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THE PREDICTION OF READING READINESS
WITH AUDITORY AND VISUAL ASSESSORS AND INTELLIGENCE
TEST IN THREE SUB-SAMPLES

DISSERTATION
Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By
Jane D. Rupp, B.A., M.A.

* * * * *

The Ohio State University
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The completion of this study provides an opportunity to look back to all those who made it possible. The author desires to express special appreciation to the members of her committee, Drs. Joseph J. Quaranta, Ann W. Engin, and Donald J. Tosi.

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It would be most appropriate to end at the beginning by expressing my great indebtedness to my parents whose faith in me is never ending.
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CHAPTER I
INTRODUCTION

The largest number of referrals made to elementary counselors and school psychologists concern those children who are having difficulty learning to read. Our school systems are praised or condemned according to the number of children who are reading at the appropriate grade level. Therefore, it becomes a matter of great importance to examine those factors which might determine success or failure in the reading process.

For the child, reading failure results in adverse emotional reactions. His self-image is impaired and he often becomes a social and emotional casualty. Because his education involves such an extensive period of time, the school experience becomes a tremendously vital factor in a child's life. Therefore, it becomes important to the child that the schools determine those factors that can provide him with the successful experiences which will enable him to become a productive member of society.

The prerequisites to success in reading are often assumed to have been developed by the time a child enters first
grade at age six. Kindergarten is the time for getting a child "ready" to read. There are three basic components which experts agree influence a child's readiness to read: (1) a neural sensori-motor pattern which consists of the organic elements having to do with learning, (2) environmental factors, and (3) psycho-genetic development which has to do with the origin and development of behavior, personality, and mental or psychological processes such as motivation and self-concept.

This study dealt largely with the first area: the neural sensori-motor pattern as it affects readiness to read. Environmental factors were touched upon only as they affected perceptual-cognitive development. Psycho-genetic factors can have an important influence on a child's readiness to read. The Coleman survey (1966) reported that a racial gap in school achievement existed at every grade level. This survey urged further study of the contribution of motivational factors to racial differences in school achievement.

In order to be "ready" to read, a child must bring certain competencies with him so as to bring meaning to the words. He must have the perceptual maturity to detect likenesses and differences in both visual and auditory form, the memory to maintain these forms in a sequential order, the capacity to relate the symbols to sound, the maturation to attend to and concentrate on the problem at hand, the experiential background and concepts needed to bring meaning
to the printed words and the mental capacities to deal with ideas and abstractions.

It is evident, then, that reading is more than a recognition, retention and recall skill. It is a complex procedure which involves organizing sensory complexes (perceptual processes) into stable, meaningful, recognized patterns of perceptions (conceptual processes).

There are many different theories seeking to explain the perceptual-conceptual process. Wepman (1964, 1960), Osgood (1963), Johnson and Myklebust (1967), Hebb (1949), Hunt (1961), Piaget (1952), Chalfant and Scheffelin (1969), Milner and Glickman (1965), and Penfield and Lamar (1959) are a few of the many who have developed theories.

Most of these theories would agree to five basic steps. These steps would be included under three phases of the process: sensory recognition, cognitive processes and motor response. The steps would be: (1) input or recognition of incoming stimuli along appropriate sensory nerve endings; (2) decoding or integration of the stimuli into meanings; (3) encoding or formulation of the meaning into appropriate behavior; (4) output or response of the behavior decided upon; and (5) feedback on the adequacy of the response.

Since the perceptual-conceptual process is important in learning to read, it becomes important to be able to identify its development in each child.

Perception is the awareness, or process of becoming
aware of the external or internal world by means of the five sensory processes: hearing, seeing, tasting, smelling and feeling. These five processes, present at birth, develop slowly over a period of eight years. Two of them, hearing and seeing, are the most important processes used in learning to read. If these processes are not fully developed or if they are damaged in a five year old child as he starts to school, chances for successful reading are reduced.

McGrady and Olson (1970), in their clinical practice, have found that many children with reading disabilities have problems with specific auditory and/or visual learning processes. It becomes important to know just how large a percentage of our beginning school-age population have auditory and/or visual perceptual deficits which may cause difficulty in reading.

Once it has been determined that a child may have a perceptual deficit, it becomes important to know whether the child learns best through auditory channels or through his visual senses. The answer to that question can help determine the best teaching method to use. Reading, in the United States, is taught largely through sets of instructional materials called basal-reading series. Each series presents a total sensory approach to reading but each tends to emphasize either a visual or an auditory approach to reading.

The "look-say" versus "intensive phonics" controversy
which has been raging for forty years has now become the "gradual phonics" versus "intensive phonics" dispute. The gradual phonics method of teaching reading, as exemplified by the Scotts-Foresman program, starts by having the children acquire a sight vocabulary before teaching them the sound values of letters. The intensive phonics or sound-symbol approach, as in the Lippincott series, starts by teaching the children the sounds of all the letters and combinations without special emphasis on teaching meaningful words. Later, sound blending is taught which permits words to be read. If a child's visual perception is strong but his auditory perception is not developed or is impaired, it makes sense to teach him with a visual approach. On the other hand, if his strongest sensory channel is auditory, a strong phonics program would be important.

It has already been mentioned that the input or recognition of sensory stimuli is processed in the brain to give it meaning and interpretation. This is called thinking or the cognitive process. In the schools this process is measured by means of intelligence tests. How important is the level of intelligence for beginning reading? DeHirsch, Jansky and Langford (1966) found that intelligence did not basically account for correlations between perceptuomotor tests and predicting success in reading by the end of second grade. Eleven other kindergarten tests were better predictors of subsequent reading. Birch and Belmont (1965) found
that reading readiness was more strongly associated with auditory-visual integrative development than with intelligence (IQ). Harrington and Durrell (1955) found that reading difficulties existed at almost all intellectual levels. Piaget (1952) states that higher cognitive function does not fully develop in a child until he is six and one-half to seven and one-half years old. A child's perceptual development precedes this, occurring roughly between the ages of three and one-half to seven years of age. Therefore, in kindergarten, a child's perceptual skills would be more highly developed and more important to reading than his cognitive abilities.

Because of the growing awareness of the need for early detection of children with potential learning problems, more and more school systems are administering some form of readiness tests to their kindergarten population in order to determine correct placement. Teachers frequently use these results to place children in beginning reading groups. If auditory-visual perceptual skills are an important factor in successful reading, it is essential to know if there is a significant correlation between those skills and well standardized readiness tests.

Just as schools are concerned with a child's readiness to learn to read, it has been noted by many researchers that boys usually lag behind the girls in obtaining this state of "readiness." The preponderance of boys among children
with difficulties in reading and related language skills has been interpreted in the light of the particular theoretical position of each researcher. Kagan (1964) believes that boys do not find activities in the primary grades to be congruent with their masculine role. Bentzen (1963) believes in a biological age differential between boys and girls that is not taken into account by the schools, and Ilg and Ames (1964) stress the slower development of boys to girls in their readiness for school.

Even as the development and maturity of the perceptual-conceptual processes are important to a child beginning to read, so are the language skills he brings with him from his environment. It is generally agreed that the language-symbolic process plays an important role at all levels of learning. In order for a child to handle multiple attributes of words and to associate words with their proper referents, a great deal of exposure to language is presupposed. Such exposure involves training, experimenting with identifying objects and having corrective feedback, listening to a variety of verbal material, and just observing adult language usage. Exposure of children to this type of experience is one of the great strengths of the middle-class home and, concomitantly, represents a weakness in the lower-class home. (Hess and Shipman, 1964 and Deutsch, 1962).

The relationship between social background and school performance is not a simple one. Background variables
influence the patterns of perceptual, cognitive and language development of the child and these diffuse into all areas of the child's academic and psychological performance. To understand these effects requires delineating the underlying skills in which these children are not sufficiently proficient.

Statement of the Problem

It was the purpose of this study to examine the relationships among measurements of auditory and visual modalities, intelligence, and readiness skills of kindergarten children in a stratified, urban school setting. Specifically, the study attempted to answer the following questions:

1. Of the twenty-one predictors employed in this study, what is the most effective combination for predicting performance on the readiness test used with the sample?

2. What percentage of the kindergarten children included in the sample demonstrate the following discrepant modality pattern?
   2.1 Failed to meet success criteria for auditory perception tests.
   2.2 Failed to meet success criteria for visual perception tests.
   2.3 Failed to meet success criteria for both auditory and visual perception tests.

3. What is the relationship between mental age and the scores on the various auditory and visual assessors employed in this study?
4. What is the relationship between intelligence (IQ) and the readiness test employed in this study?

5. What is the relationship between the Metropolitan Readiness Test score and the scores on the various auditory and visual assessors employed in this study?

6. What are the sex differences on the performance of each of the three types of tests?
   6.1 Perception tests.
   6.2 Intelligence test.
   6.3 Metropolitan Readiness Test.

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Discussion

What percentage of the kindergarten children included in the sample demonstrate the following discrepant modality pattern?

DeHirsch, Jansky and Langford (1966) found that 19 percent of their sample kindergarten population were markedly superior in one modality as compared to the other. Frostig (1964) stated that her studies in various school systems
showed that approximately 20-25 per cent of the children starting first grade lacked the necessary perceptual maturity to succeed in beginning reading, writing and arithmetic without putting forth undue effort. Ilg and Ames (1967) estimated that 33 per cent of the students in the public schools are perceptually handicapped to some degree or other. Samuel Clements (1966) states that 10 per cent of the public school population demonstrated significant perceptual handicaps.

When Bateman (1969) studied the efficacy of an auditory approach to first grade reading compared to the visual approach, she placed children in classes according to their preferred modality. Using the auditory sequential memory and the visual sequential memory subtest of the Illinois Test of Psycholinguistic Abilities (ITPA), she was able to equally divide her placement children (N=87). However, she made adjustments in the age norms of the two tests in order to do so. Originally there were more children with poor visual memory. DeHirsch, Jansky and Langford (1966) found that 70 per cent of the kindergarten children in their study who showed a discrepancy pattern were poor visualizers and 30 per cent were poor auditorily. However, Tarnopol (1969) feels that there are probably as many children with auditory perceptual problems as visual perceptual problems.

What is the relationship between mental age and the scores on the various auditory and visual assessors employed in this study?
DeHirsch, Jansky and Langford (1966) and Birch and Belmont (1965) found that perceptuomotor tests did not correlate highly with intelligence at the kindergarten level. Martin Deutsch (1962) tends to agree that perceptual development comes first and language growth on a conceptual level comes later.

What is the relationship between intelligence (IQ) and the readiness test employed in this study?

Many research studies have been conducted correlating the Metropolitan Readiness Test (hereafter referred to as MRT) with various general mental ability tests (Hildreth, Griffiths and McGauvran, 1969). The overall results show correlations between .41-.74 depending upon the particular study. The one subtest of the MRT which correlates most significantly with intelligence is the alphabet subtest - success on the test depending largely on previous exposure and experience rather than on auditory-visual development.

What is the relationship between the Metropolitan Readiness Test scores and the scores on the various auditory and visual assessors employed in this study?

Most readiness tests, since they require the child to respond to abstract forms, demand a high level of visual-perceptual maturity. The subtests of the MRT primarily involve visual perception. Goins (1958) and Albert Harris (1959) found visual perceptual skills correlated significantly with reading readiness as determined by tests. No studies were found correlating auditory perceptual skills
specifically with the MRT. Birch and Belmont (1965) found that the correlation between auditory-visual integrative performance and readiness as tested by the MRT was .70 (p. 001).

What are the sex differences on the performance of each of the three types of tests?

What are the sex differences within each stratum for each of the three types of tests?

Many researchers have discussed the reason why girls perform significantly better on auditory-visual perceptual tests and readiness tests. Tanner (1961) points to important physiological reasons for the inferior performance of boys. Betts (1936) and Bryant (1962) found that boys mature less smoothly than girls which could account for academic differences.

Test constructors combine intelligence test items in such a way as to cancel out or minimize sex differences. The principal reason for adopting such a procedure is that it avoids the necessity of separate norms for men and women. Within a test it is possible that some tasks would be easier (or more difficult) for one or the other of the sexes but the total score would not show a clear-cut sex difference.

What are the stratum differences for each of the three types of tests?

Riessman (1962) states that socio-economic factors influence lower performance by inner city or culturally disadvantaged children whereas a study by Fite and Schwartz
(1965) presented evidence that the children from disadvantaged populations were physiologically immature and this caused the perceptual and intellectual deficits. Numerous studies have been made on both sides of the heredity versus environment controversy (Hunt, 1961) trying to determine which has the greater influence on an individual's development.

Limitations of the Study

Correlational studies are more practical than experimental studies largely because of the great difficulty performing controlled experiments involving the participation of human beings over a prolonged period of time. However, the difficulty of a correlational study is the inability to infer causality among the inter-correlated variables. Dependent and independent variables are hopelessly confounded.

In this study, there was no attempt to control socio-economic factors that might influence test results. None of the kindergarten children in the study were given medical examinations which might have found visual and/or auditory acuity problems. It has been demonstrated in other studies (Bereiter and Engelmann, 1966) that nursery school and pre-kindergarten involvement can affect perceptual-cognitive development. Yet it was not possible to control for this variable due to the lack of gathering consistent information upon the child's enrollment into a regular public
kindergarten.

Other limitations involved various procedural aspects of the study. Schools used in the study were chosen by a random table. Two of the three outer city schools in the sample came very close to meeting the criteria for transitional schools. Therefore, they could not be considered "typical" outer city schools.

It was not possible for the writer to administer the auditory and visual perceptual tests, intelligence test and the MRT to all the 215 kindergarten children in the sample population. Six testers were trained to administer the tests. In spite of the training, it cannot be guaranteed that each tester uniformly administered the tests. Also, some tests were administered under less than ideal conditions due to crowded building facilities.

An important variable that was not controlled was the kindergarten teacher herself. Data collection for this study was done in the months of April-June, 1971. It is quite possible that those children who had structured kindergarten programs aimed at developing perceptual-cognitive processes would do better on these tests than those who had more of a traditional type of kindergarten program. None of the kindergartens had a very structured language or skills approach but it was observed that some teachers appeared to be more effective in teaching readiness skills.
Organization of the Study

Chapter I of this study includes the introduction, a statement of the problem, relevant questions, discussion of the questions, a discussion of the importance of the study, a brief indication of the limitations of the study and a statement on the total organization of the study.

Chapter II of this study includes a review of the literature relevant to the research contained in this study.

Chapter III describes the sample population, instrumentation, data collection and statistical analysis of the data.

Chapter IV presents the results of the investigation.

Chapter V contains the summary, implications, and the recommendations.
CHAPTER II

REVIEW OF THE LITERATURE

This chapter will review the relevant literature concerning auditory-visual perception processes, intelligence and readiness to learn and read as they pertain to beginning reading.

Auditory-Visual Perceptual processes

Studying perceptual processes can very rapidly lead one beyond the field of education into psychology, neuropsychology, linguistics, neurology, biology, chemistry, biochemistry and physiology. Computer science via the world of engineering also began to enter the picture as talking "brains" or "humanized robots" were discussed. All these fields are actively engaged in research trying to fathom out the mystery of the human brain.

Karl Pribram (1971) states in his preface:

The brain apparently organizes perceptual, motor, and memory processes by repeatedly restructuring its own activity. Sensory excitations are transformed into patterns of neural activity without undue loss of information. Further transformations into other neural patterns, other neural "codes," take place as "information processing" continues
and behavioral acts become organized. Much of my work, therefore, entails the identification of the set of brain codes, the brain's languages that are involved in one or another phase of psychological processing. What brain codes make visual pattern recognition possible? What brain codes coordinate the building of a nest or the skillful rendering of a piano sonata? What brain codes do I interpret as feeling hungry, sleepy, sexy, apathetic, or interested? And what are the brain's coding operations that allow it to communicate with another brain? What are the "Languages of the Brain"?

The perceptual literature is far too voluminous for this chapter to present a full review. What will be presented is an overall view of some of the viewpoints, theories, experiments and continuing controversies that are pertinent to a child who is "ready" to begin reading. The theoretical viewpoint one takes can greatly influence the type of curriculum that is developed for teaching children.

There are three general approaches to study of perception in children that have changed the older normative-descriptive approach into a more analytic investigation of the determiners of children's behavior. Hebb (1949) attached great importance to early experience and sensory stimulation. His ideas were developed in the context of perceptual problems and the perceptual aspects of discriminative learning. Of particular importance to the study of perceptual development is the work of Piaget (1952). Piaget's view that an early sensorimotor stage is the precursor of intellectual development and his observations of the spatial conceptions of children have inspired interest
in children's perception. From the neurophysiological approach to perceptual development, Birch and Lefford (1964) have presented an integrated theoretical view of perceptual-motor development based on evidence from brain damage and the evolution of behavior. They provide for increasing hierarchic integration across modalities with increasing differentiation.

Perceptual development is the process by which the organism builds basic information-processing strategies needed to learn other skills and information. Bruner (1963) demonstrates great interest in this area. Some psychologists call this process "primary learning" whereas other use the term "learning set." Harlow (1949), for example, demonstrated learning sets or strategies for learning to learn in rhesus monkeys. Essentially he demonstrated that learning discrimination tasks at an earlier point in development facilitated learning more complex discrimination tasks at a later time.

The most thorough statement of this theory and its supporting evidence is provided by Hebb (1949). Long before Hebb, developmental psychologists had grown disenchanted with the failure of classical learning theory to explain learning with its stimulus-response theory. It was felt that learning was something more than the process of a new response to a stimulus. Something called "mediational processes" were also present. Hebb called these mediational processes autonomous central processes (ACP). He stated
that in man attention, perception, thought and learning are controlled less by the immediate stimulus and more by ACP that in lower animals.

Harlow's experiments in learning to learn can be construed as evidence for Hebb's theory of ACP - that the quantity and quality of later learning depends upon ACP resulting from early primary learning. Hebb's theory states that, attention or set, as observed by the psychologist or as measured by physiological changes in the eye or the retina, is evidence of ACP. Hunt (1961) concludes that "invention" and "insight" in adults are dependent upon ACP.

Hebb, then, conceived of primary learning as perceptual experience. He viewed man as a visually dominant animal who depends more upon visual and visual-motor processing for adequate development of ACP than any of the other higher animals. Early perceptual deprivation would therefore result in retarded development of ACP. He did concur that the earliest visual perceptual development also involved motor, tactual-motor and kinesthetic learning. He quotes much research indicating that deprivation of visual, motor and kinesthetic processes early in development retards ability to learn in all species from rats (Lashley, 1938), to chimps (Reisen, 1947), to humans (Hunt, 1961).

Perhaps the most useful description of these developing processes in human infants has been provided by Piaget (1952) in his research reports on "sensorimotor intelli-
gence" and Gesell (1967) in his reports on vision development in infants and young children. Although Piaget and Gesell differ in their basic philosophies of development, the reports of what they observe in children are strikingly similar. Using Gesell's model, every child organizes his visual space world in three fields - skeletal, visceral, and cortical. On a skeletal level, the child seeks and holds a visual image, and at this stage, tactual, proprioceptive, and kinesthetic perception dominate visual perception. On the visceral level he "discriminates and defines the image." Visual perception leads but is dependent upon motor (skeletal) reinforcement. On the cortical level, he interprets, integrates and processes the image. At this level, Gesell includes association and higher mental processes comparable to Piaget's cognitive stages in the development of intelligence. All three levels develop jointly, but not uniformly. The lower functions (skeletal and visceral) are operative more often than the higher functions (cortical) at an early stage. This explains a child's need to touch and to taste whatever catches his eye.

Therefore, Gesell would maintain that perceptual maturation is largely a matter of age as Piaget would believe that the development of organizational schemes is age linked. There is other evidence that visual development moves from a motor, to a perceptual, to a cognitive level. Bender
(1954), Frostig (1961), Jersild (1960), and Siegel (1953) all take this approach. Three classic texts by Coghill (1929), Hooker (1952), and Sherrington (1948), establish the same principles of development that the higher conceptual processes are based on perceptual-motor behavior.

Another factor in physiological readiness to learn is the ability of the organism to process information through one sense modality and transfer it to another, or to coordinate information-processing through more than one modality simultaneously. Recent research (Birch and Lefford, 1964; Birch and Belmont, 1964) indicates that there are relationships between cross-modal transfer, or poor auditory-visual integration, and reading ability.

Birch and Belmont (1964) differentiated retarded readers from adequate readers, matched on all relevant variables, with a test of intermodal shift. Retarded readers had more trouble matching a set of spatially distributed dots (visual input) with an "equivalent set of temporally organized auditory stimuli" than did adequate readers. Because one task involved processing of spatial (visual) factors and the other temporal (auditory), Blank and Bridger (1966) carried this approach one step farther by testing intramodal rather than intermodal shift. Instead of matching auditory stimuli (timed "beeps," a half-second pause for short space, full second pause for long space) with
printed dot patterns, two matched groups, one of retarded readers and the other of adequate readers, had to match a flashed pattern from a light source (visual stimuli but still temporally organized) with the printed dot patterns. Once again these tests were able to differentiate good from poor readers. Blank and Bridger concluded that a deficiency in applying verbal labels to physical stimuli leads to poor inter- and intramodal transfer of equivalent stimuli.

According to Birch and Lefford, complete integration of vision, touch, and movement does not usually take place until age seven or eight. The most rapid improvement in the auditory-visual integration of temporal and spatial patterns seems to occur between ages five and seven. These findings suggest a developmental sequence but Chalfant and Scheffelin (1969) raise the question as to whether this sequence of events and rapid improvement is due to maturation or is the result of instruction and practice that make increasing demands on the integrative processes.

Other research related to cross-modal transfer differentiation was reported by Goins (1958) and Poling (1953). More recent work has been done by Katz and Deutsch (1963) and Lee and Loy (1965). All these studies suggest the possible value of working in inter- and intramodal shifts at the learning readiness stage with children who already show retarded perceptual and language development.

All these studies look at perceptual development in a
child from a different perspective. Hebb (1949) takes an experiential view toward development, Piaget (1952) and Gesell (1967) look at the maturational aspect of perceptual development and Birch, et al (1964) stress the relationship between the two. The one side sees the ability and readiness of a stimulus to affect present behavior as being determined largely by the organism's previous perceptual experience and the other, particularly Gesell, tends to sit back and let "nature" take its course in developing a child's perceptual processes. Just as there is a heredity-environment controversy in the field of intelligence, there has been a nativism-empiricism issue in the study of perception; that is, how much of perception is innate and how much of it is learned. Schilder (1964) states that training plays a significant part even in those functions in which maturation of the central nervous system is of primary importance. The question is really what kind of training and above all, training at what level? A match between a child's developmental readiness and the type of teaching offered him is desirable.

In the early decades of this century, the positions on the nativism versus empiricism issue were strongly outlined: all perception was independent of prior experience and reflected the operation of an innate mind or that all perception was based on prior experiences which fell essentially on an initially blank tablet of the mind. Hochberg (1962)
states, in his review of the controversy, that currently, investigators are not concerned so much with proving the innate or acquired character of a specific type of behavior as they are with viewing the interaction between heredity and environment in the development of perception. In defining the exact nature of this relationship, the fundamental question asked is: "How do different influences modify different aspects of perception, and under what conditions and for what subjects?"

Historically, the Gestalt school with its nativistic emphasis held the pre-eminent place in experimental psychology. Their investigations of form perception, an important area for teachers of beginning reading, posited that we see things the way we do because our brain functions that way. The Gestalt school felt that shape perception, except in a very restricted way, does not depend on prior experience. Because of this emphasis, little attention was given to the potential role of an individual's conditions of life in determining or influencing his perceptual development.

Another group interested in shape perception is the Soviet school (Pick, 1964). The Soviet psychologists have attempted to examine the subject while he is identifying or discriminating shapes. Perhaps the most interesting fact was that these investigators started with the idea that touch teaches vision but were forced by their data (precise
identifications were given earlier by vision than by touch) to reject this hypothesis. Other studies in the United States, have also explored the role of tactual shape perception as a stimulus property in relation to shape discrimination (Pick and Pick, 1970). The general conclusion is that visual perception improves at a much faster rate than tactual perception at the pre-school level. Yet the developmental psychologists, who stress orderly maturational factors, would say that the development of visual perception is dependent upon prior tactual perception. Perhaps relevant stimulus dimensions are not clearly defined or tactual perception develops at a slower rate but is still farther along in the beginning than visual perception. These studies are of interest to those who teach beginning reading. It has been thought that tactual perception developed before visual perception. Therefore, if a child was having trouble learning to read, a tactile or kinesthetic modality was added to the visual and auditory inputs, as is seen in the Fernald (1943) method.

Still another type of studying shape perception outside the Gestalt school, is exemplified by the studies of Gibson, Gibson, Pick and Osser (1962). In such studies the stimuli were constructed so that inferences could be made about the perceptual process from an analysis of the discrimination errors. These studies by Gibson, et al (1965), were eventually written into a book, Principles of Perceptual
Learning and Development (1969), and were conducted as part of the governmental-sponsored Project Literacy which was under the direction of Harry Levine at Cornell University, 1965. This project was designed to investigate the basic processes involved in reading. Gibson's group was to trace the development of children's ability to discriminate letter-like forms.

The result of the investigation by Gibson, et al, (1962) was the suggestion that the kinds of discriminations a child makes in his everyday life transfers to shape or form perception. It was suggested that children transfer this perception of critical features from one situation in their environment to another and, in fact, to completely novel situations. It also suggested that this transfer occurs easily from three-dimensional to two-dimensional stimuli. This could be considered an answer to those who do not feel that it is valid to teach three-dimensional shape such as squares, circles, rectangles or triangles as they might appear in boxes or clocks because there is no guarantee that this learning will transfer over to letter discrimination.

Gibson (1965) states that the first step in reading involves learning the features that are different in discriminating letters. The most relevant kind of training for discriminating is practice which would provide experience with the characteristic difference that distinguish letters.
Features which are actually distinctive for letters could be emphasized by presenting them in contrasting pairs.

The studies conducted by Gibson's group were not considered to be in the Gestalt school, as past experiences of the child certainly had an effect on discrimination of letters or letter-like forms. White's work (1970) has initiated a series of studies on enriching sensory experience and then evaluating behavioral effects with infants. His work shows that the addition of visual stimulation can affect the timing of acquisition of visual-motor responses. Deutsch (1964) found evidence to support the assumption of social-class differences (the environment) in auditory discrimination based on differential stimulus exposure.

The controversy between the two different approaches to perception - nativism versus empiricism - obviously cannot be resolved in this study. However, there are some considerations arising from the data that have been presented for educational programs. A program providing stimuli in the environment and training children to attend to the distinctive features of the stimuli, takes into account both White's (1970) and Gibson's (1965) research findings. There is so much visual and auditory stimuli in the ordinary classroom, some care should be taken to play down irrelevant cues. It is quite possible to engineer the child's attention to what is planned as the relevant aspect of the stimulus. With visual stimuli this can be done by the spacing
of competing visual cues on bulletin boards. With auditory stimuli taped stories and earphones at listening centers can cut down extraneous auditory stimuli and help the child attend to relevant cues.

Various viewpoints, theories, and experiments have been discussed exploring the development of perceptual processes in children. Even if one constructed a compromise between the nativistic and empiricist point of view that a certain number of perceptual reactions are innate and others are modifiable through experience, there always remains the question of the cause of perceptual dysfunction. It could be genetic inheritance or lack of learning; it could be an organic impairment or a developmental lag. All these ideas have been discussed to some extent. When the central information-processing system is faulty for any one of the above reasons, a child is said to suffer from a "perceptual dysfunction."

Various professions have their own pet nomenclature for describing a child with dysfunctions in his perceptual processes. Some call them neurological disorders, others dyslexia, minimal brain damage, visual motor problem, specific language disability, strephosymbolia, specific reading disability, and so on. These terms symbolize diagnostic patterns related to perceptual and perceptual-motor behaviors. When many of these behaviors are grouped together into a syndrome, it is sometimes called a perceptual
dysfunction syndrome.

The cause of this syndrome is relatively unimportant for educational remediation. There are many types of perceptual behaviors that could be dysfunctioning, and all children have, at various times, many of these symptoms. The important thing is to observe the specific perceptual behaviors and either strengthen the dysfunctions or teach the children to compensate for them. This study attempts to identify important perceptual behaviors upon which to base future teaching.

Pasamanick (1958) claims that most of the dysfunctions found in minority groups reflect organic impairment. He postulates that these conditions stem indirectly from short- and long-range effects of deficient diet, poor general living conditions, and poor prenatal care experienced by those members of the disadvantaged minority subculture. Birch and Gussow (1970) present a further elaboration of this point.

Deutsch (1963) suggests that developmental lag and lack of learning play an important role. Deutsch's theory tends to be more probable because most of the behaviors that are observed as dysfunctioning are learned. However, the efficacy of Pasamanick's claim, that is, that organicity may be present, cannot be denied, especially when we consider the likelihood of brain damage during birth being undetected or untreated because of the inadequate care socially dis-
advantaged women receive. However, minimal organicity could be compensated for by the incidental perceptual learning during the early years of development. This may be a key factor. Both the advantaged and the disadvantaged child may suffer the same minimal brain lesion at birth. The environment of the former, however, may offer the opportunity to learn compensatory skills, an opportunity not given to the latter group. Therefore, not just organicity, but also less opportunity for perceptual learning, may be the cause of the high rate of incidence of perceptual dysfunctioning in disadvantaged children.

Perhaps, at this point, it might be well to take a physiological look at the brain. One of the instruments commonly used to detect brain damage is the electroencephalogram (EEG). It attempts to trace the source of electrical connections in the brain or the lack of electrical contracts that would be found in lesions. These tracings have not been found to be as accurate as one might wish. As Buchanan (1968) describes the brain, he says that, in man, the cell division of the neurons of the cerebral cortex is complete by the fifth fetal month, and at that time the number and quality of these cells is permanently determined. That means that any neurons that might be destroyed by injury or by disease are not replaced by other neurons. Other cells in the body can be replaced but not these. Why? If replacement were possible, memory could not exist and language
and learned actions would have to be relearned every few months. Brodmann described forty-seven cortical fields at the turn of the century. These fields are still the most widely used cortical maps. The areas most often thought to be related to visual perception are areas 17 (visual cortex); 18 (visual association), and 19 (goes to the limbic system). The greatest growth of the human brain is in this area when it is compared to that of nonhuman primates. There are similar areas relating to auditory functions. Knowledge of human cortico-cortical connections is very limited partly due to the fact that experimental neuroanatomy is not done in man and because neuroanatomists, in general, have not been too interested in this area (Geschwind, 1968).

The research discussed up until this point has dealt largely with visual perception. Since reading involves decoding the written or visual symbol into the spoken language, auditory processes are of vital concern. Researchers in linguistics and speech and hearing have been those who have contributed most in this area. The ear receives sound and transmits the stimuli along the auditory nerve to the brain. The route to the brain is not a direct one. It passes along several synapses where some of the information being transmitted is coded and analyzed. Finally, impulses from both ears arrive at the temporal lobe of the brain. Once there, a most complex form of processing takes place which enables
the person to understand and interpret what has just been heard. Once the sounds have been sensed by the ear and processed or perceived by the brain, they are stored in the memory vault ready for future use. Sets of sounds are organized into concepts which form the basis for understanding the sound world. Language sounds become symbols conveying meaning in communication. (Barry, 1961; Brown, 1958; Richter, 1966; Penfield and Lamar, 1959; Osgood and Miron, 1963).

This study concerns itself with the development of auditory processes and language comprehension rather than the development and use of speech. In other words, it is more concerned with the receptive and associative auditory processes than with the expressive functions. Auditory learning begins with recognition and identification of sounds, localization and discrimination. Cattell (1950) and Darley and Winitz (1961) present data on the stages of auditory perceptiveness while Ervin-Tripp (1966) gives a general summary of its development. Language comprehension, which begins as the association of particular phonetic patterns with particular objects, grows to enable the child to understand communication between people, for structuring and organizing the mass of information in the world and for thinking. The child has to be able to differentiate between sounds presented to him and develop listening skills in order that he may imitate the speech of those around him.
Auditory impressions of words consist not only of sound qualities but also of the temporal distribution of sounds in a pattern. Broadbent (1957) demonstrated that when different stimuli are presented simultaneously to both ears, information presented to one channel must be stored momentarily while the other channel is being attended to. Frequently, restructuring and reorganizing of the stimuli takes time and breaks down if the system is bombarded with too much stimuli at a time. In order to fully comprehend, therefore, a child must be able to sequence sounds in words as well as to discriminate between sounds.

As language skills develop, associated auditory perceptual and memory skills are also maturing. The child develops the capacity for storage of auditory symbols and experiences. By the time the child reaches school age, he has developed some skills in auditory localization, discrimination, perception of rhythm, sequencing and memory. The process of learning to read means imposing the read symbol on the auditory one. Myklebust and Johnson (1967) state that no one learns to read by vision alone, hence, the great difficulty in teaching deaf children. A child must be able to differentiate the sequence of sounds in words as well as the spatial pattern of the letters. He must be able to hear syllables and eventually needs auditory blending and synthesis skills. The ability to blend isolated sound together to form words matures well after six years of age (Spencer,
but poor performance on measures of auditory synthesis in the first, second, or third grades is a clue to the detection of poor readers (Chall, 1967).

The heredity versus environment controversy can be applied to the auditory processes as well as to the visual processes. However, in this area there does not appear to be as determined a case for either point of view. It seems clear that the human language is learned because of the many thousands of languages in the world today. Yet, no matter what the spoken language, all children normally start talking between their eighteenth and twenty-fourth month. A child cannot learn verbal responses until he is old enough and mature enough to learn them. Maturation sets the pace. With a normal environment, a child's speech unfolds in a step-by-step fashion. The language environment can modify or delay the development, but a child cannot start to talk before he is ready.

All these skills of auditory discrimination, auditory sequencing, auditory memory, and language comprehension come to bear on the reading process with the additional factors of auditory analysis and synthesis introduced. The study of children with dyslexia (those children who have a reading problem despite adequate intellectual capacities, sensory acuity, motor abilities, normal opportunities for learning in home and school, and no primary emotional disturbance) has provided substantial evidence of the relationship of
auditory processes to the read word (Johnson and Myklebust, 1967; Zigmond, 1966; Poling, 1953; Rabinovitch, 1959; Reichstein and Rosenstein, 1964).

**Intelligence as it relates to reading achievement.**

There are many ways of defining intelligence. As interpreted in the schools, it means a general scholastic aptitude, intellectual potential or ability, problem-solving, information-processing or primary mental abilities. The term itself refers to what can be done rather than to what is actually being done; that is, aptitude rather than achievement. Intelligence usually refers to verbal and perceptual behaviors that have been acquired from past learning.

Early investigators worked on an analysis of man's intellectual capacities by concentrating on perceptual problems and measuring such aspects as reaction times and color discrimination (Wechsler, 1958). Later, largely through the efforts of Binet, measures of more generalized functions came into prominence. In 1905, the French psychologist Binet and Simon published a test to predict success of pupils in the French schools. A number of translations and adaptations later, it appeared in the United States, the most famous of which was L.M. Terman's Stanford-Binet published in 1916. The IQ became well established and all mental testing was gauged by Binet's classical measure of
intelligence. Because there was a heavy emphasis on verbal items in this test, however, there evolved a concern with non-verbal measures of mental functioning, the comparisons between individuals' verbal and nonverbal behavior being of value both clinically and theoretically.

Many attempts have been made to analyze the composition of man's intelligence factorially. As a result, it appears that there is some sort of "g" factor in intelligence as originally hypothesized by Spearman (1927), but there are other specific and group factors that enter into it. Vernon (1950) first proposed verbal-educational and practical classifications. These were very much like the verbal and performance scale developed by Wechsler (1958). The multidimensional findings of factor analytic studies of intelligence cannot be underestimated. They broaden the range of abilities being assessed in any given individual. It is quite possible for two people to have the same IQ, but the combination of factors that make up their total intelligence may be quite different. It is to the individual patterning that educationalists look to develop a particular program for a child.

The contributions of Thurstone (1938) and Guilford (1967) must be mentioned at this point because what one man started is having wide repercussions in the field of intelligence even though it has not, as yet, changed our intellectual assessment in the schools to any great extent. Thurstone first developed the notion of six predominant
factors: verbal, number, spatial, word fluency, memory, and reasoning, with variations of these factors at different age levels. Guilford has gone beyond this to develop a paradigm which he describes as three faces of intellect. He has subdivided all intellectual functions according to the operations involved, their content, and the products of these. He has recently suggested adding a fourth dimension; that being a sensory modality of the content or stimulus. (1966).

Currently intelligence tests measure limited verbal and perceptual behaviors. With all the work being done on a wider range of behaviors, for instance, in creativity and cognitive styles, it is to be hoped there will be better ways of assessing children and thereby, a more appropriate job of teaching will be done. Now, a child is presented with a series of word and picture problems in order that an evaluation may be made concerning how he works (achieves) in these tasks. If this information is used to measure what he has learned in the past, the observation is called an achievement test. If this information is used to predict how well he will perform similar tasks in the future, it is called an aptitude test. If a sampling is taken of a wide spectrum of verbal and perceptual behaviors, the result is a "wide-range" achievement test or general aptitude test: an intelligence test.

Past learning, then, largely determines what a child
can presently achieve. Therefore, intelligence tests really
tap achievement. But unlike most achievement tests, intel-
ligence tests try to tap basic general learning, factor "g",
that is common to achievement in all areas of school func-
tioning. Achievement tests tap specific behaviors. There
is much controversy today concerning intelligence testing
(Anastasi, 1967). But if intelligence tests attempt to tap
general areas basic to all academic behaviors in schools as
they are presently functioning, they can be a useful tool
for predicting future achievement. If the intelligence
tests not only predict future school achievement, but also
pinpoint strengths and weaknesses in specific areas of
learning, they can be used to indicate behaviors that should
be taught to children to help them succeed in school.

Intelligence can be modified by environment and ex-
perience because intelligence tests measure those behaviors
which are largely the organism's varied responses to en-
vironmental stimuli. The more intensive and varied those
stimuli, the higher the resulting level of effective stimu-
lation upon the organisms.

Hunt (1961) includes the most thorough discussion of
this conclusion in his book, Intelligence and Experience.
He defines intelligence as "problem-solving capacity based
on a hierarchical organization" of symbols and of "informa-
tion-processing strategies." The symbols, organizational
patterns, and strategies for processing information are
learned. Hunt reviews the literature on cognitive and perceptual development based on the theories of Hebb (1949), Harlow (1949), Piaget (1947) and Wiener (1948). None of these theories denies the genetic limitations inherited by an organism. However, all of them postulate that learned patterns are cumulative and that for all practical purposes, the quantity and quality of what an organism learns now depends upon the quantity and quality of patterns learned in the past. Deutsch (1964) speaks of a "cumulative deficit phenomenon" which takes place in children in their years from first grade to fifth grade. This could be considered an indictment on the schools who are not taking the children where they are and teaching them the skills they need to know to succeed in the academic world. Intelligence tests can help us pinpoint what some of these basic skills are that underlie success in later learning.

It has been stated by Hess (1963, 1964) at the University of Chicago that inferior verbal interaction between mother and child in the first three years of life leads to a paucity of both expressive language and concept development in the child. So language development enters the total picture as a vehicle for developing what is measured in intelligence tests. John (1963) states that cognitive processes develop directly from the incidental learning of the structural aspects of language. She proposed teaching children in three stages going from the concrete to the
abstract: labeling, relating (syntactical analysis) and introverbal relations and classifying. For example, a label is given to the object "bread." You expand this labeling to a sentence involving ideas such as slice, crust, white, soft, and then classify bread with other foods.

Perhaps the role of language in learning is less simple than has been assumed. It would seem that the time at which words can function efficiently as mediators of response is later than has been assumed, for the performance of six and seven year olds does not consistently indicate that mediation has occurred. Labeling objects, as suggested by John (1963) may improve learning by providing a verbal mediator that focuses the child's attention on the stimuli and emphasizes the differences among the stimuli.

Bereiter and Engelmann (1966) state:

From our earlier work in teaching concrete logical operations, it became evident that culturally deprived children do not just think at an immature level; many of them do not think at all. That is, they do not show any of the mediating processes which we ordinarily identify with thinking. They cannot hold on to questions while searching for an answer. They can not compare perceptions in any reliable fashion. They are oblivious of even the most extreme discrepancies between their actions and statements as they follow one another in a series. They do not just give bad explanations. They cannot give explanations at all, nor do they seem to have any idea of it is to explain an event. The question and answer process which is the core of orderly thinking is completely foreign to most of them.

As a result of this discovery, the two men have developed a structured approach for teaching children to think in
pre-school and report gains in IQ to be between twenty and thirty points.

Intelligence tests are often used as predictors for assessing reading readiness. But Cohen (1969) states that the relationship between IQ and reading achievement is relatively weak. Studies reporting fairly high correlations are usually from studies of older children. Ames (1964) found a correlation of .57 between a kindergarten WISC and later reading achievement in fifth grade. In kindergarten and first grade, the correlation coefficient between the various measures of intelligence and success in reading clusters around .45. For older children, the intelligence tests become more verbal than for the younger children. Thus, at the seventh grade level, intelligence tests and reading achievement tests appear to tap similar behaviors and would, thereby, correlate highly. DeHirsch, Jansky and Langford (1966) would add that intelligence tests do not necessarily take into account important perceptuosomotor factors that are significant for reading success or failure. This study investigates just this point.

Although there have been many studies of the relation of IQ to performance in school, there have been few studies of the relation of IQ to performance in standard learning tasks. Zeaman and House (1967) did a study on the relationship between intelligence and learning. They found that intelligence and simple conditionability are unrelated over a
wide range of intelligence. They found that intelligence levels were associated more with differences in attention rather than learning in the sense of habit acquisition. If the subject could focus on the relevant dimension to be learned, it was possible to get fast learning that washed out the effects of intelligence. These studies, therefore, found that although the level of intelligence may be a significant variable in the performance of learning tasks, intelligence and learning ability were not identical functions. Those instances in which high correlations were found tended to use verbal materials - tests of ability to acquire associations and material similar to that found in intelligence tests.

Stevenson (1970) states that individual differences in children's learning cannot be attributed to any single characteristic. Even though intelligence may be a significant variable, especially among older children, it accounts for only a moderate portion of the variability found. He would agree with Zeaman and House (1967) and with Gibson (1964) that the two most common obstacles to rapid learning are the child's failure to attend to the stimuli and to determine the critical features of stimuli differentiation. Once appropriate attentional and discriminative habits have been developed, the child can transfer prior learning to a new situation with comparative ease.

Social variables such as personality, relationship with
the tester, level of anxiety, and motivation to achieve all effect measured intelligence.

Readiness to learn and read

One's philosophy of child development comes into focus whenever the attempt is made to introduce different readiness practices into preschool and kindergarten classrooms. Chall (1967) presents ample evidence of "fads" in educational practices. Research that supports the current belief about children's readiness to learn and read is the research that is much quoted. Contrary research is overlooked until a later time when it then supports a new point of view.

There are many variables that influence the current viewpoint. In the 30's and 40's the ideal school was child-centered. This view was supported, in large part by the Gestaltist psychologists with their genotypic approach and also by G. Stanley Hall and his student, Arnold Gesell. They believed that child development was an unfolding of relatively predetermined processes. Gesell developed the normative study of child behavior describing characteristic behaviors at each age. The position was one of waiting and observing the child; when certain behaviors emerge, the child is then ready for a particular set of stimuli. Their view supported the idea that the potentials for behavior were locked inside the child at birth ready to unfold according to predetermined time and sequence scales.
Educators, during the 30's and 40's, attempted to provide those experiences that would develop a child's emotional and social behaviors. There was a reaction to the specific alphabet and phonic training in the early years of the century. The climate of opinion reversed with the arrival of Sputnik. A great hue and cry went up declaring that our children could not read. Fowler (1962) has a summary of pre- and post-Sputnik research on early learning and reading. It is illuminating. Now we are less concerned with social and emotional development. Research by Durkin (1964) and others indicated that younger children can and do learn and perhaps an earlier start may be a better one. The fact that this concept has been accepted is witnessed by the tremendous amount of money the government allocated to preschool Head-Start programs.

In accord with this current push for greater academic achievement at an earlier age, the views of men like Hunt (1961), Piaget (1952) and Bruner (1963) are in the forefront. They embrace a position that sees child development as being a continuous interaction between innate growth mechanisms and environmental conditions. They would not explain a child's behavior simply by means of a developmental chart. They would state that educators need to study the child's interaction with his environment now and in the past in order to determine how a child learns. Learning affects development. The opportunity to be affected by certain
quantities of stimuli will shape behavior at any age.

Elkind (1969) applies Piagetian thought to educational situations. He presents a viewpoint that combines developmental observations with what a child can be "taught" at an early age. He deplores an overreaction which attempts to push children beyond their developmental abilities. Thinking, to Elkind, allows people to anticipate the consequences of their actions and to exert a higher order of regulation over them. In young children, this internalization process has not gone too far, and they must experiment in fact with problems that older children and adults can deal with in their heads. This can be observed simply watching a young child perform on a simple pencil-maze. A young child will put his pencil to paper as soon as the task is described to him and will proceed along whichever path he sees first. Older children, however, spend a few moments looking at the maze as a whole and do not put pencil to paper until they have found the correct path by mental experimentation. It is likely that these differences in thinking are the reason for including pencil mazes on both the Weschsler and Binet tests.

But even beyond this example of differences in thinking between a younger and older child, is the fact that Piaget found that a young child, in his relatively undeveloped thinking, cannot abide by rules from without. This has great educational significance when "readiness to read" is
being considered. Piaget's psychology (1952) assumes that there is a logic — and hence there are rules — inherent in the child's actions from the very start of life. The conscious making, learning, and obeying of rules must wait for internalization of action, which is thought. Piaget studied the classificatory behavior of young children. They could not come up with solutions because they were not able to form a general or directive rule that would allow them to group the materials in a systematic way.

The child's inability to internalize rules has considerable educational significance. All formal education involves the inculcation of rules. Writing, spelling, reading, and arithmetic all involve rules. There would appear to be little point in beginning formal instruction in these areas unless one has some assurance that the child can internalize and operate according to these rules. Prior to that stage, education has, of necessity to be preparatory in the sense of familiarizing the child with the subject matter of the rules he will be learning later. In other words, there is a difference between "readiness to learn" and a "readiness to read." In short, one clear implication of Piaget's research is that formal instruction be delayed until the age of six or seven when most children can learn rules. The pre-school child is a facile learner but learns by rote rather than by rule and it is the latter that is crucial to formal instruction.
If one keeps in mind the distinction between readiness to learn and readiness to read, much controversy concerning appropriate materials for pre-school and kindergarten materials becomes meaningless. Frostig materials are frequently criticized because there is little statistically valid research demonstrating the transfer from the materials to later success in reading. It appears to be accepted that perceptual training is essential for cognitive growth. Therefore, Frostig materials could be classified as "readiness to learn" as they teach visuo-motor control, establish a "set" for following directions and provide a structure that later develops in first grade.

Although Gibson et al, (1962) felt there was transfer of perceptual training from three-dimensional to two-dimensional planes, it would appear that the bulk of research follows a "play-it-safe" policy which means that educators should not assume transfer of learning from one set of responses to another. There does not appear to be convincing evidence to assume, for example, that auditory discrimination of a tinkling bell transfers to auditory discrimination of oral language sounds. It may, however, teach the child to "attend" which could be considered an essential learning prerequisite (Dykman, Ackerman, Clements and Peters, 1971).

Once the child has acquired a "readiness to learn," that is, a readiness to function within a routine and work
as a member of a group within the school setting, specific reading readiness skills can then be taught. Learning numbers and letters, drawing, practice in classifying and ordering materials, could all be considered a part of a reading readiness program. Operational goals should be specific.

Alphabet knowledge appears to be the best single predictor of reading success in early grades (Durrell and Murphy, 1953; Olson, 1958; Hildreth et al, 1969; and Chall, 1967). These studies report that letter knowledge has a generally higher association with early reading success than mental ability as measured by various intelligence tests and other tests of language and verbal ability. Perhaps the fact that all but two of the letters of the alphabet include one major sound of that letter in their name accounts for this relationship, and it may aide children in beginning phonics. The ability to discriminate letters is included in the larger skill of matching letters and reading them. These factors plus the high predictive correlation, warrant the intelligent teaching of the alphabet in reading readiness, although this technique has not been in vogue for the past several years. The material presented has to be consistent with the child's perceptual development. Letter sound and letter shape training should be as interesting as training in geometric shapes and general sounds in a learning readiness program.

In reading, this emphasis on learning the alphabetic
code and putting sounds to the letters is called an "intensive phonics" approach. There are others who favor a "gradual phonics" or meaning approach to reading. This latter group would put more emphasis on acquiring a whole word sight vocabulary based on the child's past experiences. This approach was consistent to the "whole child" philosophy of education for it was meant to develop a greater interest in reading.

Chall's (1967) analysis of the existing experimental comparisons of a meaning emphasis versus a code emphasis tends to support Bloomfield's (1942) definition that the first step in learning to read is essentially learning a printed code for the speech we possess. Early stress on code learning not only produces better word recognition and spelling, but also makes it easier for the child to eventually read with understanding - at least up to beginning fourth grade, after which there is practically no evidence.

There is some experimental evidence that children of below-average and average intelligence and children of lower socioeconomic background do better with an early code emphasis. Wollam (1961) indicates that by fourth grade systematic phonics is a more effective beginning approach for slow learners only. Systematic phonics is probably more effective for slow learning pupils because it can be made easier than a gradual phonics approach which requires them to induce generalizations from an irregular environment.
A study by Dolch and Bloomster (1937) came to apparently different conclusions. They stated that systematic phonics was acceptable for bright children but was too hard for slow learners. They correlated mental age and phonic ability and found a substantial relationship between the two. They concluded that a child must have a minimum mental age of seven to benefit from a systematic or intensive phonics program. However, a closer look at their definition of phonic ability, an ability to make phonic generalizations, finds it be nearer to what is now called a "gradual phonics" approach. Bliesmer and Yarborough (1965) compared ten beginning reading programs and concluded that those giving greater emphasis to the code or "intensive phonics" approach were more effective in teaching reading. Daniels and Diack (1960), testing after two years of instruction, concluded that a stronger phonics emphasis was better than a gradual phonics approach. They also found that intelligence and the method of teaching reading were not significantly related.

To conclude, correlational studies support the experimental findings that an initial code emphasis produces better readers and spellers. They show a significant relationship between ability to recognize letters and give the sounds they represent and reading achievement. Although knowledge of letters and their sound values does not assure absolute success in reading, it does appear to be a necessary condition for success. In fact, it seems to be more
essential for success in the early stages of reading than high intelligence and good oral language ability. Reading readiness skills, therefore, should place emphasis on the visual discrimination of letters. A progression of steps to be followed in the teaching of letter differentiation might be: matching, recognition, identification, reproduction and habituation.

Summary

For many children, learning to read is a regular process that is mastered fairly easily. A combination of visual and auditory functions are utilized in varying ways and degrees in different children. Visual discrimination, visual memory, visual association, auditory discrimination, auditory memory, and auditory association are involved. By the end of first grade, many children have attained a sight vocabulary, having memorized the visual configurations of various words and associated concepts to the configurations. At the same time, a beginning use of auditory clues is developing with letters and syllables being associated with their sounds, which are blended into whole words. For many children the specific method of reading instruction is probably of minimal significance. The child utilizes both visual and auditory processes with the gradual evolution of intersensory transfer of visual to auditory and auditory to visual. However, when educators are
working with children who cannot learn readily, it becomes

crucial that the best method for each type of learning prob-
lem be used. Principles of learning need to be carefully
delineated. Children with learning problems cannot tol-
erate lack of review, negative transfer, interference, in-
proper sizing of new bits of information or poor sequencing
of materials.
CHAPTER III

METHODS AND PROCEDURES

The determining considerations in this investigation are presented within this chapter. There is a description of the population and the methods by which the sample for this study was chosen. There follows a description of the instruments used in the study including their validity and reliability. A rationale for their use is presented. The procedure for establishing criterion score levels is explained.

Sample Population

There are 8,624 kindergarten children in the Columbus Public Schools according to the January, 1971, census kept by the Pupil Personnel office. In this study it was intended that three percent of that population be used in order to give a large enough sampling permitting generalization to the whole kindergarten population. The total number of children to be tested would have been 257. However, for a variety of reasons such as illness, attrition due to moving, and lack of facilities at certain times for testing,
the actual population for this study was 215 kindergarten children.

The sample population was divided into three strata. Using the Columbus Public School Profile (1969-1970), it was possible to select three homogeneous strata within the school population. The criteria used to determine the three groups are the incidence of Aide to Dependent Children (ADC) cases to the enrollment of each school. The research staff of the Columbus Public Schools felt that, using this criteria, those schools with 21 per cent or above of ADC cases would be considered Inner City schools, those with 11-20 per cent of ADC cases would be considered Transitional schools and those with 10 per cent or below of ADC cases would be considered Outer City schools.

Clusters of children were tested within schools that were selected randomly within each strata. The following chart indicates how the number of cases were selected once the strata was determined:

<table>
<thead>
<tr>
<th>Inner City</th>
<th>Transitional</th>
<th>Outer City</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of schools in each strata</td>
<td>35</td>
<td>14</td>
<td>77</td>
</tr>
<tr>
<td>Population No. in each strata</td>
<td>1983</td>
<td>831</td>
<td>5810</td>
</tr>
</tbody>
</table>
It was felt that 59 children from the Inner City schools and 26 children from the Transitional schools, although proportional to the total population, would not be a large enough sample to permit any generalization within each strata. Therefore, the number of children to be tested were doubled in each of these two strata and the number of children to be tested in the Outer City schools was cut in half. Therefore, the number of kindergarten children to be tested were: 118 from the Inner City schools, 52 from the Transitional schools and 87 from the Outer City schools: a total of 257. However, because of factors already mentioned, the actual number of kindergarten children tested in this research study were 215: 81 from the Inner City schools, 48 from the Transitional schools and 86 from the Outer City schools. Since the average class size in Columbus schools is thirty pupils, it was decided to use approximately that number of students per school. Thus, four schools were to be used in the Inner City, two schools in the Transitional strata and three schools in the Outer City.
In order to determine which children from what schools within each strata were to be tested, the following procedure was followed. All the elementary schools in Columbus were listed alphabetically. All the schools within each strata were assigned consecutive, two-digit numbers. Using Table of 105,000 Random Decimal Digits, Statement No. 4714, File no. 261-A-1, Interstate Commerce Commission, Washington, D.C., May, 1949, page 1, a point was placed at random on the table and the numbers were read horizontally across the page. The numbers which corresponded with those assigned to a school indicated which schools were to be used in this study. The schools chosen in this manner were:

**Inner City**
- Lincoln Park
- Main Street
- Franklinton
- Beck

**Transitional**
- Northwood
- Hamilton

**Outer City**
- Oakmont
- Southwood
- Watkins

The total number of kindergarten children in each of the above schools was listed. The proportion of each school's kindergarten class to the total kindergarten population of the sample population within the strata was figured. These percentages determined the number of kindergarten children to be tested in each school in relation to the total number already decided upon within each strata for the research study. In this way, the larger schools
had more children in the study and the smaller schools had fewer children in the study. The following chart shows the schools in each strata, their total kindergarten population, the percentage of their population to the total sample population, the number of kindergarten children to be tested in that school based on these percentages and the actual number of children who were tested.

The total kindergarten population of each school was alphabetized; the boys in one column and the girls in the other. Each pupil was assigned consecutive, two-digit numbers. The random table cited above was used until a sample of the desired size for that school was selected. An even number of boys and girls were selected.

**Instrumentation**

I. One aspect of this research tested the relative strengths and weaknesses in the auditory and visual modalities at the kindergarten age. Four auditory perceptual tests and five visual perceptual tests were administered individually to each child in the sample population.

These tests were:

<table>
<thead>
<tr>
<th>Auditory perception</th>
<th>Visual perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imitation of tapped patterns</td>
<td>Horst Reversals Test</td>
</tr>
<tr>
<td>Auditory sequential memory (Illinois Test of Psycho- linguistic Abilities)</td>
<td>Visual sequential memory (Illinois Test of Psycho- linguistic Abilities)</td>
</tr>
<tr>
<td></td>
<td>Total No. to kdg.</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------</td>
</tr>
<tr>
<td><strong>Inner City</strong></td>
<td></td>
</tr>
<tr>
<td>Lincoln Park</td>
<td>(82)</td>
</tr>
<tr>
<td>Main Street</td>
<td>(92)</td>
</tr>
<tr>
<td>Franklinton</td>
<td>(56)</td>
</tr>
<tr>
<td>Beck</td>
<td>(69)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>299</td>
</tr>
<tr>
<td><strong>Transitional</strong></td>
<td></td>
</tr>
<tr>
<td>Northwood</td>
<td>(50)</td>
</tr>
<tr>
<td>Hamilton</td>
<td>107</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>157</td>
</tr>
<tr>
<td><strong>Outer City</strong></td>
<td></td>
</tr>
<tr>
<td>Oakmont</td>
<td>69</td>
</tr>
<tr>
<td>Southwood</td>
<td>114</td>
</tr>
<tr>
<td>Watkins</td>
<td>44</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>227</td>
</tr>
</tbody>
</table>
Auditory perception

Wepran's auditory discrimination test
Language comprehension

Visual perception

Bender Visuo-Motor Gestalt
Word recognition tests I and II

A. Rationale

Imitation of tapped patterns. The children were required to imitate four increasingly complex tapped-out patterns on this non-verbal test. Training in auditory perception involves helping the child pay attention to auditory stimuli, to discriminate sounds, and to interpret what he hears. Preliminary training is concerned with sounds other than speech sounds. The child learns to discriminate between rhythms and also to distinguish those sounds to which he should attend from background noises. (Barry, 1961). This test, then, starts at the beginning of developing auditory perception.

Auditory sequential memory. This test assesses the child's ability to reproduce from memory sequences of digits increasing in length from two to eight digits. Standard intelligence tests measure mostly knowledge and skills which a child must already have acquired before taking the test. Jensen (1970) feels that a proper test that minimizes past differences in learning would include new learning tasks of serial objects. He states that the digit span tests have
more in common with his direct learning tasks than any other subtests of the standard intelligence tests. Wechsler (1958) also comments that clinicians believe that digit span is best for detecting mental defectives since, barring emotional disturbance, brain damage, and senility, poor digit span almost invariably means low intelligence by all other criteria, while good digit span is not invariably associated with superior or even average general intelligence. The digit span test of the Illinois Test of Psycholinguistic Abilities was chosen rather than the digit span test of the Wechsler Intelligence Scale for Children because there were a larger number of items presented at each level, a second trial was given for each sequence and the rapid presentation (2 per second instead of the 1 per second on the WISC) is easier for younger children to remember. Short-term memory, as tested by repeating digits, is important in processing incoming auditory stimuli. It is closely related to attention.

Wepman's Auditory Discrimination Test. Twenty alternate pairs from Joseph Wepman's Auditory Discrimination Test (1958) were presented, and the child was asked to judge whether they sounded the "same" or "different." This test is frequently used as an initial screening device to see if a child can detect the finer differences in sounds at the beginning, middle and end of words. Deutsch (1964) found a significant association between auditory discrimination
and reading. However, in the author's experience, it is sometimes difficult to tell whether a kindergarten child knows the meaning of the words "same" or "different" and then, whether his answers really reflect discrimination between two words or whether he is guessing. This is particularly true of the inner city child where social class and/or dialect may affect performance on the test.

**Language comprehension.** A simple story was told to each child. (Story was used in DeHirsch, Jansky and Langford's study, 1966, and sent to author in personal communication, March, 1971). Four questions were then asked dealing with both spatial and temporal concepts of the story. This test involves skill in processing auditory stimuli, integrating the stimuli, grasping the meaning of the stimuli and then being able to verbally express the meaning of what was heard. These are necessary competencies for beginning reading.

**Horst Reversals Test.** This test forms one part of the first version of a larger reading readiness test constructed by Dr. Maria Horst (DeHirsch, Jansky and Langford, 1966). It was used for this research in the same version presented in the DeHirsch study. It consists of ten rows of two- and three-letter combinations, presented in correct and reversed order, which have to be matched to a model. The first row is used for demonstration purposes. There is some controversy as to whether the ability to see likenesses
and differences in objects transfers to ability to see likenesses and differences in letters. Frostig (1964) uses objects to test this ability. However, Gibson (1965) and Harris (1959) state that only the ability to match letters is important to reading. The first task of a child learning to read is his ability to discriminate letters. Since this study concerns itself with those perceptual processes directly related to reading, it was decided that this test be used with its letter sequences.

**Visual sequential memory.** This test assesses the child's ability to reproduce sequences of nonmeaningful figures from memory. The child is shown each sequence of figures for five seconds and then is asked to put corresponding chips of figures in the same order. The child is allowed two trials on each sequence if the first attempt is unsuccessful. The sequences increase in length from two to eight figures. Bateman (1969) sees beginning reading as a decoding of nonmeaningful stimuli. This short-term memory test could assess one aspect of this "decoding" ability. It is important to beginning readers to remember the visual sequence of letters in a word. The question that could be raised here is whether the memory of nonmeaningful symbols is equivalent to a memory of nonmeaningful letters.

**Bender Visuo-Motor Gestalt.** The child was asked to copy six (A, 1, 2, 4, 6, and 8) of the nine designs. DeHirsch, Jansky and Langford (1966) found this test to
be among the ten best predictors of successful reading achievement by the end of second grade. It requires the ability to organize parts of a Gestalt into a meaningful whole. The child has to be able to perceive the shapes and sizes of the figure and translate what he perceives into an integrative whole using a high level of eye-motor coordination. In Koppitz (1963) several studies are cited that demonstrate a significant correlation between the beginning first grade predictive value of the Bender Visuo-Motor Gestalt and the end of first and second grade reading achievement. The findings also suggest that the Bender is relatively "culture-free" and is not unduly influenced by social and cultural factors.

**Word recognition tests I and II.** This was a direct learning task for each child. At the beginning of each session, the child was "taught" to read the two words, "boy" and "train," each of which was printed on 3"x5" index cards. Both the shapes of the letters and the meanings of the words were presented. He is taught to recognize and say these words when they are presented one after the other and when they are placed side by side on the table. Approximately fifteen minutes later, after the administration of the Slosson's intelligence test, the two words were again presented to the child one at a time. He was asked to repeat each word. At the end of the 45 minute testing session, the words "boy" and "train" are placed in third and seventh
position among a pack of ten words. These ten words were presented one after another, and the child was asked to point to "boy" and "train" when he saw them. For the second part of this test, the same ten words were placed in rows on the table. The child was required to pick the words "boy" and "train" from among the others. Although this test had an auditory component, it was largely a comprehensive test of visual perception with a long-term memory component. It could be considered analogous to the language comprehension test under the auditory perception section.

B. Critical Score levels

The critical score levels for seven of the nine perceptual tests are taken from DeHirsch, Jansky and Langford's kindergarten study (1966). Their study determined what score on each test gave the maximum differentiation between the children who, two years later, failed in reading, writing and spelling at the end of second grade. The value shown is the lowest a child could have scored and still have attained the critical score level.

<table>
<thead>
<tr>
<th>Test</th>
<th>Score Range (best-poorest)</th>
<th>Critical score level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imitation of tapped patterns</td>
<td>0-4</td>
<td>1 (3 imitated correctly)</td>
</tr>
<tr>
<td>Test</td>
<td>Score Range (best-poorest)</td>
<td>Critical score level</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Wepman's auditory discrimination test</td>
<td>0-11</td>
<td>1 X-error</td>
</tr>
<tr>
<td>Language comprehension</td>
<td>0-4</td>
<td>1 (3 answered correctly)</td>
</tr>
<tr>
<td>Horst Reversals test</td>
<td>0-9</td>
<td>4 (at least 5 rows correctly matched)</td>
</tr>
<tr>
<td>Bender Visuo-Motor Gestalt</td>
<td>0-6</td>
<td>1 (at least 5 designs copied correctly)</td>
</tr>
<tr>
<td>Word recognition test I</td>
<td>0-2</td>
<td>0 (Both words identified)</td>
</tr>
<tr>
<td>Word recognition test II</td>
<td>0-2</td>
<td>0 (Both words identified)</td>
</tr>
</tbody>
</table>

The Bender Visuo-Motor Gestalt was the only test of the above seven that was not scored in an objective fashion.

Scoring directions in the Dellirsch study (1966, Appendix II) read as follows:

The score is the number of copies, from 0-6, on which the child fails to reproduce the essential features of the Gestalt. One point is added if he is unable to arrange the designs on paper - if, for instance, designs are superimposed on one another. Another point is added if he rotates three or more of the figures.

The author consulted Koppitz's (1963 scoring criteria for the Bender and Keogh and Smith (1961) who developed a simple five category rating scale for scoring the Bender performance of kindergarten children. The following
criteria was followed for this study:

**Design A:** 1. Distortion of shape - square or circle could not be excessively flattened or misshapen; one axis of circle or square could not be twice as long as the other. The square or the circle could not be twice as large as the other.

2. Figure could not be rotated more than 45°.

3. The circle and square had to be within a 1/2" of each other and not overlapped more than 1/8".

**Design 1:** 1. Dots could become circles but the size was not to exceed a 1/4" in diameter.

2. No fewer than 4 dots were acceptable but the dots could extend all across the page.

3. The line of dots could not go up or down more than 45°.

**Design 2:** 1. The importance here was that the child understand the idea of three circles in rows. If the child added an extra circle in places, he was not penalized so long as the majority of circles were three in a row.

2. The rows of circles were not to exceed 45° in either direction.

**Design 4:** 1. The three sides of the square could not rotate to one side or the other more than 45°.
2. The curvy line had to be wavy in some fashion and be within 1/2" of the right or bottom side of the square lines.

**Design 6:**
1. All that was required in this design was that there be one wavy line bisecting another at some point.

**Design 8:**
1. An approximate oval shape was acceptable.
2. There had to be some sort of circular or square figure inside.

The critical score level for the auditory and visual sequential memory tests were taken from the *Examiner's Manual* of the *Illinois Test of Psycholinguistic Abilities*, 1968. Two scores were recorded for each of the two tests: (1) The first raw score was translated into age norms. These age norms are global scores like mental ages and are considered to be overall indices of functioning. The norms were developed through group means. Therefore, if a child has a CA of 6-5 and receives an age norm score of 5-8 on his auditory sequential memory, he is considered to be functioning as a child who is five years, eight months old. This study considered a child who was functioning one year below his CA on his age norm as having a disability. (2) The raw score was then translated into scaled scores. Whereas the age norms considered only group means, the scaled scores take into account both group means and variances. The scaled scores are transformations of the raw scores such
that at each age and for each of the subtests the mean performance of the referral group is equal to a score of 36 with a standard deviation of 6. Therefore, McCarthy, et al. (1968) suggest that differences between a score of ± 36 not be considered an indication of special ability or disability. This is the range within which over 80 per cent of average children score. This study then, did not consider a child to have a problem on either the auditory or visual sequential memory tests unless the scaled score was below 30.

There were instances when one score indicated a problem and the other did not on either one of the two tests. For instance, it was possible for a child to receive an age norm score more than one year below his CA and still receive a Scaled Score of 30. Because the authors of the ITPA recommended that the Scaled Scores be used as a more reliable indication of a child's abilities, this author always chose on the side of the Scaled Scores in such a case and did not record the child as having a problem in that area.

II. A second part of this research involved the administration of the Slosson's Intelligence Test (hereafter referred to as SIT) individually to each of the 215 kindergarten children. It meets all the minimal criteria for a good standardized test. The items finally selected for this short screening test are similar in nature to the valid
Stanford-Binet tasks.

A. Validity.

For validation purposes, the most recent revision of the Stanford-Binet, Form L-M was used. The author of the SIT administered a large number of both tests in alternate manner. The children and adults used in obtaining comparative results, came from both urban and rural populations in New York State. The total number tested was 701. The concurrent validity of this short intelligence test is indicated by the high correlations between the Binet and the SIT. For children aged 5, the correlation is .93; for children aged 6, the correlation is .98 and for children aged 7, the correlation is .98 (Slosson, R.L., 1963).

B. Reliability.

A high reliability coefficient of .97 (test-retest interval within a period of two months) was obtained for this short test on 139 individuals from age 4 to 50 years.

III. The total kindergarten population of the eight schools involved in the study were administered the Metropolitan Readiness Tests – Form B (MRT). This test has been thoroughly standardized meeting all the criteria necessary for a good test.
A. **Validity.**

The extent to which the six subtests go together to form a meaningful composite readiness measure and to which each contributes uniquely to this composite is indicated by the intercorrelations among the subtests. All are positive and, for the most part, would be considered moderate. None of them are so large as to suggest that any two of the tests are measuring identical or nearly identical functions. The most closely related subtests are Alphabet and Numbers \((r=0.64)\). These two contain the most directly taught material.

Data are available on the relation between the Metropolitan Readiness Tests and certain other readiness and intelligence tests. The correlation between the MRT and other readiness tests runs high - between .70 and .80. The correlation between the MRT and other intelligence tests show correlations between .41-.74. The total MRT score correlates .67 with the Stanford-Binet, Form L-M, using 277 pupils (Hildreth, Griffiths, and McGauvran, 1969).

The predictive validity of a test is evidenced by the relation of its scores to some future criterion measure. The MRT has been correlated with many achievement tests most of which were given at the end of first grade. The overall estimate of predictive value would be approximately .60.
B. **Reliability.**

Data on the reliability of the MRT for both forms A and B were obtained from both end-of-kindergarten tests and beginning-of-first-grade tests. The testing on which the determinations are based was done in seven different school systems. Both split-half and alternate form values were reported. The general level of reliabilities was good, particularly those found for the total score, the median being .92.

Forms A and B were standardized with a population of approximately 15,000 pupils in schools throughout the country.

**Data Collection**

The individual administration time of the test battery including the perceptual tests and the intelligence test took anywhere from thirty to sixty minutes depending on the child.

The total working time for the administration of the Metropolitan Readiness Tests was sixty minutes. Each of the eight schools worked out a different arrangement as to how this was done. Some tested the children on three successive days and some tested the children all in one day with breaks in between subtests. Some schools tested the children in groups of ten and others tested a total class at one time.
with the help of several adults. It was suggested that the
children be tested in groups of not more than fifteen and in
two sessions.

The entire time span utilized in this research study
was from April 5-June 4, 1971 - a total time of nine weeks.
The week of April 5 was spent acquainting the principals and
kindergarten teachers of the schools involved in the study
with the objectives of the study. Decisions were made con­
cerning space for individual testing, which children were to
be tested from morning and afternoon kindergarten classes
and how the Metropolitan Headiness Tests were to be admin­
istered. The testers, working under the supervision of the
investigator of the study, were trained during that week.
The investigator scored all of the tests.

**Data Analysis**

The method used to analyze the data, stepwise multiple
regression, is a direct extension of the linear (or curvi-
linear) regression model. For purpose of explanation for
the person in school psychology or counseling it might be
helpful to understand that in linear regression, each sub­
ject or member of the sample under study is represented by
a single coordinate or point in two dimensional space. With
many individuals an array of coordinates or points in two-
dimensional space is represented. This array of points is
best summarized by fitting a line (or curve) to the data.
The process of fitting, the least squares procedure, gives the line (or curve) of best fit, that is, the unique line for which the sum of the distance of the coordinates to the line is at a minimum when compared to a similar sum for any other line. This line of best fit, the regression equation for the two variable case, is utilized to predict one variable from other, that is, to predict x from y or vice versa.

One speaks not of two - but of three - dimensional space in the three variable case of predicting one variable from two others taken together. Instead of fitting a line or curve to the array, the best fit solution is represented by a plane. With more than two predictors of a single variable the terminology consists of n-dimensional space or hyperspaces and hyperplanes or surfaces.

This study is an example of the situation where there are more than two predictors of a single variable. The Wherry Test Selection program employed in this analysis selects that combination of predictors which, when taken together gives the best prediction of the single variable. Specifically, it yields a multiple correlation coefficient which indicates the strength of the relationship between one variable and two or more other variables taken together and the equation of the surface or hyperplane best fitting the data (Guilford, 1965).

The first step in the Wherry Test Selection program is the generation of a matrix containing the zero order inter-
correlations for all the possible variable combinations, including the criterion-independent variable combinations. Next, the variable having the highest correlation with the criterion is entered first into the prediction equation, for example, the variable most predictive of success in reading readiness is entered first. A significance test is computed (see following paragraph) to determine if this predictor variable is explaining a significant portion of the variance of the criterion variable. If it is, the question next posed is: "Which of the remaining variables when taken in conjunction with the first predictor increases the prediction most?" To ascertain this, a modified Doolittle procedure\(^1\) is used to solve the correlation matrix.

After selecting the second predictor variable, a multiple correlation coefficient, R is calculated. This R (two predictors) is compared with the previous one\(^2\) and a significance test is made (see following paragraph). This test of significance determines whether or not the prediction has been significantly increased by the inclusion of a second predictor.

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\(^1\)The Doolittle procedure is a method of solving simultaneous equations, the correlation matrix is a series of simultaneous equations in matrix form. See McNemar, 1966 for the computational steps necessary to analyze the matrix.

\(^2\)The Pearson r which expresses the relationship between two variables can be thought of as a multiple R with one predictor.
predictor. The question then becomes: "Does the inclusion of this second independent variable significantly increase the amount of criterion variance that is explained or accounted for?" The Program continues this step-wise process of adding one variable at a time and computes a significance test comparing the previous R to the subsequent one until the point of no significant difference is reached. In other words, adding further variables is stopped when they no longer help explain the criterion variance.

The general formula for the test of significance between two R's is:

\[ F = \frac{R_1^2 - R_2^2}{1 - R_1^2} \cdot \frac{N - m_1 - 1}{m_1 - m_2} \]

Where

- \( R_1 \) = multiple R with larger number of predictor variables
- \( R_2 \) = multiple R with one less predictor variable than \( R_1 \)
- \( m_1 \) = larger number of independent variables
- \( m_2 \) = smaller number of independent variables
- \( N - m_1 - 1 \) = degrees of freedom for the denominator
- \( m_1 - m_2 \) = degrees of freedom for the numerator

In the case where there is only one predictor variable and no possible prior multiple correlation the formula is:
This formula is used to test whether or not the correlation between the first variable entering the prediction equation and the criterion is significantly different from zero. In the case where \( m_1 \) is one unit larger than \( m_2 \) such as in the comparison of subsequent multiple R's in the Wherry Test Selection program, the formula becomes:

\[
F = \frac{R_1^2}{1-R_1^2} \cdot \frac{N-2}{1}
\]

This formula is used to test whether or not the one extra variable in \( R_1 \) is adding a significant contribution to the explanation of criterion variance.

In Wherry's program, the level of significance for these F tests is always set at \( p. > 50 \). The choice of this level greatly simplifies computer operations (any F of 1.0 or greater would be significant so therefore it would not be necessary to place an F table in computer storage).

Again it might be helpful to understand that the multiple correlation coefficient generated from procedures described above is a biased estimator of the population parameter. As the number of selected predictor variables
approaches the size of the sample, \( R \) becomes inflated, that is, \( R \) will overestimate the true population coefficient (Garrett, 1966 and Guilford, 1965). It is therefore necessary to reduce (or shrink) the original coefficient so that it more accurately reflects the population value. The adjusted coefficient, the shrunken \( \bar{R} \), is obtained by the use of the following formula:

\[
\bar{R} = R \cdot \frac{1-(1-R^2)}{(N-n)}
\]

where:
- \( \bar{R} \) = shrunken multiple correlation coefficient
- \( R \) = the original \( R \)
- \( N \) = the sample size
- \( n \) = the number of predictors included in the prediction equation

To fully interpret multiple regression, it is important to consider, in addition to the shrunken \( R \), the order in which variables are selected into the prediction equation. The variable that enters first will reduce the apparent predictive power of other variables which are correlated with it. When two predictor variables are correlated, both may be explaining the same portion of the criterion variance. The one that explains best (that is, the variable having the higher zero order correlation with the criterion) enters the prediction equation first. The predictor variable
correlated with it is then prevented, or at least hindered, from entering the prediction equation because its contribution to the explanation of criterion variance has already been accounted for.

Summary

Chapter III was a detailed discussion of the procedures employed in this investigation. The sample population, instrumentation, data collection and the multiple regression model utilized in the study for analyzing the data were discussed. The next chapter presents the results of the study.
CHAPTER IV

FINDINGS

The problem of concern in the study consists of examining relationships among measures of auditory and visual modalities, reading readiness, mental age and intelligence of kindergarten children in a stratified, urban school setting. The fundamental question of concern in the study is: What is the most effective combination among the twenty-one variables employed in the study, for predicting performance on the readiness test used with the sample? Answers to specific questions subsidiary to the basic question are also considered.

Analysis of the criterion on the predictors is summarized in Table 1. The first variable selected was the mental age score of the Slosson Intelligence Test (SIT) which showed a correlation of 0.752 with the criterion. This correlation was both significant and substantial. The above R attained significance at the 0.001 level. Mental age alone accounts for approximately 57 per cent of the criterion variance in the present sample as indicated by the square of the above correlation. The shrinkage for mental age was
**TABLE 1**

**STEPWISE REGRESSIONS PROCEDURES**

**FOR CRITERION**

<table>
<thead>
<tr>
<th>Variable</th>
<th>R</th>
<th>( \bar{R} )</th>
<th>F</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>.752</td>
<td>.750</td>
<td>276.98</td>
<td>1,213</td>
<td>0.001</td>
</tr>
<tr>
<td>15</td>
<td>.803</td>
<td>.801</td>
<td>47.89</td>
<td>2,212</td>
<td>0.001</td>
</tr>
<tr>
<td>14</td>
<td>.813</td>
<td>.810</td>
<td>10.13</td>
<td>3,211</td>
<td>0.001</td>
</tr>
<tr>
<td>8</td>
<td>.820</td>
<td>.816</td>
<td>7.09</td>
<td>4,210</td>
<td>0.001</td>
</tr>
<tr>
<td>20</td>
<td>.826</td>
<td>.822</td>
<td>6.51</td>
<td>5,209</td>
<td>0.001</td>
</tr>
<tr>
<td>9</td>
<td>.829</td>
<td>.823</td>
<td>2.86</td>
<td>6,208</td>
<td>0.01</td>
</tr>
</tbody>
</table>
The selection of mental age as the first predictor of the criterion shows the importance of the general maturity level. The higher the mental age of a child, the better his chance of reading success as measured by the criterion: the Metropolitan Readiness Test (MRT).

The second two variables selected, the Horst and the Bender, both measure visual perception. Both the Horst and the Bender resulted in increments in $R^2$ which attained significance beyond the 0.001 level. Examination of the respective increments in $R$ after shrinkage, shown in Table 1, demonstrates that these two visual tests substantially increase prediction of criterion performance. The obtained $R$ of 0.80 indicates that mental age, in conjunction with the two visual perception tests, might reasonably be expected to account for approximately 66 per cent of the criterion variance in a cross-validation study employing a similar sample.

It is important to note that both tests of visual perception, the Bender and the Horst, enter the regression equation with negative beta-weights. Examination of the regression procedure indicates that both variables were selected because of a high negative correlation with the criterion and relative independence from each other. That is, these visual tests function to subtract criterion variance unrelated to mental age thus improving prediction.
Conceptually, the regression equation thus far obtained indicates that a child with a high mental age and no problem with visual perception is highly likely to earn a high score on the MRT. On the other hand, a child who earns a high mental age score on the SIT but has high error scores on the Bender and the Horst is much less likely to earn a high score on the MRT.

Alternatively stated, if a child has a high mental age and no problem in visual perception, he is almost certain to earn a high score on the MRT.

The Wepman Test of Auditory Discrimination was the fourth variable selected. The increment in $R^2$ resulting from the addition of the Wepman attained significance at the 0.001 level. This variable also entered the regression equation with a negative beta-weight. Examination of the stepwise procedure indicates that the Wepman was selected because of a negative correlation with the criteria. More specifically, the Wepman also functions to subtract criterion variance unrelated to mental age thus enhancing prediction.

The matter in which the four variables discussed above function in the regression equation can be readily ascertained. The child who has a high mental age and remains free from auditory and visual perception problems, is almost certain to earn a high score on the MRT. The extent to which the child is deficit in visual and/or auditory per-
ception tends to decrease his chances for effective performance on the MRT despite the high mental age.

Two additional variables were also included in the final regression equation. Addition of these variables resulted in slight but significant (p. > .01) increments in prediction. The Word Recognition Test II (WRII) was selected with a negative beta weight. The Language Comprehension test was selected with a positive beta-weight. These weights indicate that the WRII functions to subtract from the equation whereas Language Comprehension tends to improve predictability by adding to the equation.

Table 2 contains the standard score (beta) weights, bee (raw score) weights, associated t-values, and A-weights (constants) for the six variables included in the final regression equation obtained from the test selection procedure described above. This regression equation can be readily interpreted. Mental age is the most effective single predictor of the performance on the MRT but the presence of deficits in auditory and/or visual perception qualifies the effectiveness of the SIT mental age. The negative beta-weights were obtained for the four perceptual tests yielding error scores. That is, the greater the number of errors on any combination of these four tests, the greater the likelihood of a child's earning a low score on the MRT regardless of mental age.

The relationship between the criterion and the pre-
<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta-Weight</th>
<th>Bee-Weight</th>
<th>T for Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.471</td>
<td>0.708</td>
<td>8.589</td>
</tr>
<tr>
<td>15</td>
<td>-0.220</td>
<td>-1.248</td>
<td>-4.139</td>
</tr>
<tr>
<td>14</td>
<td>-0.160</td>
<td>-1.522</td>
<td>-3.400</td>
</tr>
<tr>
<td>8</td>
<td>-0.144</td>
<td>-0.918</td>
<td>-2.961</td>
</tr>
<tr>
<td>20</td>
<td>-0.113</td>
<td>-2.927</td>
<td>-2.703</td>
</tr>
<tr>
<td>9</td>
<td>0.072</td>
<td>1.029</td>
<td>1.691</td>
</tr>
</tbody>
</table>

A weight: 9.457
dictor variables was both significant and substantial. The six variables included in the final regression equation have an $R$ of 0.829 ($R^2 \approx 0.677$) which, when shrunken, yield an $\bar{R}$ of 0.823 thus indicating that one might reasonably expect this equation to account for approximately 68 per cent of the criterion variance in a cross-validation study with a similar sample. An $F$-ratio of 76.17, which attained significance beyond the 0.001 level, was obtained for the $R^2$ resulting from the final regression equation. These data, then, clearly indicate that performance on the MRT can be effectively predicted from the regression equation presented in Table 2.

Including the last two variables results in only a slight improvement in predictive efficiency. Consequently, including the WRIT and Language Comprehension in a predictor battery would be of questionable value.

Once the major research question was answered, that is, finding the most effective combination among the twenty-one variables for predicting performance on the readiness test used with the sample, data relevant to the remaining questions were examined.

Question #2: What percentage of the kindergarten children included in the sample demonstrate the following discrepant modality pattern?

2.1 Failed to meet success criteria for auditory perception tests.
2.2 Failed to meet success criteria for visual perception tests.

2.3 Failed to meet success criteria for both auditory and visual perception tests.

Table 3 presents the percentage of the total sample showing auditory, visual and both auditory and visual deficits. A child was considered to have an auditory perception problem if he failed to meet the criteria for three of the four auditory perception tests. If a child failed to meet the criteria on three of the five visual perception tests, he was considered to have a visual perception problem. If a child failed to meet both the auditory and visual perception criteria, he was considered to have a problem in both areas. There was a significant correlation between the perception tests and the MRT total scores. Therefore, this definition of a perception problem for a child appeared justified.

Eleven per cent of the sample population failed to meet the success criteria for the auditory perception tests, 25 per cent of the population failed to meet the success criteria for the visual perception test and 20 per cent failed to meet the success criteria for both the auditory and visual perception tests.

Summary

In this kindergarten sample of 215 children from inner city, transitional, and outer city school, there were
<table>
<thead>
<tr>
<th>Type of Problem</th>
<th>Auditory</th>
<th>Visual</th>
<th>Both Auditory and Visual</th>
<th>No Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>23</td>
<td>53</td>
<td>44</td>
<td>95</td>
</tr>
<tr>
<td>%</td>
<td>11</td>
<td>25</td>
<td>20</td>
<td>44</td>
</tr>
</tbody>
</table>
significant numbers of children who presented perceptual problems.

Question #3: What is the relationship between mental age and the scores on the various auditory and visual assessors employed in this study?

Table 4 contains the correlations between mental age and the scores on the auditory and visual assessors. Tapped Patterns correlates negatively with the mental age variable at the 0.05 level of significance. A negative correlation appears at the 0.01 level with Auditory Discrimination and a positive correlation appears at the 0.01 level with Auditory Memory Scaled Scores. One positive correlation at the 0.05 level appears with Visual Memory Scaled Scores and one negative correlation at the 0.05 level appears with Word Recognition II. The Bender and the Horst both correlate negatively at the 0.01 level of confidence with mental age.

Summary

The negative correlations are best understood as error scores. The positive correlations are correct scores. A significant relationship exists between three of the four measures of auditory perception (Tapped Patterns, Auditory Discrimination, and Auditory Memory Scaled Scores) and four of the five tests of visual perception (Bender, Horst, Visual Memory Scaled Scores and Word Recognition I) with mental age.
TABLE 4

COEFFICIENTS OF CORRELATION FOR MENTAL AGE AND SCORES
ON THE VISUAL AND AUDITORY ASSESSORS

<table>
<thead>
<tr>
<th>Tapped Patterns</th>
<th>Auditory Language Patterns</th>
<th>Auditory Language Comprehension</th>
<th>Auditory Language Memory Scores</th>
<th>Bender Scores</th>
<th>Horst Scores</th>
<th>Visual Scaled Memory Scores</th>
<th>Word Recognition Scores I</th>
<th>Word Recognition Scores II</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA</td>
<td>-0.40*</td>
<td>-0.57**</td>
<td>-0.36</td>
<td>0.48**</td>
<td>-0.46**</td>
<td>0.57**</td>
<td>0.40*</td>
<td>0.42*</td>
</tr>
</tbody>
</table>

*r(P > .05) = 0.398

**r(P > .01) = 0.430

df = 213
### TABLE 5

COEFFICIENTS OF CORRELATION FOR INTELLIGENCE (IQ) AND SUBTEST SCORES OF THE METROPOLITAN READINESS TEST

<table>
<thead>
<tr>
<th>Word Meaning</th>
<th>Listening</th>
<th>Matching</th>
<th>Alphabet</th>
<th>Numbers</th>
<th>Copying</th>
<th>MRT Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ</td>
<td>0.28</td>
<td>0.37</td>
<td>0.50**</td>
<td>0.54**</td>
<td>0.63**</td>
<td>0.53**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.69**</td>
</tr>
</tbody>
</table>

*\(r(P > .05) = 0.398\)

**\(r(P > .01) = 0.430\)

\(df = 213\)
Question #4: What is the relationship between intelligence (IQ) and the readiness test employed in this study?

Correlations between IQ and the MRT subtest scores are presented in Table 5. The following four subtests showed a positive correlation with IQ: Matching, Alphabet, Numbers, and Copying. All four of these correlations attained significance at the 0.01 level. The Word Meaning and Listening subtests also showed positive correlations with IQ but these failed to attain significance at the 0.05 level.

These data reveal a definite pattern. The four visual tests showed significance and substantial positive correlation with intelligence while the two auditory subtests showed lower positive but non-significant correlations with IQ. These findings suggest that visual-information processing is a more important component of intelligence as measured by the SIT than does auditory information processing.

Summary

It would appear that the four subtests of the MRT which showed the most significant and substantial correlation with intelligence as measured by the SIT are Matching, Alphabet, Numbers, and Copying. These four tests are the visual perception components of the MRT.

Question #5: What is the relationship between the Metropolitan Test Score and the scores on the various auditory and visual assessors employed in this study?
Table 6 contains the correlations between the MRT Total Scores and the scores on the auditory and visual assessors. Two of the four auditory assessors and three of the five visual assessors correlate significantly with the MRT Total Score. Both Tapped Patterns and Auditory Discrimination showed significant negative correlations with the MRT scores. Tapped Patterns attain significance at the 0.05 level while Auditory Discrimination attains significance at the 0.01 level. Bender and Horst scores also showed significant negative correlations with the MRT scores while the Visual Memory Scaled Scores showed a positive significant correlation. The Bender and the Horst correlate significantly at the 0.01 level while the Visual Memory Scaled Scores attained significance at the 0.05 level.

Summary

The negative correlations are best understood as error scores while the positive correlations are correct scores. This study found that two of the four auditory assessors (Tapped Patterns and Auditory Discrimination) and three of the five visual assessors (Bender, Horst, and Visual Memory Scaled Scores) correlated significantly with the MRT Total Scores.

Question #6: What are the sex differences on the performance of each of the three types of tests?

Tables 7, 8, and 9 contain the information necessary
### TABLE 6

**COEFFICIENTS OF CORRELATION FOR METROPOLITAN READINESS TEST TOTAL SCORE AND SCORES ON AUDITORY AND VISUAL ASSESSORS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Tapped Language</th>
<th>Auditory Language</th>
<th>Auditory Memory</th>
<th>Visual Memory</th>
<th>Word Recognition I</th>
<th>Word Recognition II</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRT</td>
<td>-.41*</td>
<td>-.56**</td>
<td>-.22</td>
<td>.39</td>
<td>-.54**</td>
<td>-.66**</td>
</tr>
</tbody>
</table>

\[ r(p > .05) = .398 \]

\[ r(p > .01) = .430 \]

\( df = 213 \)
<table>
<thead>
<tr>
<th>Variable</th>
<th>Tapped Patterns</th>
<th>Auditory Discrimination</th>
<th>Language Comprehension</th>
<th>Auditory Memory Scaled Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>-0.03</td>
<td>-0.10</td>
<td>-0.05</td>
<td>0.09</td>
</tr>
</tbody>
</table>

*r(p > .05) = 0.398
**r(p > .01) = 0.430
\[ df = 213 \]
TABLE 8
CORRELATION BETWEEN SEX AND VISUAL ASSESSORS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bender</th>
<th>Horst</th>
<th>Visual Memory Scales Scores</th>
<th>Word Recognition I</th>
<th>Word Recognition II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>-0.14</td>
<td>-0.11</td>
<td>0.13</td>
<td>-0.10</td>
<td>0.04</td>
</tr>
</tbody>
</table>

\*r(p. > .05) = 0.398
\**r(p. > .01) = 0.430
\(df = 213\)
TABLE 9
CORRELATION OF SEX WITH IQ
AND MRT TOTAL SCORE

<table>
<thead>
<tr>
<th>Variable</th>
<th>IQ</th>
<th>MRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>0.08</td>
<td>0.10</td>
</tr>
</tbody>
</table>

\*r(p. > .05) = 0.398
\**r(p. > .01) = 0.430
\[df = 213\]
to answer this question. Data analyses were so designed that sex functioned as a control variable. That is, sex was included among the predictors to select potential differences in performance on the part of boys and girls in the total sample. The presence of significant sex differences should, then, be indicated by a significant correlation between the sex variable and any assessor upon which either sex scores higher than the other. For purposes of classification, all boys were assigned a score of 1 and all girls a score of 2. This assignment of numbers was purely arbitrary as the numbers could have been reversed without changing the interpretation given to the findings. With the present procedure, a negative correlation between sex and any assessor indicated superior performance on the part of the boys while a positive correlation indicated superior performance on the part of girls. There was no significant correlation for the total sample.

Question #7: What are the sex differences within each strata for each of the three types of tests?

Question #8: What are the strata differences for each of the three types of tests?

Tables 10, 11, and 12 contain an analysis of variance summary for the three perceptual assessors that were the best predictors of the criterion variable – the MRT total scores: the Horst, the Bender, and the Wepman. Tables 13 and 14 contain the analysis of variance for the
### TABLE 10

ANOVA SUMMARY FOR HORST

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Sex)</td>
<td>34.626</td>
<td>1</td>
<td>34.626</td>
<td>4.63*</td>
</tr>
<tr>
<td>B (Strata)</td>
<td>13.911</td>
<td>2</td>
<td>6.956</td>
<td>.93</td>
</tr>
<tr>
<td>AxB (Interaction)</td>
<td>23.397</td>
<td>2</td>
<td>11.699</td>
<td>1.57</td>
</tr>
<tr>
<td>Within Group</td>
<td>1,561.567</td>
<td>209</td>
<td>7.472</td>
<td></td>
</tr>
</tbody>
</table>

*F .05 (df 1,200) = 3.89

*F .05 (df 2,200) = 3.04
**TABLE 11**

ANOVA SUMMARY FOR BENDER

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Sex)</td>
<td>9.587</td>
<td>1</td>
<td>9.587</td>
<td>2.89</td>
</tr>
<tr>
<td>B (Strata)</td>
<td>17.967</td>
<td>2</td>
<td>8.984</td>
<td>2.71</td>
</tr>
<tr>
<td>AxB (Interaction)</td>
<td>2.782</td>
<td>2</td>
<td>1.391</td>
<td>.42</td>
</tr>
<tr>
<td>Within Group</td>
<td>693.804</td>
<td>209</td>
<td>3.320</td>
<td></td>
</tr>
</tbody>
</table>

*F .05 (df 1,200) = 3.89

*F .05 (df 2,200) = 3.04
TABLE 12
ANOVA SUMMARY FOR WEPMAN

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Sex)</td>
<td>10.626</td>
<td>1</td>
<td>10.626</td>
<td>1.46</td>
</tr>
<tr>
<td>B (Strata)</td>
<td>13.877</td>
<td>2</td>
<td>6.939</td>
<td>.95</td>
</tr>
<tr>
<td>AxB (Interaction)</td>
<td>.402</td>
<td>2</td>
<td>.201</td>
<td>.03</td>
</tr>
<tr>
<td>Within Group</td>
<td>1,519.719</td>
<td>209</td>
<td>7.271</td>
<td></td>
</tr>
</tbody>
</table>

*F .05 (df 1,200) = 3.89

*F .05 (df 2,200) = 3.04
### TABLE 13
ANOVA SUMMARY FOR INTELLIGENCE

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Sex)</td>
<td>558.443</td>
<td>1</td>
<td>558.443</td>
<td>2.06</td>
</tr>
<tr>
<td>B (Strata)</td>
<td>1,485.942</td>
<td>2</td>
<td>742.971</td>
<td>2.74</td>
</tr>
<tr>
<td>AxB (Interaction)</td>
<td>212.517</td>
<td>2</td>
<td>106.259</td>
<td>0.39</td>
</tr>
<tr>
<td>Within Group</td>
<td>56,528.940</td>
<td>209</td>
<td>270.731</td>
<td></td>
</tr>
</tbody>
</table>

*F .05 (df 1,200) = 3.89

*F .05 (df 2,200) = 3.04
TABLE 14

ANOVA SUMMARY FOR METROPOLITAN READINESS TEST

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Sex)</td>
<td>1,094.763</td>
<td>1</td>
<td>1094.763</td>
<td>3.67</td>
</tr>
<tr>
<td>B (Strata)</td>
<td>2,424.502</td>
<td>2</td>
<td>1212.251</td>
<td>4.06*</td>
</tr>
<tr>
<td>AxB (Interaction)</td>
<td>1,084.037</td>
<td>2</td>
<td>542.019</td>
<td>1.82</td>
</tr>
<tr>
<td>Within Group</td>
<td>62,353.385</td>
<td>209</td>
<td>298.365</td>
<td></td>
</tr>
</tbody>
</table>

*F .05 (df 1,200) = 3.89
*F .05 (df 2,200) = 3.04
intelligence test (SIT) and for the Metropolitan Readiness Test (MRT). The two variables being analyzed were sex and strata differences.

Using an F-ratio to compute significance, this analysis found that there was a significant difference at the 0.05 level between sexes on the Horst Reversals Test. The girls' performance was superior to that of the boys. There was no significant sex difference within each strata for the Bender, the Wepman, the SIT, and the MRT.

There was one significant strata difference among the three types of tests. The analysis of variance, using the F-ratio to compute significance, showed that there was a significant difference at the 0.05 level between strata on the MRT. The Outer City sample population received significantly higher scores than either the Transitional or the Inner City sample population.

Summary

There was a significant sex difference on the Horst Reversals Test within each strata but there was no significant sex difference among any of the other types of tests: the Bender, the Wepman, the SIT, and the MRT.

The only significant strata difference among the three types of tests was the MRT. The perceptual tests and the intelligence test did not show a significant strata difference.
Summary

Chapter I of this study provided the concepts involved in the investigation, a statement of the problem which included a presentation of eight pertinent questions, and the limitations and organization of the study. Chapter II presented a review of those studies dealing with the auditory and visual modalities, intelligence and readiness to learn as they pertained to reading. Chapter III enters into the methodology and procedures of the study. It includes a description of the sample population, the instrumentation, the data collection and description of the treatment of the data. Chapter IV provides the findings from the statistical analysis of the data. The purpose of this chapter is to summarize the investigation and present the implications and recommendations.

This study explored the relationships among measurements of auditory and visual modalities, intelligence and readiness skills of kindergarten children in a stratified,
urban school setting.

Question #1: Of the twenty-one predictors employed in this study, what is the most effective combination for predicting performance on the readiness test used with the sample?

It was found that six variables entered into the prediction equation. The best predictor variable, at a significant and substantial level, was mental age. The next two variables to enter the equation at a substantial and significant level, were the Bender and the Horst Tests, both tests of visual perception and both entering into the regression equation with negative beta weights. This was interpreted to mean that if a child had high mental age but had problems with visual perception as it is measured on these two tests, his chances for a high score on the Metropolitan Readiness Tests (MRT) would be reduced.

Since it has been stated that the MRT has a predictive validity of 0.60 with reading achievement at the end of first grade, the findings from the major question of the study could be interpreted to mean that even if a child has a high mental age but has visual perception problems, his chances for reading success in first grade are limited.

A fourth variable, the Wepman Test of Auditory Discrimination, also contributed a substantial and significant beta weight to the regression equation. This test would indicate that auditory perception, as well as visual perception, are important variables to be considered when attempt-
ing to predict successful reading in first grade.

The Language Comprehension test (auditory perception) and the Word Recognition Test II (visual perception) made slight but significant increments in the regression equation. This simply adds more weight to the statement that auditory and visual perception problems can detract from a child's ability to learn to read.

Of all the twenty-one variables entered into the multiple analysis stepwise regression, these six, mental age, the Bender, the Horst, the Wepman, Language Comprehension and Word Recognition II, were the most significant predictors of the criterion variable - the MRT total scores.

Question #2: What percentage of the kindergarten children included in the sample demonstrate the following discrepant modality pattern?

2.1 Failed to meet success criteria for auditory perception tests.

2.2 Failed to meet success criteria for visual perception tests.

2.3 Failed to meet success criteria for both auditory and visual perception tests.

Success criteria were established for each of the individual auditory and visual perception tests. It was further decided that if a child failed to meet success criteria for three of the four auditory perception tests, he would be considered to have a problem in this area. It was also decided that if a child failed to meet the success criteria for three of the five visual perception tests, he would
be considered to have a problem in this area.

It was found that 11 per cent of the kindergarten children failed to meet the success criteria for the auditory perception tests, 25 per cent of the sample population failed to meet the success criteria for the visual perception tests and 20 per cent of the children failed to meet the success criteria for both the auditory and visual perception tests.

The results of this study would indicate that a significant portion of the kindergarten population have visual and auditory perception problems as determined by the instruments used in the data collection. It can also be stated that more of the sample population demonstrated visual perception problems than auditory perception problems although both were important detractors in predicting reading success in the first grade.

Question #3: What is the relationship between mental age and the scores on the various auditory and visual assessors employed in this study?

Three of the four auditory perception tests and four of the five visual perception tests showed a significant correlation with mental age at the 0.01 and 0.05 level. These results would disagree with the findings of the DeHirsch, Jansky and Langford (1966) study and of the study done by Birch and Belmont (1965) which found that perceptuomotor tests did not correlate highly with intelligence at the kindergarten level.
However, both the studies mentioned above were dealing with predictions for reading success. They both found auditory and visual perception factors to be more related to reading success in the first two grades than mental age although they did also report significant correlations between mental age and the perceptual tests. Their studies would agree with the data presented here that if a child has auditory and/or visual perception problems in kindergarten, he cannot completely compensate for this lack with a high mental age when he is learning to read in the first grade.

Question #4: What is the relationship between intelligence (IQ) and the readiness test employed in this study?

The specific correlation between the Slosson (SIT) Intelligence Test and the Metropolitan Readiness Test total score was 0.69 which was significant at the 0.01 level. This would agree with other studies (Hildreth, Griffiths and McGauvran, 1969) which have been conducted correlating the MRT with other general mental ability tests. In this study the subtest demonstrating the highest, significant correlation of 0.63. The Alphabet subtest was second with a correlation of 0.54, Copying with a correlation of 0.53 and Matching with a correlation of 0.50. These four subtests are the tests reported in all studies as being the most significant although their position varies from study
If the MRT is an accurate predictor of success in first grade reading, then it could be interpreted that a child with a high rate of intelligence development would have greater chances for success as he enters first grade.

Question #5: What is the relationship between the Metropolitan Readiness Test scores and the scores on the various auditory and visual assessors employed in this study?

The findings reported that two of the four auditory perception tests and three of the five visual perception tests correlated at the 0.01 and the 0.05 level of significance with the total scores of the MRT. It could be interpreted that the auditory and visual perceptual skills required in the writer's battery were not completely different from those skills required in the MRT. If the MRT is an accurate predictor of readiness success in the first grade, then it would follow that the writer's battery might also be able to predict those kindergarten children who might be successful in the first grade. Because the Bender, the Horst, and the Wepman were the most significant predictors of the criterion, it would be most appropriate that these three tests in combination with an intelligence test be included in a prediction battery.

This study would agree, then, with other studies (Goins, 1958, and Harris, 1959) that visual perceptual skills correlate significantly with reading readiness as
determined by tests. It also found that auditory perception tests, particularly the Wepman, correlate significantly with the readiness skills of the MRT.

Question #6: What are the sex differences on the performance of each of the three types of tests?

The findings reported that there were no significant sex differences in this study for any of the three types of tests. No attempt was made to take chronological age into account between the sexes. Perhaps the girls were a little older than the boys. There was an indication of a slight relationship between chronological age and mental age but this relationship did not attain statistical significance.

Question #7: What are the sex differences within each strata for each of the three types of tests?

Question #8: What are the strata differences for each of the three types of tests?

One of the interesting findings of this study was that there was a significant sex difference in favor of the girls on just one test; the Horst. The Horst was a learned task that required attending to the directions given by the examiner, observing and differentiating the different shapes of letters as the examiner demonstrated the task and finally, actually matching likenesses and ignoring differences among patterns of latters. Perhaps this one test was the most like the tasks required of beginning readers. The girls' performance was superior to that of the boys.
The only significant strata difference among the three types of tests was the MRT - the criterion variable. The performance of the Outer City sample population was significantly superior to that of the Transitional or Inner City sample population. There was no difference among the strata on the auditory and visual perception assessors and the intelligence tests.

Implications

Mental age was the best predictor of reading success as measured by the criterion - the Metropolitan Readiness Test. It was also found that a child's perceptual abilities could be important detractors for predicting future reading success. Yet there were no significant strata differences between either mental age or the perceptual assessors. This would mean that an Inner City kindergarten child, in this sample population, would have just as good a chance of reading success in first grade as an Outer City kindergarten child. Yet, there was a strata difference in favor of the Outer City child on the MRT total scores.

It may be that other variables such as ability to follow directions and attend to the task at hand have an important influence on the MRT scores. This would agree with Zeaman and House (1967) and with Gibson, et al, (1964), that the crucial factor in new learning is the ability to attend to the stimuli and to determine the critical features of
stimuli differentiation. Although there was not a significant sex difference on the MRT scores at the 0.05 level, the girls did receive higher scores than the boys on the MRT at the 0.07 level. They were significantly superior, at the 0.05 level, than the boys on the Horst which requires attending to the stimuli and differentiating letters.

This study found that the Horst Reversals Test entered the regression equation as the second best predictor of the criterion - the MRT total scores. It is further noted that it entered the regression with negative beta-weights. If a child received a high mental age, the first predictor variable selected, but received a low Horst score, his chances for reading success were diminished. The important of differentiating among groups of letters and words is thus emphasized. This finding would agree with other research (Gibson, 1965, and Harris, 1959) that only the ability to match letters is important to beginning reading.

It was concluded that if a child had a high mental age but had difficulties in auditory and/or visual perception, his chances for reading success would be lowered. At the same time, it was found that 11 per cent of the kindergarten children failed to meet the success criteria for the auditory perception tests, 25 per cent of the sample population did not meet the success criteria for the visual perception tests and 20 per cent of the children failed to meet the success criteria for both the auditory and visual perception
tests. This means that a large proportion of the sample population had perception difficulties as measured by the writer's test battery.

If it is true that auditory and visual perception problems do, in fact, reduce a child's chances for successful reading in the first grade, it is important to identify this child and take appropriate steps to remediate the problem. This has curriculum implications. One basal reading series would not meet the needs of all the children. It would be important, since there are such large numbers of children with perceptual problems, to have both auditory and visual approaches to reading as part of the regular reading program. If a child is successful learning to read, the chances of his becoming a useful, productive member of society is greatly increased.

Recommendations

It would appear that the Metropolitan Readiness Test does an adequate job of assessing both auditory and visual perceptual skills on a group basis. It is recommended that the MRT be given to kindergarten children as a screening instrument to identify those children who may have difficulty learning to read in the first grade.

For those children who obtain low scores on the MRT, it is recommended that more specific auditory and visual perception individual testing be done. According to the
results of this study, the Horst or the Bender would be good tests of visual perception to be given and the Wepman would be the best auditory perceptual test to be administered.

It is recommended that a standard reading achievement test be given to the same sample population used in the study at the end of first grade. This follow-up study would be able to determine the validity of the writer's test battery in predicting first grade reading success. It would be interesting to note whether there would be any significant sex or strata differences in the year's time since the original study was completed.
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