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SENSORI-PERCEPTUAL DIFFERENCES BETWEEN
ACADEMICALLY AND NON-ACADEMICALLY RETARDED CHILDREN

DISSERTATION

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

By

April Welsh O'Connell, B.A., B.S., M.A.

*****

The Ohio State University
1963

Approved by

[Signature]
Adviser
Department of Psychology
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CHAPTER I

INTRODUCTION: ACADEMIC RETARDATION AND ITS RELATIONSHIP TO THE SENSORI-PERCEPTUAL CONTINUUM

Purpose of Study

The investigation of academic retardation within a sensori-perceptual framework

The purpose of the present investigation was to study the sensori-perceptual differences of academically retarded children for whom no recognized causal factor had as yet been established. The study was predicated on the hypothesis that these children, who are average or better in intelligence and who evince no apparent physical or psychological problems which might account for their retardation, would not show essential differences in the sensory aspects of vision and hearing from a comparable group of average achievers, but would evince certain perceptual differences in both vision and hearing. If research could establish the existence of such a sensori-perceptual differential in children already known to be academically retarded, then there would be opened up possibilities for the prevention of remediation of such a sensori-perceptual differentiation which ultimately might avoid the resulting academic retardation.

Actually, this sensori-perceptual framework is not new, but is, rather, gaining momentum in educational and psychological research. Such perceptual differences have already been described by researchers in many areas. The unique contribution of the present study lies in
the rigid controls set up for comparison of children who are academi-
cally retarded and of children who are achieving at a grade level
commensurate with their ability. In order to carry out this objective,
the children involved were tested in both the sensory and perceptual as-
perts of vision and audition. Should the sensory aspect reveal no
significant differences between these two groups, then any perceptual
differences found would have to be independent of the sensory component.
Such a conclusion would lead to increased focus of a child's perceptual
abilities in relationship to his school achievement.

Two other aspects of the present study include the relationship
of laterality to both the problem of academic retardation and the sen-
sori-perceptual continuum, and the sub-test patterning of the WISC to
determine its effectiveness as a predictor for both academic retardation
and the sensori-perceptual differential.

Descriptions of the child with
a sensori-perceptual differential

The problem of academic retardation has aroused the concern of
administrators, teachers, and parents. This concern has led to research
in the etiology of academic retardation. To some extent, it has been
explained by the identification of children with gross physical and
psychological problems such as poor vision, loss of hearing, low in-
tellectual functioning, and poor teaching methods. When the following
causal factors have been identified, there remains still a percentage
of children for whom no causal factor for their retardation has been
established. These are the children who have good school attendance,
whose parents show concern for their school progress, who evince no
gross physical or psychological disability; who, in other words, are
failing in school for no known reason. The cause of their academic retardation remains undiagnosed.

A number of writers have indicated that one causal factor for these undiagnosed academically retarded children might be a lag in their perceptual development, both in vision and in hearing, and have observed particular characteristics about them. Harris (1961, pp. 33-34) presents these characteristics rather cogently. He writes:

Even if the eyes are normal, the child may have immature visual perception. Seeing a thing does not always mean noticing its details. Many young children pay attention only to the main characteristics of visual stimuli—the size, shape, and color—and ignore the details. When asked to match letters or words they make many errors, not because of faulty vision, but because they do not notice differences which are obvious to older children.

Inability to distinguish between words which sound somewhat alike may prove a severe handicap in learning to read. In some children it is due to faulty hearing. In others hearing acuity may be normal, but the child has not learned to perceive the differences in the sounds of the words.

Harris was describing the problems of the beginning reader. Vernon (1957, p. 188), summarizing research data on the older disabled reader, suggests rather similar characteristics:

It is quite clear that they often fail to recognize that a certain spatial orientation of the letters is essential, and also a particular order and arrangement of the letters within the work...Again, we have no definite evidence that they cannot hear the sounds of letters and words, though this may occur in some cases of mild hearing loss and high frequency deafness...but it is probable that many of them do not listen to, and hence do not hear, the separate phonetic units in the total word sound, and do not remember them in their exact order. This may often be due merely to inattention and lack of interest; but sometimes it seems as if they
are 'like the deaf adder that stoppeth her ears,
which refuseth to hear the voice of the charmer,
charm he never so wisely'!

It becomes obvious that in order to determine if there are perceptual problems associated with this undiagnosed child, sensory deficiencies must be first ruled out. Then, if perceptual deficiencies are found, they are not necessarily resultant effects of sensory problems and can be studied independently.

**General method of investigation**

One of the first steps in the research was to define carefully the undiagnosed academically retarded child, and to match him as carefully as possible with a child similar to him in all vital respects save that of the academic criterion.

Reviews of the literature have criticized experimental comparisons of academically retarded children on the grounds of the high selectiveness of the populations used. In many instances, the studies used children already referred to clinics and which, therefore, constitute a particularized socio-economic segment and thus introduce a possible contamination of some other variable such as personality disturbance. These studies also have used "ex-post-facto" research methods, which Underwood (1957) regards as being unscientific in nature. This term applies to those studies which draw on data collected for purposes other than the study being carried out. Another weakness of previous studies is the comparison of children of such highly dissimilar characteristics that one could almost a priori assume differences of the dependent variables. A popular example is the comparison of the highly unsuccessful reader, with the highly successful reader, and
which, in effect, eliminates the middle group. Yet other studies have not attempted to control for intervening variables such as intellectual functioning, environmental background, etc. Such designs tend to weaken the equivalence of the groups compared, with the result that perceptual differences found can be interpreted only with a good deal of caution.

The object of the present investigation was to control the relevant contaminating factors in order to determine the actual existence of a sensori-perceptual differential. If this study is noteworthy, then, in any respect, it is in its attempt to define carefully the populations of both the "undiagnosed" academically retarded child and his matched, but successfully-achieving peer.

**Definition of the academically retarded criterion population.**—

Criticisms of previous investigations, then, led the writer to define carefully the "undiagnosed" academically retarded child. Otto and Estes (1960, p. 5) define retarded progress as the condition "resulting when a student repeats one or more grades or half-grades during his school career." This incomplete definition was not acceptable since school systems vary in their promotional policies. Some students may fail in one school system but be passed by a school system with relatively lower standards. Indeed, the present investigator found such disparities to exist, and it was necessary to eliminate possible criterion children from two school systems for this reason. These children, who were called academic retardates by their school systems, were nevertheless achieving higher norms in national achievement tests than some of the successful achievers in two other school systems.
A second consideration was the fact that some schools prefer not to retain students when this can be avoided. Some classes, therefore, have students whose achievement shows academic retardation of a year and a half although the records do not show actual repetition of any grade.

In order to establish a definite standard for the academically retarded population of the present study, the criterion was set as achievement of one and a half grades or more below age-grade norms established by national averages. The criterion population of the present study encompassed three types of children: 1) children who had never been retained but whose academic work was at least a year and a half below national averages; 2) children who had been retained for at least one year and whose achievement was still considerably poorer than average for that grade; 3) children who had actually been retained for two years and whose achievement still showed a two-year retardation from his age level.

The second step was to define the undiagnosed academically retarded population as children whose retardation could not be explained by any of the commonly found reasons for retardation. First, all possible organic reasons that might explain the retardation of such children (poor vision, hearing impairment, brain damage, crippled condition, chronic illness, and low intellectual functioning) were used as criteria for screening. Non-organic criteria, which also might account for retardation such as poor attendance, frequent change of school, foreign language in the home, and homes with non-cooperative school attitudes, were also used for screening out purposes. Furthermore,
children whose behavior or cumulative records indicated severe emotional problems were excluded from sampling.

One final aspect for the selection of the criterion group was the necessity for avoiding specialized segments of the population such as is encountered in referred clinical populations. Such an attempt meant going into the schools to select the children rather than using a pre-determined referral group.

Definition of the average achieving control population.--Another essential aspect of the study was a definition of the control population as carefully defined as the criterion population. Previous studies have sometimes used either "unselected" control groups or groups so dissimilar in certain respects from the criterion groups that results cannot be considered unequivocal.

The criterion population for the present study, then, was to be as equivalent as possible to the criterion population. Thus, they had to be similar in sex, age, race, intellectual functioning, socio-economic background, school system, and if possible to come from the same school. The criteria for screening of the criterion group were also used for screening of the control group. In other words, they were to match the criterion group in all respects save that of achievement. But even in this respect, the investigator did not want gross differences of achievement. Children who were doing straight "A" work, or nearly so, were not included. The children of our control group were to be achieving at a more average "B" or "C" level.

Testing and statistical treatment.--Once the control and criterion groups were selected, the investigator arranged for all testing
to be done at the University under standardized environmental conditions. The data were to be processed with I.B.M. cards and correlated with the academic retardation criterion. The significance level for all correlations was set at the .05 level in order to determine applicability for predictions to other samples. If the results showed that the sensory aspects of vision and hearing were not significantly related to academic retardation, then any perceptual relationships could not be attributable to sensory deficiencies. The results of the laterality tests and the WISC sub-tests were also to be related to the sensory and perceptual aspects of retardation.

The Academic Retardation Problem

**History**

Before the middle of the last century, the problem of academic retardation, *per se*, did not exist in this country. After 1850, graded classes were organized in the public school system and instruction was quantified; i.e., each grade had its allotted quota of content to be achieved before promotion to the next grade. When such quantification was introduced, the problem of academic retardation arose almost by definition.

By the beginning of this century, the problem of academic retardation had become recognized by early American psychologists. Thorndike (1908), Ayres (1909), and Blan (1911) expressed concern for this growing problem, and emphasized the differences between this child and the normally achieving child.
By the 1930's, both education and psychology had shifted their emphasis from conformity of all children to a pre-established scholastic norm toward a more flexible policy of providing for individual differences. Recognition of individual differences in the public school had begun with the publication of the Binet-Simon test of individual intelligence in France in 1905. This test was developed for the specific purposes of identification and weeding out of children of subnormal intelligence. Thus, the mentally retarded child was the first to be given special help in the public school. Following that, special education was provided for the deaf, the blind, the hard-of-hearing, the partially-sighted, the crippled, the child with speech problems, and many others. Indeed, there has come about an area, Special Education, whose first concern is the identification and assistance of children whose learning problems cannot be adequately handled in the regular classroom.

With gross learning problems involving physiological deviations having been identified, educational research has now turned its attention to the more subtle psychological problems of academic retardation, such as the present interest in the perceptual organization of the child. Incidence

Establishing national norms for academic retardation has been extremely difficult because of the lack of standard criteria of accounting. Some reports are based solely on non-promotion figures; others are based on national norms established for achievement tests; still others are computed on an age-grade ratio. Because of the lack of uniform
evaluation, the incidence of academic retardation can only be estimated. In 1929, Heck studied 25 city school reports and found a median figure of 10%. Later studies (Otto, 1950; Stanford, 1950) reported figures of 17% and 21%. Riessman (1962) has emphasized the socio-economic proportions when he states that among deprived groups, reading disability estimates are as high as 50%.

Significance

The significance of the problem of academic retardations lies not only in the incidence, but in the outcomes of this problem as well. The academically retarded population in the elementary school graduate into the "drop-out" population of the high school. This drop-out population is not only a potential source of delinquency but is also an economic drain on the national income. Sociological studies (Eckenrode, 1950; Glueck and Glueck, 1934; Healy and Bronner, 1926; Kvaraceus, 1945) reveal that this drop-out population will later comprise, first, the majority of the unskilled labor force, which in the times of recession and depression is the most unemployable; and second, that it is the pool from which is drawn the largest percentage of juvenile and adult delinquents. Clearly, academic retardation is an area that needs concentrated research in epidemiology, etiology and remediation.

Causes

As Loutit (1957) remarks, the first task of a clinical approach to the problem of retardation is the determination of the cause or causes of a particular child's retardation. Several approaches to this problem have been utilized. The first has been teacher explanation for
retardation. The second approach uses interviews with youth or adults who were themselves "drop-outs". The third method utilizes clinical diagnosis of school disabilities. For the purposes of this section, we will consider the first two approaches only, since the writer could find no evidence of published national norms for the third.

Percival (1926) presents a table of the frequency of teacher explanation for school failures replicated below:

<table>
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<tr>
<th>Cause</th>
<th>Percentages of Cases</th>
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<tr>
<td></td>
<td>Cities</td>
</tr>
<tr>
<td>Learns very slowly</td>
<td>36.7</td>
</tr>
<tr>
<td>Lack of application, attention, etc.</td>
<td>35.5</td>
</tr>
<tr>
<td>Entered with weak foundation</td>
<td>22.5</td>
</tr>
<tr>
<td>Change of schools during year</td>
<td>17.8</td>
</tr>
<tr>
<td>Absence (illness)</td>
<td>16.7</td>
</tr>
<tr>
<td>Foreign language handicap</td>
<td>13.0</td>
</tr>
<tr>
<td>Intelligence tests show pupil abnormal</td>
<td>12.9</td>
</tr>
<tr>
<td>Immaturity</td>
<td>12.7</td>
</tr>
<tr>
<td>Poor home conditions</td>
<td>10.0</td>
</tr>
<tr>
<td>Absence (other than illness)</td>
<td>8.5</td>
</tr>
<tr>
<td>Poor health (pupil not absent)</td>
<td>5.2</td>
</tr>
<tr>
<td>Defective vision</td>
<td>2.3</td>
</tr>
<tr>
<td>Other physical defects</td>
<td>2.1</td>
</tr>
<tr>
<td>Defective speech</td>
<td>1.8</td>
</tr>
<tr>
<td>Defective hearing</td>
<td>1.0</td>
</tr>
<tr>
<td>Total no. of pupils failing</td>
<td>7531</td>
</tr>
</tbody>
</table>

Berlman (1949) used the second approach, namely interviews with the drop-out population and reached the following causal figures: dissatisfaction with school 47.7%; economic need 19.4%; lure of a job 11.7%; marriage and pregnancy 6.6%. Berlman notes, however, that despite their ostensible reasons, the majority of the subjects in the study had experienced school failure.
Lafferty (1948), who reviewed 27 studies between 1925 and 1945, lists the most frequently mentioned reasons for school failure and retardation; irregular attendance, low mentality, lack of interest, poor health and physical defects, poor effort, poor home conditions, poor foundation, outside work, laziness, failure on tests.

The above lists of causes helped to determine the screening out criteria for the population as discussed in the previous sections.

The Sensori-Perceptual Problem

The Sensori-Perceptual Continuum

The sensori-perceptual problem has had as long a past and as short a history as psychology itself. In one form, it is the epistemological branch of philosophy. A part of the early history of psychology was the attempt by Wundt and his associates to isolate the atoms of pure sensation and put them together into more complex perceptions. In 1890, James suggested that the world for the new born infant was a buzzing confusion of pure sensations, and that adult perceptions were sensations grouped together.

As there developed different theories of learning, the sensori-perceptual problem was adapted into the individual theory. To the associationists, perception was merely learned connections or associations. The behaviorists followed a similar non-cognitive approach. The Gestaltists and field theorists, on the other hand, tended to view perception more nativistically and as a function of insight, from which results a total reorganization of the structural field.
Actually, psychology has come a long way from viewing perception as merely the grouping of sensations. There is no such arbitrary distinction of sensation on the one hand and perception on the other. Gesell (1941) and Cohen (1962), for example, have stressed the dynamic quality of the vision process of the child. A child, they say, actually learns to use his vision sense through the validity of kinesthetic associations of his hands and legs with that which visually stimulates him. His perceptions of a three-dimensional object learned through his actual manipulations of that object actually help him develop the ability to sense depth. Thus, it is more proper to speak of a sensori-perceptual continuum.

On the other hand, that there is at least some sort of differentiation between sensation and perception has become generally recognized through clinical observations of persons with brain damage. Starting with Broca, in the middle of the last century, there has come to be recognized that damage to certain areas of the brain may not affect the physical ability of the eye or optic nerve to register light impulses, or of the ear or auditory nerve to register sound waves, yet the person is unable to make out what he "sees" or what he "hears" (Nielsen, 1947). Such observations have led to the actual mapping out of the cerebral cortex into various centers of sensation and perception. Holmes (1957, p. 58) has described very succinctly what happens when there is damage to a perceptive area of the brain but not to a sensory area.

It has been shown that Brodmann's cytoarchitectonic area 17, in the occipital lobe, corresponds exactly with what we now know to be the primary visual area of the brain....From the
primary visual area impulses are relayed to areas 18 and 19 where memory engram patterns are laid down. The visual memory engrams in area 18 are utilized specifically for the identification or recognition of objects when they are seen for a second time. A lesion here results in an inability to recognize objects within the field of vision. This is true, even though the person is not blind, and will avoid hitting objects as he walks through a room. Furthermore, the individual may still be able to visualize quite clearly those objects which he once could identify by sight alone. When this happens, we say the person has visual agnosia for objects—that is, he cannot recognize what he sees!

Similar disassociations of the sensory and perceptual processes occur in the other sensori-perceptual modalities. These perceptive difficulties clearly mark a division between the two areas of the sensory-perceptual continuum.

Definitions of Sensation and Perception

Defining the two aspects of sensation and perception must take into account the whole sensori-perceptual continuum. Indeed, many writers describe the two terms rather more on a continual series of levels rather than as discrete terms.

Vernon (1937) early described four stages of the process of visual perception. The first is a vague awareness of something "out there"; the second is when the visual stimulation is associated with a specific object; the third is the recognition of the essential parts of that object; and the fourth is the meaning that becomes attached to that object. Presumably, the first two stages are more related to the sensory aspect while the last two bring the object into the realm of perception.
In the area of hearing, Ramsdell (1960) has formulated three levels of hearing. Specifically, his formulation is as follows: the symbolic level in which hearing is used to comprehend language; the warning level which alerts us to danger (such as a whistle or the word "bee"); and finally, the primitive level which is the auditory background for daily living which, though we are not fully aware of it, contributes to our sense of being "alive". While he notes three discrete levels, he does emphasize that all three levels are probably occurring simultaneously.

The associationist's assumptions about the sensori-perceptual problem were as follows: sensations precede perceptions; sensations are simpler and less complex than perceptions; sensations and perceptions are distinct psychological phenomena with the first being related to direct experience and the second, being indirect and derived from direct experience. While maintaining the usefulness of sensory pathway parameters, there is a growing trend to regard perceptions not as a complex built up by smaller atoms of sensation, but rather as a complex which is steadily differentiated into simpler component parts. Strauss (1947) noted that perception is an "all-or-nothing" phenomenon; as soon as meaning is attached to sensation, it becomes a perception and is grasped as a whole. Vernon's previously cited work (1937) described an object in its total configuration first, with later differentiation of its parts. Bevan (1961) views the recent research as indicating "perceptions as depending upon unique and specific cognitive structures evolving from simpler, less thoroughly articulated,
more vague, more general frames of references through a process of
differentiation, or if you will, individuation." The evolving point-
of-view, then, points toward the sensation of a given object or symbol
as a general awareness of the "wholeness" and later the perceptual
differentiation of its relevant and essential component parts. Holmes
(1957) has applied this formulation to reading which he describes as
"the process of making discriminative responses."

Related Research

It was Strauss (1947) who first called attention to the
sensori-perceptual disturbances in brain-injured children. He de-
cribed them as unable to perceive the whole, but rather as transfixed
by one of the parts which then becomes the foreground, reducing the
other elements to background status. Bender (1949) and Fabian (1945)
view the development of reading ability as dependent upon perceptual-
motor maturity. Rabinowitch (1960) accounts for certain reading
retardation as the result of an immature brain pattern which causes
speech retardation, vagueness and inaccuracy in visual and auditory
perception, directional confusion, space confusion and a difficulty
with part-whole relationships. Townsend (1951) studied the factors
which enter into the ability of copying and concluded that copying is
largely a function of perceptual ability more than it is a function of
motor skills. Coleman (1953) studied 33 children with reading problems
and found that their perceptual development lagged significantly behind
their development of general intelligence in a majority of subjects. He
noted also that this retardation was cumulative with age and accounts for much reading disability as a function of perceptual retardation.

In the area of hearing, Myklebust (1954) has noted that aphasic children are unable to use the world of sounds selectively and that all sounds have equal importance, thus all sounds are foreground and not background. He notes that aphasic children sometimes respond better to hearing when given with a controlled background of sound. Meyerson (1955) and Brown (1956-7) call the ability to understand spoken language as the ability to "aud" as compared to "hearing" which is related to the hearing of pure tone or noise.

Recently, there has been much work done on both the auditory and vision perception abilities of children as it relates to reading disability by Durrell and his associates (Durrell et al., 1958; Durrell and Murphy, 1953). They conclude that auditory and visual skills are independent of M.A. and C.A.

Statement of Hypotheses and Questions

The underlying hypothesis is that while the sensory aspects of vision and hearing bear little or no relationship to academic retardation of the undiagnosed child, the perceptual aspects of both these processes evince a differential lag. The specific formulations of this hypothesis are stated thus:

1. The sensory aspect of seeing as indicated by various measures of optometric examinations will not reveal a significant relationship to academic retardation.

2. The perceptual aspect of vision as indicated by various vision skills tests will reveal a significant relationship to academic retardation.
3. The sensory aspect of hearing as indicated by various measures of pure-tone testing will not reveal a significant relationship to academic retardation.

4. The perceptual aspect of hearing as indicated by various auding tests will reveal a significant relationship with academic retardation.

The underlying assumption of the above hypotheses is that while the sensory and perceptual aspects of vision and hearing are better understood as two parts of a continuum, this sensori-perceptual continuum can be reasonably dichotomized for purposes of research.

The investigation of the other areas of this study can be better phrased as questions since no specific predictions were made for them. The additional questions are stated as follows:

5. Is there a relationship between the various aspects of laterality and academic retardation?

6. Is there a relationship between the various aspects of laterality and the sensori-perceptual differential?

7. Is there a sub-test patterning of the WISC that can be used as a prediction for academic retardation?

8. Is there a sub-test patterning of the WISC that is related to the sensori-perceptual differential?

Limitations of the Present Study

This study does not attempt to further any specific theoretical framework as the causal factor of the proposed sensori-perceptual differential. The concern is only with the existence of a differential with children who are known to be academically retarded compared with children who are achieving at a level commensurate with their ability.

Although this study has attempted to control all known bias factors, namely, certain emotional, physical and environmental variables,
the writer is well aware that some bias can exist in spite of the rigid controls placed upon the study.

Finally, the study does not attempt to investigate all perceptual differences, nor all sensory variables. It is focused rather on the two sensori-perceptual processes of seeing and hearing. Bevan (1961), Gesell (1949) and others have noted that these sensori-perceptual processes are interacting and interdependent. Gesell has long emphasized the kinesthetic and motor quality of vision, while audiologists have stressed the fact that the lower frequencies of pure-tone reception are "felt" rather than heard. Such separation of the senses, as also in the present study, tends to be arbitrary in its distinctions.
CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The following review of the literature deals with academic retardation in the elementary school as it relates to (a) the sensori-perceptual aspects of vision and hearing; (b) laterality; and (c) the sub-test patterning of the Wechsler Intelligence Scale for Children. It has been estimated that 90% of school failures is due to a failure in the area of reading (Saunders, 1941). Consequently, the vast majority of research has been carried out in relation to reading disability rather than in the more general area of total academic retardation. The following review reflects this specific orientation.

Since the number of studies which have been done in the field of reading disability and academic retardation are voluminous enough to have merited whole texts on the subjects, the writer has limited the present review to those studies which have attempted to compare the criterion group with a control group, or against a theoretical normal reading population. Such a limitation eliminates those research studies which report findings on clinical samples. Various reviews of the literature (Gray, 1960; Hildreth, 1949, 1950; Robinson, 1947, 1953; Traxler and Jungeblut, 1960; Vernon, 1957) have noted that such findings tend to be more positive than those done with comparative school samples. Harris (1947) and Vernon (1962) explain this difference as the result of the survey technique. The positive findings, they argue, come from the
more severely retarded cases of reading disability which are overlooked and undifferentiated in school surveys. This explanation sounds reasonable but the investigator believes that only the rigorous comparison to another group can validate such a theory. For this reason, then, the focus is on those studies which have attempted comparative measurement.

A further note is needed on the outline of the various sections of this chapter. The sensori-visual section, which includes screening, optometric, and ophthalmological studies, is presented and summarized separately from the perceptual-vision studies; while both the sensory and perceptual aspects of hearing have been presented together in the same section. This difference of presentation is accounted for in the differences of the research techniques and procedures of these two areas. The evaluation of the perceptual aspect of vision tends to use somewhat different and less standardized instruments from the sensory aspect; while audiological testing is such as to be able to encompass both the sensory and perceptual aspects of hearing. Too, audiological research has often included both the sensory and perceptual aspects of hearing, more often than vision research.

These three sections are followed by the sections on laterality, and finally, by the section on the sub-test patterning of the Wechsler Intelligence Scale for Children, hereafter called the WISC. While there is overlap among these areas in the literature itself, the investigator has tried to differentiate the studies and to group the studies under appropriate headings.
Studies in the Sensori-Visual Area

Actual research in the physiology and psychology of vision of reading began in 1879 when Javal discovered that the eyes did not move continuously along the printed lines of a page. The following years brought the technical aspect of observation of fixation to greater efficiency so that by 1917, Schmidt was able to discriminate good readers from poor readers by the pattern of eye movement. Since then, many studies have been undertaken to define the eye movement and other visual characteristics of poor readers. Unfortunately, as Bing (1958) notes, the degree of relationship between vision and reading found in research studies depends upon the concept of vision; and, in general, research in this field has been such as to raise more questions than answers.

One of the earliest studies in the area of vision is that reported by Monroe (1932) who remains the earliest, most-referred-to writer in reviews which deal with this area of academic retardation. She compared the visual acuity of 100 disabled readers with 100 "satisfactory readers," and reported that 77% of the poor readers and 73% of the good readers had better than 8/10 vision in both eyes. In more familiar terms, she found that visual acuity did not differentiate between average achievers and underachievers. She noted, however, that other tests of vision might well prove to be more important if quantitatively measured.

A study by Selzer (1933), which has since been the subject of much controversy, found that 90% of his criterion subjects evidenced
eye-muscle imbalance while only 9% of his control population showed muscle imbalance. Vernon (1957) has criticized these findings as not proving that Selzer's measurements of visual fields were unequally present in his control group and that muscle imbalance is a causative factor in reading disability.

A study by Fendrick (1935) in the New York City schools used both screening and optometric findings of pairs of children matched on sex, age, years of formal schooling, and school environment, but differentiated by 1/2 year or more of reading retardation. He found no significant differences for lateral muscle-imbalance at either far or near points. He did find a difference for good readers with better-than-normal visual acuity for distance vision in the right eye. A better-than normal acuity in the left eye was also found, but the difference was not as great. On telebinocular tests, he found a marked incidence of astigmatism among poor readers. Fendrick concluded that readers with a higher percentage of good vision had been taught by visual methods of reading as contrasted with other more phonetic methods.

Both Monroe and Fendrick utilized an achievement criterion while examining the vision scores as the dependent variable; it is also possible to use the vision scores as the criterion variable while the achievement scores assume a dependent variable position. Such a treatment of the data was carried out by Farris (1936). His tests included visual acuity, accommodation and convergence. His 384 seventh graders were matched with another 384 seventh graders in terms of achievement, C.A., and intellectual ability. Since the study was done under his principalship and utilized his own school population, there
was some environmental school control. He found both hyperopia and strabismus associated with less-than-normal progress while myopia and myopic astigmatism were both found to be associated with more-than-normal progress.

In the same year, Witty and Kopel (1936) compared the differences between 100 children having problems in reading with 100 average or better readers. The ratio of boys to girls was approximately 2:1, a population having somewhat more girls than usually found. The difference between the mean I.Q. scores of the groups was 8 points; the difference between the mean C.A.'s was 1 year, 2 months. The authors do not mention if these differences were partialed out in the handling of the data, nor what effect these differences, if not accounted for, have upon the results of their findings. They do state that the groups came from the same schools and from the same grades. The vision scores were obtained from the Betts Tests of Visual Sensation, using the Keystone Ophthalmic Telebinocular. They found that 29% of the criterion group exhibited slow fusion as compared with 1% of the control group. The percentage between the two groups in the other visual tests (acuity, ametropia, lateral muscle imbalance) were highly similar. From these results, they conclude that the visual defects studied do not appear to cause or to contribute to reading disability.

Dearborn and Anderson (1938) present evidence of a relationship between reading disability and aniseikonia. They matched 100 reading disability cases with 100 unselected controls according to age, covering a range from 9 to 18 years and older. Using the Ophthalmico-Eikonometer, they found that 51% of the criterion cases and 23% of the control cases
had clinically significant amounts of aniseikonia, and that more
aniseikonia was encountered than any other structural defect. They
note that aniseikonia is related to binocular visual functioning and
that it relates more to reading than the refractive errors which they
argue to be more monocular in their effects.

An extensive visual survey of 5000 school children was under-
taken by Dalton (1943). The Keystone Telebinocular survey consisted
of tests for fusion at far and near point, visual acuity of both eyes
and for each eye; lateral and vertical imbalance; stereopsis; and astig-
matism at far and near points. Of the original sample, 457 elementary
pupils having defective vision were matched (mean age, grade placement,
and intellectual functioning as reported by reading grade placement)
with 204 elementary pupils having normal vision. Dalton not only con-
cluded that defective vision does not differentiate good from poor
achievers but also postulated that defective vision may be the result
of excessive or improper use of the eyes associated with high achieve-
ment.

Park and Burri (1943) attempted to control for intelligence by
converting reading scores of 225 unselected Chicago city school children
from Grades I through Grades VII into Mental Age Expectancy scores. In
this study, all children were given a "fairly complete" eye examination
consisting of tests of phoria, duction and fusion at both near and far
distance. Each child was given a point for every clinical vision prob-
lem exhibited so that the higher the number of vision problems, the
higher the score for that subject. From these additive points, they
compiled a "total duction" score. The correlation between the reading scores in terms of Mental Age Expectancy and this total "duction" score with the scale reversed was .465. Park and Burri accounted for this unusually high coefficient of correlation by the control of the intelligence factor; when they correlated the vision eye scores and reading scores in terms of grade equivalents only, the coefficient dropped to .161. Of the individual tests reported, exophoria and esophoria and monocular vision were related to the reading scores by r's of .631, .422, and .226 respectively. They found little relationship with refractive errors.

Another study which uses vision as the criterion factor was carried out by Edson, Bond and Cook (1953). They used analysis of variance technique to determine differences between children with good and poor vision. Four schools, randomly chosen from the St. Paul, Minnesota, school system, were used. One hundred and eighty-eight fourth grade pupils completed the tests and after combining two of the schools, the remaining three groups were compared on near-point acuity of both eyes, far-point acuity of both eyes, near and far fusion, lateral imbalance, and stereopsis, and the effect of these vision problems on achievement. Although the screening battery took only 15 minutes for each child, the experimenters had obtained high reliability scores. They concluded that achievement in reading is not necessarily limited by visual acuity and that "visual fusion" difficulty, lateral imbalance and defective stereoscopic vision do not appear to be characteristics restricted to poor readers. Huelsman (1949) has criticized this study on the basis that the various groups were not able to be combined because of lack of homogeneity of groups.
Robinson and Huelaman (1953) reported comparisons of vision screening tests with children in Grades IV and VII. As a part of a larger study, they divided the data of ten pupils in both grades "reading nearest to their intellectual expectancies and another ten whose reading achievement was most retarded in comparison to intellectual expectancy." Thirteen tests from their large visual screening battery showed markedly different means. Analyzing these data further, they identified those tests on which the means of the low achievers scored consistently below the means of the normal achievers. At Grade VII, the 2 variables that showed consistent differentiation were the range score on the relative phoria test; the ratio between near-convergence break and recovery on the duction tests. On Grade IV comparisons, the three variables which were consistently different were the near and far divergence-break scores; and the ratio between divergence break; and recovery on the duction tests. They concluded that the only significant visual scores of both groups were those that involved binocular visual performance, and that these measurements are not included in any single visual battery known at the time of the report.

While investigating the validity of visual screening methods in the school system, Kelley and his associates (1957) studied the relationship of school achievement and visual problems on a North Carolina population. Following the progress of 213 children in several grades over a period of three years or more, Kelley found that good readers tended to have myopia, no lateral imbalance, good fusion or no fusion on monocular vision while poor readers tended to have hyperopia, lateral imbalance, overconvergence and fusion problems. He found no other
differences in a wide variety of visual sensory tests. At the same
time, Kelley noted that high intelligence also was related to several
of these functions, but he was unable to separate the part played by
intelligence and the part played by reading achievement.

Kephart et al. (1960) report a total duction technique similar
to the one used by Park and Burri (1943). They first tested kinder-
garten children with a wide battery of visual skills test. Any test
which showed a significant chi-square in relation to achievement was
selected for their final test battery. The tests which received signifi-
cant ratings were the following: the four tests of motor movement;
binocular rotations; monocular rotations; saccadic fixations; near-to-
far fixations; stereopsis; and far and near visual efficiency of right
and left eyes. A correlation coefficient for this final total battery
was computed for the original population and was also computed for a
control sample. A total score of 45 points was possible; as in Park
and Burri, the higher the score, the poorer the visual rating. The
total duction coefficient on the original population was \(1.56\). However,
on the control sample, the coefficient was an equally high \(1.49\).

A recent study by Spache and Tillman (1962) emphasizes the
importance of binocular acuity at nearpoint. They computed t-tests on
114 retarded readers with 101 "non-retarded" readers; both groups in
this study were selected from clinical cases referred over a nine-year
period. The minimum retardation was one year below grade placement in
Grades I to III, and two years below grade placement in Grade IV or
above. Mental age was also considered in the retardation factor.
Reading levels were established by means of a reading test normalized
in the Florida area. The data were scored on a pass-fail criterion, and the vision measures included the vertical and lateral phorias; acuity of each eye, and acuity of both eyes (all acuity measures at both far and near points), depth, and color perception. A major finding was that disabled readers and normal readers tend to be more alike than unlike in the visual areas investigated. Three significant differences were found: poorer left-eye acuity; marked differences in the acuity of the separate eyes (probably anisometropia) and poorer results in a test of binocular acuity of significant numbers. The authors believe that these three tests somewhat support each other in indicating a weakness in binocular acuity at near point.

No review of the literature is complete without noting the work of Eames. Starting in 1932, he has continued to gather data on school children up to the present time. His latest findings (1959) are drawn from optometric examinations on 3,500 children, half of whom he designates as reading failures and the other half as "unselected school children." The age range extends from 5 through 17 years and the median I.Q.'s are reported as 102 and 109 respectively. The boy-girl ratio for the school failures is roughly 4 to 1, while the control ratio is more equally divided with 46% girls. His findings concerning reading retardation can best be summarized as follows:

1. No differences in incidence of visual acuity;
2. 2% less frequent esophoria;
3. 2% greater frequency of astigmatism;
4. 4% more fusion difficulty;
5. 11% more exophoria of 6 diopters or more at near point;
6. 30% more frequent incidence of hypermetropia of 1 diopter or more.

7. Two times as many strabismus problems.

In comparing Eames' work with other studies, it must be remembered that Eames has not been so concerned with the control of sex, intellectual factors, etc., as he has been with the general vision problems of children who are having difficulty in school. Thus his population has included many factors excluded from other studies such as low intellectual functioning, brain damage, and various other physical handicaps of children, making it difficult to compare his findings with the findings of others who have attempted to rule out these intervening variables.

**Summary**

It is easier to summarize the studies having negative results in the sensori-visual area than those having predictive value, and the difficulty is due to the contradictory results of the various studies. It can be said, with some certainty, that the majority of studies which have investigated the functions of accommodation, convergence, stereopsis, and color screening have not yielded positive results. While some reports do not find any relationship between the refractive errors and school achievement, a few show that myopia and myopic astigmatism may be associated with average or better achievement in school and that hyperopia may be associated with poorer school achievement.

Only occasionally do studies report positive findings for the isolated functions of the vertical or lateral phoria, aniseikonia, anisometropia, ametropia, etc. These visual functions, however, plus
several findings which indicate problems in fusion indicate that there may be a tendency for the poorer reader to have problems in binocular vision. Park and Burri (1943) found correlations with exophoria, esophoria and monocular vision; Dearborn and Anderson (1938) relate aniseikonia to poor binocular vision; Robinson and Huelson (1953) find that the tests which discriminate poor readers involve binocular vision; and recent studies by Kelley (1957), Kephart (1960), and Spache and Tillman (1962) confirm these findings. A major problem seems to be in defining the nature and extent of the factors which enter into binocular vision. As Bing (1958) has pointed out, the problems inherent in vision testing of problem readers may be related to the fact that we have measured these functions separately, while vision as it relates to reading, may only show high correlations if it can be studied as a totality.

Two studies (Park and Burri, 1943; Kephart, 1960) have reported fairly high correlations but these studies have not so much measured total eye functioning as the additive effects of various vision problems.

In addition, there are many deficiencies in standards in the research. One such lack can be seen in the definition of academic retardation or reading disability, which ranges from 1/2 year (which may be no retardation at all) to severe reading disability with a minimum grade retardation of 2 years. Another shortcoming lies in the types of criterion and control samples selected. Many studies have used referred clinical populations for both groups; others use total school surveys; still other studies eliminate these organic variables
from criterion groups and yet compare their criterion group against an "unselected" control sample.

Finally, there are the opinions of Harris (1961) and Vernon (1957) that the problem of conflicting results lies in sampling of large school surveys as compared with the intensive studies of referred and badly disabled readers: the differences in results may be caused by differences in the population parameters.

Studies in the Perceptual Vision Area

The eye no longer is likened to a camera; the skill called vision is regarded now as developmental in nature. This development begins at birth with the vague distinction of light and dark and reaches a zenith in the complex function involved in "grasping" a line of printed words. The act of visually perceiving one's world is said to be a learned achievement.

It is apparent that learning to read requires the discrimination of written symbols which are associated with verbal symbols. By the time the average 6 year old enters first grade, it is assumed that he will be able to discriminate the letters and words contained in reading material.

The question that has concerned psychologists for the past 40-odd years can be phrased thus: if such a perceptual continuum exists, where along the continuum does the disabled reader encounter difficulty? Where along this continuum is he unable to distinguish the details necessary for reading? Where along this continuum can he be differentiated from the able reader?
It is not as easy to answer these questions as it is to ask them. Eventually, the researcher encounters the problem of defining the operational tasks involved in visual perception and then the problem sounds like the tautological definition of intellectual functioning: Visual perception is whatever is measured by tests of visual perception. Consequently, evaluating the role of visual perception as it relates to reading disability ultimately lies in the evaluating instrument. The following review reflects the many approaches that have been used to define and measure visual perception as it relates to academic retardation and reading disability.

One of the first attempts to differentiate the visual perception problems of disabled readers was in 1921 when Fildes compared readers and "non-readers" aged 9-16 years. She showed both groups 20 simple but irregular shapes for 2 minutes each. They were shown these designs once again and were asked to specify which designs they had seen before. The non-readers had difficulty only with those designs which were given in reversed or different orientation, or with those designs which were similar in nature.

Gates (1922) studied over 100 children in Grades III to VIII, 25 of whom were having learning problems. The Stanford-Binet I.Q. scores indicated an intellectual functioning covering a range of 80 to 160 with a median of 116. A wide battery of achievement tests, perceptual vision tests, auditory tests, speech and other tests were given to the group and correlation coefficients were computed on the raw data. Gates' visual perception battery included tests designed to detect small
differences between pairs of printed figures, groups of digits, nonsense syllables; tests designed to distinguish capital A's from other letters, a group of letters from other letters, groups of digits, the correct word from a number of incorrect words, etc. Of the entire battery, the only tests which showed a relationship to poor achievement were those that involved actual words as distinguished from nonsense syllables, geometric figures, digits, etc. The perceptual tests revealed low order intercorrelations which led Gates to theorize the existence of not one "general perceptual ability" but many relatively specific perceptual abilities: words, digits, letters, etc. At the same time, partial and multiple correlations revealed an ability or abilities common to all perceptual tests involving words as materials. Gates called this factor the ability "to perceive clearly the significant details of words."

A study by Sister Mary Riley (1929) confirmed Gates' findings when she found little relationship between tests of discrimination of geometric drawings and reading performance, while tests which involved fine discrimination of letters and words revealed a definite relationship with reading performance.

Smith (1928) was one of the first to note a definite reversal tendency gradient. She also noted that while there was negligible difficulty in distinguishing capital letters, children frequently confused lower case letters, particularly b, p, q, and d, which are similar in shape but must be distinguished by their orientation. She found a high correlation in matching letters and recognition of words in beginning reading.
Monroe (1932) matched 100 disabled readers, aged 6-10, with 100 others, matched on C.A., M.A., I.Q., and sex. She found that 4.7% of the disabled readers tended to name rows of pictures in reverse order, while less than 1% of her control group did. She also found that disabled readers were much more likely to reverse letters and that they showed greater facility for mirror writing. In analyzing the data of each child, she found that children have a tendency to be consistent in the type of error they make, whether in reversing, adding, omitting or substituting letters.

Subsequently, two further studies confirmed the reversal gradient and the fact that reversals are only part of the common language errors. Teegarden (1933) reported a study of visual perception which focused on the reversal problem. She developed several reversal tests and administered them to 262 first graders. She found that children who were reading poorly were much more likely to make reversals in copying letters, digits, and nonsense characters. She also noted that the tendency to reverse was gradient in effect. Hildreth (1934) tested 220 readers, aged 8-10 and 7-9 and found that the poorer readers made many more errors than the good readers. Among these errors were reversals which also were more frequent among poorer readers. Hildreth has emphasized the development aspect of the reversal tendency in both this study and later research (1949, 1950).

Fendrick (1935) gave nine tests of visual perception to groups of retarded and non-retarded readers. His matching was rigorous and included sex, age, years of formal schooling and school environment. His battery included eight tests involving non-literal measures (geometric figures;
2-5 digit numbers; Greek symbols; non-geometric shapes) and one test of similar words. He found that the mean performance on eight of the tests of visual perception were consistently better for the control group but only 2 tests showed a significant critical ratio. The significant tests were matching similar digits of 2-5 numbers and similar geometric shapes. He also found that the intercorrelations of his usual perception tests were more highly correlated for his control group than for his experimental group. These results caused him to depart from the position taken by Gates and he concluded that there is a specific factor involved in visual perception which seems to be more highly developed in good readers than in retarded readers. He noted that reversal errors present in words that were less phonetic, again indicating a perceptual ability in vision necessary to reading.

In 1935, as part of a larger study, Frank found that her retarded readers, aged 7-11½ years tended to reverse letters with similar shapes such as "l" and "i"; "n" and "h"; and "m" and "n". They also tended to reverse similar letters and words capable of being reversed. Frank also noticed the gradation involved in reversing and like Hildreth concluded that the older disabled readers who make reversal errors are merely behaving like younger normal children who have trouble with shape, orientation, and order of letters.

In 1936, Bennett found 8-10 year old retarded readers made 12% more reversals than the control group. One interesting aspect of the study involved the attempt to remedy the problem of reversals. He found that word reversals were more difficult to eliminate as well as being more frequent than letter reversals.
Wolfe (1939) confirmed the earlier findings of Gates and Riley when she reported that there was no significant difference in identification of geometric shapes between 18 disabled male readers, aged 9 years, and a matched group of normal readers of the same age. Using a tachistoscopic technique, Wolfe found that the retarded group tended to reverse more letters, words, and letters within words, as well as making other errors. An interesting finding was that children tend to reverse the less familiar form of a reversible word to a more familiar form (nip to pin). She also found a tendency for the retarded reader to be more fluent in mirror writing and mirror reading.

In the same year, Petty (1939) attempted to discover modes of perceiving in young children. She found that the ability of 6 year old children to copy real objects correlated about .48 with reading achievement. She noted that some children with high reading ability, however, had low drawing ability. She considered the latter to be unsuccessful in reading because they select the incorrect detail. She called this quality a highly analytic approach to perception. She hypothesized a bimodal approach to reading; subjective readers who recognize words from the whole Gestalt; objective readers who approach reading from an analysis of details.

Schonell (1940, 1941) found that while letter and word reversals evidenced a gradient in both retarded and non-retarded readers, and that by 12 years of age, they had disappeared altogether from even the retarded group, he emphasized the fact that the tendency to reverse lasts considerably longer in the retarded group.
Kendall (1948) studied the ability of children of 6-6½ years to reproduce fifteen straight-line designs from memory. She computed a reading quotient by dividing the reading scores by mental ages and found zero correlations between this reading quotient and the ability to reproduce straight-line designs.

In the same year Thurstone and Thurstone (1948) published the Primary Mental Abilities test for ages 7 to 11. After many years of research with factor analyses of reading abilities, they devised what they considered to be the fundamental factors in school achievement. Two of these factors were defined as "the ability to visualize and think about objects in two or three dimensions," and "the ability to recognize likenesses and differences between objects or symbols, quickly and accurately." The factors were called Space and Perception factors, respectively.

A French study by Galifret-Granjon (1951) reported results on 100 normal and 100 retarded readers. He found a high incidence of reversals in a slightly different medium. He had the children reconstruct figures with match sticks and found that retarded readers tend to mirror reverse these figures. Galifret-Granjon did one of the first quantitative studies of the Bender-Gestalt figures, published only a few years earlier. He used only six of the figures and compared the performances for accuracy of construction of angles, orientation of axes of figures and relative positions of these elements. There was a definite relationship to age, but even in the 10-13 year old group, there were definite differences in the ability to copy correctly these figures.
Coleman (1953) studied the perceptual abilities in 33 retarded readers aged 8-18. All the subjects were average or better in intelligence and had no apparent emotional or physical handicaps. He used the Alpha Test of the Otis Quick-Scoring Test series because he believed it to rely heavily on perceptual factors. The test requires the ability of differentiating one dissimilar shape from four others along a continuum from simple geometric shapes to higher-order abstractions. Coleman notes that some of the items require the ability to read figures and do simple additions. The scores of these subjects were converted into age scores which Coleman believed to be representative of their "perceptual ages." He found that his disabled readers were almost a year retarded in perceptual development when compared with the published age norms. He then computed a perceptual lag score by subtracting the Alpha M.A. from the M.A. obtained on individual intelligence tests. The perceptual lag score revealed that his disabled readers were $2\frac{1}{2}$ years behind their general intelligence. Another interesting facet of Coleman's study was that the visual perception lag seems to be cumulative with age up to but not including adulthood.

Sister Mary James Harrington and Donal Durrell (1955) reported a study of various mental, phonics, auditory and visual abilities of over 500 children in Grade II in various parochial schools. Each time one of these abilities was computed, the children were paired on the other three abilities. Mental age showed little effect on reading achievement, or with any of the other three abilities. At the same time, ability in phonics, auding, and visual perception all had significant correlations to reading achievement. These experimenters
concluded that auditory and visual discrimination was independent of mental age, and along with knowledge of phonics, correlated significantly with achievement.

Similar to the study done by Smith in 1928, Nicholson (1958) studied the ability of children to match and identify alphabetical letters. Her sample included 2000 beginning first graders. She found that the majority of her subjects could match capital letters perfectly, but that lower case letters were much more difficult to discriminate. Especially hard were those letters that are alike except for orientation: p, b, d and q. Nicholson concluded that children seem to pay more attention to shape than direction. In a field where studies often contradict each other, the highly similar results of Nicholson and Smith are outstanding in their agreement.

As had Petty and the Thurstones, Goins (1958) attempted to distinguish types of perceptual abilities, as well as levels of competence associated with achievement in school. To prevent handicapping non-readers and beginning readers in the first grade, Goins used only tests which were non-verbal in nature. According to Goins the battery purported to measure speed of perceptual discrimination, closure, visual memory of perceived forms, reversals and visual space perceptions. She identified a general factor of visual perception related both to reading and to levels of reading achievement. This general factor included "speed of perception," which calls for simple discrimination of likenesses and differences; also "strength of closure," which incorporates the ability to keep in mind a configuration against distracting influences. She noted that the two factors were bimodal in effect and
seem to suggest a Gestalt versus an analytic approach to reading.

Goins' generalized factors are similar to those found by Petty, Fendrick, and the Thurstones, and run counter to the theory of Gates and Anderson and Dearborn (1942). The large majority of Goins' perception tests were found to be correlated with reading ability.

Durrell et al. (1958) summarized the findings of a series of research studies undertaken under his supervision. The research consisted of a year's periodic testing of achievement, visual and auditory perception tests of over 200 children in the first grade. Similar to the findings of the previous study he had done with Sister Mary Harrington, the newer study indicated that C.A. and M.A. had little or no relationship with a battery of tests which purported to measure visual and auditory perceptual abilities. The visual tests required the ability to identify letters and words. He concluded that success in reading was more predictable by measures of auditory and visual perception than by high mental age.

Lachman (1960), using the Bender-Gestalt test, attempted to differentiate retarded readers from either a comparable group of normal readers, or a group of emotionally disturbed children who have normal reading. Retardation was established as "below the 20th percentile for the subject's chronological age" while normal reading was established as "above the 40th percentile." In this study three groups of children were used: children referred to a clinic for reading disability; children from a public school with no reading disability, or emotional disturbance; children referred to clinics for psychological help but normal in reading. All groups were equated on sex, age, and
intelligence. Scoring criteria on the Bender-Gestalt test were taken from the five measures of immaturity in perceptual-motor development if present above the age of eight (Bender, 1938). Lachman's groups were each sub-divided into an older group of 10-12 years and a younger group of 8-10 years. A multivariate information transmission analysis, which he describes as a nonparametric analogue of analysis of variance, was used for the treatment of the data. Lachman found that while Bender's itemized distortion criteria readily distinguished the reading disability group from the normal group, they were not as efficient in distinguishing between the reading disability group and the emotionally disturbed but normal readers. Lachman believed his findings substantiated Bender's theory of developmental lag in the perceptual-motor function.

Harris (1961) reports a Swedish study by Malmquist who used 5 different tests of visual perception with first graders. The tests which involved groups of alphabetical letters and arabic numbers showed significant relationships with learning to read, while those that involved geometric shapes and meaningful pictures barely reached significance levels. Malmquist's study confirms many previous studies and seems to add further strength to the hypothesis that the more the perceptual object looks like a printed word, the better is the predictive efficiency for school achievement.

Another series of studies using the Bender-Gestalt test has been summarized recently by Koppitz (1962). She finds that a combination of this test and the Draw-A-Person test is highly perdictive of reading achievement in children up to the third grade. However, she believes
that the Draw-A-Person test is supplemental and that the Bender-Gestalt, using her own quantitative scoring system, is predictive of reading failure.

Summary

Despite the wide variety of evaluative instruments used, certain definite trends can be discerned in the perceptual vision area literature. Although Gates (1922) early hypothesized the relative specificity of abilities of visual perception, recent research studies utilizing multiple correlations and factor analyses (Fendrick, 1935; Petty, 1939; Thurstone and Thurstone, 1948; and Goins, 1958) indicate the existence of some sort of generalized visual perceptual factor. Further, there seems also to be a remarkable agreement regarding the breakdown of the generalized factor into specific ones: a factor involving speed of closure; and a factor involving an analytic approach. An interesting finding of Fendrick — which may perhaps bridge the gap between Gates and later studies — was that this general perceptual factor seems more highly inter-related and developed in his normal readers than in his retarded readers. Huelsman (1949) contributes an additional insight into this apparent gulf: analyzing the approaches of the adult versus the child to the reading task, he defines the reading of the adult as being one of grasping the Gestalt or totality of the configuration, with cues of peripheral vision giving him some orientation before the direct act of vision; the child, on the other hand, lacking the experiential background of the adult reader, must search for details which help him to distinguish one word from another in a more analytic method. Thus, one's ability to perceive in a holistic fashion develops with age.
There is growing evidence that visual perception is independent of mental age, chronological age or intellectual functioning. This possibility opens up several theoretical approaches. For example, it is possible that visual perception ability is the result of environmental background and ultimately it may be associated with some other intervening variable, such as meaning vocabulary skill.

A second approach has attempted to use dynamic interpretations in explaining. For example, Graham (1951), Jarvis (1958), and Vorhaus (1946) view reading disability as negativistic resistance toward the home and school. The latter type of explanation could be framed within a perceptual defense outline: as a child begins to have a breakdown in understanding, he becomes progressively less eager to perceive the stimulus and, perhaps, resists its image. The effect becomes cumulative, as was noted by Coleman (1953).

A third approach would define the perceptual process as being a part of general intellectual functioning of the child. Tests of general ability involve such an assumption.

Finally, there is the interpretation which was formulated at the beginning of this review, namely, that there is a continuum of learning to perceive which begins at birth and develops into the complex function of reading. Children come to the reading situation with different levels of perceptual abilities, as well as different levels of intellectual functioning, age, and experiential background. If at any point, the child is unable to make the next step of visual discrimination required of him in the classroom, there may result a perceptual defense against perceiving the stimulus. At that point begins the
perceptual lag hypothesized by Bender (1949) and Coleman (1953) which ultimately results in reading disability and academic retardation.

Studies in the Sensori-Perceptual Hearing Areas

There is no doubt that actual loss of hearing results in retarded academic achievement and that the amount of retardation is related to the amount of hearing loss (Loutit, 1957). Studies which have correlated hearing loss with achievement have generally found positive results although there is always the controversial and problematic issue of verbal versus non-verbal achievement and/or intelligence factors. Representative of these studies are those carried out by Humphrey (1928), Laurer (1938), and Sprunt and Finger (1949).

Another aspect of hearing is the central rather than the peripheral components of audition. This approach was used by Strauss (1947) who noted that children with a brain-damage syndrome might have normal hearing as indicated by pure-tone acuity but have trouble integrating spoken language. Other clinical investigators also describe the same differential (Doll, 1952; Bender, 1949).

The ability to comprehend and integrate spoken language as distinct from the ability to hear pure-tones has been named the "auding" ability by such writers as Caffrey (1949), Meyerson (1955), and Brown (1956). This term now covers what has been called "listening," "hearing," "understanding," and "hearing-for-speech." Brown describes auding as "involving hearing, listening to, recognizing (or perceiving) and interpreting spoken symbols." Both Brown and Meyerson liken "auding" to reading in that it is the input or decoding process of spoken language as reading is input or decoding process of written language.
Most of the work in hearing has been focused on the academic problems of children who have actual loss of auditory acuity. However, there has been a steady, if somewhat attenuated interest in the auding ability or abilities of children with normal hearing who evince academic retardation. The term "auding" is of comparatively recent origin; other terms which have been previously used to describe the phenomenon are "auditory ability," "auditory perception," etc. Subsumed under the latter terms are such abilities as the ability to match spoken sounds, phonics ability, ability to match rhythms, ability to blend sounds, ability to distinguish words out of the component parts, pitch discrimination of subjective evaluation to name some of the definitions. There are also the more "objective" definitions. For example, "speech reception threshold," "responses to phonetically balanced words," "ability to hear language against noise interference," etc.

The following review reflects both types of evaluations and studies done in both the acuity aspect and the auding aspect of hearing.

Monroe (1932) compared auditory acuity and auditory discrimination of 32 non-readers with a group of 32 unselected normally-reading children. She found an insignificant incidence of hearing acuity loss but a definite lack of ability in auditory discrimination, which is even more significant when it is realized that the control group was "less mature" both in C.A. and M.A. The children were asked to discriminate between slight differences within similar words, and to match sounds with written nonsense syllables. The differences she found led Monroe to theorize an auditory deficiency, somewhat similar to color-blindness, that was independent of auditory acuity. To test this theory, Monroe gave both groups a word synthesis test in which the various sounds of a word are
given separately in a drawn-out fashion. The child must give back the
total word from its isolated component parts. Monroe found significant
differences in this ability between the two groups, as well as an even
bimodal distribution favoring the control group.

Bond has completed two studies of auditory abilities, the first
in 1935 and another one in 1939 (Gates, Bond, and Russell). The audi-
tory tests in his first study included auditory acuity, auditory memory,
phonics ability, the ability to blend sounds into words, ability to
remember associations between verbal and visual symbols, and ability to
perceive rhythm. All of the tests except auditory acuity, perception
of rhythm, and auditory memory were found to discriminate between
children 1/2 years or more retarded in school and children reading at
or above grade level. Bond concluded that his retarded group could per-
ceive speech sounds but could not make functional use of them in a total
language fluency.

In the second study, which used even more extensive auditory
tests, Bond, Gates and Russell found slight correlations for auditory
acuity in each ear and both ears, while those tests which involved com-
plex hearing functions, such as rhyming, blending, and matching orally
given beginning word sounds, were more highly predictive of later read-
ing success. In the latter tests he obtained correlations in the .40's
and .50's.

Kennedy (1942) tested the hearing acuity of low and high reading
achievers in the first, second and third grades. She correlated all
frequencies and the sums of various frequencies and obtained an in-
significant correlation with reading achievement. However, Kennedy did
discover an interesting fact: children of 6 years had a lower hearing acuity as a group than those of 8 years as a group. She decided that there seems to be an age and/or experience factor in even the perception of pure tones, which tends to be thought of as purely sensory in nature. She also noted that poorer readers tended to be poorer in pitch discrimination as indicated by the Seashore Test of Pitch Discrimination.

Wolfe (1941) found that 18 retarded readers (retarded 2 or more years) were not differentiated on auditory acuity from normal readers, but were differentiated on the original Monroe tests of auditory discrimination and auditory memory for words.

In 1948, as part of a larger study, Rossignol investigated the role of hearing acuity and reading performance on 229 children in Grades I and II. Rossignol measured the seven levels of frequency and found a relationship between hearing acuity and reading performance; when she partialed out the mental age factor, at which point the correlation was no longer significant.

Ewers (1950) reported another study of auditory abilities as related to reading abilities. Of the various auditory abilities, she found low but significant correlations on the majority of the tests (given mainly by group disc recording). The highest correlations obtained were for pitch discrimination when the children listened to higher or lower monosyllabic sounds containing vowels and diphthongs (.70); in syllable blending the correlation was .60; while memory for limericks, accenting, and noise-interference tests were in the .50's to .40's. Ewer accounted for her high correlations as being the result of using a continuous measurement criterion rather than a dichotomized criterion. She
noted that the higher the level of abstraction the greater the correlation.

In 1951, Stambak tested 7-14 year old children in copying rhythms (groups of one, two, or three taps). She found that the retarded group was not only much poorer in copying these rhythms, but also that it did not improve with increasing age, as did the non-retarded group. Furthermore, the retarded readers were less able to tap out the rhythms of a familiar song.

Reynolds (1953) studied the relationship between auditory abilities and silent reading abilities. Using several tests of auditory perception, he found that auditory acuity had no predictive value for reading achievement and only certain of the auditory abilities, including auditory memory span, word discrimination, and pitch discrimination, had predictive value.

Templin (1948) compared the performance of 26 "best" readers with 26 "worst" readers in a group of 78 children around 10 years of age who were similar on I.Q. Her tests involved the identification of vowel and consonant sounds in isolation and in both words and nonsense syllables. She found a significant difference only in the identification of isolated sounds.

Wheeler and Wheeler (1954) gave tests of pitch discrimination and discrimination of sounds and words to 629 children, aged 10-12 years, with a wide range of I.Q. (76-139). They found correlations between reading scores and tests of word sound discrimination of about .31 to .40; the correlations between word sounds and intelligence were even higher (.38 and .40).
Poling (1953) investigated auditory acuity and auditory discrimination and memory via use of the Monroe-Sherman Group Diagnostic. She found no differences in auditory acuity in children aged 8-13 who had an extremely homogeneous range of I.Q. as measured by the Stanford-Binet. She found some correlation with auditory memory span, and the tendency to make reading errors and reversals.

In comparison to the rather negative findings of Reynolds, Templin, and Wheeler and Wheeler, some more recent studies have indicated a higher correlation between reading ability and auding ability. These studies tend to confirm the findings of Monroe, Bond, and Wolfe.

The first of these reports was a study by Durrell and Murphy (1953) which investigated both the auditory and discrimination abilities of elementary school children and the effect of auditory training on these children. In the first experiment, Murphy gave ten minutes of ear training daily for a period of six weeks to 50 retarded readers. At the end of six weeks, she compared the learning of new words of this group with a control group that had been matched for intelligence and learning rate. She found the experimental group had increased in learning rate from an initial score of 2.5 words to 5.2 words, whereas the control group made only a mean gain of one word.

Later, the same experimenters conducted a larger study on 540 pupils who had been divided into 4 groups and had been matched on M.A., learning rate, speaking vocabulary and auditory discrimination ability. Group I was given 10 minutes of ear training daily, Group II was given a like amount of visual training, Group III was given both, and Group IV received only the usual teaching of reading methods. The results of
this experiment were: the group which received both auditory and visual training had the highest scores; the next highest scores were obtained by those who were given auditory or visual training. She also noted that those children who had received the lowest auditory discrimination scores had profited the most.

Barry (Durrell and Murphy, 1953) compared the relationship of auditory abilities of children with their reading ability and found unusually high correlations: .56 in Grade I; .52 in Grade II; .52 in Grade III. She found no correlation between reading achievement and auditory acuity or singing ability.

Durrell and Murphy, in summarizing their research progress, emphasized the fact that children who are severely handicapped in perceptual auditory ability seldom achieve primer level in reading, and moreover for these children special training is needed. They also point out that while it is difficult to understand how children with excellent vocabularies, good speech and training in phonics fail to acquire auditory analysis ability, these children can respond to training and with training show a marked increase in the rate of learning to read.

Another series of reports by Durrell et al. (1958) confirm their earlier findings when they studied the reading progress of over 200 first grade children. Durrell summarized these results as follows: most reading difficulties can be prevented by early instruction in letter names and sounds; C.A. shows little relationship to visual and auditory perceptual abilities (such as ability to identify sounds in words, ability to give names and sounds of letters). M.A. has only a little more relationship. High mental age, as a matter of fact, does
not have as much efficiency as a predictor of reading success as does ability in auditory and visual perception.

Also in 1958, came another report by David Russell. He administered various reading capacity tests and six tests of auditory discrimination presented orally by the teacher. The tests involved discrimination of likenesses and differences of pairs of words; tests of whether pairs of words are alike in the middle, beginning or end; identification of written words which have a similar initial as a spoken sound; oral paragraph comprehension; and the ability to name three words orally presented which begin or end like another word. The correlation for the combined auditory tests were much more highly correlated with reading and spelling than with the individual tests. C.A. and M.A. did not seem to be a factor in these abilities, but rather seemed to be independent of these abilities. The tests which involved more complex functioning such as comprehension of orally given paragraphs were more highly correlated with reading (.66) than the simpler and more analytic tests, such as testing similarities, or differences of pairs of words (.22). Another finding of this study was a higher auditory relationship for reading than for spelling. As a result, Russell hypothesizes that in spelling the visual perception is the more important function.

Plessas (1963) studied the relationship of auding to reading. Using the California Auding Test, Plessas tested the auding ability of 414 eighth graders, dividing the lowest auders and the highest auders from the group. While the highest auders were best in matching sounds, all tests corroborated the fact that the superior reading group were high auders and the poorer reading group were low auders.
Summary

While the number of studies which have investigated the sensory-perceptual aspects of hearing are fewer than in the other areas in this review, the research results are somewhat more definitive and less equivocal. The major problem in research in audition is the disparity between the subjective types of measurements, which depend on examiner variability, and the objective types of measurements, which are mechanically recorded and presumably have less human error.

Generally speaking, comparisons of normal and retarded readers do not show a relationship with the sensory aspect of hearing as defined by pure tone acuity. In fact, of the nine studies which utilized pure tone testing, seven showed no relationship, one showed a correlation in the .20's and one showed a significant relationship until the mental age factor was partialled out. Such uniformity of findings lends strong support to the conclusion that academic achievement is independent of auditory acuity.

The perceptual aspects of hearing do tend to show more positive results depending on the type of evaluative instrument used. Varying amounts of relationship have been reported, from low but significant relationships to rather high relationships, depending on the type of auding task: Simple discriminations of words that are alike or not alike, and pure-tone pit discrimination tend to be on the lower end of the continuum; while complex auding functions, which may require certain cognitive ability, such as syllable blending, pitch discrimination within words containing vowels, and comprehension of orally spoken paragraphs, represent the higher end of the continuum.
There is the problem, too, of intervening variables, such as knowledge of vocabulary. A child with a better understanding of vocabulary might well be able to perceive and interpret the reading of oral paragraphs while a child with a vocabulary deficit might not be able to understand what has been said. Thus, the measurement of the "auding" function which depends upon the interpretation of spoken language is largely influenced by the variables involved in the measurement itself. Researchers who wish to validate the generally positive findings of the relationship of auding and reading disability apparently will have to take into account the factors of vocabulary, I.Q., and experiential background.

Studies in Laterality as it Relates to the Sensory-Perceptual Problem

Many terms have been used to describe laterality such as "cerebral dominance," "neurological confusion," "peripheral dominance," "central dominance," etc. These terms are implicitly inferential in nature; that is to say, they infer from behavioral characteristics the neurological structure of the organism. As Jastak (1934) pointed out, these theoretical terms are interpolations which lie outside the immediate facts. The writer will use the term "laterality" to avoid such inferential meaning, since that term describes only the simple behavioral characteristics.

Laterality refers to the most consistent preference of the use of the hands, eyes, ears, feet, or side of body (Robinson, 1947). Complete lateralization means that the subject uses one side (either right or left) for all parts of the body; crossed laterality means that
the subject uses one side of the body for one or more of these parts and
the other side for the rest; mixed laterality means that there is no con-
sistent right or left preference for one or more of these parts of the
body.

Laterality characteristics have been related to problems of speech,
mirror writing and reversals, reading, intelligence, sex, emotional
problems, etc. Both Hildreth (1949, 1950) and Smith (1950) have pre-

tered excellent reviews of the theoretical and experimental literature.
The present review includes only those studies which have attempted to
correlate laterality characteristics of academic under-achievers and
normal achievers. Again, we will concentrate on those studies which
have attempted some control factor, as noted at the beginning of this
chapter.

Earliest recognition of the linkage of reversals to reading
disability was in 1896 when Morgan hypothesized the reversal tendency
as a specific disease which he labeled "congenital word blindness."
Another English ophthalmologist, Hinshelwood (1917), designated the
problem of reversals among non-mentally retarded children as a psycho-
logical problem rather than as a physiological one.

In 1925, Orton presented his strephosymbolia theory. He had been
particularly impressed by the fact that a lesion in the "dominant"
hemisphere results in a loss of an associative function while a lesion
in the non-dominant hemisphere did not produce such a loss. Yet, no
such dichotomy appears to exist structurally in the two hemispheres.
He hypothesized that a silent or inactive area must also be "irradiated"
with the associations which he called engrams. He envisioned the
non-dominant hemisphere as a mirror image of the dominant one; the non-dominant side engrams would be the reverse of those of the dominant side. Ordinarily, the mirrored engram remains inoperative, especially in those with strongly established laterality. However, for those with confused or mixed dominance, the elision of these non-dominant engrams is not complete and may emerge as a failure to differentiate between "p" and "b" and "was" and "saw." It would, if valid, account also for facility in mirror writing that was often noticed in left-handed children. He coined the term "strephosymbolia" or "twisted symbols" to describe this syndrome. While he has had only a few "takers" his impact on educational psychology has been such that, to paraphrase Tolman, for the past 35-odd years all studies of laterality have largely to do with agreeing or disagreeing with Orton.

Certainly the left-handed child can have trouble since he is a minority in an essentially right-handed world. This trouble is particularly noticeable, for example, in the exaggerated writing position that left-handers sometimes use to copy the normal, right-handed slant. Whether this left-handedness or tendency to left laterality of hand, foot, eye, etc., is a dominant factor in ultimate reading achievement is another matter.

Dearborn (1930) compared 100 children with reading problems with another group of "unselected" children. He found that one-half of his unselected group were right laterals, both in eye and hand, but that only 1/5 of his reading problem group were right lateralized in eye and hand. Over 80% of his reading problem group were either completely left lateralized or they were cross or mixed laterals compared to only slightly 50% of the unselected group. Dearborn's unusually contrasting
results led him to the conclusion that reading and writing is best achieved when the child is completely lateralized, and particularly lateralized to the right. He expressed the opinion that the easiest directional movement for left-lateralized children is toward the left from the center of the body, or counter to the direction of the reading of Western European languages.

Jastak (1934) has criticized Orton's theories as lying outside the facts: Crider (Robinson, 1946) questioned Dearborn's conclusions on the basis of neurological facts. He stressed the fact that while there is complete decussation of the neurons from the hands and feet on the way to the brain, there is only partial decussation of the optic nerve. While the nerve fibers on the nasal side decussate, the temporal fibers do not. Yet in 1939, Dearborn reported finding 1½% more left-eyedness and 17½% more crossed dominance among 76 severely retarded readers compared with 124 readers who were clinically referred but presumably not necessarily retarded in reading.

Monroe (1932) compared the laterality of eyes and hands of 101 normal readers and 155 retarded readers. She found no differences in the percentage of right and left hand laterality. She did find a greater incidence of left eye preference in sighting and a greater incidence of crossed laterality. Specifically, the cross laterality entailed preferences for left-eyeedness and right handedness. She found that cross laterality did not have a relationship with a tendency to reversals, but that left eye preference had a tendency both toward reversals and also toward fluency in mirror writing. Cross laterality
appeared to be more closely linked with poor intelligence than specific reading disability. Her results may indicate the confusion of the intelligence and reading disability factors. Monroe states that cross laterality of eye and hand might have a tendency to impede "the coordination of directional response." She says also that "the child who prefers his left eye may adjust more easily to objects on the left side of his visual field," whereas a child who prefers his right eye would presumably adjust more easily to objects on the right side of his visual field. If the child then tends to move his eyes in the direction of the preferred left field, the child may experience difficulty in learning to read to the right as is demanded by the English language.

Teegarden (1932, 1933) compared eyedness and handedness of 50 first graders. She found a continuum of reversals from few to many reversals. She concluded that the most "successful" condition for learning to read was consistent laterality or consistent eye laterality with mixed hand laterality. The "least successful" condition was mixed or crossed eye and hand laterality. While her results are not conclusive, and apparently it is more important for the eyes to be consistent in laterality than for hands to be lateralized, complete lateralization is the most "satisfactory" condition of all.

Moody and Phillips (1934) compared 136 right-handed children with 136 left-handed children. They did not find a greater tendency toward reversals in the left-handed group than in the right-handed group in either reading, writing or drawing. The children in this study had been matched on sex, C.A., M.A., reading ability and grade placement.
The investigators had selected only "pure" hand laterals and their investigation did not, therefore, include mixed laterality.

Hildreth (1934) gave reading tests to all third and fourth graders in a public school, and for a second grade in a private school. A year later she gave perception-copying tests to the children who were still available. While she found that poorer readers made more reversals, she did not find a relationship of hand laterality to reversals. The median I.Q.'s of Hildreth's groups were notably different. She noted also that the most reversed items were those items with which children were least familiar.

Witty and Kopel (1936) compared an experimental group of 66 boys and 34 girls with an equal number of children of like sex, grade, and school. The I.Q. average of the retarded group was 96 whereas that of the control group was 104. There was an average difference of age of one year and two months between the two groups. The effects of the differences are not known. The overall age range of the samples extended from 7 to 14 years, with the range of I.Q. being from 80 to 123. The reading retardation was 1/2 grade or more below their actual grade level. The conclusions were that the poor readers tended to make more reversals but did not show greater frequency of mixed laterality. Since there were highly similar percentages of right, left, mixed laterality of hand and eye in the groups, the researchers concluded that there was little, if any, relationship between reversals and laterality and reading disability.

Gates and Bond (1936) compared 65 normal readers and readers retarded one and half years. The groups were equated on age, I.Q., number
of years in school and socio-economic background. Their data showed no significant relationship between eye or hand laterality and reading achievement; similarly, neither Gates' visual perception tests nor reversals showed a significant relationship with the experimental variable. There was a tendency in their data for older children with left eyedness to make a relatively higher percentage of reversals.

Bennett (1938) compared laterality characteristics of 50 able and disabled readers. He found that children with mixed laterality had a tendency to be poorer readers than those who showed more complete laterality. This difference was not statistically significant. He did not find a tendency for reversals to be related to laterality characteristics.

Crosland (1939) found a majority of 34 inferior readers to be left-eyed compared to 31 superior readers. He concluded that there was a relationship between left-eyedness and reading failure. He also found that tachistoscopic tests revealed that the superior readers excelled the poor readers in the left visual field, whereas the inferior readers excelled the superior readers in the extreme right field. His control group was superior on intelligence scores although it is not clear from his report what the differential was. Since his results revealed a tendency for the retarded readers to be left-eyed and for the superior readers to be right-eyed, Crosland concluded that eyedness was an important factor in reading ability.

Wolfe (1941) found no differences in proportions of right-, left-, or mixed laterality of eye, hand or eye-handedness. The retarded readers were an extremely homogeneous group, aged 9 years on the average, and retarded 2 years below the matched control group.
Schonell (1940, 1941) found a considerably greater proportion of cross-laterality among 10,000 readers, aged 7-13 years; they were retarded by 1½ or more years than a matched group of 10,000 normal readers. Schonell's group had an I.Q. range that extended down to 70. His results, consequently, may be more indicative of the low mentality of the group than of reading disability. His retarded group showed many more reversals and made more frequent reversals in reading than in writing. The latter result led Schonell to believe that the manual use of kinaesthetic training was valuable in reducing reversal errors. He concluded that while left-handedness, per se, may not be a contributive cause of reading disability, left-handedness with right eyedness may be.

Harris (1947) attempted to explain the controversial differences found in the studies in this area as a function of the populations studied. Studies which find no differences in cross-laterality tend to be large school surveys while studies which do show a lack of complete laterality he believes are the result of intensive clinical studies of referred severely retarded readers. Harris found three times as many cross-laterals in his referred clinical group than can be expected in the normal population.

Hallgren (1950) found no difference between normal readers and a group of severely retarded readers with eye laterality, cross-laterality, and a slightly higher incidence of left-handedness.

A study of French children by Galifret-Granjon and Ajuriaguerra (1951) utilized tests of handedness, eyedness and footedness when comparing 108 normal readers with 97 retarded readers. They found a higher incidence of cross-laterality in younger retarded readers, also incomplete hand laterality. Although the laterality tended to become
more complete with age, the older 11-13 year retarded reading group
still showed a higher incidence of cross and mixed laterality than did
the normal readers. Galifret-Granjon and Ajuriaguerra emphasized the
fact that there was considerable overlap of reading ability and complete
lateralization. Thus, many retarded readers were completely lateralized
while many normal readers were not.

Smith (1950) compared 100 retarded readers with 100 normal
readers. Using an extensive battery of tests, she found no differences
between the groups in eyedness, handedness, footedness, ear preference,
change of handedness, speed or accuracy of mirror drawing, or combina­
tions of eye-handedness. The only differences she obtained between
the two groups was a tendency in the retarded group toward reversing
lower case letters and to reverse with right hand on the Van Riper Test
of Central Dominance, while the normal readers tended to reverse more
on the left hand. The two groups were extremely homogeneous in age
(9-11); I.Q. ranged from 90-131.

Stevens and Robinson (1953) compared the reading progress of
kindergarten pupils who had been tested for eye-hand preference, re­
versals, and directional tendencies. The pupils' progress was recorded
until the beginning of Grade III, when they were given the Chicago
Reading Test and the Metropolitan Achievement Test. By the end of the
first year, 22 pupils who had tended to reverse story pictures, had
learned how to place the pictures in a left to right sequence and tea­
chers' evaluations on the pupils indicated there were no unusual reversal
tendencies. At the beginning of the third grade, the Stanford-Binet
test was given. Statistical treatment of these data revealed that the
the intellectual factor was not influential in the groups of superior pupils with mixed laterality. Finally, the reading tests given at the beginning of the third grade revealed that pupils with mixed laterality read as well as those with consistent right eye-hand laterality.

Clark (1957) investigated the laterality characteristics of 162 boys and 168 girls of about 11 years of age. Her battery included 11 tests of laterality besides an actual writing test. The obtained scores were correlated with group intelligence test scores and with scores obtained on achievement tests on all 11 year old children in Scotland. Clark found no significant differences in the mean achievement scores of 13 left and right handed subjects paired on sex, intelligence, class. However, she did find significant differences between right handed children with a tendency toward the left and children who were completely right lateralized. Five subjects, in particular, who had been changed to their right hand were more than 20 points below their paired right handers; indicating perhaps that laterality has less relationship to achievement than change of handedness.

Using data on over 3,500 clinically referred children undifferentiated on I.Q., sex, organic symptoms, etc., who were divided on reading achievement, Eames (1959) found higher percentages of cross and mixed laterality on the part of retarded readers. A factor to be considered in all of Eames' work, however, is that he has not controlled for I.Q., and other organic variables.

A recent study by Beck (1960) concerned the relationship of monocular and binocular vision with reversals, mixed laterality, and eye dominance. His sample consisted of 44 second graders with a C.A.
range of 7-5 to 10-1 years, I.Q. scores of 77 to 115, and a reading quotient of 76-115. The subjects were chosen on the basis of a tendency to reverse. Children with gross disabilities were eliminated the better to study normal vision. The children were ranked on number of reversals made and then placed alternately into groups to avoid sampling error. One group was presented with binocular symbols and the other with monocular symbols. The monocular symbols were presented half left and half right to avoid error. Reversals were noted and scored as the children read. Beck found a higher mean difference of reversal errors for the monocular group. The difference was not significant, however, and was not related to either mixed laterality or eye dominance.

Summary

Perhaps nowhere else is opinion so sharply divided as over the question of the relationship of laterality to reading disability. Moreover, the results of the various studies often contradict each other. For example, Dearborn (1930, 1939) obtained results that indicate reading disability has a definite tendency to be related to cross laterality. Other researchers did studies that show no effect of laterality upon later reading progress (Stevens and Robinson, 1953).

Vernon (1957) and Harris (1947) have explained this wide range of results as being due to differences between types of studies. The referred clinic populations tend to show positive results; while large school surveys tend to show negative results. Harris is of the opinion that one of the problems inherent in the measurement of laterality is the lack of sufficiently accurate tests of laterality.
Perhaps one of the most confusing aspects of the studies in laterality is the contradictory results obtained with the very same measure, so that those studies that show positive results do not always show the same positive result. Thus, while Monroe found that left-eyedness and crossed laterality, but not left-handedness, may have a relationship to reading disability, Hallgren (1950) found the difference to be in left-handedness, and not left-eyedness or cross laterality.

In general, the studies which have carefully controlled the factors of intelligence, age, and those studies which have been longitudinal (so that right and left lateral groups have been followed up on their later achievement) do not find any differences noted by those studies which have compared the results of clinical populations to "unselected" school children or have covered a wide range of intelligence and age. That some studies do show a relationship between reading disability and laterality characteristics may be a part of a general syndrome that includes intelligence factors, organic problems, and perhaps certain environmental influences. At the present time, it is premature to conclude that laterality, per se, has a relationship with either reading disability or academic retardation.

Reversals and mirror writing have also shown inconclusive relationships with both laterality and with reading disability. Until more highly controlled studies are carried out, there is as yet no equivocal answer to any of these questions.
Studies of the Wechsler Intelligence Scale for Children

In the publication of the Wechsler-Bellevue Scales, a test of adult intelligence, Wechsler had specified certain profiles which he believed to be diagnostic in nature. Since the publication of the Wechsler Intelligence Scale for Children (1949), popularly called the WISC, there have been a series of investigations to determine if Wechsler's original diagnostic profiles would apply to the WISC, or if there are other patterns which might be used diagnostically. Such studies include investigations of a specific profile patterning related to reading disability or total academic retardation.

Interest in such a WISC profile arises from several considerations. First, the WISC has gained considerable popularity as an intelligence test for children and has been widely used. Second, the test attempts to be qualitative as well as quantitative; not only does it measure the child's intellectual functioning as compared with other children of his own age, but it also attempts to elucidate the individual child's strengths and weaknesses. Thus, profile investigations are steadily gaining interest. Third, if there were found to be a profile for the academically retarded child, that profile could be used as a predictive instrument as well as a categorical one. Such an instrument would allow for the possibility of filling in the child's weaknesses and perhaps by-passing the possibility of failure.

Wechsler described the adolescent psychopathic profile as follows:

1) tends to be better on Performance than on Verbal tests;
2) a high "social intelligence" as indicated by the Picture Arrangement subtest;
3) a low level of abstract ability as reflected by his poor performance on the Similarities subtest;
4) low scores on Arithmetic and Information;
5) comparatively high scores on the Picture Arrangement and Object Assembly as pathognomonic of this group;
6) variability among sub-tests not great.

Our interest in the profile of the adolescent psychopath is because more often than not, he can also be classified as an academic retardate, if not an academic drop-out. Since there may be considerable overlap between these two groups, the essential question becomes can these two groups ever be differentiated?

In 1949, Croley observed that the Wechsler-Bellevue (WB) profile he obtained for adolescents with reading problems was very similar to the profile described above for the adolescent psychopath. Using a comparison of slope technique, Croley created a projected rank order profile for the WB subtests for the adolescent psychopath, and compared this profile with the mean profile of 45 unsuccessful readers. The resulting rps was 1.00, but only 8 subtests were compared. The three subtests not included in the Croley data were the Vocabulary, Similarities, and the Digit Symbol subtests. From highest ranking to lowest ranking, Croley found the following results: Object Assembly, Block Design, Picture Arrangement, Picture Completion, Comprehension, Information, Digit Span, Arithmetic.

In 1951, Graham noted a similarity between the WB profile obtained for adult hysterics and that of unsuccessful readers. He hypothesized a dynamic interpretation as follows: reading as a verbal tool for communication lends itself as a symbol for repressed or suppressed hostility in a home climate that is either smothering or hostile.
The same author later compared the Wechsler test profiles of 96 children with reading disabilities. The children were aged 8-0 to 16-11 and had either a Verbal or Performance level of 90 or higher. Fifty-four of these children had been given the WB Form I; 11 had been given the WB Form II; and 31 had been given the WISC. The following table is reproduced from his article and shows the Mean Scaled Scores and Rank Order of the WB and WISC tests.

Table 2.—Mean Scaled Scores and Rank Order of the Wechsler-Bellevue and Wechsler Intelligence Scale for Children Classified as Reading Disabilities

<table>
<thead>
<tr>
<th>Test</th>
<th>Mean Weighted Scores WB I</th>
<th>Mean Weighted Scores WB II</th>
<th>Mean Scaled Scores WISC</th>
<th>Rank Order</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 54</td>
<td>N = 11</td>
<td>N = 31</td>
<td></td>
</tr>
<tr>
<td>Information</td>
<td>5.5</td>
<td>7.0</td>
<td>9.4</td>
<td>9 9 8 4 4 4</td>
</tr>
<tr>
<td>Comprehension</td>
<td>8.5</td>
<td>9.0</td>
<td>11.0</td>
<td>5 5 3 1 1 2</td>
</tr>
<tr>
<td>Digit Span</td>
<td>5.4</td>
<td>5.5</td>
<td>9.5</td>
<td>10 10 7 5 5 3</td>
</tr>
<tr>
<td>Arithmetic</td>
<td>4.0</td>
<td>5.4</td>
<td>8.3</td>
<td>11 11 11 6 6 6</td>
</tr>
<tr>
<td>Similarities</td>
<td>7.5</td>
<td>7.4</td>
<td>11.6</td>
<td>6 8 1 2 3 1</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>6.1</td>
<td>8.1</td>
<td>8.8</td>
<td>8 6 9 3 2 5</td>
</tr>
<tr>
<td>Picture Arr.</td>
<td>9.6</td>
<td>11.1</td>
<td>10.4</td>
<td>2 2 6 2 2 5</td>
</tr>
<tr>
<td>Picture Com.</td>
<td>9.4</td>
<td>9.5</td>
<td>11.2</td>
<td>3 4 2 3 2 4 1</td>
</tr>
<tr>
<td>Block Design</td>
<td>9.1</td>
<td>10.5</td>
<td>10.9</td>
<td>4 3 4 4 3 3</td>
</tr>
<tr>
<td>Object Assembly</td>
<td>11.1</td>
<td>14.6</td>
<td>10.7</td>
<td>1 1 5 1 1 2</td>
</tr>
<tr>
<td>Digit Symbol</td>
<td>6.8</td>
<td>8.1</td>
<td>8.5</td>
<td>7 7 10 5 5 5</td>
</tr>
</tbody>
</table>

Excluding Similarities, which was not included in Croley's study, Graham's ranking of the subtests are highly similar to that of Croley's. Arithmetic and Digit Symbol are lowest in rank while Picture Completion, Comprehension, and Block Design rank high. Graham found that the WISC
was less variable in the Verbal-Performance ratio than on the WB. Twelve of the 31 children demonstrated Verbal ability equal to Performance ability. The second dissimilar finding between the WISC and the WB scales was in the ranking of Similarities, as can be seen from Table 2. All other rankings were similar in nature, with above average Object Assembly, Picture Completion, Picture Arrangement, Block Design, and Comprehension (and Similarities in the WISC) ranking high and the Arithmetic, Digit Span, Information, Digit Symbol, and Vocabulary averaging below the mean.

Graham noted that while his scattergram was similar to that described by Wechsler for the adolescent psychopath, his own population was educationally retarded and not to his knowledge in trouble with the law. This profile, then, Graham attributed not to any "moral quality" of the population but more specifically to the educational achievement of Wechsler's population.

Another of Graham's conclusions was that the subtest items in which the retarded reader achieves his highest scores are those most distant from the classroom activities. For example, the Digit Symbol most closely resembles the original reading situation; while the Digit Symbol (with its required rote memory) and Information (with its recall type questions) most closely resemble the school situation. The unsuccessful reader is, thus, according to Graham, unconsciously resisting the emotional climate of the school or home.

Burks and Bruce (1955) tried to determine the characteristics of 31 poor readers as compared with 11 good readers. Using the method of
comparing deviation scores in test age, they found the following differentiations: the poor readers were significantly higher on Picture Arrangement, Block Designs, and Comprehension; lower on Information, Arithmetic and Coding. The good readers were significantly higher on Similarities and lower on Picture Arrangement. Their subjects were all eighth graders with a mean I.Q. of 117 for the control group and 101 for the retarded group. Burks and Bruce argue that the deviation scores hold constant the intelligence factor.

These experimenters advanced a theoretical explanation based on Goldstein and Scheerer's concepts of concrete and abstract attitudes. Poor readers, say these authors, seem to approach learning situations in a concrete manner and lack the ability to use abstractions and have much more retentive ability. They postulate also two factors as common to the three subtests on which their poor readers scored high: first, the relative lack of need for long or short term symbolic memories; second, the immediate availability of a structured stimulus. They reject Wechsler's hypothesis that the Comprehension subtest measures judgment. Contrary to the classical interpretation, Burks and Bruce believe that this subtest requires only slight association. They say that Picture Arrangement, Block Designs, and Comprehension should be considered as calling for less abstract behavior than the other subtests in the Scale - Coding, Information, and Arithmetic. They hypothesize that these latter subtests require good memory functions and that they do not have structured stimuli immediately available.

Another study without a control population was done by Altus (1956). As with Graham's research, Altus' population was a selective
one - all children having been referred to a clinic. Of the 25 children tested, all but one were boys. They had a full WISC score of 80 or higher and were between Grades III and VIII as rated by standardized reading tests. Altus' WISC profile did not show a significant Verbal-Performance discrepancy and she presumed it was not differentially diagnostic. The subtest patterning, however, was fairly distinctive. Coding and Arithmetic were significantly lower than Vocabulary, Digit Span, Picture Completion, Object Assembly and Picture Arrangement (at the .01 level of confidence); and Information was significantly lower than Picture Completion at the .01 level, and lower than the Vocabulary and Digit Span at the .02 level.

Altus noted that her results were similar to a previous study she had done in which Arithmetic, Information and Digit Symbol or Coding had turned out to be predictive of graduation of trainees for illiterate soldiers.

Sheldon and Garton (1959) criticized two of the previous studies as being uncontrolled, stating that other intervening variables might have entered into the results. They attempted to control their study by using a group of children matched in age and having "no known reading difficulty." Using the same procedure as Burks and Bruce, they calculated deviation scores rather than scaled scores. They found low scores on Coding and high scores on Block Designs and Object Assembly to differentiate the poor readers. Since their criterion group was small (N = 11), it is difficult to decide how much weight to place in their results.

Spache (1957) studied the profile of the WISC and tried "to avoid the flaws in similar studies by more careful definition of the subjects
and criteria for comparison of subtest results." He considered a value of 3 in the weighted scores above or below the subject's own average as more indicative of a significant deviation. Thus he added a more rigorous definition of deviation than had been employed previously. In an attempt to avoid the effect of intercorrelations and reliabilities among subtest scores, Spache compared each subtest only with the mean subtest score within the same scale. His subjects were 100 retarded readers chosen randomly from clinic files; subjects who showed emotional problems were eliminated from the sample. The ages of the children (mostly boys) were 6-9 to 15-16 at time of testing. The children had a Verbal WISC of 97.0, a Performance of 103.1 and a total WISC score of 99.3. Spache found that using his deviation score of 3 from the child's own average, 90% of the sample showed deviation in at least 1 verbal subtest; 89% showed deviation in at least 1 performance test; and 97% showed deviation from the total WISC score. Spache found almost a 1-3 differential ratio with 31% of the group higher in Verbal scores and 66% higher in Performance scores. The mean difference of almost 6 points Spache found to be a statistically significant difference. His results find high scores in Comprehension, Similarities, Picture Completion, Picture Arrangement, Object Assembly and low scores on Arithmetic and Coding.

Spache advances two alternative explanations for his results and those of previous studies. First, if Verbal differences are the distinguishing factors, then language inferiority may well be the predisposing factor in reading failure. Second, faced with a language inferiority, the retarded reader finds compensatory achievement in other
fields of effort, namely, the performance area. Perhaps, Spache suggests, the retarded reader finds adequate satisfaction in an informal, non-academic adjustment to his environment.

Another single population group study was done by Kallos, Grabow and Guarino (1961). Following the example of Altus, they tested 37 boys with C.A. from 9-0 to 14-0 with Full Scale I.Q.'s from 90-109. Their reading achievement group was retarded by 2 years or more. The significantly high score on this study was Block Design, the significantly low scores were Information, Coding, and Arithmetic. Compared to Altus' results, no statistically different results were obtained in this study. However, the Block Design was high in this study while it was found to be only average in the study done by Altus. Grabow et al. offer the interpretation of the low Coding not as being the farthest from school tasks or as a symbolic disparity function, but as being the result of retarded development of motor-visual skills. Low Information and Arithmetic they postulate as being dependent upon home and school variables.

Hirst (1960) used a two-way analysis of the WISC. She did not use a deviation score of 3, but 2 or 2/3 of a standard deviation. She applied this statistical approach to 30 remedial reading clinic cases whose full scale I.Q. was 89 or above, and whose reading level, as measured by standardized tests, was at least 6 months below their C.A. of 8-0 through 13-6. Her criterion of retardation was less stringent than that of previous studies. Although she found an 11 point difference in I.Q., the difference was not statistically significant. She divided her groups into mild and severe reading disability. Her total group showed high
scores on Picture Completion and Picture Arrangement, and low scores on Digit Span, Arithmetic, Coding, and Vocabulary. The severe retardation group showed the highest performance on the Block Design; all the Performance tests except Coding were higher than the Verbal tests. The lowest scores were on Arithmetic and Coding.

Concerned about the lack of controlled studies, Neville (1961) attempted to compare the WISC performance of matched groups. He chose 53 retarded readers with WISC I.Q. scores of 90 or above that had been selected from a reading clinic and matched with a non-retarded group reading at or above grade level. He was able to match 35 of the original 53 readers on the following factors: 1) total WISC I.Q. within one point; 2) grade level; and 3) sex (all boys). In addition, both groups had been referred to the clinic because of a suspected reading problem. The subtest scores of the WISC were treated by means of a t-test for the significance of differences between correlated groups.

Neville's results show that retarded readers are significantly high in Performance I.Q., with a mean difference of 10.6 points; high in Picture Arrangement and Block Design; and low in Digit Span, Arithmetic and Information.

Noting a factorial analysis of the WISC done by Cohen which found 5 relatively separate factors, Neville applied his findings to those of Cohen's and concluded that retarded readers tend to lack abilities in Verbal Comprehension (Information, Arithmetic, Similarities) and in Freedom from Distractibility (Digit Span); also that they do well in Perceptual Organization (Block Design and Object Assembly) and a factor
involving both Coding and Picture Arrangement. However, he also noted that the best performance of retarded readers did not show a logical factorial patterning. Neville contends that the subtests on which these subjects do their best are clearly divorced from the school situation and that excellent performance on the Picture Arrangement subtest results from long practice in using pictures as clues to the context of the printed page they are unable to read.

Neville questions the assumption of previous investigators that there are certain innate strengths in the retarded reader. Neville prefers to think that the retarded reader is merely underdeveloped in some areas.

Reviewing previous studies, Dockrell (1960) hypothesized the following: that retarded readers would exhibit greater ability in Comprehension and Similarities than the other three subtests of the Verbal Scale; that the Picture Arrangement score would be greater than the Block Design and that the Block Design score would be greater than Coding. His research group of 34 children who had been accepted for remedial instruction by a clinic had a Full Scale mean WISC profile of 104.5. Their ages ranged from 8.2 years to 14.9 years with a mean of 11.1 years. No control group was used. Dockrell's statistical treatment was the t-test of the differences between WISC subtest scores from the means of the total group. He concluded that Arithmetic, Information, and Vocabulary scores are lower than other verbal tests because these abilities are developed either from school or from reading. He does not place much emphasis on the idea of "unconscious resistance." The Coding subtest he believes merits more examination, since, according to him,
learning to recognize nine meaningless symbols, to reproduce them accurately, and to relate them to established meanings (digits) closely resembles learning to read and write. This subtest isolates the visual aspects of reading from the auditory and from meaningful association. Of the skills needed in reading, Coding taps only visual discrimination and memory. He points out also that Goins has found that a test of visual memory and discrimination is a good predictor of good and poor readers even before Grade I. Dockerell concluded, therefore, that Coding measures "visual discrimination and memory skill that is so important in learning to read both letters and numbers throughout the primary school; further, that a typical retarded reader WISC profile with a low Coding score is a diagnostic sign of importance in planning a remedial programme."

Summary

Summarizing the common trends in the studies of WISC profiles of retarded readers is relatively easy; summarizing the conflicting results of the studies is somewhat less easy. The three findings that emerge over and over are low scores in the Information, Arithmetic and Coding subtests for the retarded reader group. The findings on the other subtests are inconclusive because they conflict with each other. High trends are noted in Comprehension, Picture Completion, Picture Arrangement, Block Design, Object Assembly which find no differences or no significant differences between the groups.

Trying to explain these differences in research results is quite difficult. The studies use differing statistical methods, and criteria
for retardation range from mild (less than 1/2 year of retardation) to severe (at least two or more years of reading retardation). With no exceptions, the studies represent a selective referred population and many represent _ex-post-facto_ research methods.

What is needed in research in this area is standardization of criteria, rigorous controls of the various independent variables, such as age (broken down into various levels), intellectual functioning (broken down into more homogeneous groupings), socio-economic background, level of reading retardation, etc. Another suggestion would be to allow less experimenting with statistical techniques and to encourage more replication of the kind of study done by Graham. His profiles revealed significant similarity to the profiles of Croleys study on the Wechsler-Bellevue scales. Replication is needed also on various segments of the population to verify findings and to eliminate sampling error.
CHAPTER III
SPECIFIC PROCEDURES AND ADMINISTRATION

Introduction

In Chapter I, it was specifically noted that an essential aspect of the present investigation was the careful definition and selection of both control and criterion populations and samples. As has been noted in Chapter I, the academically retarded criterion population is that group of children, two or more years retarded in school achievement, and for whom there was no known reason for their retardation. The control population is defined as that group of children from the same socio-economic background, intellectual functioning, race, sex, school system, and, if possible, from the same school who are achieving at an average level commensurate with their ability. By definition, no subject in either population may exhibit any gross physical or psychological problem that would distinguish him as an exceptional child.

This chapter is devoted to the procedures used for the selection of the criterion and control samples, the description of both groups in terms of various independent variables, the administrative and testing procedures involved, and finally a brief description of the various tests used in the investigation.

Selection of Samples

Criterion Sample

Four school districts were contacted as a source of subjects for the research study. A preliminary pilot study of two of the school
systems revealed that their defined academically retarded population were achieving at or above their grade norms as measured by standardized achievement tests, and, therefore, would not meet the retardation criterion. These two school systems were not used in the subsequent investigation. Of the remaining two school districts, choice of school was determined by a combination of several factors:

1. Previous personal contact with the school, or school personnel.

2. Effort to get a cross section of schools through at least two major socio-economic segments.

3. Proximity to the University to minimize transportation time and expense.

4. Readiness of the principal to volunteer his school for the study.

Fourteen schools in all were used, representing urban and suburban, white and mixed populations, and middle and lower socio-economic levels.

Once a school was selected, the cumulative school records of all children Grades IV through VI were examined. Since the study was concerned with those children who were failing for no known reason, all children were eliminated from the sample whose retardation might be attributed to one or more of the following causal factors:

1. Low intellectual functioning as indicated by group, or individual I.Q. tests.

2. Frequent absence, irregular attendance, or frequent change of school, as indicated by attendance records.

3. Poor vision, or hearing problems, as indicated by examination of health records and school photograph.
4. Poor health or physical disabilities, as revealed by nurse's records, physical examinations by physicians, teacher's comments, or parental notes.

5. Severe emotional problems, as indicated by any of the above records and psychological examinations and evaluations.

This preliminary group of children were then given a hearing screening examination to rule out hearing loss; they were also tested by the WISC to establish a better estimate of intellectual functioning. A total of 48 children were finally selected for the criterion sample.

Control sample

As each criterion child was selected, the cumulative folders of all other children in that school were surveyed for possible matching. When a child could not be found to match one of the criterion children in the same school, the criterion child was matched with another child in a different school in the same school system. (Both school systems are highly organized in administrative matters so that the schools in each of these systems use the same teaching methods, texts, and grade achievement standards. For this reason, and because care was taken to match schools of like socio-economic community and racial proportions, the investigator believes that the school environment is not a confounding factor in this investigation.) The children being considered for the control group were also given hearing screening tests, and the WISC. The final matched control child was selected according to the following requirements:

1. No physical disabilities, such as had been used for screening of the criterion children.

2. No severe emotional or behavioral disabilities, such as had been used for screening of the criterion group.
3. School attendance records within standards set up for the criterion group.

4. Sex.

5. Race.

6. Intellectual functioning within 6 I.Q. points of the matched experimental child.

7. Similar socio-economic background (father's occupation, educational background, and community) as measured by McGuire and White's (1955) "The Measurement of Social Status" scale.

Description of Children

The children in the criterion and matched control groups consisted of 48 pairs. Table 3 shows the distribution by sex and racial distribution of the two groups.

<table>
<thead>
<tr>
<th>Race</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>33 pairs</td>
<td>7 pairs</td>
<td>40 pairs</td>
</tr>
<tr>
<td>Negro</td>
<td>8 pairs</td>
<td>0 pairs</td>
<td>8 pairs</td>
</tr>
<tr>
<td>Total</td>
<td>41 pairs</td>
<td>7 pairs</td>
<td>48 pairs</td>
</tr>
</tbody>
</table>

As can be seen, of the 48 pairs of children 7 pairs were girls. All girls were white, whereas 8 of the 33 male pairs were Negro. While the investigator would have preferred a more even distribution of race, academically retarded Negro girls could not be found to meet either the criterion, or control criteria.
The age range of the group varied from 8 years, 10 months (8-10) to 11 years, 4 months (11-4). The I.Q. scores (WISC) ranged from 89 to 123.

The means and standard deviations for the criterion, control, and combined groups are shown in Table 4. The table reveals extreme homogeneity of the groups both in age in months and in WISC I.Q. scores. The WISC I.Q. scores reveal a more homogeneous group than that of Wechsler. The criterion group have a mean age in months of 123.10, with a standard deviation of 7.19; the control group has a mean age of 123.22 months, with a standard deviation of 7.43 months. The WISC mean I.Q. and standard deviation for the criterion group are 99.89 and 7.92, respectively. A mean of 101.70 was obtained by the control group and a standard deviation of 7.26.

Table 4.--Means and Standard Deviations of Age in Months, and WISC I.Q. Scores for the Criterion, Control, and Combined Groups

<table>
<thead>
<tr>
<th></th>
<th>Mean Age</th>
<th>Sigma</th>
<th>Mean WISC</th>
<th>Sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion Group</td>
<td>123.10</td>
<td>7.19</td>
<td>99.89</td>
<td>7.92</td>
</tr>
<tr>
<td>Control Group</td>
<td>123.22</td>
<td>7.43</td>
<td>101.70</td>
<td>7.26</td>
</tr>
<tr>
<td>Combined Groups</td>
<td>123.16</td>
<td>7.31</td>
<td>100.80</td>
<td>7.65</td>
</tr>
</tbody>
</table>

The socio-economic factors show a preponderance of middle to upper-lower rankings as revealed by The Measurement of Social Status scale (McGuire and White, 1955), as represented by their 4 and 5 rankings on a 1-7 continuum.
Administrative Procedures

Many precautions were taken when working with the public school population. Since all children, parents, and schools involved were volunteers, and under no compulsion to cooperate, their willingness to take part in the research depended, in good measure, on the approach of the research team. Because of the care taken in public relations, only one instance of disturbance was reported and only one mother refused to allow her child to be a subject for the research.

Of the twenty principals contacted, permission was received from all twenty. However, only 14 of the 20 schools were sampled because of the difficulty with meeting the academic criterion. Each principal was told what the study entailed, particularly regarding the amount of time that would be involved, both in the screening, and in the actual testing.

As each child was selected as a criterion or control child, letters signed by the school principal were sent to the parents. The fact that the study was sponsored by the school, with whom the general population have more familiarity, rather than by the University, may account for the fact that all but one of the parents signed and returned the permission slips.

Before the day of testing at the University, each parent was contacted and arrangements were made for transportation by taxi. The parents of the criterion group were told that there was no intellectual factor entering into the child's school problems; that, in fact, the child had to be of average (or better) intelligence to be included in the investigation; that the main interest of the investigation was to
find out if there were any vision or hearing difficulties that might account for the child's retardation. This approach met with universal acceptance.

The parents of the control group were also told the purpose of the investigation, and of the need to measure the performance of the child who was doing well the better to understand the child who was not achieving successfully.

Every parent had been contacted both by letter and by phone before the day of testing. Arrangements were made for six children to be tested per day. To prevent a halo effect, all children from one school were tested on the same day. However, in some instances, more than six children were selected from one school and these had to be tested on the second day. It is not known what effects this factor had on the results of the study.

To make the University testing day a less formidable event for the children, certain features were added to the testing schedule. To offset factors of fatigue, boredom, and loss of attention, there were included paper-and-pencil activities for use in between tests, and other items of interest, such as a limited tour of the University and small souvenirs to take home.

Some of the children were found to have eye conditions that warranted further examination. The parents of these children were contacted and notified to this effect. At the end of the project, all parents were once again contacted by telephone and thanked for their participation in the research.
Testing Procedures

All tests of vision, hearing, laterality, and reversals were carried out at The Ohio State University. Testing on campus was only somewhat randomized. Three children were given the hearing and reversals tests in the morning while the other three children were given the optometric, vision perception, and laterality tests in the afternoon. With these two groups of three children each the procedure was reversed in the afternoons.

Scoring

Raw scoring was done at the time of testing by the individual examiner. Attempts were made to conceal the classification of the child, criterion or control group, to prevent a halo effect. Since the total number of children tested number almost 100, the examiners themselves quickly forgot which children had been which at the time of screening. The writer was the only one who had absolute knowledge of the child's classification at the time of testing. The writer also administered the Bender Gestalt and the laterality tests, and she arranged with another person unconnected with the study to help tabulate the final scores.

Testing environment

Testing environment was kept constant throughout the study. All tests of a particular kind were given by one person. Hearing tests were performed in a sound-proofed room. The details of instrumentation and procedure for the hearing testing are discussed in detail in Duchan's (1963) M.A. thesis. Optometric tests were carried out at the School of Optometry under the supervision of the Director of the School of Optometry.
Tests Used

The tests used in the present study fall into several categories: sensori-vision; perceptual-vision; sensori-hearing; perceptual hearing; laterality tests; and, finally, subtests of the WISC. The tests are listed below with a brief description of what each test purports to measure.

I. Sensori-Vision Tests

1. Visual Acuity, O.D.
2. Visual Acuity, O.S.

Visual acuity is a measurement of the minimum separable, i.e., the least distance by which two bodies must be separated to give rise to two distinct impressions. It has been called the "sharpness of vision," just as hearing acuity has been called the "sharpness of hearing." Visual acuity is measured by the Snellen chart and recorded as fractions. The numerator is the distance at which the test was made, while the denominator refers the letter to be read. The measurement norm is generally read as 20/20. If a subject reads at 20/30, he is reading at 30 feet a letter designed for 20 feet. The visual acuity measurements in this study relate to unaided vision or without corrective lenses. All children with refractive errors were eliminated at screening. O.D. stands for Occular Dexter, or right eye; O.S. stands for Occular Sinister, or left eye.

3. Anisometropia

Anisometropia is the condition in which the refractive error of one eye differs from that of the other. Anisometropia is the rule rather than the exception, and for this reason, the term is generally used only to denote a considerable difference between the two eyes. In this study, any difference in the measurement has been noted. Anisometropia sometimes results in monocular vision with suppression of vision in the poorer eye; or use of both eyes with alternating monocular vision.
4. **Phoria Distance**
5. **Phoria Near**

Phorias are functional disorders in that they concern ocular muscle imbalance. Measurements of phoria in this investigation include only the lateral phorias. Phorias represent a tendency for the eyes to deviate from parallel lines of sight. **Esophoria** is the condition in which the line of sight converge closer than the test point of fixation; the external recti being insufficient, the internal recti are relatively stronger and the eyes tend inward. **Exophoria** is the condition in which the position of the lines are such as to converge to a point farther away than the test point; the internal recti being insufficient, the external recti are relatively stronger and the eye tends outward. Either of these conditions fall under the general classification of heterophoria, and are as common as anisometropia. Heterophoria relates to the ability of the eyes to fuse, and may result in fatigue, eye strain, and other symptoms.

6. **Amplitude of Accommodation**

Accommodation is defined as the function whereby the converging power of the optical system of the eye is increased so that light diverging from a near source may be brought to a focus upon the retina. **Amplitude of accommodation** represents the maximum amount of accommodation of which the eye is capable. Amplitude of accommodation is measured in diopter units which is applied as the reciprocal of the distance closest to the eye at which clear vision can be maintained.

7. **Near Point of Convergence**

This measurement refers to the nearest point to which the eyes can converge. A bright pencil or spotlight is brought as near to the eyes as possible. A subjective measure results when the patient reports diplopia or double vision. Generally, when this limit is reached, one eye will turn out. A limit of convergence farther from the eye than 10 centimetres can be considered abnormal (Giles, 1960). If the patient sees double when the eye turns out, this test is also a measure of binocular vision.

8. **Color Screening**

Color blindness is a misnomer; actually very few people have total blindness to color. Color deficiency is a
better term since most people are blind only to certain types of colors. Color screening in this investigation was carried via the use of the Ishihara test which is a series of pseudo-isochromatic plates on which there are a series of numbers. The child is asked to identify the numbers. According to Giles (1960) there is evidence that some children take longer to develop a full color sense than do others. Colors are perceived most readily between approximately 16 and 35 years of age.

9. Stereopsis

Stereopsis is that kind of depth perception created by use of a stereoscope. Stereopsis is an impression of depth which results from the fact that images reaching the two eyes are not identical.

II. Perceptual Vision Tests

1. Reading Reversals Test

This is a test of 27 words, most of which were taken from Gates' Primary Reading Vocabulary Test. All words can be read in a forward or reverse position. The words include the following: no, spot, got, top, on, saw, row, war, keep, team, peek, won, net, pal, bad, am, rat, dab, ton, was, won, tar, nap, dear, now. The child was told to read the words one after the other aloud. The examiner marked a scoring sheet as he read, noting the substitutions or reversals.

2. Bender-Gestalt Test Total Score Using the Koppitz Scoring System

The Bender-Gestalt as developed by Bender (1938) is a series of cards with geometric designs. As formulated by Bender, it is a test of developmental maturity in visual-motor perception and also as a test of emotional adjustment. The original scoring system was qualitatively measured, but has been quantified by Koppitz (1960) with an objective scoring system. The directions for administration of this test are given by Koppitz (1962) and were followed by the present investigator. Since this test was one of the few that could have been influenced by knowledge of classification of child, the writer asked another psychologist to score the test according to the Koppitz manual.
3. **Bender-Gestalt Test Rotations Score**

The scores for this measure were derived from the total scoring system as described in II-2 above. Only the rotations were scored in this measure.

Both II-2 and II-3 are scored negatively; i.e., the larger the score, the more serious the problem. A zero score indicates no perceptual-motor, or emotional problem as present.

4. **Tachistoscopic Measure Using Introduction of Numbers**

5. **Tachistoscopic Measure Using Five-Digit Numbers**

Both of these measures involve the use of the tachistoscope, a device which projects an image on a screen for a brief time. The first measure introduced numbers up until five digits, starting from one digit. The second measure was a series of all five-digit numbers. The exposed time was .01 second. The score is the number of digit units correct.

III. **Sensori-Hearing Tests** (Details and Instrumentation of the hearing tests can be found by referral to Duchan (1963)).

1. **Pure-Tone Acuity Average**

   Pure-Tone frequencies of 500, 1000, and 2000 were averaged for both ears to get a pure-tone acuity average. These frequencies are the ones which are necessary for hearing of the speech range. It was administered by use of the Beltone Audiometer Model 10-A.

2. **Pure-Tone Differential**

   The pure-tone average of one ear was subtracted from the pure-tone average of the other ear to determine if there was a differential similar to visual anisometropia.

IV. **Perceptual-Hearing Tests**

1. **Speech Reception Threshold**

   A Grason Stradler Speech Audiometer, Model 162, was used for the administration of the word tests W-1 and W-2, prepared by the Central Institute for the Deaf. These lists are made up of two-syllable words which have an equal stress on both syllables. (Example: Blackboard). Levels of intensity are attenuated until the child does
not respond to two consecutive words. Then the intensity is raised until the child responds to 2 out of the 4 words given at the final level of intensity. Both this test and the Phonetically Balanced Words Test are measures of "auding" or "hearing for speech" as compared to pure-tone.

2. **Phonetically Balanced Words**

This test is one of a series derived first from the Harvard University Psycho-Acoustic Laboratory to do research with words that were monosyllabic in structure, of equal average difficulty, of equal range of difficulty, of equal phonetic composition and representation of the frequency of the English language. In the list of 50 words given to the child, the intensity was set as 40 db over the child's SRT level. The score was determined by the number right out of the list of 50. If he missed 2 words, his score was 48.

3. **Signal-to-Noise Ratio**

This is a measure of the ability to perceive words against the distraction of extraneous noise. Specifically, it is the difference in db between the intensity of the spoken word, and the intensity of the masking noise. If the spoken word, or signal must be louder than the noise, the score is registered as a db and vice versa. The noise-interference level (plus was recorded when the subject could hear only 50% of the words given.

4. **Rhythm Reproduction**

This test was composed of a group of sounds produced through a telegraph key, which correspond to certain English phrases. "Good morning" would appear as a short, long, short grouping of buzzes. The child was told to listen and reproduce it back over the same telegraph key. Three groups of the same pattern were given back, with 15 patterns in all and making a total of 45 correct possible answers.

5. **Rhythm Discrimination**

In the event that the ability to give back rhythms was dependent on motor skills, another scoring system was used, which relied more on the child's perception of whether he could distinguish from the right pattern and his own. After the child had given back his rhythms in IV-4 above, he was asked to discriminate his correctness of response. Again the total number possible correct answers was 45.
V. Laterality Tests

A number of measures were used in an attempt to discover the best measures of laterality. The scores were derived from a series of small requests of the child to perform a task. These tasks represent items selected from the Van Riper Tests of Laterality (1935) and from Davison's tests (1948) of handedness.

Hand Laterality was tested by the following measures:
- throwing a ball
- winding a watch
- hammering a nail
- brushing teeth
- combing hair
- turning a door knob
- erasing with a pencil
- cutting paper
- cutting meat with a knife
- writing
- using a knife and fork for cutting
- using a baseball bat
- peeling potatoes
- threading a needle
- and screwing a top off a bottle.

Eye Laterality was tested by the following items:
- sighting with one eye at a distant object
- aiming with a rifle
- looking through a hole at an object. (Two trials each.)

Foot Laterality was tested by the following items:
- hopping (3 trials)
- stamping (3 trials)
- kicking a football (2 trials).

From these measures, percentages were derived of the amount of laterality. These distributions represented highly skewed distributions of the J-Curve variety; the raw scores were, therefore, transposed to T-Scores.

1. Eye Laterality, Left-to-Right Measure

T-Scores for the percentage of times the child used his right eye were computed. Six out of 6 right responses would give him a score of 100%.

2. Eye Laterality, Pure or Mixed

This was a dichotomous score dependent on whether the child used his right or left eye consistently 5 out of 6 times. A 4-6 or 3-3 ratio would give him a "mixed" classification.

3. Hand Laterality, Left-to-Right Measure

Thirty responses were possible. However, the child was not always able to give 30 clear responses and the measures ranged from 25 to 30 responses. From these responses percentages were derived and T-Scores were computed.
4. **Hand Laterality, Pure-Mixed Measure**

These scores are dichotomous. If the child averaged 90% either left or right, he was given a "pure" rating, otherwise, a mixed one.

5. **Crossed Laterality**

Scores for Eye, Hand, and Footedness were computed. Any major indication that one or more of these measures was crossed from the others was a sign of crossed laterality. Frequency distributions were computed and transformed to T-Scores.

6. **Mixed Laterality**

If anyone of the lateralities showed significant ambilateral, the child was counted as evincing mixed laterality. Scores were computed as in V-5 above.

VI. **The Sub-Test Patterning of the WISC**

Most of the psychological rationale for Wechsler's sub-tests have been worked out on the Wechsler-Bellevue. Therefore, the following rationale can only be implied for the sub-test patterning of the WISC. However, many of the tests are so similar in nature, that most authors borrow the rationale of the Wechsler-Bellevue and apply it to the WISC. Most of the rationale for the following subtests was derived from two sources: Wechsler (1944) and Rapaport (1945).

1. **Information**

Wechsler believes this subtest to measure the individual's cultural environment and his alertness to it. Rapaport believes it to also be a measure of temporary dysfunction of the memory area in the highly restricted testing situation. Its value may lie in its possibility of providing clues to native endowment, degree of maturation, cultural and social surroundings and possibly a deep-seated malfunctioning or temporary inefficiencies that hamper immediate recall of information actually possessed.

2. **Comprehension**

Wechsler believes this test to measure the ability of the individual to assimilate and evaluate his past experiences
in his present environment, as well as being a measure of that environment. In this respect, the emotional problems of the individual may interfere, and although the person may be aware of the appropriate action to take, he may be unable to organize his response satisfactorily enough to respond appropriately.

3. **Similarities**

Wechsler describes the Similarities test as revealing the nature of the individual's thought processes. The test is scored on a 1 or 2 basis, interpreted as the ability to think on a concrete or abstract level. Rapaport believes the diagnostic implication of this test to be related to verbal concept formation - the individual is able to categorize the objects of his every day life. Both authors stress that this test may represent the characteristic mode of the individual.

4. **Arithmetical Reasoning**

Although the obtained score is somewhat dependent on educational level, Wechsler believes that the test measures such low level arithmetical problems, that the test measures the individual's mental alertness in the field of practical calculations. Rapaport believes that low scores on this test may be influenced by anxiety within the rigid testing situation.

5. **Vocabulary**

Wechsler believes this measure to be directly related to the individual's learning capacity since it measures the amount of verbal information the individual was able to acquire. Rapaport considers the Vocabulary test to be indicative of the environmental stimulation of early childhood and, thus, to reflect early environmental influence.

6. **Picture Completion Test**

Wechsler believes this test to measure the individual's basic perceptual and conceptual capacities. The test requires the ability to identify familiar objects and the ability to distinguish between important and unimportant details. Rapaport believes that the time element involved in this test may reflect the ability to concentrate rather than the ability to attend to details of visually perceived materials.
7. **Picture Arrangement Test**

Wechsler describes this test as calling for ability to comprehend total situations or what has been called social intelligence. Wechsler says it measures general intelligence of a social nature. Rapaport believes this test to measure planning and anticipatory functions, which require a projection into the future. Since anticipation has been likened to "set", this test may involve emotional considerations as well.

8. **Object Assembly**

Wechsler described this test as measuring the working and thinking habits of the individual, and as being useful in revealing reactions to error and frustration. It also seems to indicate ability to perceive spatial relationships, and the ability to deal with whole-part relationships. Rapaport considers this test to be a measure of visual-motor coordination, and thus may provide the examiner with insight into the individual's visual organization and the speed with which he is able to reconstruct visual patterns.

9. **Block Designs**

This test was first described by Kohs as a measure of general intelligence. Since it depends on the ability to solve problems, Kohs regarded it as evidence of analytic and synthetic intelligence. Wechsler agrees with Kohs' rationale as being a good measure of analytic and synthetic abilities, but adds that it could also indicate organic brain damage. Again, Rapaport regards this as a test of visual-motor coordination.

10. **Digit Symbols** (Coding)

Both Wechsler and Rapaport believe this test to measure visual perception and visual-motor coordination. Wechsler believes a low score to indicate a high degree of "neuroticism" since it requires flexibility, attention, and persistence. Rapaport believes this test is particularly sensitive to impairments in visual-motor perception.
CHAPTER IV

STATISTICAL TREATMENT: FINDINGS AND DISCUSSION

Statistical Treatment

Frequency distributions were tabulated on all dependent variable scores which were not known to be normally distributed. When such frequency distributions appeared to be skewed, the raw scores were transposed to T-Scores to meet the assumptions of parametric statistics. The following obtained raw scores were transposed to T-Scores: visual acuity measures, phoria measures, reading reversals, Bender-Gestalt measures, color screening, the tachistoscopic measures, and the tests of laterality that measure the left-to-right continuum.

Of the entire battery of tests used in this investigation, all but four of the tests were given to 48 pairs of children. The four tests given to only 40 pairs include the two measures of rhythm and the tachistoscopic measures. They are noted in the tables.

The academic criterion variable was scored dichotomously since some of the measures proved to be curvilinear in effect. All scores were tabulated on I.B.M. cards and a table of Point Bi-serial Correlations and Intercorrelations were computed. As is noted in the text, the Intercorrelations were computed so as to determine the effect of certain of the independent and dependent variables. Since the hypotheses regarding the sensori-perceptual variables had been predicted in terms of direction, the levels of significance for these measures are
one-tailed tests; all other tests were submitted to two-tailed tests of significance.

Sensori-Vision Scores

Table 5 shows the Point Bi-serial Correlations between the sensori-vision measurements and the academic retardation criterion. It can be seen that none of the eight measures of sensori-vision correlated significantly with academic retardation. As can be seen also, refractive errors were highly similar for the two groups. Of the criterion group, 7 children had refractive errors severe enough to warrant further examination; of the control group, 8 had refractive errors severe enough to warrant further examination. A frequency distribution revealed no differences between the two groups on amplitude of accommodation.

In other words, none of the sensori-vision measures used the study differentiated the underachievers from the average achievers. Moreover, age, sex, race, and I.Q. scores did not correlate with any of these measures except for the color screening, which showed slight but significant relationships to age (.277) and I.Q. (.211).
Table 5.--Point Bi-serial Correlations Between the Sensori-Vision Measures and Academic Retardation

<table>
<thead>
<tr>
<th>Sensori-Vision Measure</th>
<th>Correlation</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Phoria Near</td>
<td>.109</td>
<td>*</td>
</tr>
<tr>
<td>2. Visual Acuity, Right Eye</td>
<td>-.120</td>
<td>*</td>
</tr>
<tr>
<td>3. Phoria Distance</td>
<td>.102</td>
<td>*</td>
</tr>
<tr>
<td>4. Color Screening</td>
<td>.077</td>
<td>*</td>
</tr>
<tr>
<td>5. Anisometropia</td>
<td>-.112</td>
<td>*</td>
</tr>
<tr>
<td>6. Near Point of Convergence</td>
<td>.043</td>
<td>*</td>
</tr>
<tr>
<td>7. Visual Acuity, Left Eye</td>
<td>.025</td>
<td>*</td>
</tr>
<tr>
<td>8. Stereopsis</td>
<td>.002</td>
<td>*</td>
</tr>
<tr>
<td>9. Amplitude of Accommodation</td>
<td>No difference in frequency distribution</td>
<td></td>
</tr>
<tr>
<td>10. Refractive Errors</td>
<td>No difference in frequency distribution</td>
<td></td>
</tr>
</tbody>
</table>

*Not significant

Perceptual-Vision Scores

The correlation coefficients obtained between the five measures of vision perception and academic retardation are shown in Table 6. All of the visual perception scores, listed below, were found to be statistically correlated with academic retardation. Reading Reversals had the highest correlation not only for the measures of visual perception, but for the entire test battery (.456). The two tachistoscopic measures and the Bender-Gestalt measures had lower but still significant correlations. It is interesting to note that the Bender-Gestalt rotations
variable had almost as high a correlation with academic retardation as all the other measures that are included in the total scoring system.

Table 6.--Point Bi-serial Correlations Between the Perceptual Vision Scores and Academic Retardation

<table>
<thead>
<tr>
<th>Perceptual-Vision Score</th>
<th>Number</th>
<th>Correlation</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reading Reversals</td>
<td>96</td>
<td>.456</td>
<td>.001</td>
</tr>
<tr>
<td>2. Tachistoscopic Measure of 5 Digits</td>
<td>30</td>
<td>.306</td>
<td>.001</td>
</tr>
<tr>
<td>3. Tachistoscopic Measure for Introduction of Numbers</td>
<td>80</td>
<td>.237</td>
<td>.001</td>
</tr>
<tr>
<td>4. Bender-Gestalt Total Errors</td>
<td>96</td>
<td>.270</td>
<td>.001</td>
</tr>
<tr>
<td>5. Bender-Gestalt Rotations</td>
<td>96</td>
<td>.229</td>
<td>.01</td>
</tr>
</tbody>
</table>

Discussion of the Sensori-Perceptual Vision Findings

While all the optometric measures in the present investigation were found to be unrelated to academic retardation, all of the perceptual vision measures proved statistically significant. The latter findings confirm the hypothesis that academic retardation is related more to the perceptual aspects of seeing than to the sensory aspects of seeing.

The optometric findings of this study confirm the results of other studies which have found little or no relationship to exist between reading disability or underachievement and individual vision scores. A limitation of the studies in the area of vision has been the lack of controls. For example, many of the studies which produced significant results have compared referred clinical populations with "unselected" school children, or have covered a wide range of intelligence
and/or age. The present study, using strict controls of sex, race, age, and intellectual functioning, found no such relationship with any of the vision scores mentioned. In that respect, therefore, the present study confirms the essentially negative findings of those studies which attempted to control these various independent variables (Monroe, 1932; Farris, 1935; Dalton, 1943). The present investigator must conclude, as did Witty and Kopel (1936) that sensory vision problems are not restricted to, nor necessarily characteristic of academically retarded children.

It should be noted that the present study did not attempt to derive total "duction" scores as was done by Park and Burri (1943) and Kephart (1960). Both of these investigations report high correlations between academic retardation and vision scores when this scoring method was used. As noted by Bing (1960), however, the relationship of vision scores to academic retardation may be clearly seen only when the eye is studied as a totality.

In addition, the writer's conclusions in this regard in no way discounts the presence of vision problems in children with academic retardation. Too many studies have reported gains in achievement after eye problems were corrected. It was the essential part of this investigation to eliminate from the sampling all children who were known definitely to have severe eye problems, the better to study the differences in vision of the undiagnosed child. This present report thus merely states that the undiagnosed child of our sample does not have poorer vision than his achieving matched control.
In contrast to the findings on the sensory aspect of vision, the results of the perceptual aspect of vision are essentially positive. All five measures of vision perception revealed significant relationships with academic retardation. These relationships become even more significant when they are viewed against the background of the control population used in the study. Adequate controls tend to minimize rather than maximize statistical findings, so that even low correlations in a well controlled sample can become more note-worthy than the higher correlations of uncontrolled research. Thus, the negative findings regarding the sensory vision scores here reported tend to negate the possibility that perceptual differences are the result of poor vision: the lack of intercorrelations between these two types of measures indicates the independence of the sensory and perceptual aspects of vision.

Ruling out sensory vision problems, then, tends to give added significance to the fact that all the perceptual vision measures in this investigation were positively correlated with academic retardation. This confirms the original hypothesis that academic retardation has a more significant relationship to perceptual vision problems than to sensory vision problems.

The most significant finding is perhaps that of the Reading Reversals, with its correlation of .456. While previous studies have found that retarded readers have a tendency to reverse, some researchers have tended to minimize the importance of such reversals. Hildreth (1934) states that reversals are certainly more prevalent in poor readers than in good readers, but she believes that these errors are
only one of a number of general problems. Frank (1935) also noticed the reversal tendency but concluded that older disabled readers who make reversals are merely behaving like younger children who are having difficulty with orientation and shape. These writers give the impression that reversals are largely a matter of "outgrowing" a habit, or is the result of "immaturity."

It has also been established that reversals are related to intelligence, and some writers are prone to regard the tendency to reverse as merely a symptom of low intellectual functioning. In our sample, which was extremely homogeneous in intelligence, the intercorrelation of reversals and intelligence was not found to be significant.

While intellectual functioning may be a factor in some cases of reading reversals, the present investigator believes that it cannot explain the presence of reversals in the present study. The aspect of the experiential background in visual perception has not been evaluated in the present research and it would be a variable to consider in future research.

It certainly seems likely that if reversals are permitted to reoccur the response, if uncorrected, can become habitual. Any typist is aware that a typing error is usually one which has been made before. Just such an observation was made by Monroe in 1932. She reported that children have a tendency to be consistent in the type of error they make, whether in reversing, adding, omitting, or substituting letters. Bennett (1942) noticed as well that reversals, particularly word reversals, are hard to eliminate.
It is not enough then merely to view reversals as something to be outgrown. Since this problem is prevalent in academically retarded children up to the middle elementary years, it might better be regarded as a perceptual problem which must be eliminated before it becomes an established pattern that can hamper the child's progress in more advanced work.

Many studies have been done on the effectiveness of tachistoscopic training. Claims have been made for its usefulness (Renshaw, 1945) and for its ineffectiveness (Goins, 1958). Few studies have attempted to utilize this visual perception measure as a discriminating factor in educational retardation. Wolfe (1939), using a tachistoscopic technique, found that academically retarded children tended to reverse letters, words, and letters within words. Goins (1958) has established a perceptual factor related to speed. The present study found that academically retarded children were less able to perceive digits of numbers presented by the tachistoscopic technique. It seems highly probable that any educationally related material presented tachistoscopically, and therefore under a time stricture, will tend to find differences between achievers and underachievers. It is difficult to say at this time if a factor such as perceptual span of digits is influential on academic learning. Similarly, we do not know definitely if a narrowed perceptual span for numbers utilizing a time stricture is a result of negative conditioning to an unpleasant situation; i.e., trying to learn a distasteful subject. The present study merely confirms the difference in perceptual span for digits utilizing a timed tachistoscopic method.
The two Bender Gestalt measures are interesting to compare. While the total scores, using the Koppitz (1962) scoring system have a somewhat higher correlation (.270), the scoring which utilizes only the rotations item has a correlation of .229. These similar correlations, together with the fact that the intercorrelations of the two measures is .758, suggest that the rotations score, by itself, might be diagnostic of academic retardation as distinguished from organic brain damage. If the other measures in the Bender-Gestalt-Koppitz Scoring System were found to be less related to academic retardation and more highly correlated with organic brain damage, then the rotations score could be used as a differential measure. Such a differential sign can only be isolated by future research that uses item analysis, or factor analysis of the total scoring system.

The primary reason for using the rotations measure in the present study was to investigate the possible correlation of this measure with reading reversals. No such relationship was found to exist either with the reversals measure and the rotations measure, or with the reversals measure and the total Bender-Gestalt scoring. However, both the reading reversals and the Bender-Gestalt rotations have a high percentage of zero scores and any relationship between these two measures thus may be masked by the low ceiling on both tests. Further testing between reading reversals and the Bender-Gestalt scores will have to be done at a lower age level where the ceilings are higher on both tests.

Koppitz has stated that after the age of 8, the child with a high score on the Bender-Gestalt has problems in the area of visual-motor perception. It is difficult at the present time to determine
the two distinct components that are involved in this perception. Townsend (1951) has concluded that copying is largely a function of perceptual ability and less that of motor skill. If this be a valid conclusion then the correlations found between the Bender-Gestalt scores and academic retardation would indicate the presence of a visual perception problem in academically retarded children.

Examination of intercorrelations in the present study reveal no relationship with any of these visual-perception measures, nor with the factors of age, sex, race, or intellectual functioning. This finding confirms the opinions of Cole (1953), Lachman (1960) and Durrell and Murphy (1953) that vision perception abilities are independent of chronological age, and of mental age as established by intelligence tests.

Sensori-Perceptual Hearing Findings

Both the sensory and perceptual measures are presented together since they were measured by the same kinds of instrumentation. The findings are shown in Table 7. The measures which are double asterisked in the table are categorized as the sensory measures and include the pure-tone average for both ears, and the pure-tone differential between the two ears. Neither measure showed a correlation with academic retardation.

Of the five perceptual measures of hearing, three are significantly correlated with academic retardation: rhythm reproduction (.365), P.B. Words (.233), and SRT (.207). The two measures of perceptual hearing which are not correlated with academic retardation are the measures of signal-to-noise ratio and rhythm discrimination.
Table 7.—Point Bi-serial Correlations Between Sensori-Perceptual Measures of Hearing and Academic Retardation

<table>
<thead>
<tr>
<th>Sensori-Perceptual Measures</th>
<th>Correlation No.</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rhythm Reproduction</td>
<td>80</td>
<td>.365</td>
</tr>
<tr>
<td>2. PB Words</td>
<td>96</td>
<td>.233</td>
</tr>
<tr>
<td>3. Speech Reception</td>
<td>96</td>
<td>-.207</td>
</tr>
<tr>
<td>4. Pure-Tone Differential**</td>
<td>96</td>
<td>-.107</td>
</tr>
<tr>
<td>5. Pure-Tone Average**</td>
<td>96</td>
<td>.066</td>
</tr>
<tr>
<td>6. Rhythm Discrimination</td>
<td>80</td>
<td>.064</td>
</tr>
<tr>
<td>7. Signal-to-Noise Ratio</td>
<td>96</td>
<td>.049</td>
</tr>
</tbody>
</table>

*Not statistically significant
**Sensory measures

Before going on to the discussion, there should be made mention of two facts. The first refers to the findings of the hearing tests above and those reported by Duchan (1963). In most instances, there is general agreement as to findings. However, a couple of measures are slightly different from hers in their results. An explanation for the discrepancy may lie in the sampling. Her sample is on 40 pair for all the measures used; the present results are on 48 pair except where indicated in the table.

A second notation refers to the negative correlation of the speech reception threshold. It might appear that the correlation favors the academically retarded child. Actually, the higher the score in decibels in this measure, the less acute the level of the hearing. Therefore, the negative correlation favors the average achiever rather than the underachiever.
Discussion of Hearing Findings

The findings on the hearing tests are not as clearcut as the findings on the vision tests. However, there are certainly highly visible trends. Neither of the sensory measures are found to be related to academic retardation, while three out of the five perceptual hearing measures are found to be related. The present investigator must conclude a lack of significant relationship between measures of pure-tone acuity and academic retardation, confirming the substantial majority of previous findings. Furthermore, the negative intercorrelations with age, sex, race, and intellectual functioning reveal that these independent variables in the sample were not influential in the statistical results.

Of the correlated perceptual measures of hearing, rhythm reproduction had the highest correlation of .365 with lower correlations for the PB words (.233) and SRT (.207). The latter measures are significant at the .01 level, the first at an even higher level. The higher correlation of rhythm reproduction confirms previous findings that the more complex the audition function, the greater the correlation to academic retardation.

On the other hand, both the SRT and PB measures require only a simple and immediate verbal repetition of the auditorily perceived stimuli. The rhythm reproduction measure requires not only the grasp of the auditory stimuli of rhythmic patterns, but the ability to hold it long enough "in mind" to reproduce it, and the motor ability to then actually reproduce the pattern.
The PB words and the SRT measures were also significantly related to academic achievement. A determining factor for these measures has been related to intellectual functioning and to verbal comprehension. Thus any statistical finding of PB words and SRT may be more related to the intervening variables of I.Q. and vocabulary than to the criterion measure. Intercorrelations revealed no relationship of these measures and age, race, sex, I.Q., as determined by the WISC or to the Verbal Score of the WISC. However, there were intercorrelations of both measures (PB and SRT) to the Vocabulary score of the WISC. When the vocabulary correlation was partialed out of both measures, they dropped to insignificance. What, then, can we conclude from these data? Is it wise to say that because the PB and SRT measures are positively correlated with the Vocabulary subtest of the WISC, that there is little meaning to the correlation of PB and SRT with academic retardation? The present investigator believes not. Rather, it should be stressed that while the perceptual aspects of hearing, as indicated by PB and SRT, are related to academic retardation, they are particularly related to the verbal deficiency of academic retardation.

Further research in the auding area should take into account this vocabulary factor. Because effects of vocabulary and auding ability are related in this study does not mean that they are identical measures, but rather that future research will have to eliminate the effects of vocabulary before determining the exact relationship of hearing perception to academic retardation.

Another interesting question to pose is: why is there a correlation between rhythm reproduction and no correlation with rhythm
discrimination? Several explanations may be possible. The first is that reproduction and discrimination are two separate abilities. The second is that the discrimination test was not measuring what it purported to measure. The third explanation relates to the second: the judgment of the child was more a reflection of his own self-criticalness than in discrimination. The test required the child to make a judgment on the similarity of his own pattern with the original pattern and children of this age level and in this situation may be unable to give an objective evaluation of their own work.

Results of the hearing tests indicate that pure-tone acuity has little relationship with academic retardation and that the more complex the auding ability, the more related it is to academic achievement. The latter ability is confounded with vocabulary in this study but independent of age, sex, race, and intellectual functioning. Since the levels of all the hearing tests in the present study are relatively simple, it is probable that use of more complex auding tasks would reveal even higher correlations.

Results of Laterality Measures

Point bi-serial correlations between the various tests of laterality and academic retardation are presented in Table 8.
Table 8.--Point Bi-serial Correlations Between Tests of Laterality and Academic Retardation

<table>
<thead>
<tr>
<th>Measures of Laterality</th>
<th>Correlation</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Eye Laterality:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left-to-Right Measure</td>
<td>-.060</td>
<td>*</td>
</tr>
<tr>
<td>2. Eye Laterality:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pure vs. Mixed</td>
<td>-.093</td>
<td>*</td>
</tr>
<tr>
<td>3. Hand Laterality:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left-to-Right Measure</td>
<td>-.071</td>
<td>*</td>
</tr>
<tr>
<td>4. Hand Laterality:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pure vs. Mixed</td>
<td>-.022</td>
<td>*</td>
</tr>
<tr>
<td>5. Cross Laterality</td>
<td>.096</td>
<td>*</td>
</tr>
<tr>
<td>6. Mixed Laterality</td>
<td>.021</td>
<td>*</td>
</tr>
</tbody>
</table>

*Statistically non-significant

As can be seen above, none of the measures of laterality were significantly related to academic retardation. However, these measures of laterality are crude, as are many of the same type, and may be a function of the lack of fine measurement than any inherent lack of relationship. The writer would interpret these findings very cautiously in view of the other studies which have found significant results. Another explanation may be found in the sample selected. These children, by and large, are not the ones that would be found in a referred clinic population; and that their problems are less related to organic difficulties than those who are referred.

There were several intercorrelations of laterality with chronological age and such a correlation seems reasonable as the child learns
to do more and more things with a preferred hand. It is not possible, however, to make unequivocal statements about such intercorrelations, since in a 50 x 50 intercorrelational table, intercorrelations can occur 5% of the time by chance alone. There were no intercorrelations between laterality and intelligence, sex, and race.

Summing up, there seems to be no evidence that laterality in our population has a correlation with academic retardation and the intercorrelations of laterality and other variables will have to be validated in other research specifically designed to investigate those relationships.

Results of the Subtest Patterning of the WISC

Table 9 shows the correlations between the subtests of WISC and the academic retardation criterion. In contrast to previous tables, the order of correlations is not presented in rank but in chronology of giving of the test.

The statistical findings of the subtest patterning are sharply different from most of the previous findings. Only three aspects of the WISC are significantly correlated with academic retardation in the present study. They are in rank order: Information with a correlation of .337, the Verbal Score with a correlation of .288, and the Arithmetic subtest with a correlation of .211. All other measures were not found to be statistically significant, although the next two highest correlations were the Vocabulary at .183 and Picture Arrangement at -.173.
Table 9.—Point Bi-serial Correlations Between Academic Retardation and the Subtest Patterning of the WISC

<table>
<thead>
<tr>
<th>WISC Subtest</th>
<th>Correlation</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total WISC Score</td>
<td>.118</td>
<td>*</td>
</tr>
<tr>
<td>2. Verbal Score</td>
<td>.288</td>
<td>.01</td>
</tr>
<tr>
<td>3. Performance Score</td>
<td>-.042</td>
<td>*</td>
</tr>
<tr>
<td>4. Information</td>
<td>.337</td>
<td>.01</td>
</tr>
<tr>
<td>5. Comprehension</td>
<td>-.075</td>
<td>*</td>
</tr>
<tr>
<td>6. Arithmetic</td>
<td>.211</td>
<td>.05</td>
</tr>
<tr>
<td>7. Similarities</td>
<td>.058</td>
<td>*</td>
</tr>
<tr>
<td>8. Vocabulary</td>
<td>.183</td>
<td>*</td>
</tr>
<tr>
<td>9. Picture Completion</td>
<td>-.031</td>
<td>*</td>
</tr>
<tr>
<td>10. Picture Arrangement</td>
<td>-.173</td>
<td>*</td>
</tr>
<tr>
<td>11. Block Designs</td>
<td>.053</td>
<td>*</td>
</tr>
<tr>
<td>12. Object Assembly</td>
<td>.031</td>
<td>*</td>
</tr>
<tr>
<td>13. Digit Symbol (Coding)</td>
<td>.151</td>
<td>*</td>
</tr>
</tbody>
</table>

*Not statistically significant

The present study, then, confirms those other studies which have found a significant difference between the Verbal Score and the Performance Score of the WISC. Furthermore, since the total WISC scores of the two groups are so evenly matched, the correlation between the Verbal score and academic retardation becomes even more significant.

The two subtests which show significant differences are Information and Arithmetic, the very two abilities or skills that are
tapped by standardized achievement tests. Contrary to the majority of previous studies, there was not found to be a low Coding score; on the contrary, whatever difference there was favored the criterion group. Two major considerations are involved in these differences. The first is that the deficiencies of Arithmetic and Information for the criterion group may only be a validation of the original matching. If such be the case, then the present study has not tapped any essential academically retarded profile. The second consideration is that the low score on the Coding found in other studies may be a reflection of a particular quality of the populations of those studies. It will be remembered that all other studies have used clinically referred reading disability cases, which by and large represent a higher socio-economic segment. Such children, with their superior experiential background may not be deficient in perceptual abilities, and the cause of the reading difficulties may be rather an emotional problem. This emotional problem, then, may be reflected as resistance to learning new material such as that represented by the Coding subtest.

If such a theory be valid, then the Coding subtest may have a diagnostic value in differentiating these two groups. Validation will have to be done in research particularly oriented toward this direction.

It will be noticed that none of the Performance scores were found to be significantly correlated with academic retardation. Such findings do not support the theory that children who are academically retarded tend to be superior in performance tasks.
Summary

The purpose of the present study was to investigate the sensori-perceptual differences of children who were academically retarded, but for whom no causal factor had as yet been established. The underlying hypothesis was that while the sensory aspects would not be related to academic retardation, the perceptual aspects of both vision and hearing would be significantly correlated with academic retardation. The underlying assumption was that while the sensory and perceptual aspects of vision and hearing are better conceptualized as a continuum, this sensori-perceptual continuum can be reasonably dichotomized for purposes of research. In addition, two other areas were also investigated in relationship to both academic retardation and the sensori-perceptual differential. They were the various aspects of laterality and the subtest patterning of the WISC.

For purposes of definition, the undiagnosed academically retarded population was identified as any child, achieving at least 1½ years below national norms for their age and grade, and who evinced none of the following possible reasons for retardation: low intellectual functioning, poor health or crippling, organic handicaps such as poor vision, hearing, or diagnosed or suspected brain damage, foreign language, poor school attendance or frequent change of school, and any
indication of severe emotional problems. Forty-eight children between the ages of 8-10 to 11-4 were found in 14 schools of 2 different school systems to fit these criteria. Of these, 33 were male and 7 were female. All the girls were white, while 8 of the boys were negro. The intellectual scores on the WISC ranged from 89 to 123. The entire sample represents a socio-economic segment not usually investigated in referred clinic populations, but rather represents a preponderance of middle to upper-lower levels of the general population. Contrasting findings of the present study to those of previous studies may reflect the differential of population parameters.

Each of the 48 criterion children was matched to a child of equal intellectual functioning (within 6 I.Q. points on the WISC), race, sex, age (within 6 months), socio-economic environment, and finally school system, but who was achieving at a level consistent with his ability, averaging B and C grades, and who also evinced none of the problems for which the criterion group was screened.

All the children were then tested on the following measures:

1) sensory vision measures as represented by visual acuity of each eye, anisometropia, refractive errors, the lateral phorias, amplitude of accommodation, and near point of convergence, color, and stereopsis;

2) perceptual vision measures as defined by 2 tachistoscopic measures utilizing numbers, reading reversals, and two measures of the Bender- Gestalt test using the Koppitz scoring system; (3) sensory hearing measures as defined by tests of pure-tone acuity, 4) perceptual hearing measures as defined by SRT, PB words, Rhythm, and Signal-to-Noise ratio;
5) laterality as defined by 6 measures of eye, hand, crossed and mixed laterality; and 6) the subtest patternning of the WISC.

Conclusions

General findings indicate that while the sensory aspects of hearing and vision are not significantly correlated with academic retardation, the perceptual aspects of both these areas are significantly correlated with academic retardation. Specifically, the statistical findings are as follows:

1. Of the sensory vision measures used, none were significantly correlated with academic retardation.

2. Of the perceptual vision measures used, all were significantly correlated with academic retardation.

3. Of the sensory hearing measures used, pure-tone acuity was not significantly correlated with academic retardation.

4. Of the perceptual hearing measures used, 3 of the 5 measures were significantly correlated with academic retardation. These 3 measures were SRT, PB words, and Rhythm Reproduction.

Intercorrelations revealed that the various independent variables such as age, I.Q., sex, and race had been successfully controlled and were not influential on the results. SRT and PB words were shown to have an intercorrelation with the Vocabulary subtest of the WISC, which when partialled out lowered the correlations of PB and SRT to insignificance.

Of the various tests of laterality, none were found to be significantly related with either academic retardation or sensori-perceptual differences. Specifically, the findings are as follows:

5. Of the measures of laterality used, none were significantly correlated with academic retardation.
6. Of the measures of laterality used, none were significantly correlated with academic retardation.

Of the various subtests of the WISC, three scores were found to be related to academic retardation and one was related to perceptual hearing. Specifically, the findings are as follows:

7. Of the various subtest scores of the WISC, the following were found to be significantly correlated with academic retardation: Verbal Score, Information, and Arithmetic.

8. Of the significant intercorrelations of the WISC, Vocabulary was found to be related to both the SRT and PB measures of hearing perception. When Vocabulary was partialed out of the hearing measures, both hearing perceptual measures were no longer correlated with academic achievement.

Intercorrelations revealed that the various independent variables have been successfully controlled and are not influential on the results.

Discussion

The writer concludes that undiagnosed children who are Average or better intelligence and who have no gross physical or psychological problem that might account for their retardation, tend to have a sensori-perceptual differential in both hearing and vision which may help to account for differences in academic ability. However, the correlations are low, and cannot account for the entire variance. At the same time, the study was rigidly controlled, and, therefore, any correlations found will be truncated rather than non-existent. In addition, all correlations were significant at the .01 level or better, indicating that the same results will probably be found in a replication of this study on another population.
The highest correlation on the visual perception measures was that of Reading Reversals with academic retardation with a correlation of .456 and indicating the extremely important use of this measure as a diagnostic predictor. The highest correlation of the hearing perceptual measures was that of rhythm reproduction with a correlation of .365. This correlation was found to be uncontaminated by any other intervening variable which indicates that of all the perceptual hearing measures used, this measure is the most predictive and separate of the auding abilities. Such a finding is important as little attention in rhythm has been attempted in the area of academic retardation.

With the exception of an intercorrelation between the auding abilities of PB and SRT measures and Vocabulary, all correlations of perceptions and academic retardation were found to be independent of age, sex, race, and intellectual functioning, confirming studies by Durrell and Murphy (1953) and another series of studies done later by Durrell et al. (1958).

None of the measures of laterality showed significant correlations with academic retardation or with any significant variables as previously mentioned. The writer concludes that either laterality is unrelated to the population investigated or else that the measures used are so gross as to be unable to detect differences which actually exist.

Comparisons of the WISC reveal a significantly different result from most previous studies, which have generally found that at least three subtests are significantly lower for academically retarded children: Information, Arithmetic, and Coding. The present findings
show a significant correlation with only the first two of these tests with correlations of .337 and .211 respectively. In addition, the present study confirms those investigations which have found a substantially lower Verbal Score for the academically retarded group with a correlation of .288.

Educational Implications

A certain amount of intellectual functioning is expected from beginning school children. Generally speaking, it is accepted that a certain mental age level is necessary for the child for the successful completion of the requirements of the first grade. It has been assumed that given the intellectual capacity, a child will have the necessary perceptual vision and hearing perceptions to grasp the significance of verbal symbols. Certain recent studies, however, have shown that these perceptual abilities are independent of age, intellectual functioning, and the results of the present investigation confirm those findings. At the same time, the present study revealed no significant differences between the successful achiever and the underachiever in the sensory or organic aspects of vision and hearing. Thus, the perceptual differences found cannot be attributed to deficiencies of the senses themselves.

What, therefore, can be concluded from these findings? While in no way refuting the fact that there is a continuum for the sensori-perceptual process, the present investigation does emphasize the fact that the perceptual aspect of this continuum is perhaps a more steadily developing process of achievement on the part of the individual. If
through lack of previous experiences, the child does not have the visual perception necessary to grasp the details of the written symbol, he will be unable to successfully integrate the next more complex visual task required of him. Similarly, if the auding aspects of hearing have not been sufficiently stimulated, or if the child has not a large enough vocabulary so that he is overwhelmed by new words, he will again have difficulty in associating the sounds of the symbols in the reading process.

The population of the present study represents a lower socio-economic element with somewhat less enriched environmental background. The learning problems of these children, in contrast to those referred to clinics as reading problems, would tend to be the result of lack of perceptual abilities that prevent them from grasping the fine distinction necessary for academic achievement. Once such difficulty is encountered the perceptual process is associated with feelings of failure and a negative conditioning may be set up. Coleman (1953) found that this perceptual differential becomes cumulative with age up until adulthood. Evidently, the primary difficulties in perception act in fashion of a vicious cycle.

What can be done to halt the cumulative perceptual lag? Studies of perceptual vision reveal several interesting and somewhat consistent trends which together suggest some answers. First, the tasks which differentiate the underachiever are not those connected with straight lines, or geometric patterns, but rather are those patterns which are asymmetrical in design. Of this fact is the positive correlation found in the present study between academic retardation and the Bender-Gestalt
designs, almost all of which are asymmetrical. Second, two studies (Smith, 1928; and Nicholson, 1958) found remarkably similar results; namely, that the beginning of the difficulty of reversals begins not with Capital letters as much as with lower case letters. It is the opinion of the present writer that the lower case equivalent of the capital is much less symmetrical. Compare, for example, the capital "A" which can be grasped as a triangle with the third side acting as a crossbar between the other two, with the lower case "a" which is certainly not equivalent to any common geometric design. In fact, the teaching of writing of this lower case letter emphasizes a substantially different form and looks like: or a circle standing next to a straight line. This form is somewhat dissimilar from the reading-test equivalent. A few other comparisons could be made for B and b, D and d, E and e and right down the alphabet. Third, many studies have confirmed the fact that the most consistent reversal errors occur in those smaller case letters which are alike except for orientation as, for example, in p, b, q, and d. Comparing these to their capital equivalents, we do not find such similarities: P, B, Q, and D. Fourth, reversals are generally higher in children who are academically retarded and the present study found that this tendency to reverse was the highest correlation of all the vision perception tests given.

Some writers have maintained that reversals are simply one of a number of errors made by children, and it is viewed as something which will be "outgrown" as the child "matures." Reversals, of course, are common in Grade I, but in the present study they had not been outgrown as late
as Grade VI or age 11 years. It is about time to become impatient with such a point-of-view. While reversals are a developmental phase, they are surely a hindrance in the co-development of good reading habits, especially when research has already pointed out that errors once made tend to be consistent, and that reversal errors are difficult to eliminate.

Obviously, the answer to halting the perceptual lag must include an attempt to prevent its development. Unfortunately, this implies an educational system somewhat at odds with that presently prevailing in the United States, where there is a tendency to group all children in one class solely on the basis of chronological age and regardless of levels of development. Such an educational system tends to make prominent various levels of achievement among the children, and while they are grouped more homogeneously within the class into "reading groups," this grouping only emphasizes to the children their relative standings. Any first grader will be able to tell you whether or not he is in the first reading group even if it has been disguised under another name. Grouping by classes may lessen the effect of self comparison, but as long as there are grading systems in which the grades of D and F tend to emphasize to the children their beginning difficulties, lessened self-esteem and feelings of failure cannot be prevented.

Measures which can be taken to negate the perceptual differential should take into account several factors. First, there must be heightened recognition of these perceptual deficiencies which means a testing program that includes differential perceptual measures. Several investigators (Goins, 1958; Koppitz, 1962; Durrell and Murphy,
1953) have already found success in the use of perceptual measurements that have good predictive value for school progress. Secondly, intensive training must be given to these children to "catch them up" so to speak, so that they can successfully perform the perceptual tasks required in school subjects.

Durrell and Murphy (1953) have already reported that intensive training in vision and hearing perception of only 10 minutes a day, and as a part of the regular reading program, showed a marked increase in the learning rate of new material. Especially significant is the fact that the children most deficient in these skills were the ones who profited the most. Third, there must be an attempt to prevent the feelings of hopelessness and discouragement which accompany failing grades in the first year of school. Statistics reveal that over 1/2 of all school failures occur in the first grade, a poor start for positive motivation and a good start for the differential lag.

The whole theory of social learning rests on the fact that failure at tasks tends to lower the expectancy level at which one can achieve and to strive toward. In other words, nothing achieves like success, and failure begets failure. Whether the answer lies in some other type of motivational approach or in no grading system at all cannot be answered by the present writer.

Turning the focus toward the perceptual aspects of hearing, the same considerations which have been applied to visual perception can also be applied to hearing perception or auding. In addition, the present study confirms previous studies that the more complex the function of the auding task, the more highly correlated it is with
academic retardation. Furthermore, the relationship of auding and vocabulary are so interwoven as to be confounded. Obviously, the child who starts out in the first grade with a deprivation of spoken language will be under a distinct disadvantage compared to the child who has developed these abilities sufficiently.

If future research cannot separate the auding function from measures of vocabulary, then we must take steps to increase the child's usable speaking vocabulary before attempting to relate it to visual abstractions that represent this vocabulary. Should the auding function be separated from vocabulary, then both the hearing and speaking aspects of vocabulary must be emphasized.

The present study was concerned with the measure of the separate sensori-perceptual processes, but the writer would like to conjecture some purely theoretical considerations involving a multi-perceptual ability. It has become apparent that the more complex the visual or auding task, the higher is the relationship of the task with academic retardation. It seems not unlikely, then, that as a task approaches a combination of these two or more perceptual modalities, the correlation of this multi-perceptual task to academic retardation will become even greater. Assuming that reading is just such a multi-sensory task, an explanation for retardation in reading could be formulated within a perceptual differential framework. Incidentally, the fact that the reversals measure in this study showed the highest of all the correlations may be indicative of just such a bi-perceptual task.
Educational implications of such a theory extend to the training of the separate perceptual abilities or to the training of both abilities jointly. While, the writer would feel predisposed to attempt one or the other separately before joining them into a combined process, Durrell and Murphy (1953) found that they could get greater gains in learning rate by a combined vision and hearing perceptual program.

The negative findings concerning laterality may reflect the population studied, as previously mentioned. On the other hand, laterality may be related more to generally physically handicapped children specifically screened out of the present study.

The fact that differences in the WISC subtest patterning are slightly different from previous studies may also reflect this population differential. Huelsman (1963) has suggested that low scores on the Coding subtest may be the result of negative reactions to the learning of new material caused by emotional problems. Thus low scores on Coding would be more frequent in clinically referred populations. The present population would have difficulty because of previous deprived perceptual experiences so that Coding would be no more affected than any other perceptual task. If this be a valid conclusion, the question becomes whether the Coding subtest can be used as a differential diagnostic measure for these two types of disabled readers, which would ultimately indicate the remedial steps to be taken.

Turning to the positive findings of the subtest scores of the WISC, the present investigation confirms those studies which have found a negative relationship between the Verbal Score of the WISC and
recommendations for future research. The two verbal subtests which correlated significantly with academic retardation were Information and Arithmetic, the very abilities along with reading, which determine standing on standard achievement tests. Whether this fact merely validates the original matching or denotes a predictor effect for learners who have perceptual deficiencies compared to learners who have emotional problems will have to be determined by research oriented specifically toward an answer to this question. The negative findings on the Performance part of the WISC do not lend any support to those who have attributed superior performance abilities to children academically retarded. It would seem that given equal intellectual ability, children who are academically retarded are simply deficient in certain areas of the verbal section.

Recommendations for Future Research

In the area of sensori-vision, the writer would recommend that some sort of total vision score be computed for a population of academically retarded children similar to that of the present study with equally rigorous controls. Two studies that computed such a score found statistically very high correlations while this study only confirms many others that academic retardation bears little relationship to the isolated functions. Since many investigators have suggested that their findings apply to poor binocular vision, there needs to be a better definition of the nature and extent of binocular vision. Finally, the writer suggests that in order to avoid time-consuming errors and
erroneous statistical assumptions regarding various types of measures, the investigator have more background in the area of vision than the writer.

In the area of vision perception, there are many avenues open for further research. First, there should be attempted some sort of graduated scale of visual perceptual abilities such as has been achieved on tests of intellectual functioning. We have already certain elements of such a proposed scale in such examples as the Columbia Test of Mental Maturity. These tests, however, have been predicated on the assumption that visual perception is synonymous with general intelligence. The proposed Visual Perception Scale would have to be independent of I.Q. scores to be consistent with research findings. This scale could be both diagnostic of a child's perceptual level, and instrumental as a guide to enrichment measures.

Parenthetically, a similar scale could be devised for hearing perception or "auding." As a matter-of-fact, the writer has come upon a mention of such a test (Plessas, 1963) but nothing else is known of it. The next obvious avenue of research, once the individual modalities have been scaled, is the scaling of combined visual-audio tasks. Before such a scale can be attempted, however, the vocabulary measure will have to be separated from the auding measure in order to establish more precisely the separate functions of auding and vocabulary.

A number of questions revolve around the Bender-Gestalt test. Item analyses of this test with follow-up studies of their progress may reveal that the various items that are now lumped together as a total
error score may be used differentially. Such a study will have to de-
fine carefully the populations and samples to be used and the writer
recommends the following three types of populations: emotionally
disturbed children, diagnosed brain-damaged children, and academically
retarded children not known to exhibit either emotional problems or
brain damage. To what extent will the different items diagnose these
differential populations? To what extent, if any, is there a relation
between the rotations item and the tendency to reverse? The present
study revealed no relationship on the test at the age levels studied.
Is there an actual correlation between the Bender-Gestalt designs and
any asymmetrical design including lower case letters as has been
suggested by the writer? If so, this would substantiate Kephart's (1960)
hypothesis that children first become acquainted with the perceptual
world, are best able to grasp its Gestalt, in terms of symmetry. The
perception of asymmetry is a sophisticated achievement. Finally, are
there truly separate visual and motor components in the copying of de-
signs both of the Bender-Gestalt or any other type of designs? Or is
it, as has been suggested by Townsend, really a question of visual per-
ception with little motor facility entering into the task? If so, then
to perceive is to accomplish.

This latter consideration opens up an important facet of both
visual and auditory perception. To what extent is the performance of any
motor perception task such as rhythm reproduction or copying designs
a function of discrimination and perception, and to what extent is it
a motor task? The present study found a lack of correlation between
the discrimination and the performance but the writer suggests that
the discrimination test was not valid. It did not test the child's ability to perceive or discriminate so much as it did to pass judgment on himself which contaminates the findings with the child's self-criticalness or shyness to admit success. Future measures of rhythm discrimination should include a more object measure for the child to judge.

In the area of the WISC profile, there should be replications of the present study particularly in regard to the population parameter. If the results obtained in the present study hold up, then there may be a definite differential use of the Coding subtest to categorize a child's learning problem. Low Arithmetic, Information, and Coding may indicate a personality difficulty, while a low score in the first two subtests only may indicate a perceptual experiential learning problem. Such classifications are not worthless. On the contrary, they give us quick clues for further investigation which, if valid, lead to special types of remediation. For truly beneficial results, however, the WISC and its profile will have to be replicated on the lower age levels where there is a better chance to remedy the learning problem given the proper personal and teaching techniques.

The sensori-perceptual problem is not new. It seems merely to be always rediscovered. But now, at last, the sensori-perceptual problem is becoming the focus of research in many institutions of learning and in various fields and professions. The writer believes that such a multi-disciplinary approach will lead eventually not only to a practical solution for academic retardation, but will also supply a basic theoretical formulation of the reading process itself.
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