

AN ABSTRACT OF THE THESIS OF

Beulah G. Gilkey _____ for the M.S. _____ in Education
(Name) (Degree) (Major)

Date Thesis presented Jan. 23, 1941 _____

Title "A Diagnostic Study of the Reversal Tendency in
Elementary School Pupils" _____

Abstract Approved: _____
(Major Professor)

In this study an effort has been made to discover why many children, while reading and writing, reverse symbols, letters, and words. Some few children reverse complete sentences. To determine the occurrence and significance of this problem, tests were given to 324 children in Ainsworth Elementary School in Portland, Oregon. After the results of these tests were analyzed, the 50 children who had made the greatest number of reversals were chosen for special study. Tests for determining hand and eye dominance and intelligence were given. Finally the parents were contacted in an attempt to learn of any emotional disturbances which might affect the progress of the children.

Access to school records revealed much in the way of retardation, and personal conferences with teachers added considerable to general information concerning these children. The Department of Special Education aided materially by giving a Binet Intelligence Test to each child. Several visits were made to the Child Guidance Clinic where it was possible to see at first hand the methods used in treating those who showed reversal tendencies.

It was found from the tests that the reversal tendency decreases with maturation. Of the 50 children tested, 46 per cent were in the first grade, 24 per cent in the second, 18 per cent in the third, 4 per cent in the fourth, 4 per cent in the fifth, and 4 per cent in the sixth and seventh grades. The average number of reversals per child decreased also with maturation except in the seventh grade which was represented by only one child.

There is much variation in the determination of dominance, but an average of the various methods showed that of the 50 children, 58.6 per cent are right-handed, 34.7 per cent are ambidextrous, and 6.7 per cent are left-handed.

Left dominance was indicated to the greatest degree in the thumbs-up test, 66 per cent of the children reacting thus. The ocular test ranked second with a total of 25 children, or 50 per cent. Since left-eye dominance is quite generally accepted as contributing to the reversal tendency, this test is especially significant. Throwing, which some authorities use as a determining factor of handedness, gave four throwing with the left hand, with two alternating.

Of the five children who wrote with the left hand, only one showed left-eye dominance, which means that four had mixed hand and eye dominance, another accepted cause of reversals. All gave left dominance in the thumbs-up test. No child gave complete left dominance and the average for the five was 56 per cent right dominance to 44 per cent left, which indicates decided mixed dominance among the five. Of the 50 tested, none gave complete left or right dominance.

Physical and emotional history of the 50 children was classified under the following heads:

1. Handedness
2. Vision
3. Physical defects or handicaps
4. Emotional disorders, or contributory to
5. Personality traits

Each child proved to possess an average of 3.9 per cent of the traits or conditions listed. Forty-six per cent of the children were left-eyed.

The I. Q.'s ranged from 75 to 133, which verifies the fact that reversals cannot be said to be due to low mentality.

Many of the children with normal I. Q.'s showed retardation or a history of retardation. Again we are faced with the question as to how much of the responsibility for this may be placed upon the tendency to reverse.

The three case histories which are reviewed in Chapter IV were chosen because they were among the most extreme cases studied. Yet all of them improved, the record of J. B. being over a long enough period that complete recovery seemed evident. The second case has recovered so far as reading ability is concerned, while the third is now beginning to show improvement.

An interesting point about these cases is that none is considered left-handed, though M. shows more left tendencies than three of the five children who write with their left hands. Since J. B. was not one of the original 50 cases, test data were not available for him; however, it is significant to note that he wrote with his right hand. J. M. showed left dominance only in the thumbs-up test.

A DIAGNOSTIC STUDY OF THE REVERSAL
TENDENCY IN ELEMENTARY
SCHOOL PUPILS

by

BEULAH GUSTAVIA GILKEY

A THESIS

submitted to the
OREGON STATE COLLEGE

in partial fulfillment of
the requirements for the
degree of

MASTER OF SCIENCE

June 1941

APPROVED:

Redacted for privacy

Professor of Education

In Charge of Major

Redacted for privacy

Head of Department of Education

Redacted for privacy

Chairman of School Graduate Committee

Redacted for privacy

Chairman of State College Graduate Council

ACKNOWLEDGMENTS

The writer wishes to express especial appreciation to Dr. F. W. Parr who, through his counsel and guidance, has made this study possible. For permission to conduct the testing program in the Portland schools, she is indebted to Superintendent E. H. Whitney, Superintendent Norman C. Thorne, Dr. Lewis C. Martin, and Mr. H. M. Barr. Much appreciation is due the following persons for assistance in securing material and aiding in the performance of the program: Dr. H. W. Dixon and Miss Gladys Dobson of the Child Guidance Clinic; Mrs. D. Wilson and other members of the staff of the Department of Special Education, and of the respective libraries of Oregon State College, City of Portland, and the Oregon Medical School; the parents of the fifty children whose cases were studied; Mr. C. G. King and Mr. Earl Condit, principals of Portland schools; the teachers of Ainsworth School; Mrs. Margaret Hartsook; Mrs. Margaret Preston; Miss Pauline Beck; Mrs. Frank Groshong; and my sister, Dr. Helen M. Gilkey.

B.G.G.

TABLE OF CONTENTS

Chapter		Page
I	INTRODUCTION	1
	A. The Problem.	1
	B. Purpose and Value of the Study	3
	C. Source of Material and Method of Procedure.	4
	D. Limitations of the Study	6
II	REVIEW OF SIMILAR STUDIES.	7
	A. Methods of Testing for Reversals . . .	7
	B. Occurrence or Frequency of Reversals .	14
	C. Types of Reversals	17
	D. Causes of Reversals.	18
	1. Left-handedness	19
	2. Visual defects or abnormalities .	23
	3. Sex	27
	4. Emotional disturbances.	28
	E. Remedial Measures.	31
III	AN ANALYSIS OF THE REVERSAL TENDENCY AS RELATED TO THE FIFTY MOST EXTREME CASES AT AINSWORTH SCHOOL	34
	1. Tests for Reversals.	36
	2. Dominance Tests.	39
	3. Physical and Emotional History	44
	4. School History	47
IV	CASE HISTORIES	54
	Case 1 - J. B.	54
	Case 2 - N.	57
	Case 3 - J. M.	60
V	SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND FURTHER STUDIES.	62
	Summary	62
	Conclusions	66
	Recommendations	68
	Further Studies	69
	Bibliography.	70
	Appendix.	75

LIST OF TABLES

Table		Page
I	Age-grade Range of the 50 Children Who Made the Greatest Number of Reversals	37
II	Average Number of Reversals Per Child for Each Test Together with the Average Per Grade on all Tests and the Average Number of Reversals for Each Test for all Grades . . .	38
III	Handedness of the Fifty Reversal Cases According to Three Criteria.	40
IV	A Descending-ascending Scale Showing the Number and Percentage of Children with Left and Right Dominance or Mixed Dominance According to the Tests Designated.	42
V	Showing Dominance Results of the Five Children in This Study Who Write with the Left Hand	43
VI	Showing the Conditions and Traits Which May Indicate Physical or Emotional Instability and the Number of Children Possessing Each .	45
VII	Intelligence Quotient Ratings of 49 Reversal Cases.	47
VIII	Children Arranged Chronologically as to Total Number of Reversals Made on the Four Tests, Giving Intelligence Quotients, Degree of Retardation, History of Retardation, Grade, and Grade Placement	50-51
 Chart		
I	Distribution of Intelligence Ratings of 49 Reversal Cases	48

A DIAGNOSTIC STUDY OF THE REVERSAL TENDENCY IN ELEMENTARY SCHOOL PUPILS

CHAPTER I

INTRODUCTION

A. The Problem

For more than fifty years, doctors and laymen have been puzzled by a curious phenomenon of apparent abnormality. It has been called by various names, the most common of which are: Word blindness, congenital word blindness, mirror writing, mirror reading, and reversals. Despite the name, the fact is that some persons may read or write in reverse, numbers, letters, and words. Whether this tendency is due to incorrect training, to eye defects, to an abnormal brain condition, or to emotional disturbances, has long been a subject of speculation and investigation. Research has been conducted and articles have been published in an attempt to discover not only what the individual does or how he does it, but, primarily, why he performs in exactly the reverse of the accepted method.

From the beginning, the inclination has been to connect reversals with left-handedness. As far back as we have recorded history, left-handedness has been con-

sidered abnormal or sinister, while right-handedness has been considered the normal or dextrous. From these assumptions have grown the words designating these two conditions, sinistrality or left-handedness and dextrality or right-handedness. An article published in 1896 by F. J. Allen and M. T. Contab (1) calls mirror writing "left-handed writing". Teachers who have observed in their pupils the tendency to reverse numbers and letters have usually attributed it to mere directional confusion, though many have noticed that the left-handed children seemed to make more reversals than right-handed children. This led to the quite generally accepted theory that reversals were in some way connected with left-handedness.

Gates (13) in his "Improvement of Reading" believes too often children have been criticized as careless or as making wild guesses when instead they are actually reporting what they see. The mystery to him is that children with these difficulties are able to learn to read at all.

That this tendency to reverse might lead to particular reading difficulties was impressed upon the writer after first-hand experience with two extreme and several minor cases of mirror writing. Some of these are discussed in detail in Chapter IV.

B. Purpose and Value of the Problem

Much emphasis is being placed today upon reading and the problems connected with it. It is evident that a child who sees in reverse or writes from right to left must be handicapped in a schoolroom. Though he may be normal or even superior mentally, his adjustment will necessarily be more difficult than that of a child without this unfavorable condition.

In this research, an attempt has been made to discover to what extent reversals are made throughout the elementary school, in which grades they are most prevalent, when they begin to decrease, and as far as possible to determine their relation to reading difficulties.

The results of this study verify the conclusions reached by similar previous studies, the most outstanding being the decrease of reversals with maturation.

The writer has been particularly interested in the subject in its relation to reading difficulties. Many persons who knew nothing of the existence of this condition have become interested in observing the tendency in retarded pupils. Many high school teachers are watching their remedial cases with added interest. If through this study a new hope has been created for many children who are mentally alert but who are having difficulties

in school, the effort has been worth while.

C. Source of Material and Method of Procedure

Because the writer was a teacher in Ainsworth Elementary School in Portland, Oregon, and was personally acquainted with all the teachers and pupils, that building was chosen for the testing program.

*Four tests were given to each of its 324 children.

When the four tests were scored, the total number of reversals for each child was determined. Previous research has proved that there is a greater tendency to reverse unfamiliar material than familiar. The reversals on the first test were given twice the value of those of the other tests since they dealt with unfamiliar material and were therefore more likely to give the information sought.

The 50 children who made the greatest number of reversals according to the scoring were selected for intensive study. They were then given the following ten tests to determine hand and eye dominance: Cutting, winding, throwing, receiving (with non-dominant hand), easy reaching, energetic reaching, batting, eating, thumbs-up test, and cone ocular test.

*These tests are described in detail in Chapter III.

The Department of Special Education of the Portland Public Schools rendered valuable service in the giving of intelligence tests to these 50 children. The results are both surprising and significant.

Achievement tests for grade placement helped materially in determining whether the children were working up to capacity.

Finally the writer made appointments with the parents of these children. Through these conferences it was possible to discover types of emotional disturbance which were not shown on the school records. The parents seemed intensely interested and many conditions were discussed which probably have had decided influence upon their children but which, to the parents, had previously seemed insignificant. The particular questions asked were:

1. Has your child ever shown any tendency to
left-handedness?
2. Are any relatives left-handed?
3. Have you had any reason to suspect eye or
ear defects?
4. Any speech defect?
5. Is the child nervous or irritable?
6. Sleep well?
7. Any tendency to asthma?
8. Glandular defects?

9. Jealous of other children?
10. Other physical history which might upset the emotional life of the child?

Two other factors which seemed vital were: Home conditions, especially if the home were broken, and whether the child had been adopted. Questions of this type were avoided but the information was sometimes gained during the discussion.

D. Limitations of the Study

Vital as the subject of reversals is in its relation to all academic work, it is amazing how little research material is available. Most authorities agree as to the important part reversals play, yet the elusiveness of this form of behavior presents an obstacle that is extremely difficult to analyze and investigate. The writer felt handicapped in having no authoritative body of facts upon which to base her study.

CHAPTER II

REVIEW OF SIMILAR STUDIES

The libraries of the Oregon State College, the city of Portland, and the Oregon Medical School were canvassed for all available material concerning mirror writing or the tendency to reverse. Some of the most interesting articles, and some of the most enlightening, came from British journals. Some American authorities believe mirror writing to be more common in England than in this country. If it were possible to establish this fact, it might prove significant. The studies reviewed in this chapter have been classified under the following headings:

1. Methods of testing for reversals
2. Occurrence or frequency of reversals
3. Types of reversals
4. Causes of reversals
5. Remedial measures

A. Methods of Testing for Reversals

Testing has been the principal device used to determine reversal tendencies. The administering of these tests and the results obtained are given chronologically in this section.

One of the most interesting studies of reversals was made in England in 1920 and is recorded by Gordon (17). The research was made in special schools after it was discovered that many of these children were left-handed. The schools were designated "Schools for Defective Children" yet these children were not imbeciles. Many were placed there for physical rather than mental difficulties.

When asked to write with the right hand, many wrote mirror-wise. At another time, when asked to write with the left hand, some wrote in reverse. "As a rule the writing was done very rapidly, without hesitation..... But there were other cases where it was evident the child was following carefully with the eye every letter and it seemed certain that the letters were being formed in exact accordance with an optical mental image formed at the time."

Gordon summarized his findings as follows:

1. One left-handed boy wrote mirror-wise with his right hand.
2. Children wrote mirror-wise when asked to begin at the right of the paper.
3. A left-handed teacher was asked to close her eyes and write her name with her left hand. The writing was completely reversed.
4. Most of the mirror-writers were left-handed children who wrote with the right hand.

In 1921 Lucy G. Fildes (11) tested 26 children for reversals. These children, who were reported because of poor reading, had an I.Q. range of from 50 to 111.

The test consisted of two cards with opposite designs. The children were asked to tell whether they were alike or different.

Orton (38) tells of a series of tests given in 1925 to 125 children at a mental hygiene clinic. Only 15 of the children were found to be retarded in reading. One of these showed marked word-blindness while the other 14 showed symptoms to a less degree. Orton noted the following tendencies:

1. Differentiating between b and d.
2. Tendency to confuse pallindromic words
as: was for saw.
3. Ability to read from mirror. (One boy was able to read more rapidly from a mirror than from the printed page.)
4. Ability to write in reverse.

Marion Monroe (33) tells of an intensive study, made in 1928, of eight children at the Iowa State Psychopathic Hospital. It was found that all showed some tendency to reverse letters in words; all confused somewhat the letters b and d, p and q, and n and u; all read fluently when material was held before a mirror; and all

wrote mirror-wise with some facility and unconsciously reversed numbers and letters.

In another study, Monroe gave this series of tests to a group of normal readers and retarded readers:

1. Reading from a card, letters and words,
 some of which were correct, some reversed.
2. Reading from a mirror
3. Reading from copy made in reverse
4. Naming pictures, the order in which they
 were named being noted
5. Writing name with normal hand then with
 unaccustomed hand

Retarded readers showed a more nearly equal writing ability with both hands than did the normal. More stuttering was found in the retarded group. The retarded group showed more variability in speed.

In 1926-27 Helen P. Davidson (9) tested all kindergarten and first grade pupils in four schools. Two tests were used. In the first, a key form was given. After it, five other forms were drawn, one like the key form, one reversed. The children were told to look at the key form, then look along the line for another like it and draw a ring around it.

The second test was word perception. It was similar to Test 1 in that the first word was the key word, one

was like the key word, and one was reversed. The others on the line were similar. Nearly all kindergarten children made some reversals. Though the first grade reversals were much fewer, the percentage was high considering that many words were familiar to them. Aside from this, the teachers had been instructed previously to insure left-to-right eye movements when new words were presented.

In 1933 Teegarden (51) prepared a series of tests for detecting reversal tendencies, hoping in this way to establish preventive measures. The tests were designed to discover to what extent children in the first grade were subject to this confusion and what relation could be found between this tendency and reading progress. The four tests used in this study were:

1. Writing or printing from memory
2. Matching written characters
3. Matching printed characters
4. Copying unfamiliar characters

The results showed it was possible to test for reversals. It was also discovered that children with kindergarten training made fewer reversals than those with no such training.

In the same year, Gates and Bennett (14) report their findings of an experiment in which 350 children were tested for reversal tendencies. Two groups were

selected for special study. The first group was composed of the 26 children making the greatest number of reversals, while the other 26 had made no reversals. The children had the same reading ability, and similar mental ability as judged by intelligence quotients. The reversals group made more errors of all kinds than the non-reversals group.

Pace, in 1937, (40) realizing handedness had long been associated with reading difficulties, prepared tests for university and high school students in an attempt to determine whether handedness were still, at that age, related to reading ability. The university tests showed two-thirds of the laterality cases to be boys. Reading examinations were not given. Results of tests given high school students showed the right-handed students to be superior in speed tests 96 times out of 100, but in comprehension there was little difference.

In 1939 Gertrude Hildreth (22) gave tests in three types of schools. These schools were: A public school, a private school, and a private Hebrew-English school. The reading test contained a word pronunciation test, three paragraphs of oral reading ranging in difficulty from the first to the fourth or fifth grade level, and a perception copying test of increasing difficulty. Finally, intelligence quotients were secured. The medians

were reported as follows:

Public school	100
Private school	119
Hebrew school	116

Lillian Wolfe (55), in 1939, selected for her study two groups of children, a control group and an experimental group. The children of the first group were of average achievement in reading while those of the second group were retarded at least two years. The children were the same age chronologically, all having average intelligence with no special defects, and all were from unilingual, American-born families of the middle class. In these tests the experimental group or the retarded children made a greater number of partial and complete reversals in all tests than the control group. The conclusion was that the control group had established left to right movements while the experimental group had not yet reached this stage.

A study of these tests shows:

1. It is possible to test for reversals.
2. Retarded readers show more nearly equal writing ability with both hands than do the normal.
3. More stuttering is found in the retarded group.

4. Retarded children show more variability in speed.
5. A reversals group makes more errors of all kinds than a non-reversals group.
6. Kindergarten children make more reversals than children in the first grade.
7. Reversals decrease with maturation.
8. Unfamiliar items are more often reversed than familiar ones.
9. Left-handed children are inclined to make more reversals than right-handed children.
10. An appreciable percentage of children show some tendency to reverse.
11. There is no marked tendency to consistency in making reversals.
12. Some words and symbols are more easily reversed than others.

B. Occurrence or Frequency of Reversals

The fact that primary children appear to reverse more frequently than other age groups presents an interesting and perplexing study. A number of research workers have investigated this phase of the general problem. Some of the more significant findings are included in this section.

Teegarden in "Tests for the Tendency to Reversal in Reading" (51) summarizes results of the tests as follows:

1. The reversal tendency may be entirely absent or it may be extreme.
2. The reversal tendency bears a close relation to reading achievement at the end of the first year.
3. Correlation between reversal scores and reading achievement is .541 for children with kindergarten training; .769 for non-kindergarten children.

Hildreth (22) made these conclusions:

1. The frequency of reversals declined in the higher grades.
2. The number of reversals was low as compared with other errors.
3. An appreciable number of children showed no tendency to reverse.
4. Some words and symbols were more easily reversed than others.
5. Items most often reversed were the unfamiliar ones.
6. Some reversals seemed logical.
7. Children in private schools made more reversals than public school children.

8. No cases of pure mirror writing were found.

9. Left-handed children made slightly more reversals than right-handed children.

However, the author makes this assertion: "The inconsistency of the reversal tendency prevents a conclusion that the reversal tendency is a cause of poor reading."

Betts (4) in his "Prevention and Correction of Reading Difficulties" believes that some children exhibit a tendency to reverse until seven and one half years of age and that confusion is encountered if these children are placed in reading situations before that time. He also contends that the dextro-sinistrad (left-handed changed to right) normally resorts to mirror writing.

An article by Dr. Orton (36) published in 1939, asserts that the normal adult uses only one side of his brain. The conflict comes in the effort to decide which side of the brain shall be used, as Orton believes ten per cent of our school population encounters some difficulty in establishing one-sided brain dominance. A combination of heredity and environment determines dominance finally.

It is noticeable that from the beginning, reversals have been connected with left-handedness. While this is still considered one factor, many others are perhaps as

important. The articles reviewed above show:

1. Some right-handed persons write mirror-wise.
2. The reversal tendency apparently has little or no association with intelligence.
3. Eventual recovery is possible.
4. It can be diagnosed.
5. The reversal tendency may be absent or it may be extreme.
6. The reversal tendency bears a close relationship to reading achievement at the end of the first year.
7. The child with the lesser reversal tendency will make the greater progress in school, other things being equal.

C. Types of Reversals

In general, reversals are indicated in two ways, by reading and by writing. There may be, however, variations in these. Reversals may seem to rotate about an axis. In 1937 Wechsler and Pignatelli (52) made a special study of reversals. Their conclusions were that there are three types of reversal errors: b for d, n for u, and N for Z. They believe that in each case the letter has been rotated about an imaginary axis.

Again, some words or letters may be reversed while others are not, which bears out the statement from Hildreth (22) that some words and symbols are more easily reversed than others.

Hildreth (22) found the following four types of writing reversals:

1. Reversal of single letters or numbers as 3 for 6.
2. Reversal of order as 36 for 63.
3. Reversal of letters as pan for nap.
4. Mirror writing as: .yttɹɹ ɹɛɹ I

Reading reversals found were as follows:

1. Pronunciation reversed as on for no.
2. Inversion of order as: Kitty I see, for I see kitty.

D. Causes of Reversals

Second only to a remedy for reversals, the causes are of the greatest concern. Though many tests have been given in an effort to determine these, and though much thought and time have been spent in an attempted solution of this problem, the fact that specific stimuli affect various individuals differently makes it difficult to determine how all would react under given conditions. However, certain facts are rather generally accepted as

contributing causes to the reversal tendency. These are:

1. Left-handedness
2. Visual defects or abnormalities
3. Sex
4. Emotional disturbances

1. Left-handedness

As stated in the introduction, left-handedness has been from the beginning connected with reversals. Following are the results of tests and other research of different authorities.

As far back as 1879, Heywood Smith (47) asserted, "Writing retrographically with the right hand is an effort but is automatic with the left hand." Reasoning by the same method, he assumes that writing from left to right with the left hand requires the same effort as from right to left with the right hand.

Ireland (26) tells this interesting story of Leonardo de Vinci. In his later years, de Vinci wrote from left to right and claimed it was because he wished to "preserve his work from the eyes of superficial readers." It was later learned, however, that his right arm had become paralyzed. It is assumed that he fell into this habit from the necessity of using his left hand.

Ireland also reported the case of a boy who not only wrote mirror-wise but read it fluently. He states,

"There is a physiological tendency of left-handed children to fall into mirror writing."

Mention was made earlier of the article by Allen and Contab (1) in which mirror writing was termed left-handed writing.

In the January 4, 1908 issue of Lancet, Pendred (42) reported the case of a six year old boy who not only wrote mirror-wise but who also drew in reverse. Two weeks later the article was answered by E. Hughes (25), a doctor, who gave in detail his own experience. He was normally left-handed and showed facility as a child in writing in reverse with that hand, though he was taught to use his right hand. During his years of preparation for the medical profession he felt handicapped while taking notes because of "the halting way with which thought followed pen." In recalling his early experience he decided to try taking notes in reverse with his left hand. His first attempt resulted in a neat, even, rapid handwriting, much better than that of his right hand. He could not read it, however, but was compelled to resort to a mirror for transposition. Later he conceived the idea of using transparent paper and turning it over in order to read it. His letter was written after ten years of this method, and though he had continued writing in reverse, he still was unable to read it easily. He says in closing, "Apparently during all

those years the centers on the right side, though unused, were secretly profiting by the training given to the left."

Experiments made with 729 children as reported by Gordon (17) in 1920 show 30 per cent of the left-handed to be mirror writers. Most of the mirror writers were left-handed children who wrote with the right hand. Gordon states that in ordinary schools teachers reported the left-handed children as the brighter while in special schools they were frequently reported as the duller. He found one-third of mixed twins (boy and girl) to be, one left-handed, one right-handed. In eight cases the left-handed child was considered mentally defective while the right-handed child was in an ordinary school. In twelve cases the left-handed child was very nervous.

Gordon states finally: "It is clear that mirror writing is closely associated with mental deficiency, and also with such left-handedness as has been brought to light by tests already described. It is also clear that mirror writing is not itself due to mental deficiency alone as only eight per cent of feeble-minded write mirror-fashion, nor is it due to extreme left-handedness alone, as very few left-handed children in ordinary and physical defective schools write mirror-fashion. Further, it does not seem impossible that the same cause may in some cases have brought about left-handedness and also

mirror writing, that in fact something may have affected the dominant hemisphere. It may have been a lesion causing among other things slight hemiplegia, or it may have been due to defective development of the dominant hemisphere. It would then follow that such left-handedness differed from what is usually termed 'natural left-handedness.'"

In 1924 Beaufort Sims Parson (41) made this statement, "Spontaneous mirror writing occurs only among left-handed children and among right-handed adults who have suffered right hemiplegia and a consequent change of eyedness from right to left—in other words, exclusively among persons who use the left visual line for sighting."

Orton (39) believes right to left to be the normal writing of the left-handed child.

Monroe (33) found retarded children gave a more equal writing ability with both hands than did the normal children.

In 1933 Selzer (46) believed in his testing for lateral dominance, that the tendency of the left-handed child to work from right to left is due not only to greater muscular control but that he may see more readily what he has written.

Tests were given by Woody and Phillips (56) in 1934. They state, "handedness.....had little or no influence on the type of reading responses made."

Among the theories advanced as to hand preference, Betts (4) names the following: Inheritance, visceral displacement toward the right side causing right-handedness, uneven blood supply to cerebral hemispheres, and eye dominance. It may even be an acquired habit. Left brain dominance is believed by many to result in right-hand dominance.

Pace, in 1937, (40) names these additional factors as associated with retarded reading: "Lack of ocular and manual dominance, mixed conditions of ocular and manual dominance, shifts in handedness, ambidexterity, and proportionately high incidence of left-handedness in their immediate families."

2. Visual Defects or Abnormalities

To what extent the reversal tendency can be explained by conditions of the eye is controversial, since apparently reactions differ with circumstances.

As a sub-heading, left-eye dominance has been considered. Though perhaps incorrectly called either a defect or an abnormality, it is a variant which is believed by many to play its part in the reversal tendency.

Ireland (26) believed there were grounds for suspecting that in some cases of mirror writing the image was really reversed.

Albert B. Hale, M. D. (20), in 1901 accounted for reversals from the fact that all images are inverted upon the retina and that it is only from experience that we interpret these images correctly. Since the child and the feeble-minded lack this experience, an inversion is the result.

To Hinshelwood (23), because of his research reported in his book, "Congenital Word Blindness", published in London in 1917, probably belongs the most credit for research on the subject which he terms word-blindness, both acquired and congenital. Many of his cases, especially the acquired, are undoubtedly due to actual defects to the visual memory centers of the brain. Those which he terms congenital may also be due to this. Because children have had no previous experience in reading, it is impossible to refute the statement, but later investigation tends to disprove this in our so-called mirror writers.

Lucy G. Fildes (11) after her testing program, reached the following conclusions:

1. Non-readers are found with all degrees of intelligence.
2. Word-blindness is but one aspect of a more general, yet still in itself specific, defect in either the visual or auditory regions or in both.

In 1927 Gates (13) made the statement that twice as many visual defects are found among children who make reversals and other errors in reading as among other children.

Orton (38) the next year, however, after testing a group of children who reversed, found no ordinary visual defects.

Selzer (46) believes the different types of reversals are due to eye-muscle imbalance. He states, "It will readily be seen that when the alternating takes place with these individuals they will be unable to maintain their point of fixation on the page. As one eye ceases to function and the other assumes control, the point of fixation may move backward, causing a reversal in the reading of letters." Tests made showed ninety per cent of reading disability cases had an eye-muscle imbalance. Compared with 100 other cases examined, imbalance was not found to be common. Two cases fitted with prisms to correct the imbalance showed decided improvement while wearing the prisms.

The author names two types of imbalance, Heterophoria—imbalance of the muscles that rotate the eyeballs, and Suspenopsia—momentary blindness in one or both eyes.

Two tests were given to denote imbalance. First: A red lens was placed over one eye, a blue over the other

while fixating on a white surface. Sometimes it would appear red, sometimes blue. The dominant eye functioned oftener than the non-dominant. Second: A stereoscope was used with two columns of digits. The columns were so arranged that at no time did the same digit appear in both columns. Most persons saw only one column at a time. Some alternated rapidly from one to the other, some slowly. The test determined which eye functioned.

Speaking of eye-muscle imbalance, Selzer says, "This.....is not generally recognized by the ocular profession and many oculists are bitterly opposed to the remedy most needed by these unfortunate children, who, although having average or superior ability, are often regarded as dull and sometimes as feeble-minded."

In his "Prevention and Correction of Reading Disabilities" Betts (4) makes the statement that "lack of normal two-eyed vision may contribute to reversals." The same author (5) considers eye-muscle imbalance as a cause of reversals, but couples it with near-sighted and far-sighted astigmatism. He recommends not only glasses but eye training as well.

Monroe and Backus (34) recommend visual tests for excessive reversals. They list as visual defects affecting reading, refractive errors, eye-muscle imbalance, and restriction of the visual fields.

Marion Monroe (32) in the book entitled, "Children Who Cannot Read," published in 1933, found in all tests given, a tendency for the left-eyed children to make more reversals than the right-eyed.

Gates and Bennett (14) the same year found the left-eyed pupils not only more susceptible to reading difficulties, but much more susceptible to reversals. They say, "Left-eye dominance may be considered a real but by no means an invariable source of difficulty."

Again in 1933, Selzer (46) states that the left-eyed child is handicapped by light over his left shoulder as it forces him "to do the most of his reading with his non-dominant eye."

In 1936 Gates and Bond (15) and Betts (4) state that some believe that eye-dominance determines hand dominance.

Witty and Kopel (54) believe that "left-eye dominance may in some cases induce definite right-to-left eye movement in reading."

3. Sex

Most authorities agree that of retarded readers, the percentage of boys is larger than that of girls. Since they have also been found in many cases to make more reversals, this has been added as a challenge for more future research.

Davidson (9) discovered the boys made a larger percentage of reversals than the girls. She found, however, the mental age of the girls to be higher. In her "Study of Confusing Letters b, d, p, and q" which she published the following year, no sex difference was found in the reversals made by kindergarten children, but in the first grade the boys made more errors than the girls.

In the tests given by Pace (40) to University students, two-thirds of the laterality cases were boys.

Wilson, Burke, and Flemming (53) in 1939 discovered a tendency for boys in the lower grades to make more reversals than girls. Their conclusion was that this tendency may be responsible for the "apparent superiority of girls in progressing in learning to read in grades one and two."

4. Emotional Disturbances

Probably rather general is the belief that emotions play a large part in reading difficulties. To what extent emotional disturbances are responsible for reversals is a matter of conjecture, but there is a growing tendency to attach considerable significance to this factor.

In 1915, Calhoun (6) in his "Report of a Case of Mirror Writing" told of a left-handed child who reversed. He stated that it was not a case for an ophthalmologist but one for a psychiatrist, an alienist, or a neurologist.

Gordon (17) found, as stated under "Left-handedness," many left-handed children to be of a highly nervous temperament. In 12 cases of twins, one of whom was left-handed and one right-handed, Gordon found the left-handed child to be highly nervous.

Gates (13) believes wrong reading techniques may cause emotional and volitional maladjustments. To relieve this condition he suggests that an effort be made to replace these methods with correct ones.

Orton (38) recognizing the almost universal influence of emotional disturbances states that it has now been carried into the realm of children's difficulties and that psychiatrists have found the emotions play a causative part when "associated with special disabilities."

Under "Testing for Reversals", mention was made of the eight children examined in the Iowa State Psychopathic Hospital as reported by Monroe (33). The fact that they were all psychopathic cases and that all showed decided reversal tendencies, makes a connecting link between these two conditions. In additional tests Monroe found in the retarded groups such evidences of emotionality as: stuttering, clearing the throat, saying "ah", and tremulous voice.

Willard C. Olson, in an article published in 1935, observes that many external symptoms of emotion are

apparent to the teacher, blushing, becoming pale, trembling, laughing, and crying being the most common. Glands probably play a large part in emotional behavior. Quoting from Olson (35), "A number of the investigations suggest that an emotional reaction places the organism in a state of readiness for response by additional releases of energy.....The secretion adrenin appears to have a well established function in stimulating the liver to the secretion of blood sugar, in slowing the coagulation rate of the blood, and in increasing the sensitivity of the muscles to nerve impulse. At times the advent of an emotional state is incapacitating since the organism cannot make an adaptation by primitive flight or attack. A fundamental principle in management as related to emotions is that once the energy-releases involved in emotional reactions are set off, there must be some adaptive movement or there will be an emotional explosion.....Some children appear highly emotional and react in an extreme fashion to almost every situation. Still others appear emotionally unstable and their responses are touched off by stimuli that for the normal person are entirely inadequate for the behavior."

Witty and Kopel (54) conclude that "certain conditions of laterality may be contributing factors in emotional difficulties related to poor reading. For example, a strongly left-handed child whose manual

behavior has been changed by unwise pressure may be working under nervous tensions prejudicial to effective learning."

The case of a Mexican boy who wrote mirror-wise is reported by Norma V. Scheidemann (45). Nothing physical which could account for the difficulty was apparent, but the emotional situation was acute. He came from a very poor home; the mother was considered psychopathic and the father had deserted the family, leaving no trace of his whereabouts. The child was normal mentally.

Eva E. Gerstmyer (16) records the case of a highly emotional boy who reversed letters and some words. She states, "As yet there is no specific test given as a check on the emotional characteristics of the child."

E. Remedial Measures

Educators, generally, are interested primarily in preventive measures. But when irregularities exist, remedial measures must be found in an effort to combat the difficulties already present. In this section different types of remedial methods are presented.

Gates' (13) suggestions for remedial work in reading are: "Relief of the emotional and volitional maladjustments," and correction of wrong reading techniques.

In a paper published in the Journal of the American Medical Association in 1928, Dr. Orton (38) offered the word, strephosymbolia, meaning twisted symbols, as a substitute for word-blindness. He believes the assumption of a certain degree of intellectual defect is questionable but difficult to eradicate. Since many of these children exhibit unusual ability in other lines and since many overcome these reading difficulties and later show a high degree of intelligence, Orton attributes it to a physiologic variant rather than to a mental defect, which is definitely more assuring. Since he contends that strephosymbolia is a physiologic variant rather than a mental difficulty, he urges the use of phonics, directional aids, and kinaesthetic training as remedies. In his article "Sight Reading Method of Teaching Reading as a Source of Reading Disability" he states that for children of this type, real harm would be done if they were given only sight words.

Selzer (46) recommends writing on the blackboard from left to right to correct mirror writing. For mirror reading he would use prisms or eye muscle exercises.

Betts (4) would employ the kinaesthetic method—see the word, repeat it, trace it, and finally write it, without copy. In extreme cases he suggests the use of Braille.

Monroe and Backus (34) also suggest the kinaesthetic method.

CHAPTER III

AN ANALYSIS OF THE REVERSAL TENDENCY AS RELATED TO THE
FIFTY MOST EXTREME CASES AT AINSWORTH SCHOOL

Tests and research have proved that many children reverse symbols, letters, and words in both reading and writing. In an attempt to discover why this is true, a series of tests was given to 324 children of Ainsworth Elementary School on Council Crest in Portland, Oregon.

This school is composed principally of children from homes of professional people—doctors, lawyers, professors, and men of business in general. The comforts of home have never been denied these children, and with the most of them, luxuries abound. Almost every home boasts at least one maid, a fact which some persons believe partly accounts for the difficult disciplinary situation in the school. These children are particularly high-strung, but for the most part have a large fund of general knowledge. Some few are from homes of the working class, mostly Italian families, who live down the hill but not outside the district.

Four tests to measure the reversal tendency were given to these children. The first test was a series of 35 symbols, most of which were unfamiliar. Each symbol was placed on a 4" x 6" card, printed large and in black

ink. Each card was displayed for three seconds, then removed while the children reproduced the symbol on paper in the way in which it appeared to them.

In the second test the children were asked to write the numbers from one to 18, and to write the alphabet. In the beginning classes, many of the children were not familiar with all of these, but were encouraged to do their best. When special difficulty was encountered, some of the letters and numbers were named by the examiner, the object being to see how they were made, not whether they could be named.

The third test consisted of nine rows of words. In each row were several words, two of which were alike, and one the reverse of these two, as: nut not cot ton not. The children were asked to find the words which were alike and connect them with a line.

The last test was composed of groups of two or three words. In each group were words with approximately the same letters but in reversed positions, such as owl and low, froth and forth. Two different tests were given, a simple one to the first two grades and a more difficult one to the remaining six grades. In conducting this test, the examiner stated: "Here are two words. I shall name one and you draw a line under the one I say." This procedure was used for each group.

After the tests were scored, the 50 children who had made the greatest number of reversals were chosen for further study. They were given ten tests to determine hand and eye dominance, each was given a Binet intelligence test, and the parents were interviewed concerning the emotional lives of their children.

In this chapter the results of the various tests and histories will be discussed under the following heads:

1. Tests for reversals
2. Dominance tests
3. Physical and emotional history
4. School history

1. Tests for Reversals

This study verifies the findings of previous studies in showing a decrease of the reversal tendency with maturation. Table I shows that 46 per cent of the 50 cases were first graders while 88 per cent were found in the first three grades. The remaining 12 per cent were divided equally between grades 4,5, 6-7.

Since the fourth and fifth grades have only two cases each and the sixth and seventh only one each, it is difficult to assign any significance to results in the last 4 grades. It is interesting to note, however, that the chronological ages show more than their normal

increase between grades 2 and 6. This is no doubt due to the failures that have occurred during this period.

TABLE I

Age-Grade Range of the 50 Children Who Made
the Greatest Number of Reversals

Grade	Average Chron. Age	No. Making Reversals	% Making Reversals
1	6.6	23	46
2	7.6	12	24
3	9.2	9	18
4	9.7	2	4
5	11.6	2	4
6	11.0	1	2
7	13.0	1	2

Table II shows the gradual decrease in percentage of reversals with maturation, per grade, per child, through the sixth grade. Tests 1 and 4 showed approximately the same average. Test 1 dealt with unfamiliar material. In test 4, though similar words were used and the children were asked to underline those named, much of this material also was unfamiliar. Words such as supreme and supernal, used in grades 3 to 8, required the ability to analyze them phonetically. The writer believes the use of unfamiliar material accounts for the higher per-

centages in these two tests. Test 2 consisted of the writing of the digits to 17 and the writing of the alphabet. Only the ones written were considered as many primary children were unable to complete either the digits or the alphabet. Test 3 was merely the joining of words alike as: on so of no on. This would appear to be the least difficult of the four and it proved to be the case.

Special mention should be made of the one seventh grade child who made 8.5 reversals in test 1. She is a child with an I.Q. of 88, a serious sinus infection, a history of school failure, and from a home where the German language is spoken.

TABLE II

Average Number of Reversals per Child for Each Test
Together with the Average per Grade on All Tests
and the Average Number of Reversals for Each Test
for All Grades

Grade	No. of Cases	Average Reversal per Child				Gen. Av. per Grade
		First Test	Second Test	Third Test	Fourth Test	
1	23	4.2	4.2	2.0	5.5	3.9
2	12	2.8	5.0	1.4	3.0	3.0
3	9	2.9	0.5	0.4	6.4	2.5
4	2	3.5	1.0	0.0	4.0	2.1
5	2	1.7	0.0	0.5	5.5	1.9
6	1	0.0	0.0	4.0	0.0	1.0
7	1	8.5	0.0	0.0	1.0	2.4
Average per Test		3.4	1.5	1.2	3.6	2.4

2. Dominance Tests

Various dominance tests were given to determine handedness and eyedness. After these tests were tabulated, three methods were followed to interpret the findings.

The first method is one proposed by Pace (40) in a program for testing laterality in which he used the "University of Minnesota Speech Clinic Questionnaire." According to this criterion, persons with laterality index below 30 per cent were considered left-handed, those between 30 per cent and 85 per cent were considered ambidextrous and all above 85 per cent were classed as right-handed.

The second method is the one used by Gordon (17) in his study of left-handedness and mirror writing. His conclusion is that left-handed throwing indicates left-handedness.

The third method, the one ordinarily used, is to determine handedness by the hand used in writing.

The following table lists the variation in the classification of the 50 cases when grouped into three types of dominance determination.

TABLE III
Handedness of the Fifty Reversal Cases
According to Three Criteria

	Pace's		Gordon's		Writing		Ave. of the 3 criteria	
	No.	%	No.	%	No.	%	No.	%
Right	1	2	46	92	41	82	29.3	58.6
Ambidextrous	48	96	0	0	4	8	17.3	34.7
Left	1	2	4	8	5	10	3.3	6.7

This table indicates the lack of uniformity employed in determining hand dominance. Ambidexterity is believed to be a factor in causing the reversal tendency. Pace's method shows 96 per cent of the 50 to be ambidextrous, while the other two methods combined place only eight per cent in this class. The averages show 58.6 per cent to be right-handed; 34.7 per cent, ambidextrous; and 6.7 per cent, left-handed. Pyle and Drouin (44), in a statistical study of left-handedness, found 6.7 per cent of 13,438 pupils tested to be left-handed. Recording the rate of speed as the children tapped with both hands was the method used in their

study for determining handedness. They believe any other method is inaccurate as the child's original tendency may have been changed for convenience or by a teacher.

Left-handedness has always been associated with reversals. An average of the three criteria places 41.4 per cent in the ambidextrous and left-handed groups. Such variation in determining handedness would seem to make this figure inaccurate, yet Table VI shows 40 per cent to be left-handed, ambidextrous, or to have history of left-handedness in the family.

Since left dominance is the factor sought in Table IV, the ten dominance tests are given in a descending scale based upon the left dominance results. The thumbs-up test gave the highest score, 66 per cent of the children giving left-dominance, with 2 per cent alternating from left to right. In the cone ocular test, 50 per cent showed left-eye dominance, with 4 per cent alternating. A number of authorities agree that persons with left-eye dominance are inclined to make more reversals than right-eyed individuals. According to this test half of the fifty children suffered from this handicap. Some authorities consider throwing a test for left-handedness; only four cases used the left hand in throwing; two alternated. This compares favorably with the writing test in which five used the left hand.

TABLE IV

A Descending-Ascending Scale Showing the Number and Percentage of Children with Left and Right Dominance or Mixed Dominance According to the Tests Designated

	Dominance				Mixed	
	Left		Right		Right and Left	
	No.	%	No.	%	No.	%
Thumbs-up	33	66	16	32	1	2
Ocular test	25	50	23	46	2	4
Easy reaching	19	38	31	62	0	0
Winding	14	28	35	70	1	2
Energetic reaching	11	22	39	78	0	0
Batting	7	14	43	86	0	0
Eating	5	10	44	88	1	2
Throwing	4	8	44	88	2	4
Receiving	4	8	46	92	0	0
Cutting	1	2	49	98	0	0
Average per child	12.3	24.6	37	74	0.7	1.4

In Table V the dominance results of the five children in this study who write with the left hand are indicated in the order in which they showed a tendency to reverse. Case #1 made the greatest number of reversals, #2, second, and so forth. "L" indicates left, "R" right.

It is significant to note that no child showed complete left dominance and none of the 50 tested showed complete right dominance. The thumbs-up test was the only one in which all five left-handed writers showed left dominance. Batting was the only test in which all of

the five gave right dominance. It is interesting to note that only one child showed left-eye dominance in the ocular test. Easy reaching was performed oftener with the left hand by these five reversal cases. Although these children are considered left-handed, the data showed the right hand to be used oftener than the left, the right being used 28 times or 56 per cent as compared to 22 times or 44 per cent with the left.

TABLE V

Showing Dominance Results of the Five Children
in this Study Who Write with the Left Hand

		No. 1	No. 2	No. 3	No. 4	No. 5	Total Left	Total Right
Cutting		L	R	R	R	R	1	4
Winding		L	R	R	L	R	2	3
Throwing		L	R	R	L	R	2	3
Receiving		L	R	R	L	R	2	3
Easy reaching		L	L	R	L	L	4	1
Energetic reaching		L	R	R	L	R	2	3
Batting		R	R	R	R	R	0	5
Eating		L	R	R	L	L	3	2
Thumbs-up		L	L	L	L	L	5	0
Ocular		L	R	R	R	R	1	4
Total left	No.	9	2	1	7	3		
	%	90	20	10	70	30		
Total right	No.	1	8	9	3	7		
	%	10	80	90	30	70		
Average percentage							44	56

3. Physical and Emotional History

The following four sources were used in securing physical and emotional history:

- a. Opinions of teachers
- b. Information received during conferences with parents
- c. Information supplied for children who had been patients at the child guidance clinic
- d. Test data furnished by the Department of Special Education of the Portland public schools

TABLE VI

Showing the Conditions and Traits Which May Indicate
Physical or Emotional Instability and the
Number of Children Possessing Each

Condition or trait	50 reversal cases	
	No.	%
Handedness		
Left-handed	5	10
Left-handed and right-eyed	4	8
History of left-handedness in family	17	34
Ambidextrous	4	8
Vision		
Defective eyesight	14	28
Questionable eyesight	5	10
Wear glasses	11	22
Left-eyed and right-handed	24	48
Physical defects or handicaps		
Asthma and related difficulties	14	28
Overweight	6	12
Glandular defect	2	4
Paralysis, anemia, malnourishment, heart difficulty	5	10
Twin	3	6
Poor coordination	11	22
Emotional disorders, or contributory to		
Chorea	1	2
Speech defects	12	24
Enuresis	1	2
Nervousness	23	46
Timidity	13	26
Deliberate, hesitant	7	14
Foreign language spoken in home	1	2
Adopted	1	2
Broken home	6	12
Personality traits		
Jealousy	1	2
Violent temper	4	8
Total	195	
Average per child	3.9	2

In Table VI a classification has been made of conditions or traits which may indicate emotional instability. Some children were found to possess few, yet the average was 3.9 per child. One child gave evidence of eleven; one, ten; one, nine; two, eight; one, seven; four, six; four, five; and eight, four. Two children showed only one each. The child with eleven has had two grade failures and continues to show a retardation in school. She is left-handed, left-eyed, overweight, a twin, from a broken home, has poor coordination, a serious sinus infection, and defective vision with glasses for correction. The twin sister is not left-handed nor left-eyed but otherwise possesses the same characteristics. Her school work is poor, but is superior to that of her sister. The boy who has ten of the classified traits is also left-handed, has failure history, speech defect, defective eyesight with correction, and eczema.

Forty six per cent of the fifty children are left-eyed. Marion Monroe (32), Gates and Bennett (14) and Witty and Kopel (54) believe definitely that left-eyedness contributes to the tendency to reverse. Pace (40) names mixed eye dominance as contributory to retarded reading. Seventy four per cent, or 37 children, are left-handed; left-eyed and right-handed; or there is history of left-handedness in the family. The thirteen children not

included in this group possessed one or more of the following traits or conditions: Timidity, nervousness, violent temper, poor coordination, speech defect, asthma or related difficulty, or were from broken homes.

4. School History

In the building in which these tests were given, it has been the custom to permit children to proceed as rapidly as possible in the first three grades, but actual grade placement has not been required. Determination of retardation has therefore been based upon achievement tests and upon statements from teachers as to progress.

*In the following table, intelligence quotients of 49 cases show the following: 42.9 per cent of the children have normal intelligence, 44.9 per cent are above normal, while only 12.2 per cent are below normal.

TABLE VII

*Intelligence Quotient Ratings of 49 Reversal Cases

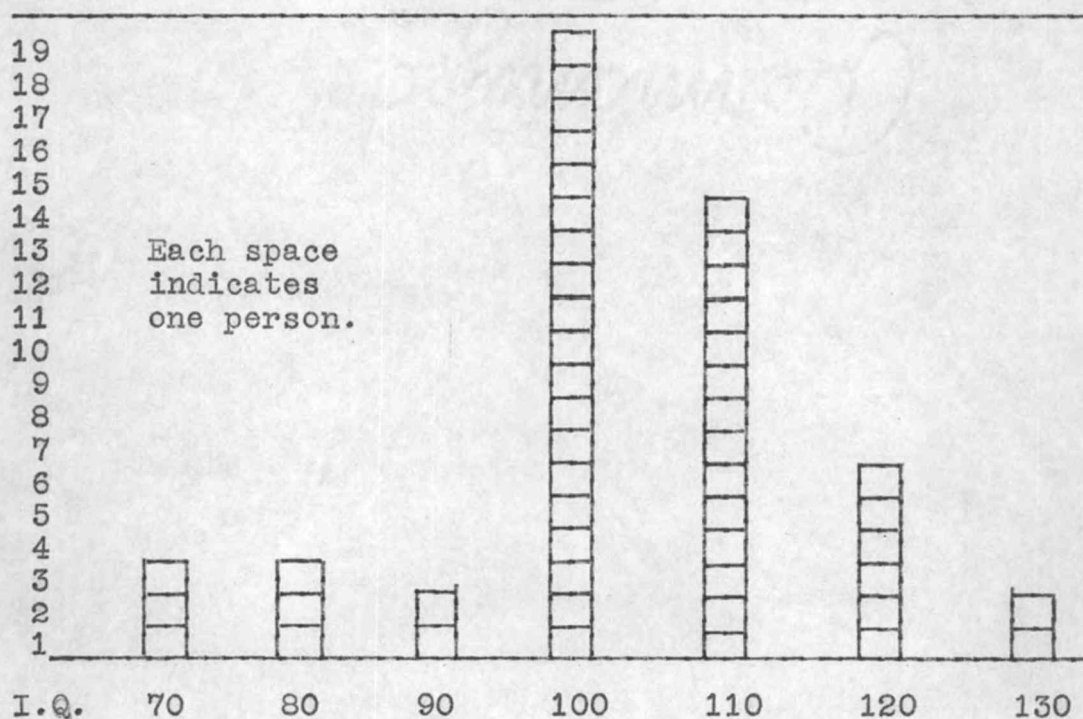
Intelligence Quotient	Number of Children	Percentage
130+	2	4.1
120-129	6	12.2
110-119	14	28.6
100-109	19	38.8
90-99	2	4.1
80-89	3	6.1
70-79	3	6.1

*One child was transferred to a private school because of retardation before his I.Q. was made.

The I. Q.'s range from 75 to 133, with an average I. Q. of 107.7. These data appear to substantiate the theory that intelligence is not related to the tendency to reverse. The following chart also illustrates the range.

CHART I

Distribution of Intelligence Ratings
of 49* Reversal Cases



*One child was transferred to a private school because of retardation before his I. Q. was made.

In Table VIII the children are arranged in chronological order with regard to major number of reversals made. The table also shows I.Q.'s; the degree of retardation of each child based upon achievement tests; histories of retardation secured from teachers and school records; the child's grade in school at the time the test was given; and results of achievement tests. The following tests were used to determine grade placement: New Stanford Achievement Tests, Gates' Primary Reading Tests, Progressive Achievement Tests, and Monroe Reading Tests.

TABLE VIII

Children Arranged Chronologically as to Total Number
of Reversals Made on the Four Tests, Giving
Intelligence Quotients, Degree of Retardation,
History of Retardation, Grade, and Grade Placement

Case No.	I.Q.	Degree of Retarda- tion	History of Retardation	Grade	Grade Place- ment
1	117	-.20		1.45	1.25
2	122	-.05		1.40	1.35
3	108	-.50		2.45	1.95
4	105	-.05	1A Reading - Fair	3.85	3.80
5	115	+.50		1.90	2.40
6	128	-.47		1.90	1.43
7	111	+.14		1.40	1.54
8	92	.00	Repeated 1A	1.40	1.40
9	108	+.10		1.90	2.00
10	133	+.14		1.40	1.54
11	114	.00		1.40	1.40
12	101	+.50	Reading - Fair Difficulty in 1A	1.90	2.40
13	114	-.15		1.90	1.75
14	109	-1.40		1.40	0.00
15	101	+.25		1.40	1.65
16	126	-.70	Repeated 1A	2.45	1.75
17	103	+.20	Repeated 1A	2.45	1.65
18	106	-.31	Repeated 1A	2.45	2.14
19	88	-.70	Repeated 1A	7.90	7.20
20	103	+.05	Reading - Fair	1.90	1.95
21	120	+.67		2.85	3.52
22	117	Normal	I.Q. Requested by Teacher	1.90	No Test
23	103	+.35		3.85	4.20
24	133	-.45		1.90	1.55
25	108	-.70	Demoted From 3A	2.90	2.20
26	112	-.32	Reading - Fair	1.90	1.58
27	114	+.85		1.90	2.75
28	75	-.90	Repeated 2B Twice	2.60	1.70
29	112	+.10		2.85	2.95
30	108	-.45	Clinic states "Very poor memory".	1.90	1.55
31	112	+.03		1.45	1.48
32	115	+.71		2.85	3.56

TABLE VIII (Cont'd)

Case No.	I.Q.	Degree of Retardation	History of Retardation	Grade	Grade Placement
33	107	+.40	Reading - Good	3.40	3.80
34	81	-.40	Repeated 3A twice	2.60	2.20
35	101	+.10		1.40	1.50
36	97	+.55	Repeated 1B	2.45	3.10
37	107	+.05		1.90	1.95
38	78	-.32	Repeated 1B	1.90	1.58
39	120	.00		1.90	1.90
40	85	-.20	Repeated 2B	3.40	3.20
41	76	+.50	Repeated 1A, 1B	4.10	4.60
42	107	-1.10	Request for test "Emotionally insecure"	2.70	1.60
43	113	+2.55		3.85	6.40
44	119	-.25	Difficulty in 1A	1.90	1.65
45	105	+.20		1.90	2.10
46	104	-.45	Repeated 3B	5.45	5.00
47		-.63	Repeated 2B	3.80	3.17
48	116	+1.00	Demoted Emotionally malad.	2.85	3.85
49	126	+1.25	Maladjusted Irresponsible	6.45	7.70
50	102		Reading - Good		

In column 3 of Table VIII, the degree of retardation is determined by the difference between grade and grade placement. If we consider those with $-.50$ or more as retarded, $+.50$ or more as accelerated, and those between these two as normal, we find: retarded, 8; normal, 32; and accelerated, 10. Besides the 8 children who show definite retardation 9 have records of at least one term's retardation due to school failure.

Cases #1, #2, #4, #6, #12, #13, #26, #29, #30, and #44 were reported by teachers as failing at some time during their early years. Cases #20, #22, #42, #48, and #49 are designated in this way: "Reading, fair"; "I. Q. requested by teacher" (indicating suspicion of difficulty); "Test requested by teacher as child is emotionally insecure"; "Demoted because emotionally maladjusted"; and "Irresponsible and maladjusted".

Case #21 (D.M.) reads well, but, because of her tendency to reverse, has much difficulty with spelling, arithmetic, and writing. Her mother, daughter of a Jewish father and a Christian Science mother, is dead, and the child is being reared by a Catholic father and two Catholic aunts. Unwelcome as a baby, she was placed in a foundling home where she remained until removed by the grandmother. Later the parents were divorced, the mother remarried and passed away after the birth of a

baby boy. "D.M." is now taught to hate the Jews.

Cases #2 and #23 are sons of elderly parents. The father is a musician whom the mother admits is very emotional and extremely severe in his discipline. Case #23 gives evidence of chorea.

Case #43 did not talk until four years of age. His father taught him to talk by the use of a mirror. He still has difficulty enunciating clearly but has done good work, due, no doubt, in large measure to his unusually understanding and patient parents.

How much retardation can be ascribed to the reversal tendency of these children is, of course, a question. But the fact that many are retarded in spite of normal mentality, as is shown in Table VIII, tends to indicate that reversals may be responsible for at least some of the trouble.

CHAPTER IV

In the preceding chapter an analysis has been made of the factors relating to the 50 children who were selected for special study in this thesis. It has been impossible in interpreting the data in Chapter III to bring out all of the pertinent facts concerning each child. The writer believes that a discussion of the case histories of several of the 50 pupils will add to the understanding of reversal tendencies as they occur in elementary school pupils.

Three cases to be designated as "J.B.", "N", and "J.M." are discussed in considerable detail in the present chapter. "J.B." is not one of the original fifty who were used in this study, but it was this case which created the writer's interest in this subject. The other cases are included in the 50.

Case 1 - J. B.

J. B. had attended school for one year before entering Mills Open Air School in 1933. He was admitted because of asthma and frequent colds. So far as his academic work was concerned, he showed no evidence of having learned anything especially in reading. He soon began to show an interest in numbers. Short sentences

and finally short paragraphs were copied neatly and painstakingly from the board, but still he did not read.

The mother was a frequent visitor at school. After a few weeks, she remarked that she feared J. B. was just "plain dumb." The reply always given was that he was not a stupid child, but it was impossible to determine his difficulty.

One day a short paragraph was written on the board and J. B. began copying it diligently. Several times he showed evidence of tenseness, but not until his paper was completed and with flushed cheeks he said to the teacher as he passed her the paper, "Is that all right?", was it possible to realize what the effort had meant. He had completely reversed the whole paragraph except for one word, "to". The original paper has been lost in its transfer from teacher to doctor, but the following will serve as an example:

The dog and the cat ran fast. Soon they came to a hill. Here they rested.

But it was written:

The dog and the cat ran fast. Soon they came to a hill. Here they rested.

With this evidence, the difficulty seemed to have been discovered, but how to deal with it was the next problem.

The mother was called and an explanation was made but she was requested to avoid any mention of it to the child. During the evening she asked him to copy something from his blackboard. He sat puzzled for a moment then said, "On which side of the paper should I begin, Mother?" She told him to decide. He began first on the right, hesitated, then changed to the left side and wrote the paragraph correctly.

The next day a conference of the mother, a visiting teacher, and the teacher was held. The visiting teacher was inclined to believe the child had written backward purposely, but after the mother and teacher both assured her that J. B. was not that type of child, she agreed it was a case for Dr. H. W. Dixon, the school psychiatrist. The case seemed so unusual and so important, the mother was urged to take him as a private patient.

Dr. Dixon told her that of the thousands of cases he had had up to that time, this was one of the eight most extreme which he had encountered. He stated that it was due, probably, to a nervous condition and that every effort must be made to keep the boy in a calm non-irritating atmosphere; also, that at certain distances from the board he would perhaps have more difficulty than at others. The mother admitted that the older sister had been teasing J. B. saying that he was stupid and couldn't

learn. The mother corrected this irritability in the home, and the school made a special effort to maintain a quieting influence.

In order to determine where he should sit, an E chart was used and J.B.'s chair was placed in the location where he showed no tendency to reverse.

Almost immediately he began to improve. Once each month for three months he visited Dr. Dixon. In the meantime the doctor's instructions had been followed as closely as possible both in the home and at school. By the end of the school year J. B. was reading practically up to grade. The next year he returned to the same school and became not only one of the best readers in the room, but a most enthusiastic one. The reversing, so far as could be detected, never reappeared.

On November 27, 1939, J. B.'s mother was again contacted. When asked whether he now has any reading difficulties, she laughed as she replied, "No, he is an inveterate reader."

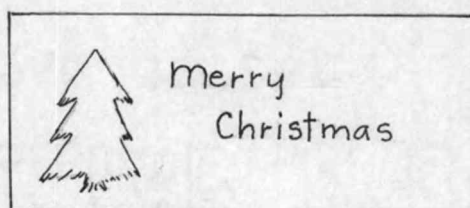
Case 2 - N.

Five years after this experience N. entered a beginning class with this same teacher but in another building. This child's reaction to school was such, it appeared to be a case of retarded mentality. An intelligence test was

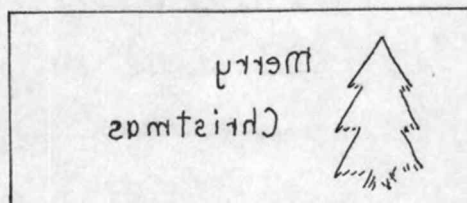
requested but the child was reported normal. Following is the report of the examiner: "Unattractive, large, plump child. Wears glasses. Right eye turns in decidedly. Friendly and talkative but attentive.....Rather weak in motor coordination and sense of form in comparison with other skills."

She was a leader in ability to think of original and unique games, yet she was not popular with the other children. The neighbors tried to be kind to her but she was emotionally maladjusted and made trouble wherever she went. Her school work was inferior and the mother's only response to an appeal for help was that N. hated school and that it was an effort each morning to get her into a school mood.

At Christmas time the children made Christmas cards like this:



but N. made hers this way:



Immediately the mother was called in for a conference. Previous experience with this type of child was explained and the mother was asked concerning the child's nervous condition, whether she might be jealous of the younger brother. The mother admitted that recently when the brother was receiving especial attention, N. had gone to the bathroom and cut herself purposely with a razor.

The necessity of plenty of rest and peaceful surroundings both at home and at school was discussed. Her eyes were refitted, and she was seated where she would have a good view of the board. Particular effort was made on the part of both the parent and the teacher to find qualities in the child, daily, which could be commended.

By the end of January she was reading. From the slowest group she advanced to the one next higher. In a few weeks she was advanced to the next group where she remained until school closed. She was now happy in school.

In September 1939 she returned to the same teacher in the second grade. Again she told her mother she hated school, and in her highly nervous state, created discord in the room. This time a psychiatrist was consulted. He found the school attitude to be the mother's reaction rather than the child's. Gradually the child regained her composure of the spring, was doing good work, and enjoyed school.

Now during her third year she reads with the most advanced group. Her spelling is poor and she is still inclined to be overstimulated emotionally, but she is socially well-adjusted and is one of the leaders of her group.

Case 3 - J. M.

J. M. had been in school three years when this testing program was conducted and he was found to be one of the 50 making the greatest number of reversals. He had a history of retardation from the beginning of his school life but neither the cause nor the remedy had been discovered. An examination by the city health office had pronounced him physically fit. During the conference with the mother she stated he was shy, easily embarrassed, walked in his sleep, and had a violent temper. These indicated effects rather than causes. She then admitted he had a glandular defect and that she had felt it might have interfered with his progress and upset him emotionally, but the doctor had scoffed at the idea. When he was seven and one half years of age, treatments in the form of glandular extract were given him over a period of several months. The result was he began developing female characteristics. Immediately the doctor changed the treatment and at the time of the conference a year

later the boy's defect had been corrected but there was no change in his emotional condition. Nine months later he was placed in a private school where he is receiving almost individual attention, is making progress, and his social attitude is much improved.

Much thought and effort are expended today in helping an adolescent adjust himself to his physical and emotional change. But much more severe must be the struggle of the six-year-old entering school, who is suffering from just as serious an adjustment but of which no one is conscious.

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS,
AND FURTHER STUDIESSummary

In this study an effort has been made to discover why many children, while reading and writing, reverse symbols, letters, and words. Some few children reverse complete sentences. To determine the occurrence and significance of this problem, tests were given to 324 children in Ainsworth Elementary School in Portland, Oregon. After the results of these tests were analyzed, the 50 children who had made the greatest number of reversals were chosen for special study. Tests for determining hand and eye dominance and intelligence were given. Finally the parents were contacted in an attempt to learn of any emotional disturbances which might affect the progress of the children.

Access to school records revealed much in the way of retardation, and personal conferences with teachers added considerable to general information concerning these children. The Department of Special Education aided materially by giving a Binet Intelligence Test to each child. Several visits were made to the Child Guidance Clinic where it was possible to see at first hand the

methods used in treating those who showed reversal tendencies.

It was found from the tests that the reversal tendency decreases with maturation. Of the 50 children tested, 46 per cent were in the first grade, 24 per cent in the second, 18 per cent in the third, 4 per cent in the fourth, 4 per cent in the fifth, and 4 per cent in the sixth and seventh grades. The average number of reversals per child decreased also with maturation except in the seventh grade which was represented by only one child.

There is much variation in the determination of dominance, but an average of the various methods showed that of the 50 children, 58.6 per cent are right-handed, 34.7 per cent are ambidextrous, and 6.7 per cent are left-handed.

Left dominance was indicated to the greatest degree in the thumbs-up test, 66 per cent of the children reacting thus. The ocular test ranked second with a total of 25 children, or 50 per cent. Since left-eye dominance is quite generally accepted as contributing to the reversal tendency, this test is especially significant. Throwing, which some authorities use as a determining factor of handedness, gave four throwing with the left hand, with two alternating.

Of the five children who wrote with the left hand, only one showed left-eye dominance, which means that four had mixed hand and eye dominance, another accepted cause of reversals. All gave left dominance in the thumbs-up test. No child gave complete left dominance and the average for the five was 56 per cent right dominance to 44 per cent left, which indicates decided mixed dominance among the five. Of the 50 tested, none gave complete left or right dominance.

Physical and emotional history of the 50 children was classified under the following heads:

1. Handedness
2. Vision
3. Physical defects or handicaps
4. Emotional disorders, or contributory to
5. Personality traits

Each child proved to possess an average of 3.9 per cent of the traits or conditions listed. Forty-six per cent of the children were left-eyed.

The I. Q.'s ranged from 75 to 133, which verifies the fact that reversals cannot be said to be due to low mentality.

Many of the children with normal I. Q.'s showed retardation or a history of retardation. Again we are faced with the question as to how much of the responsi-

bility for this may be placed upon the tendency to reverse.

The three case histories which are reviewed in Chapter IV were chosen because they were among the most extreme cases studied. Yet all of them improved, the record of J. B. being over a long enough period that complete recovery seemed evident. The second case has recovered so far as reading ability is concerned, while the third is now beginning to show improvement.

An interesting point about these cases is that none is considered left-handed, though N. shows more left tendencies than three of the five children who write with their left hands. Since J. B. was not one of the original 50 cases, test data were not available for him; however, it is significant to note that he wrote with his right hand. J. M. showed left dominance only in the thumbs-up test.

Conclusions

These conclusions confirm studies previously made and add some few generalizations. From this study we find the following:

1. Children with all degrees of intelligence may be subject to the reversal tendency.
2. Left-handedness alone is apparently not responsible for the reversal tendency, as many children who appear to be right-handed, reverse.
3. Eye difficulties appear to be definitely related to the reversal tendency, since 28 per cent of the children had defective eyesight. Ten per cent more had questionable eyesight.
4. Mixed dominance seems to be related to reversals, since 56 per cent of the children tested were apparently right-handed and left-eyed, or left-handed and right eyed.
5. It appears that asthma and similar difficulties are related to reversals, since 28 per cent of the children suffered from these conditions.
6. No one factor is responsible for the reversal tendency.

7. Because left-handedness, defective vision, mixed dominance, and physical defects can cause emotional blocks, and because children may seem normal at times and at other times show an extreme tendency to reverse, it seems reasonable to suspect that emotional imbalance is one of the principal causes of the reversal tendency.
8. Children who reverse should not be placed in classes for retarded pupils but should be referred to psychiatric clinics for emotional adjustment.

Recommendations

Until recent years, most teachers have been inclined to attribute the tendency to reverse to directional confusion or to carelessness. Even today many teachers have had no experience with extreme cases, and without tests to determine the tendency, they are unable to realize how handicapped some of these individuals may be. The writer would suggest the following program for the determination and the correction of the reversal tendency:

By means of a testing program similar to the one used in this study discover the children who are being handicapped by the reversal tendency. The following remedial methods should then be employed:

- a. Stress direction in reading by guides and other kinaesthetic methods.
- b. Discover, through conferences with parents, any emotional or physical difficulties which could hinder the progress of the child. As far as possible, correct these, both in the home and in the school.
- c. Have the eyes examined for general defects and for eye-muscle imbalance, and have correction made.

- d. If the difficulty persists, after a reasonable period of time, the child should be referred to a child guidance clinic.

Further Studies

This study would be incomplete without suggestions for further research concerning the reversal tendency. Though reversals decrease with maturation, it seems reasonable to suppose that the conditions which cause reversals in the beginning grades might at times continue to harass the older child or the adult. High school teachers have become interested in this study in its relation to retarded readers. These teachers have found many indications of the continuation of the reversal tendency in later years. Problems of this type suggest the need for further research as indicated below:

- a. A study of the relation of reversals to retarded reading in the high school.
- b. A comparative study of reversals as related to disciplinary cases.

BIBLIOGRAPHY

1. Allen, F. J. and Contab, M. T. Mirror writing. *Brain* 19:385, 1896.
2. Arthur, Mary Grace. Study of the achievement of sixty grade one repeaters as compared with that of non-repeaters of the same mental age. *Jour. of Experimental Educ.* 5:203-5, Dec. 1936.
3. Betts, Emmett Albert. Physiological approach to the analysis of reading disabilities. *Educ. Res. Bult.* Vol. XIII, Nos. 6 and 7, pp. 135-40, 163-74, Sept. 19, 1934 and Oct. 17, 1934.
4. Betts, Emmett Albert. Prevention and correction of reading disabilities. Evanston, Ill., Rowe, Peterson and Co., 1936.
5. Betts, Emmett Albert. Teacher analysis of reading disabilities. *Elem. Eng. Rev.* Vol. XI, No. 4, 99-102, April 1934.
6. Calhoun, F. P. Report of a case of mirror writing. *Ophthalmic Record* Vol. 24, 1915.
7. Clowes, Helen Coe. Measures which can be used in kindergartens to prevent reading disability cases. *Childhood Educ.* 6:452-57, June 1930.
8. Davidson, Helen Pye. Study of the confusing letters b, d, p and q. *Ped. Sem.* 47:458-68, Dec. 1935.
9. Davidson, Helen Pye. Study of reversals in young children. *Ped. Sem. and Jour. of Gen. Psych.* 45:452-65, Dec. 1934.
10. Eames, T. H. Study of the incidence of eye defects and sex among poor readers. *Jour. of Educ. Res.* 33:102-4, Oct. 1939.
11. Fildes, Lucy M. Psychological inquiry into the nature of the condition known as congenital word blindness. *Brain* 44:286-307, 1921.
12. Gardner, Warren H. Manual of instructions for left-handed writing prepared for use in psychological and speech clinics for permanship teachers. Iowa City, Iowa, 1936.

13. Gates, Arthur I. Improvement of reading: a program of diagnostic and remedial methods. New York, The Macmillan Company, 331-371, 1935.
14. Gates, Arthur I. and Bennett, C. C. Reversal tendencies in reading—causes, diagnosis, prevention, and correction. Bureau of Publications, Teachers College, Columbia Univ., New York City, 1933.
15. Gates, Arthur I. and Bond, G. L. Relation of handedness, eye-sighting, and acuity dominance to reading. Jour. of Educ. Psych. 27:450-56, Sept. 1936.
16. Gerstmyer, Eva E. Diagnosing serious reading difficulties in the primary grades. Nat. Elem. Prin. No. 7, 17:397-402, July 1938. (Bulletin Dept. Elem. Sch. Prin. N.E.A.)
17. Gordon, Hugh. Left-handedness and mirror writing especially among defective children. Brain 43:313, 1920.
18. Gray, Wm. S. Summary of reading investigations July 1, 1938 to June 30, 1939. Jour. of Educ. Res. 33:481-523, March 1940.
19. Haefner, Ralph. Educational significance of left-handedness. Teachers College, Columbia Univ. Contributions to Education No. 360, 1929.
20. Hale, Albert B. Mirror writing and the inverted image. Jour. of Amer. Med. Assn. 37:1380, 1901.
21. Harrison, Martha Lucile. Reading readiness. Boston, New York, etc. Houghton Mifflin Co., 1936.
22. Hildreth, Gertrude. Reversals in reading and writing. Jour. of Educ. Psych. 25:1-20, Jan. 1934.
23. Hinshelwood, James. Congenital word blindness. London, H. K. Lewis Co., 1917.
24. Huggett, Albert J. Experiment in reading readiness. Jour. of Educ. Res. 32:263-70, Dec. 1938.
25. Hughes, E. Mirror writing. Lancet, London, 1:188, Jan. 18, 1908.

26. Ireland, Wm. W. On mirror writing and its relation to left-handedness and cerebral disease. *Brain* 4:1881-82.
27. Jones, Chas. D. Mirror writing. *Boston Med. and Surg. Jour.* 149:515, 1903.
28. Kirk, Winifred Day and Samuel A. Influence of the teacher's handedness on children's reversal tendencies in writing. *Pedagogic Seminary and Gen. Psych.* 47:473-77, Dec. 1935.
29. Koch, Helen Lois et al. Study of the nature, measurement, and determination of hand preference. *Genetic Psych. Monographs* No. 2, 13:117-221, Journal Press, 1933.
30. Lashley, Karl Spencer. Brain mechanisms and intelligence—a quantitative study of injuries to the brain. Chicago, Ill., Univ. of Chicago Press (186 pages), 1929. (Chicago Univ. Behavior Research Monographs).
31. Leland, Bernice. Symptoms of directional confusion among children who cannot read. *Child. Educ.* 14:406-10, May 1938.
32. Monroe, Marion. Children who cannot read: the analysis of reading disabilities and the use of diagnostic tests in the instruction of retarded readers. (Behavior research fund monographs) Univ. of Chicago Press, 1932.
33. Monroe, Marion. Methods for diagnosis and treatment of cases of reading disability. *Genetic Psych. Monographs*, Vol. IV, Nos. 4 and 5, 1928.
34. Monroe and Backus. Remedial reading. Boston, Chicago, New York, etc., Houghton Mifflin Co., 17-24, 1937.
35. Olson, Willard C. Emotional and social factors in learning. *Nat'l. Soc. for the Study of Educ.* Thirty-fourth Year Book, Public School Pub. Co., Bloomington, Ill., 63-77, 1935.
36. Orton, Samuel T. Neurological explanation of the reading disability; with some remarks as to the value of this explanation in treatment. *Ed. Rec.* Sup. 12, 20:58-68, Jan. 1939.

37. Orton, Samuel T. Sight reading method of teaching reading as a source of reading disability. *Jour. of Ed. Psych.* 20:135-143, Feb. 1929.
38. Orton, Samuel T. Specific reading disability—strephosymbolia (twisted symbols). *Jour. of the Amer. Med. Assn.* 90:1095-99, April 1928.
39. Orton, Samuel T. Training the left-handed. *Hygeia* Sept. 1927.
40. Pace, C. Robert. Handedness and reading ability in high school and college students. *Jour. of Ed. Res.* 31:205-10, Nov. 1937.
41. Parson, Beaufort Sims. Left-handedness, a new interpretation. New York, The Macmillan Co., 1924.
42. Pendred, V. A case of mirror writing. *Lancet*, London, 1:20, Jan. 4, 1908.
43. Phillips, Albert J. Relation of left-handedness to reversals in reading. *Elem. Eng. Review* No. 4, 11:97,98, April 1934.
44. Pyle, W. H. and Drouin, Alice. Left-handedness: an experimental and statistical study. *School and Society* 36:253-56, Ag. 20, 1932.
45. Scheidemann, Norma V. Inverse writing—a case of consistent mirror writing. *Ped. Sem.* 48:489-94, June 1936.
46. Selzer, C. A. Lateral dominance and visual fusion—their application to difficulties in reading, writing, spelling, and speech. *Studies in Ed. Psych. and Ed. Meas. Monographs in Educ.* No. 12, Cambridge, Harvard Univ. Press, 1933.
47. Smith, Heywood. On mirror writing. *Lancet*, London, 2:712, 1879.
48. Smith, Madorah. Direction of reading and the effect of foreign-language-school attendance on learning to read. *Ped. Sem. and Jour. of Genetic Psych.* 40:422-51, June 1932.
49. Stromberg, Eugene F. and Elroy L. Left-handedness as a factor influencing academic achievement. *Jour. of Ed. Psych.* 9:335-41, August 1938.

50. Teegarden, Lorene. Clinical identification of the prospective non-reader. *Child Dev.* No. 4, 3:346-58, Dec. 1932.
51. Teegarden, Lorene. Tests for the tendency to reversal in reading. *Jour. of Educ. Res.* 27:81-97, October, 1933.
52. Wechsler, David and Pignatelli, Myrtle. Reversal errors in reading: phenomena of axial rotation. *Jour. of Ed. Psych.* 28:215-21, March 1937.
53. Wilson, Frank T; Burke, Agnes; Flemming, Cecile W. Sex differences in beginning reading in a progressive school. *Jour. of Ed. Res.* 32:570-82, April 1939.
54. Witty, Paul A. and Kopel, David. Sinistral and mixed manual-ocular behavior in reading disability. *Jour. of Educ. Psych.* 27:119-134, Feb. 1936.
55. Wolfe, Lillian S. Experimental study of reversals in reading. *Amer. Jour. of Psych.* 52:533-61, Oct. 1939.
56. Woody, Clifford and Phillips, A. J. Effects of handedness on reversals in reading. *Jour. of Educ. Res.* 27:651-62, May 1934.

APPENDIX

Test 1

Explanation

You have been given a sheet of paper with lines like this one. (Holds paper so children may see it.) I hold in my hand some cards. On each card is a design or number. I will show you one at a time and I want you to make it on the paper you have. First, I want you to make an X on your paper like this. (An X is written on the examiner's paper and held so children can see it.) When I show you the next one, I want it written under the X on the next line, the next under that, and so on down the line. When we reach the last line, I shall show you what to do next. Is there anyone who does not understand what he is to do? (If so, repeat directions.)

Now I am going to hold before you one card for 3 seconds. When I take it away, I want you to make the design on your paper. (Care must be taken that every eye is on the examiner before a card is displayed.)

(On the following page are the designs as they should be arranged.)

Test 1

Name _____ Age _____ Grade _____

X

X

7

9

|||

E

F

←

<

C

L

L

U

J

F

F

J

P

S

24

Z

FCJ

Δ

36

7

on

Z

was

C

42

Z

ton

Test 2

Explanation

You have a blank sheet of paper. Down this side of the sheet I want you to write the numbers beginning with 1 and ending with 16. Turn your paper over when you have finished.

(Wait for all before presenting next test.)

Beginning here (point to center of first line) I want you to write the letters beginning with a and ending with z. You will not have room for all down here, so you may put the last ones down this side of the paper.

Test 3

Sample Page

Name _____ Age _____ Grade _____

In each row, connect the two words which are alike.

so to flow bow so now

but can go new tan can

(Same procedure on next page)

Test 3

Name _____

on	so	of	no	on	up	ot
got	pot	top	got	ton	tog	
not	go	rot	run	ton	rot	
cart	bark	hard	track	dark	bark	
peek	keep	keen	peel	keep	leap	
chin	thin	inch	rich	chin	chick	
hand	dash	band	shad	hash	band	
very	wavy	every	ever	rave	ever	
pal	pat	tap	lap	pan	pal	

Test 4

Sample Page

Name _____ Age _____ Grade _____

Underline the word dictated:

bend

sendcat

hat

(Same procedure on next page)

Test 4

Name _____

notdearinch

ton

read

chin

was

team

net

sawmeatten

dab

band

armbadhand

mar

panbarkcold

nap

dark

clad

ban

even

quite

nab

neverquietendpeek

from

den

keep

form

pal

owlcardlap

low

crab

signal	blots	clot
single	bolts	colt
seizes	pliers	flies
sizes	pillars	files
sacred	follow	trial
scared	flow	trail
blower	supreme	tarpon
bowler	supernal	trapan
silver	draught	clod
shiver	brought	cold
sliver		
froth	brunt	eulogy
forth	burnt	eugenol
palace	perch	
place	preach	

Master Summary Sheet

	Test 1	Test 2	Test 3	Test 4
Name	Complete Reversals	Complete Reversals	Complete Reversals	Complete Reversals
	1/2 Reversals	1/2 Reversals	1/2 Reversals	1/2 Reversals
	Other Errors	Other Errors	Other Errors	Other Errors
	Remarks	Remarks	Remarks	Remarks
	Complete Reversals	Complete Reversals	Complete Reversals	Complete Reversals
	1/2 Reversals	1/2 Reversals	1/2 Reversals	1/2 Reversals
	Other Errors	Other Errors	Other Errors	Other Errors
	Remarks	Remarks	Remarks	Remarks
	Complete Reversals	Complete Reversals	Complete Reversals	Complete Reversals
	1/2 Reversals	1/2 Reversals	1/2 Reversals	1/2 Reversals
	Other Errors	Other Errors	Other Errors	Other Errors
	Remarks	Remarks	Remarks	Remarks
	Conclusions			