	.32	.41	.42	.45											8.95	3.26
7	MRT A	.26	.33	.33	.50	.36	.47	.52										12.53	3.64
8	MRT N	.47	.43	.36	.56	.53	.57	.51	.59									13.72	4.45
9	MRT C	.62	.36	.47	.34	.41	.52	.42	.54	.54								8.42	3.46
10	MRT TOTAL																		
11	DTLA AAW	.12	.24	.06	.25	.21	.20	.20	.26	.16		.33						31.97	7.70
12	DTLA AAS	.35	.32	.28	.39	.39	.40	.43	.48	.41		.52	.67					36.10	12.05
13	ITPA AR	.28	.28	.11	.46	.33	.27	.40	.35	.31		.29	.39	.34				24.97	7.69
14	ITPA AA	.36	.49	.31	.63	.47	.43	.61	.63	.45		.34	.60	.51	.68			20.08	5.06
15	ITPA ASM	.19	.20	.17	.23	.25	.25	.33	.35	.31		.46	.69	.23	.38	.54		22.59	8.26
16	G-MRST AD	.36	.37	.32	.45	.34	.43	.59	.49	.48		.15	.36	.36	.57	.34	.49	19.15	2.19

Sum of diagonal elements (squared multiple correlations) is 7.09.
Value of r @ .05 level = .148
Test 10 is a composite total of Tests 4 through 9, therefore it is eliminated in matrix.

For the sample size N = 180, correlations of r = .148 differed from zero at the .05 level of significance. Many of the correlations were subtests of a particular instrument (MRT) relating to the total score (MRT TOTAL) and these part-whole were therefore eliminated. There were three non-significant correlations: (1) DTLA Auditory Attention Span for Words with VKT Perceptual Motor; (2) DTLA Auditory Attention Span for Words with VKT Man Drawing; and (3) ITPA Auditory Reception with VKT Man Drawing. The DTLA Auditory Attention Span for Sentences, DTLA Auditory Attention Span for Words, and ITPA Auditory Sequential Memory seemed to be the most unique measures.

It appears that the auditory perceptual skills assessed by the DTLA auditory subtests, ITPA auditory subtests, and the auditory discrimination subtests of G-MRST may contribute to learning in the areas measured by the Vane Kindergarten Test and the Metropolitan Readiness Tests but no clear cut pattern emerged. Hypothesis eight (that there are no significant correlations among six auditory measures and the prereading battery) is rejected. For the correlations within the prereading tests (Tests 1-9), the average correlation equals .40. The auditory tests (Tests 11-16) have an average correlation of .41. The average correlation coefficient for the cross-correlations between the two types of tests is .34. The lower average correlation between the two types of tests (prereading and auditory measures) indicates that there is a smaller

degree of association and therefore the prereading tests and the auditory tests might be measuring different factors.

When the correlation matrix had substantial correlation coefficients in it, this indicated that the variables involved related to each other, or overlapped in what they measure. However, factor analysis provided a way of thinking about these interrelationships by positing the existence of underlying factors that account for the values appearing in the matrix of intercorrelations among these variables. In order to better explain the intercorrelations among these variables, a process called "factor extraction" was performed which provided a relatively small number of factor constructs that were needed to account for the pattern of values found in the correlational matrix. It would also show a clearer separation of the auditory tests from the others, if such existed. These factors themselves are variables that proved to be more useful in interpretation of the data than the original correlations from which they were derived.

Factor Analysis

The intercorrelation matrix was factor analyzed and varimax rotation was performed (see Appendix C, Description of Computer Programs). The factor matrix showing factor loadings for the unrotated factors and for the orthogonally rotated factors is given in Table 6. Three factors resulted. In order to facilitate comparison of the three factors, factor

TABLE 6

FACTOR MATRIX SHOWING FACTOR LOADING
FOR THE COMBINED GROUPS

	Test	Unrotated Factors			Orthogonally Rotated Factors			
		I	II	III	I	II	III	h^2
1	VKT PM	.592	-.359	-.321	.735	-.099	.180	.581
2	VKT V	.527	-.052	.072	.295	-.161	.416	.286
3	VKT MD	.450	-.263	-.213	.536	-.071	.159	.317
4	MRT WM	.657	-.003	.359	.177	-.147	.712	.560
5	MRT L	.587	-.083	-.008	.393	-.193	.400	.351
6	MRT M	.642	-.184	-.064	.516	-.159	.398	.449
7	MRT A	.681	-.023	.223	.283	-.191	.631	.514
8	MRT N	.771	-.117	.043	.491	-.227	.564	.611
9	MRT C	.692	-.320	-.276	.745	-.156	.281	.658
10	MRT TOTAL							
11	DTLA AAW	.404	.452	-.094	.018	-.578	.203	.375
12	DTLA AAS	.726	.476	-.253	.279	-.803	.310	.819
13	ITPA AR	.533	.100	.209	.132	-.231	.517	.337
14	ITPA AA	.817	.103	.280	.254	-.329	.764	.757
15	ITPA ASM	.528	.483	-.273	.172	-.729	.158	.586
16	G-MRST AD	.660	-.107	.136	.369	-.149	.554	.465
	Sums of Squares				2.567	1.929	3.170	7.666

* Test 10 is a composite total of Tests 4 through 9, therefore it is eliminated in matrix.

patterns of the orthogonally rotated factor loadings on each of fifteen tests are presented in Table 7.

TABLE 7

MODERATE AND HIGH LOADINGS OF THE ROTATED FACTOR MATRIX

	Tests	I	II	III
1	VKT PM	.735 high		
2	VKT V			.416 moderate
3	VKT MD	.536 high		
4	MRT WM			.712 high
5	MRT L	.393 moderate		.400 moderate
6	MRT M	.516 high		.398 moderate
7	MRT A			.631 high
8	MRT N	.491 moderate		.564 high
9	MRT C	.745 high		
10	MRT TOTAL			
11	DTLA AAW		-.578 high	
12	DTLA AAS		-.803 high	.310 moderate
13	ITPA AR			.517 high
14	ITPA AA		-.329 moderate	.764 high
15	ITPA ASM		-.729 high	
16	G-MRST AD	.369 moderate		.554 high

Test 10 is a composite total of Tests 4 through 9, therefore it is eliminated in matrix.

Evaluation of factor loading:

Insignificant loading:	.00 to .19
Low loading:	.20 to .29
Moderate loading:	.30 to .49
High loading:	.50 and above

The Vane Kindergarten Test had high factor loadings for Factor I on the Perceptual Motor and Man Drawing subtests. The Metropolitan Readiness Tests had high factor loading for Factor I on the Matching and the Copying subtests, and high moderate factor loading on the Numbers subtest, and moderate

loading on the Listening subtest. It accounted for 33 percent of the variance. Only one of the Auditory Screening Battery tests were represented in Factor I. The Gates-MacGinitie Readiness Skills Test Auditory Discrimination subtest had low moderate factor loading. In view of the tests' contents and tasks required, Factor I might be identified as a visual factor. The VKT Perceptual Motor, VKT Man Drawing, and MRT Copying subtests require alertness to visual cues in order to reproduce the assigned tasks. The moderate loadings on MRT Listening, MRT Numbers, and G-MRST Auditory Discrimination subtests reflect use of visual cues to correctly identify a picture or symbol.

Factor II was extracted entirely from the Auditory Screening Battery test data, and accounted for 25 percent of the total factor variance. High negative factor loadings were found on the DTLA Auditory Attention Span for Words, DTLA Auditory Attention Span for Sentences, and ITPA Auditory Sequential Memory subtests. There was a moderate negative factor loading on the ITPA Auditory Association subtest. Factor II might be considered an auditory factor. It was unique to the Auditory Screening Battery tests.

High positive factor loadings for Factor III, which accounted for 41 percent of the variance, were found in MRT Word Meaning, MRT Alphabet, and MRT Numbers. High positive factor loadings were given on three auditory tests, the ITPA Auditory Association, ITPA Auditory Reception, and the G-MRST

Auditory Discrimination tests. Moderate loadings of Factor III were given on VKT Vocabulary, MRT Listening, and MRT Matching tests. Very low moderate factor loading is found on the DTLA Auditory Attention Span for Sentences test. Taking into account that the various tests represented had more verbal comprehension and basic education content, Factor III might be identified as a schooling factor.

Taken together, the three factors account for all of the explainable variance in this system of fifteen tests. The total variance, explained and unexplained, is 15.00. The sum of h^2 values estimated from the diagonal of the correlation matrix is 7.09. These estimates are the squared multiple correlations of each test with every other test. The diagonal sum accords very closely with the sum of h^2 values in Table 6. It may be concluded, then, that only three factors are needed to account for the meaningful variance.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Children with learning disabilities stemming from minimal brain dysfunction have always existed. However, the nature of their dysfunction is so subtle when compared to the blind, deaf and mentally retarded that the problem has only been generally recognized for two decades. In the field of learning disabili[redacted] are focused toward the nature of the di[redacted]grams of remediation to alleviate it. [redacted] with educational handicaps continue[redacted]equate diagnosis and special help,[redacted]hances for adequate educational recov[redacted]

Adequate [redacted]ion is an essential component of learning. Although there is a growing recognition of the need for early detection of learning dysfunctions, group administered standardized tests used in most public schools at the kindergarten level exclude auditory measures of perceptual abilities. The major problem investigated in this study was the selection of a battery of tests which would adequately measure auditory perceptual skills of kindergarten children. Further, it was necessary to identify those auditory abilities which were not being assessed by prereading measures.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Children with learning disabilities stemming from minimal brain dysfunction have always existed. However, the nature of their dysfunction is so subtle when compared to the blind, deaf and mentally retarded that the problem has only been generally recognized for two decades. In the field of learning disabilities the efforts are focused toward the nature of the disorders and on the programs of remediation to alleviate it. Each year that a child with educational handicaps continues in school without an adequate diagnosis and special help, markedly decreases his chances for adequate educational recovery.

Adequate auditory perception is an essential component of learning. Although there is a growing recognition of the need for early detection of learning dysfunctions, group administered standardized tests used in most public schools at the kindergarten level exclude auditory measures of perceptual abilities. The major problem investigated in this study was the selection of a battery of tests which would adequately measure auditory perceptual skills of kindergarten children. Further, it was necessary to identify those auditory abilities which were not being assessed by prereading measures.

The specific purpose of this study was to (1) investigate the differences in auditory perceptual abilities between boys and girls, and to (2) examine the correlations between the auditory perceptual measures and other tests commonly administered at the kindergarten level. The focus was on the differentiation of auditory abilities in the perceptual development. The following aspects of the perceptual level of the student were considered: auditory reception, association, sequential memory for digits, discrimination, attention span for words, and attention span for sentences.

One hundred and eighty kindergarten students from two Oklahoma towns, Elk City and Sapulpa, were selected for this study. Each group was given the Vane Kindergarten Test (VKT), the Metropolitan Readiness Tests (MRT), two auditory subtests from the Detroit Tests of Learning Aptitude (DTLA), three auditory subtests from the Illinois Test of Psycholinguistic Abilities (ITPA), and the auditory discrimination subtest from the Gates-MacGinitie Readiness Skills Test (G-MRST).

Eight hypotheses were tested in this study. Six null hypotheses were formulated concerning the differences in mean scores between boys and girls on the six auditory perceptual abilities. The seventh null hypothesis was formulated to investigate the mean scores between boys and girls on prereading measures (VKT and the MRT). The first seven hypotheses were tested using analysis of variance. The eighth hypothesis stated that there will be no significant correlations among

the six auditory measures and the prereading test battery. It was tested by using a Pearson product-moment correlation matrix of the subscores of the various tests used in the study. A factor matrix was obtained showing factor loadings for combined groups. The varimax rotation of the factor matrix was performed. The results of testing these eight hypotheses are given in the following statements:

1. There are no significant differences in mean scores between boys and girls in auditory attention span for words.

2. There are no significant differences in mean scores between boys and girls in auditory attention span for sentences.

3. There are no significant differences in mean scores between boys and girls in auditory reception.

4. There are no significant differences in mean scores between boys and girls in auditory association.

5. There are no significant differences in mean scores between boys and girls in auditory sequential memory.

6. There are no significant differences in mean scores between boys and girls in auditory discrimination.

7. There are no significant differences in prereading measures with the exception of girls' mean scores on VKT Man Drawing surpassed the boys' mean scores.

8. There were significant correlations among the six auditory measures and the prereading test battery.

The investigator accepted the null hypotheses one through seven and concluded that there were no significant

differences in mean scores between boys and girls in auditory perceptual abilities and all prereading measures with the exception of the girls' superior performance on VKT Man Drawing test. There were significant correlations (only three insignificant) among the six auditory measures and the prereading test battery as shown on the correlation matrix (Table 5). This suggested underlying common factors. The eighth null hypothesis, therefore, was rejected.

The results of the correlation analysis were not definitive because, on the average, correlations within the prereading battery were higher ($\bar{r}$ = .40) than those across batteries ($\bar{r}$ = .34). Principal component analysis was used to determine the minimum number of independent dimensions needed to account for most of the variance in the original set of variables. Three factors resulted, as shown on Table 6. The factor patterns showing moderate and high loadings, both negative and positive, on each of the fifteen tests are graphically presented on Table 7. The uniqueness of four auditory tests is readily apparent. The auditory attention span for words and for sentences, association and memory skills are not tapped by the prereading measures, the VKT and the MRT. The high negative factor loadings on the DTLA Auditory Attention Span for Words, DTLA Auditory Attention Span for Sentences, ITPA Auditory Sequential Memory for Digits, and moderate negative factor loading on ITPA Association reveal a dimension which is not available in the prereading measures (VKT and MRT).

The finding of an auditory factor lends support to the reasoning behind hypothesis eight. In retrospect, it would have been more appropriate to formulate that hypothesis in terms of a factor analysis rather than a correlation matrix.

Conclusions

The findings of the present study supported the contention of no superiority in auditory preceptual skills due to sex characteristics, results similar to reported findings by McNinch (1971), McNinch and Richmond (1972), and Snyder and Pope (1972). This conclusion was restricted to the evaluated kindergarten sample and the selected measuring instruments. Both groups of children in the present study were enrolled in innovative and exemplary programs whose major thrust was early detection and prevention of learning disabilities at the kindergarten level. Samples from other communities not having resource teacher, teacher aides, and programmed material may differ considerably in the auditory perceptual development from the evaluated sample.

Identification of children with specific learning disabilities is of particular importance, and identification of such children depends upon differential diagnosis. The usual prereading measures administered in the late spring of the kindergarten year do not adequately measure auditory perceptual skills. The present study used standardized auditory perceptual measures to investigate the relationships between

the auditory measures and the prereading measures (VKT and MRT). A correlation matrix was set up on the fifteen measures, and the varimax rotation of the factor matrix was performed. Three factors resulted from the orthogonal rotation. Factor II was extracted entirely from the Auditory Screening Battery test data. It might be considered an auditory factor. Factor II pattern had high negative loadings on two auditory tests, DTLA Auditory Attention Span for Words and ITPA Auditory Sequential Memory for Digits, but had low or insignificant loadings on Factors I and III. The DTLA Auditory Attention Span for Sentences test had high negative loading on Factor II with low moderate positive loading on Factor III. The fourth auditory ability extracted, the ITPA Auditory Association, had a moderate negative loading on Factor II with a high positive loading on Factor III. These findings indicated that the abilities measured by the DTLA AAW, DTLA AAS, ITPA ASM, and the ITPA AA were not measured by the various subtests on the VKT and the MRT. Therefore, the investigator concluded that these measures of auditory perceptual skills should be included in prereading battery of tests in order to make a more accurate assessment and identification of specific learning disabilities.

Recommendations

Further research needs to be carried out with larger groups of boys and girls in schools with differing programs

to find out the relationship of the various kindergarten curricula to the development of auditory perceptual skills. The public school kindergartens of Elk City and Sapulpa in this study had innovative and exemplary programs. One major emphasis of the curricula was on early detection and prevention of learning disabilities. The services of an early childhood specialist, teacher aides, and programmed materials were used to provide individualization of instruction as well as ability training in motor development, language development, auditory and visual perceptual development, and conceptual development. The identification of the deficit areas in a child at a very early age and provision of specialized help may account for the findings of no significant differences in performances between boys and girls on the auditory measures and the prereading measures for the sample population. Some kindergarten curricula may provide adequate auditory perceptual training while others would not.

Larger groups of boys and girls should be included in further research studies concerning auditory perceptual development. This would give more stability to the statistical analysis. Furthermore, it is suggested that a higher level of confidence, such as $p < .25$, could be used which would reduce the probability of mistakenly accepting the null hypotheses. The differences between boys' and girls' performances on auditory perceptual tasks may be small but real differences.

Children with specific learning disorders are characterized by uneven profiles insofar as the sensory modalities are concerned. The extent to which learning established through one sensory modality can be transferred to situations involving impaired sensory modalities must be explored. Findings related to this problem can have immediate application in the educational setting.

REFERENCES

REFERENCES

Baker, H. J., & Leland, B. Detroit Tests of Learning Aptitude. Indianapolis: Bobbs-Merrill, 1967.

Bangs, T. E. Language and learning disorders of the preacademic child: With curriculum guide. New York: Appleton-Century-Crofts, 1968.

Bannatyne, A. Language, reading and learning disabilities: Psychology, neuropsychology, diagnosis, and remediation. Springfield, Illinois: C. C. Thomas, 1971.

Bateman, B. The efficacy of an auditory and visual method of first grade reading instruction with auditory and visual learners. In H. K. Smith (Ed.), Perception and Reading. Newark, Delaware: International Reading Association, 1968, 105-112.

Birch, H. G. (Ed.) Brain damage in children. Baltimore: Williams and Wilkins, 1964.

Birch, H. G., & Belmont, L. Auditory-visual integration in brain-damaged and normal children. Developmental Medicine Child Neurology, 1965, 7:135.

Book, R. M. Early identification of reading difficulties. Paper presented at the meeting of the Ohio School Psychologists Association, Columbus, Ohio, October 1971.

Bortner, M. (Ed.) Evaluation and education of children with brain damage. Springfield, Illinois: C. C. Thomas, 1968.

Bougere, M. B. Selected Factors in oral language related to first grade reading achievement. Reading Research Quarterly, 1969, 5(1), 31-57.

Broadbent, D. E. The role of auditory localization in attention and memory span. Journal of Experimental Psychology, 1954, 47, 191-196.

Broadbent, D. E. Perception and communication. New York: Pergamon Press, 1958.

Cabrini, M. Auditory memory span and functional articulatory disorders in relation to reading in grade two. Journal of Developmental Reading, 1963, 7, 24-38.

Chalfant, J. C., & Scheffelin, M. A. Central Processing Dysfunction in Children. National Institute of Neurological Diseases and Stroke Monograph No. 9. Washington, D. C.: Superintendent of Documents, 1969.

Charing, N. G. Minimal brain dysfunction in children: Educational, medical and health related services, phase two of a three-phase project. U. S. Department of Health, Education and Welfare, Public Health Service Publication No. 2015. Washington, D. C.: Superintendent of Documents, 1969.

Clements, S. D. Minimal brain dysfunction in children. National Institute of Neurological Diseases and Blindness Monograph No. 3. Washington, D. C.: Superintendent of Documents, 1966.

Clements, S. D., Lehtinen, L. E., & Lukens, J. E. Children with minimal brain injury. Chicago: National Society for Crippled Children and Adults, May 1964.

Crosby, R. M. N, & Liston, R. A. Dyslexia: What you can--and can't--do about it. Grade Teacher Notebook, Darien, Conn.: Teachers Publishing Corporation, 1969.

Cruickshank, W. M., Bentzen, F. A., Ratzeburg, F. H., & Tannhauser, M. T. A teaching method for brain-injured and hyperactive children: A demonstration pilot study. Syracuse: Syracuse University Press, 1961.

de Hirsch, K., Jansky, J., & Langford, W. Predicting reading failure. New York: Harper & Row, 1966.

Dember, W. N. Visual perception: The Nineteenth Century. New York: Wiley, 1964.

Diller, L., & Birch, H. G. Psychological evaluation of children with cerebral damage. In H. G. Birch (Ed.), Brain damage in children. New York: Williams & Wilkins, 1964.

Dixon, W. J. (Ed.) Biomedical Computer Programs: X-Series Supplement No. 3. University of California Press, 1969.

Dixon, W. J. (Ed.) Biomedical Computer Programs: University of California Publications in Automatic Computation. No. 2. University of California Press, 1970.

Eisenson, J. Aphasia and dyslexia in children. Bulletin Orton Society, 1963.

Elkind, D., & Sameroff, A. Developmental psychology. Annual review of psychology. Palo Alto, California: Annual Reviews, Inc., 1970, 149-238.

Ellingson, C. C. The shadow children. Chicago: Topaz, 1967.

Epstein, W. Varieties of Perceptual Learning. New York: McGraw-Hill, 1967.

Ferninden, W. E., Jr., Jacobson, S., & Linden, N. J. Early identification of learning disabilities. Journal of Learning Disabilities, 1970, 3(11), 589-593.

Fernald, G. M. Remedial technique in basic school subjects. New York: McGraw-Hill, 1934.

Flavell, J. H., & Hill, J. P. Developmental psychology. Annual review of psychology. Palo Alto, California: Annual Review, 1969.

Flower, R. The evaluation of auditory abilities in the appraisal of children with reading problems. In A. Figurel (Ed.), Perception and Reading. Newark, Delaware: International Reading Association, 1968, 21-24.

Frostig, M. Education for children with learning disabilities. In H. R. Myklebust (Ed.), Progress in learning disabilities, Vol. I. New York: Grune & Stratton, 1967.

Gates, A., & MacGinitie, W. Gates-MacGinitie Readiness Skills Test. New York: Teachers College Press, Teachers College, Columbia University, 1968.

Gearheart, B. R. (Ed.) Education of the exceptional child: History, present practices, and trends. Scranton, Pennsylvania: International Textbook Company, 1972.

Goodenough, F. L. Measurement of intelligence by drawings. Yonkus-on-Hudson, New York: World Book, 1926.

Hallahan, D. P., & Cruickshank, W. M. Psycho-educational foundations of learning disabilities. Englewood Cliffs, New Jersey: Prentice-Hall, 1973.

Hammill, D. D., & Bartel, N. R. (Eds.) Educational perspectives in learning disability. New York: John Wiley & Sons, 1971.

Harris, D. B. Children's drawings as measures by intellectual maturity. New York: Harcourt, Brace & World, 1963.

Hildreth, G. H., Griffiths, N. L., & McGauvern, M. E. Metropolitan Readiness Tests. New York: Harcourt, Brace & World, 1969.

Johnson, D. J., & Myklebust, H. R. Learning disabilities: Educational principals and practices. New York: Grune & Stratton, 1967.

Katz, R., & Deutsch, M. Relation of auditory-visual shifting to reading achievement. Perceptual and Motor Skills, 1963, 17, 327-332.

Kephart, N. C. The slow learner in the classroom. Columbus, Ohio: Charles F. Merrill, 1960.

Kephart, N. C. Learning disability: An educational adventure. West Lafayett, Indiana: Kappa Delta Pi Press, 1968.

Kirk, S. A. Behavioral diagnosis and remediation of learning disabilities. In proceedings of the conference on exploration into the problems of the perceptually handicapped child, First Annual Meeting, Vol. 1, Chicago, April 6, 1963.

Kirk, S. A., & Kirk, W. D. Psycholinguistic learning disabilities: Diagnosis and remediation. Urbana: University of Illinois Press, 1971.

Kirk, S. A., & McCarthy, J. J. The Illinois Test of Psycholinguistic Abilities: An approach to differential diagnosis. American Journal of Mental Deficiency, November 1961, 66(3), 399-412.

Kirk, S. A., McCarthy, J. J., & Kirk, W. D. The Illinois Test of Psycholinguistic Abilities. Rev. Ed., Urbana: University of Illinois Press, 1968.

Koppitz, E. M. The Bender Gestalt Test for Young Children. New York: Grune & Stratton, 1963.

Koppitz, E. M. Children with learning disabilities. New York: Grune & Stratton, 1964.

Koppitz, E. M. Emotional indicators on human figure drawings of children: A validation study. Journal of Clinical Psychology, 1966, 22, 313-315.

Luria, A. R. Higher cortical functions in man. Basic Books, 1966.

Masland, R. L. Children with minimal brain dysfunction: A national problem. In L. Tarnopol (Ed.), Learning disabilities: Introduction to educational and medical management. Springfield, Illinois: Thomas, 1969.

McNinch, G. Predictive values of selected auditory perceptual factors in relation to measured first grade achievement. Hattiesburg: University of Southern Mississippi, 1970. ERIC Accession number ED047899.

McNinch, G., & Richmond, M. Auditory perceptual tasks as predictors of first grade reading success. Perceptual and Motor Skills, 1972, 35, 7-13.

Morency, A. Auditory modality--Research and practice. Paper presented at 12th Annual Convention of the International Reading Association, Seattle, Washington, May 1967.

Morency, A. Auditory modality and reading. In A. Figurel (Ed.), Perception and Reading. Newark, Delaware: International Reading Association, 1968, 17-21.

Myklebust, H. Auditory disorders in children: A manual for differential diagnosis. New York: Grune & Stratton, 1954.

Myklebust, H. Development and disorders of written language: Vol. 1, Picture Story Language Test. New York: Grune & Stratton, 1965.

Myklebust, H. (Ed.) Progress in learning disabilities: Vol. 1. New York: Grune & Stratton, 1968.

Myklebust, H. (Ed.) Progress in learning disabilities: Vol. 2. New York: Grune & Stratton, 1971.

Norman, D. A. Memory and attention. New York: Wiley, 1969.

Orton, S. T. Reading, writing, and speech problems in children. London, Chapman & Hall (Eds.). New York: Norton, 1937.

Osgood, C. E. A behavioristic analysis of perception and language as cognitive phenomena. In J. S. Bruner (Ed.), Contemporary approaches to cognition. Cambridge, Mass.: Harvard University Press, 1957, 75-118.

Paraskevopoulos, J. N., & Kirk, S. A. The development and characteristics of the revised Illinois Test of Psycholinguistic Abilities. Urbana: University of Illinois Press, 1969.

Penfield, W., & Roberts, L. Speech and brain-mechanisms. Princeton, New Jersey: Princeton University Press, 1959.

Rappaport, S. R. Public education for children with brain dysfunction. New York: Syracuse University Press, 1969.

Rizzo, N. D. Studies in visual and auditory memory span with special references to reading disability. Journal of Experimental Education, 1939, 8, 209-244.

Rude, R. T. Readiness tests: Implications for early childhood education. The Reading Teacher, March 1973, 572-580.

Silver, L. B. Familial patterns in children with neurologically based learning disabilities. Journal of Learning Disabilities, 4, 1971, 349-358.

Snyder, R., & Pope, P. Auditory and visual inadequacies in maturation at the first grade level. Journal of Learning Disabilities, 1972, 5(10), 40-45.

Strauss, A. A., & Kephart, N. C. Psychopathology and education of the brain-injured child, Vol. 2. New York: Grune & Stratton, 1955.

Strauss, A. A., & Lehtinen, L. E. Psychopathology and education of the brain-injured child. New York: Grune & Stratton, 1947.

Tarnopol, L. (Ed.) Learning disorders in children. Boston: Little, Brown & Company, 1971.

Terman, L. M., & Merrill, M. A. Stanford Binet Intelligence Scale. Boston: Houghton Mifflin, 1960.

Treisman, A. M. Our limited attention. Advanced Science, 1966, 22, 600-611.

Treisman, A. M. Strategies and models of selective attention. Psychological Review, 1969, 76, 282-299.

Tymchuk, A. J., & Knights, R. M. A two thousand item bibliography: The description, etiology, diagnosis, and treatment of children with learning disabilities or brain damage. Ottawa, Ontario: Carleton University, 1969.

Vane, J. R. Journal of Clinical Psychology, Monograph No. 24. April 1968, Brandon, Vermont: Clinical Psychology Publishing Company.

Vane, J. R., & Eisen, V. The Goodenough Draw-a-Man test and signs of maladjustment in kindergarten children. Journal of Clinical Psychology, 1962, 18, 276-279.

Vane, J. R., & Kessler, R. T. The Goodenough Draw-a-Man test: Long term reliability and validity. Journal of Clinical Psychology, 1964, 20, 487-488.

Waugh, K. W., & Bush, W. J. Diagnosing learning disorders. Columbus, Ohio: Merrill, 1971.

Weiner, P. S. Auditory discrimination and articulation. Journal of Speech and Hearing Disorders, 1967, 32, 19-28.

Wepman, J. Recovery from aphasia. New York: The Ronald Press, 1951.

Wepman, J. Auditory discrimination, speech and reading. Elementary School Journal, 60, 325-333.

Wepman, J. Modality concept. In A. Figurel (Ed.), Perception and Reading. Newark, Delaware: International Reading Association, 1968, 1-7.

Werner, H., & Strauss, A. A. Problems and methods of functional analysis in mentally deficient children. Journal of Abnormal and Social Psychology, 1939, 34, 37-62.

Yates, A. J. Psychological deficit. In P. R. Farnsworth & Q. McNemar, (Eds.), Annual review of psychology. Palo Alto, California: Annual Reviews, Inc. XXVII, 1966, 111-114.

Zigmond, N. K. Auditory processes in children with learning disabilities. In L. Tarnopol (Ed.), Learning disabilities: Introduction to educational and medical management. Springfield, Illinois: Charles C. Thomas, 1969.

APPENDICES

APPENDIX A

DEFINITIONS OF LEARNING DISABILITY AND MINIMAL BRAIN DYSFUNCTION

There are specific ways in which terms were used in this study. These terms are defined as follows:

Learning Disability.--The definition presented by the National Advisory Committee on Handicapped Children in January 1968 will be the one used for the present study. It is as follows:

> Children with special learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written languages. These may be manifested in disorders of listening, thinking, talking, reading, writing, spelling, or arithmetic. They include conditions which have been referred to as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia, etc. They do not include learning problems which are due primarily to visual, hearing, or motor handicaps, to mental retardation, emotional disturbance or to environmental disadvantages (Chalfant and Schefflin, 1969, p. 47).

Minimal Brain Dysfunction Syndrome.--The definition used is the one given in Task Force 1: Minimal Brain Dysfunction in Children (Clements, 1966, pp. 9-10).

> The term 'minimal brain dysfunction syndrome' refers in this paper to children of near average, average, or above average general intelligence with certain learning or behavioral disabilities ranging from mild to severe, which are associated with deviations of function of the central nervous system. These deviations may manifest themselves by various combinations of impairment in preception, conceptualization, language,

memory, and control of attention, impulse, or motor function.

These aberrations may arise from genetic variations, biochemical irregularities, perinatal brain insults or other illness or injuries sustained during the years which are critical for the development and maturation of the central nervous system, or from unknown causes.

APPENDIX B

DESCRIPTION OF INSTRUMENTS

The Vane Kindergarten Test and the Metropolitan Readiness Tests and the Auditory Screening Battery were administered to all subjects in late spring. The descriptions of these instruments are given below.

Vane Kindergarten Test (VKT).--This test was developed as a measure evaluating intellectual and academic potential and behavior adjustment. The VKT consists of three subtests: Perceptual Motor (VKT PM), Vocabulary (VKT V), Man Drawing (VKT MD).

Metropolitan Readiness Tests (MRT).--This is an achievement test administered by the teacher to aid in determining readiness for first grade (Hildreth, Griffiths, and McGauvern, 1969). This battery consists of the following six subtests: 1. Word Meaning (MRT WM); 2. Listening (MRT L); 3. Matching (MRT M); 4. Alphabet (MRT A); 5. Numbers (MRT N); 6. Copying (MRT C).

Auditory Screening Battery (ASB).--Auditory perceptual development consists of a variety of skills, and measures for this study were chosen to assess different capacities. The abilities assessed by the auditory subtests from the Detroit Tests of Learning Aptitude, the Illinois Test of Psycholinguistic Abilities, and the Gates-MacGinitie Readiness Skills Test are given below:

Detroit Tests of Learning Aptitude (DTLA)

a. Auditory Attention Span for Unrelated Words subtest measures auditory attentive ability to recall series of two to eight words (DTLA AAW).

b. Auditory Attention Span for Related Syllables subtest assesses the child's ability to repeat sentences (DTLA AAS). Three points are scored for each sentence correctly repeated. Two points are given when one mistake is made, and one point is earned if two errors are made. There is no score if three or more errors are said in repeating the sentences.

Illinois Test of Psycholinguistic Abilities (ITPA)

a. Auditory Reception is designed to assess the ability of a child to derive meaning from verbally presented material (ITPA AR). It is considered to be at the representational level of organization.

b. Auditory Association is also at the representational level and the process is the ability to relate auditory symbols in a meaningful way through the completion of analogies (ITPA AA).

c. Auditory Sequential Memory is at the automatic-sequential level which measures the child's ability to correctly repeat a sequence of auditory symbols. A modified digit repetition test measures this linguistic skill (ITPA ASM).

Gates-MacGinitie Readiness Skills Test (G-MRST)

The Auditory Discrimination subtest (G-MRST AD) measures the child's skill in distinguishing between two words of similar sound. It includes twenty-one pairs of pictures (plus one sample pair) that correspond to twenty-one pairs of words. Each pair differs in only one sound. After naming both pictures in a pair, the examiner pronounces the name of one of the pictures again. The child marks the corresponding picture.

APPENDIX C

DESCRIPTION OF COMPUTER PROGRAMS

The University of Oklahoma Merrick Computing Center staff carried out the necessary machine operations, using IBM 360/50 in analyzing the data used in this study. The Biomedical Computer Program, BMD01D, Simple Data Description (Dixon, 1970), was used to obtain the means and standard deviations for each measure by sex and town (see Table 3). The computer program, BMDX64, General Hypothesis (Dixon, 1969), with variable format, was used to obtain the sums of squares, mean squares, and values of F for each measure by town and sex (see Appendix D, Analysis of Variance Table). The computer program, BMDX72, Factor Analysis (Dixon, 1969), set up the correlation matrix (see Table 5). A principal component solution using squared multiple correlations to estimate communalities and the varimax rotation of the factor matrix were performed. Principal component analysis is used to determine the minimum number of independent dimensions needed to account for a predetermined amount of the variance in the original set of variables. The varimax rotation was used to simplify columns (factors) rather than rows (variables) of the factor matrix. The output of the varimax program for factor analysis includes: (1) Means, (2) Standard deviations, (3) Correlation coefficients, (4) Eigenvalues, (5) Cumulative percentage of eigenvalues,

(6) Eigenvectors, (7) Factor matrix, (8) Variance of the factor matrix for each iteration cycle, (9) Rotated factor matrix, and (10) Check on communalities. A factor matrix showing factor loadings for the combined groups on unrotated factors and orthogonally rotated factors is shown on Table 6.

APPENDIX D

ANALYSIS OF VARIANCE TABLE

	Test	Source	Sum of Squares	df	Mean Square	F	p
1	Vane	Mean	6987.21	1	6987.21	1404.51	
	Kindergarten	City	90.00	1	90.00	18.29	.001
	Test	Sex	.01	1	.01	.002	
	Perceptual	S x C	.4	1	.4	.08	
	Motor	Error	875.57	176	4.97		
2	Vane	Mean	4972.90	1	4972.90	1565.99	
	Kindergarten	City	14.40	1	14.40	4.57	.05
	Test	Sex	.90	1	.90	.28	
	Vocabulary	S x C	.71	1	.71	.22	
		Error	558.9	176	3.18		
3	Vane	Mean	31490.80	1	31490.80	2502.26	
	Kindergarten	City	21.03	1	21.03	1.65	.25
	Test	Sex	55.23	1	55.22	4.40	
	Man Drawing	S x C	.07	1	.07	.01	
		Error	2214.95	176	12.58		
4	Metropolitan	Mean	12355.23	1	12355.23	1726.38	
	Readiness	City	25.07	1	25.07	3.54	.10
	Test	Sex	2.34	1	2.34	.32	
	Word	S x C	.14	1	.14	.02	
	Meaning	Error	1259.58	176	7.16		
5	Metropolitan	Mean	19418.71	1	19418.71	3152.85	
	Readiness	City	56.01	1	56.01	9.18	.005
	Test	Sex	1.60	1	1.60	.25	
	Listening	S x C	.10	1	.10	.02	
		Error	1084.00	176	6.16		

APPENDIX D--continued

	Test	Source	Sum of Squares	df	Mean Square	F	p
6	Metropolitan	Mean	12768.71	1	12768.71	1187.03	
	Readiness	City	.90	1	.90	.08	
	Test	Sex	.40	1	.40	.04	
	Matching	S x C	4.01	1	4.01	.37	
		Error	1893.20	176	10.76		
7	Metropolitan	Mean	25502.50	1	25502.50	2166.65	
	Readiness	City	230.40	1	230.40	19.63	.001
	Test	Sex	13.61	1	13.61	1.05	
	Alphabet	S x C	5.38	1	5.38	.46	
		Error	2071.60	176	11.77		
8	Metropolitan	Mean	30396.44	1	30396.84	1532.21	
	Readiness	City	27.78	1	27.78	1.40	.25
	Test	Sex	5.38	1	5.38	.27	
	Number	S x C	37.38	1	37.38	1.88	
		Error	3491.60	176	19.84		
9	Metropolitan	Mean	11730.63	1	11730.62	979.48	
	Readiness	City	.03	1	.03	.002	
	Test	Sex	30.63	1	30.63	2.59	.25
	Copying	S x C	1.00	1	1.00	.08	
		Error	2107.85	176	11.98		
10	Metropolitan	Mean	651525.63	1	651525.56	2797.39	
	Readiness	City	68.47	1	68.47	.30	
	Test	Sex	103.47	1	103.47	.45	
	Total	S x C	121.34	1	121.34	.52	
		Error	40991.28	176	232.91		

APPENDIX D--continued

	Test	Source	Sum of Squares	df	Mean Square	F	p
11	Detroit Tests of Learning Aptitude Auditory Attention Span Words	Mean	160740.14	1	160740.13	2786.57	
		City	245.03	1	245.02	4.24	.05
		Sex	105.63	1	105.63	1.81	.25
		S x C	16.47	1	16.47	.29	
		Error	10152.35	176	57.68		
12	Detroit Tests of Learning Aptitude Auditory Attention Span Sentences	Mean	207168.04	1	207168.00	1403.99	
		City	.71	1	.71	.005	
		Sex	19.60	1	19.60	.13	
		S x C	14.40	1	14.40	.10	
		Error	25970.00	176	147.56		
13	Illinois Test of Psycholinguistic Abilities Auditory Reception	Mean	97944.01	1	97944.00	1671.31	
		City	184.90	1	184.90	3.15	.10
		Sex	76.54	1	76.54	1.29	
		S x C	59.21	1	59.21	1.01	
		Error	10314.17	176	58.60		
14	Illinois Test of Psycholinguistic Abilities Auditory Association	Mean	64293.67	1	64293.67	2506.99	
		City	73.80	1	73.80	2.91	.10
		Sex	2.03	1	2.03	.08	
		S x C	5.63	1	5.63	.22	
		Error	4513.65	176	25.65		
15	Illinois Test of Psycholinguistic Abilities Auditory Sequential	Mean	82931.38	1	82931.38	1217.02	
		City	179.21	1	179.21	2.65	.25
		Sex	45.51	1	45.51	.67	
		S x C	4.90	1	4.90	.07	
		Error	11993.17	176	68.14		

APPENDIX D--continued

	Test	Source	Sum of Squares	df	Mean Square	F	p
16	Gates-MacGinitie	Mean	59161.74	1	59161.73	12541.36	
	Readiness Skills	City	15.63	1	15.63	3.31	.10
	Test	Sex	9.03	1	9.03	1.90	.25
	Auditory	S x C	1.00	1	1.00	.21	
	Discrimination	Error	830.25	176	4.72		