# ROTATIONS IN VISUAL MOTOR TASKS AND REVERSALS IN ORAL READING

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# CURRICULUM STUDIORUM

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# INTRODUCTION

In the differential diagnosis of poor readers, many causes have been found to be contributing factors. These range from purely psychological to purely physiological. Cases have been reported where the cause of poor reading is evident brain damage or hearing loss ranging from minimal to severe. Cases of negativism where passive resistance is used against the efforts to teach reading have also been reported. In most cases, these are evident and easily discernable as the cause and can be dealt with accordingly, but there is a group which does not display these obvious symptoms and also defies corrective measures. The performance of this group shows difficulty with language symbols which is never overcome completely continuing to plague the individual's reading.

This study is concerned with one of the types of errors found in the performance of these poor readers and its relationship to the child's visual-manual performance. The previous studies in this area have been concerned with the relationship of difficulty with language symbols and abstraction and have not studied the extent of the directional difficulty.

This paper will attempt to study the relationship of difficulty in directionality in reading and that found in

other visual motor tasks as sampled by the WISC Performance Subtests. The first chapter will be concerned with the related studies in the various areas involved in this problem. The second chapter will contain the formulation of the hypothesis, a description of the sample, the experiment, and the statistical analysis of the data. The final chapter will deal with the presentation and discussion of the results. The obtained results will be given and discussed in terms of past and future researches.

# CHAPTER I

## REVIEW OF THE LITERATURE

In order to adequately describe the problem of directional confusion, four areas of the literature will be covered in this chapter. The first will cover the etiology and the expression of the symptom. The second will cover the normal development of directionality in the child; the third, the effect of directional confusion on visual motor tasks and reading. In the fourth, the visual motor factor of the WISC Performance Subtests will be considered.

### A. Clinical Description of Poor Readers.

Burt[1] in 1921 called attention to errors in reading which consisted of failure to discriminate between similar visual forms, especially those which differed in orientation or order of component parts. Hildes[2] in the same year also noted that some readers had difficulty in discriminating between similar forms on different spatial orientations and he stated that this difficulty was greater when the method

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1 C. Burt, Mental and Scholastic Tests, London, King, 1921, p. 269-295.

2 L.G. Hildes, "A Psychological Inquiry into the Nature of the Condition Known as Congenital Word Blindness", in Brain, Vol. 44, 1921-1922, p. 286-307.

of perception was strictly visual. Kussmaul[3] in 1877 had described this as congenital word blindness, and Hinshelwood[4] elaborating on this, said that this type of performance "very closely parallels that which appears in adults who have lost the capacity to read because of injury to the brain". Orton,[5] however, disagreed and pointed out that this is not blindness for the subject can see the words and copy them, but when asked to read aloud they are unable to read the material as it appears but distort the letters and words. He refined and renamed the symptomatology of this type of performance which had been called word blindness or developmental alexia. According to Orton those evidencing an ability to see the words but having a tendency to distort the order of recall of the visual image of the word could be described as displaying "strephosymbolia".

This type of performance, described as rotations or reversals of the figures, has been classified by Wechsler and Pignatelli[6] into four types:

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3 A. Kussmaul, "Disturbance of Speech", in Ziemssen's Cyclopaedia of the Practice of Medicine, Vol. 14, Sampson Low, London, 1878, p. 770.

4 J. Hinshelwood, Congenital Word-Blindness, H.K. Lewis, London, 1917, 112 p.

5 S. Orton, Reading, Writing and Speech Problems in Children, London, Chapman and Hall, and W.W. Norton Co. Inc., New York, 1937, 315 p.

6 D. Wechsler and M.L. Pignatelli, "Reversal Errors in Reading: Phenomenon of Axial Rotation", in Journal of Educational Psychology, Vol. 28, 1937, p. 215.

1. on the vertical axis d-b;
2. on the horizontal axis b-p, m-w;
3. on the depth axis m-w, d-p; and
4. on two axises h-y, b-q.

In the literature reversals are described as occurring not only in the reading of letters but in the combination of letters, syllables and words. These produce in some cases unrecognizable distortions of words while in others the letters are reversed to produce another word: not - ton, was - saw, there - three. In some cases, the words are transposed in the sentence still making sense but in a different order.

The Scandinavian[7] school as represented by Knud Hermann[8] and Magorah Maruyama describe this type of error in reading as:

1. distortions of which there are three types -
   (a) rotation: p-d, q-b, u-n, m-w, and variations in words;
   (b) horizontal mirror image: p-q, b-d, s-z, mob-dom, May-Yam; and,
   (c) vertical mirror image: p-d, q-d, u-n, M-W, pox-box.

A second large division is described as:

2. disorganization where errors such a permits-pretism, remunerate-reereantum are made.

3. is a mixture of disorientation and disorganization: appendix-abbixeud, compute-sombent, size-sein.

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7 J.R. Gallagher, "Part II, Reports on Medical Research, European Research in Reading Disability, Report of Personal Visits in England, France, and Denmark", in Bulletin of the Orton Society, Vol. 8, issue of May, 1958, p. 11-14.

8 K. Hermann, Reading Disability, Springfield, Illinois, Charles C. Thomas, 1959, 183 p.

The etiology of this type of performance has been variously attributed to inconsistency of learning or training, heredity, emotional negativism, cerebral dominance and laterality, and soft signs of brain damage, and poor metabolic functioning.

Orton,[9] in discussing the functional supremacy of one brain hemisphere or cerebral dominance, stated:

> In considering (...) the functional supremacy of one brain hemisphere -- it is essential that we bear in mind not only that it is clearly demonstrable only in man but that even in man it is only in the language faculty of the more intricate manual skills that this specialization is to be found and that, for many of the simpler activities of the brain, the relation of the two hemispheres to each other while a variable one is quite different from that underlying speech, reading and writing.

Other workers have failed to find any relationship between laterality and/or cerebral dominance and the language faculty. Goodglass and Quadfasel,[10] in working with aphasics, state that "cerebral laterality for language and handedness are not directly linked and one does not determine the other(...)". Brain[11] comments that "(...) anomaly of handedness is a symptom and not a cause of the disorder underlying the congenital aphasias".

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9 Orton, Op. Cit., p. 28.

10 Goodglass and F.A. Quadfasel, "Language Laterality in Lefthanded Aphasics", in Brain, Vol. 77, 1954, p. 205.

11 W.R. Brain, "Speech and Handedness", Lancet, Vol. 249, 1945, p. 837.

The literature on this part of the problem is quite extensive. Dayhaw[12] has an extensive review of the literature dealing with the question of laterality and its relation to intelligence, personality, language, reading and writing. Some of the studies done to relate crossed or mixed laterality and poor reading performance are: L.C. Smith[13] who found that there was no significant differences between the retarded and normal readers on most of the tests for laterality though there was a slight difference on the Van Riper Test. However, Schonell[14] found that there was a greater proportion of cross-laterality among 104 readers aged seven to thirteen years and retarded by one and a half years or more, than among seventy-five normal controls. Harris[15] expressed the opinion that even though the large scale school surveys tended to show no excess of cross-laterality among backward readers, extensive clinical studies of severely

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12 L.T. Dayhaw, "de la preference laterale chez l'homme", in Revue de l'Universite d'Ottawa, Vol. 21, No. 2, April-June, 1951, p. 213-221.

13 L.C. Smith, "A Study of Laterality Characteristics of Retarded Readers and Reading Achievers", in Journal of Experimental Education, Vol. 18, 1950, p. 321-329.

14 F.J. Schonell, "The Relation of Reading Disability to Handedness and Certain Ocular Factors, Part I", in British Journal of Educational Psychology, Vol. 10, 1940, 227-237 p

15 A.J. Harris, How to Increase Reading Ability, Longmans Green, New York, 1947, xxii-633 p.

retarded cases did indicate a lack of clear cerebral dominance (weak laterality or cross laterality). He found three times the normally expected number of cases of cross-laterality among severe cases. The disagreement here should be viewed in the light of the research that has been done on laterality. The confusion which arises in determining laterality can be seen in the different testing methods used to find the dominant side and the disagreement about how much effect this has on functioning. The inconsistency of design in these methods makes the results questionable and comparison quite difficult if not impossible. Vernon[16] in her book gives the most comprehensive survey to date of the literature on the relationship between reading errors and lack of cerebral dominance or laterality.

In the study of symptomatology of developmental alexia, other workers have taken broader views. In France, workers at l'Hopital Henri Rouselle[17] found that in poor readers there is a disturbance in cerebral dominance, poor spatial orientation, poor visual and auditory perception of symbols and sound, and some disturbance of rhythm.

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16 M.D. Vernon, Backwardness in Reading, A Study of Its Nature and Origin, University Press, Cambridge, 1957, viii-228 p.

17 Gallagher, Op. Cit., p. 13.

In Denmark, Hermann[18] and Skydsgaad regard language disabilities as hereditary and due to a physiologically determined right-left uncertainty which resembles Gerstmann's[19] Syndrome. They distinguish this group of children who do not read, all of whom have initial difficulty discriminating right from left, by the fact that in this group of non-readers the difficulty persists and mistakes are more frequent; there are reversals; there is a familial tendency; and there are also other accompanying disturbances in symbol function, including difficulties in handling numbers, notes of music and Morse Code.

At the University of Michigan, Smith[20] has put forth a theory based on metablic disturbances to account for reading disability. He applies the Synaptic Transmission Theory which hypothesizes that transmission of impulses across neuron synapses are interferred with by a chemical and this causes the reversal tendencies.

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18 Hermann, Op. Cit., p. 124-147.

19 J. Gerstmann, "Syndrome of Finger Agnosia, Disorientation for Right and Left, Agraphia and Acalculia; Local Diagnostic Value", in A.M.A. Archives of Neurology and Psychiatry, Vol. 44, 1940, p. 378.

20 D.E. Smith and P.M. Garrigan, The Nature of Reading Disability, Harcourt Brace, 1959, viii-149 p.

In discussing the causes of reversals, DeMerlis[21] divides the authors dealing with this type of error in reading into four groups:

1. Burt, Monroe, and Fernald describe inversions, reversals, confusions, omissions, additions and substitutions of letters as confused perceptions of letters and words;

2. Orton describes the symptoms as reversals and inversions in memory of perceived letters and words;

3. A developmental group who do not state whether reversals occur in perception or in memory, Davidson, Ilg and Ames, and Kennedy, have described the difficulty as a step in the developmental sequence. They hold that these errors disappear naturally in the normal child by eight or nine years of age;

4. This group, consisting mostly of educators, holds that the reversal difficulty exists but do not consider it as a specific reading problem, but rather as one of the many symptoms of the poor reader. In this group is found Robinson and most of the other prominent authors on reading problems.

In differential diagnosis, the work done by Rabinovitch, Drew, et al[22] gives three major groups according to causal factors. In group one are those with frank brain

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21 D.S. DeMerlis, "The Effect of Phonetic-Kinesthetic Training on the Measurable Reading Performance of Primary Pupils with Reversals and Inversion Difficulties", unpublished Doctor's dissertation, University of Ottawa, 1959, p. 21.

22 R.D. Rabinovitch, A.L. Drew, R.N. DeJong, W. Ingram, and L. Withey, "A Research Approach to Reading Retardation", in Neurology and Psychiatry in Childhood, Proceedings of the Association for Research in Nervous and Mental Disease, Vol. 34, 1956, p. 363-396.

damage which is manifested by gross neurologic deficits in the form of major aphasic difficulties similar to adult dyslexic syndromes. In group two, a neurologic deficit is suspected. This is a basic or biologic deficit in origin and is called a primary reading retardation. In the third group is found exogenous factors - as opposed to endogenous or brain injury - which impair the utilization of normal potential; these are anxiety, negativism, emotional blocking, and limited schooling opportunities. These are classed as secondary reading retardation.

B. Visual-Motor Development and Directionality.

In the developmental studies of the child, the interrelatedness of visual-motor function and directionality has been described. Gesell and Ames[23] in their work describe the development of visual orientation - the process is from the vertical to the horizontal plane. The young child is able to produce vertical lines or patterns before he can produce horizontal lines or patterns. In two dimensional figures the child can produce first the square and rectangle and finally the oblique figures. Weaknesses in verticalization will appear in the reproduction of these two dimensional figures and rotations will be seen. Up to seven or eight years of

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23 A. Gesell and L.B. Ames, "The Development of Handedness", in the Journal of Genetic Psychology, Vol. 70, 1947, p. 155-175.

age this tendency to verticalization in the reproduction of patterns is to be expected. When the turning on the longitudinal axis persists after the age of six or seven, Bender[24] refers to this as a "soft" neurological sign of brain damage.

Davidson[25] found that reversals and inversions tend to disappear in grade one with d and b, q and p, b and d being the last to go at about the mental age of seven to seven-eleven. Inversions disappear before reversals and girls lose these errors before boys. In terms of horizontal and vertical planes, following the developmental pattern the rotation on the vertical plane is the first to disappear.

Werner[26] approaches the development of spatial rotations from the point of view of the child's notion of left and right. In this development there are four roughly outlined steps:

1. In the first stage there are space of action and spatial qualities of action. The child, at this stage, cannot point out left and right but knows the difference.

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24 L. Bender, "Problems in Conceptualization and Communication in Children with Developmental Alexia" in P.H. Hoch and J. Zubin, Psychopathology of Communication, Grune and Stratton, New York London, 1958, p. 155-176.

25 H.P. Davidson, "A Study of the Confusing Letters, B-D, P-Q", in Journal of Genetic Psychology, Vol. 47, No. 2, 1935, p. 458-468.

26 H. Werner, Comparative Psychology of Mental Development, translated by E.B. Carside, New York, Harper, 1940, p. 174.

2. According to Binet, Terman and others, at six or seven the average child can distinguish right and left egocentrically, i.e., on his own body but not on other objects.

3. According to Piaget, at eight years of age the child can distinguish right and left on other than his own body. At nine, Gordon found that the child will correctly imitate the movements of the hands of someone facing him.

4. At the fourth stage, according to Piaget, the eleven year old can understand the left and right properties of even inanimate objects.

The importance of this development is stated by Goody and Reinhold:[27]

> We have suggested that man used his knowledge of position in space and the structure of his own body, that is, the sensory information to measure the outside world (...) The individual is unable to make movements with any part of his body unless he is correctly orientated as regards the relation of the whole body to the parts and also to the outside world.

Reinhold[28] further elaborated:

> Directional qualities are likewise attributed to sensations by the perceiving individual depending upon both spatial and temporal relationships (...) Reading, writing the performance of skilled movements, dressing, and many other activities require perceptual judgement of right-to-left, vertical and horizontal relationships.

With this description of the normal development of directionality in mind, we now can proceed to the literature describing the signs of malfunctioning of this process.

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27 W. Goody and M. Reinhold, "Some Aspects of Human Orientation in Space", in Brain, Vol. 76, 1953, p. 337.

28 M. Reinhold, "An Analysis of Agnosia", in Neurology, Vol. 4, 1954, p. 128.

C. Visual Motor Performance and Its Relationship to Reading.

In the developmental studies done on the Bender Visual Motor Gestalt Test[29] rotations were found to be one of the characteristics of the child's performance up to eight years of age, some producing rotations in their drawings after this age. These rotations are described by other authors in the drawings and writings of children and similarly that these normally disappear around the age of eight.

Fabian[30] used the Bender Visual Motor Gestalt Test on a population of children in his study of vertical rotations in visual motor performance and its relationship to reading reversals. He found that a relationship existed between rotations on the test and reversals in reading.

French,[31] in discussing Fabian's findings and quoting Bender, points out that children who are retarded in reading have a greater tendency to alter the visually perceived Gestalten to maturationally earlier forms. This is

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29 L. Bender, Visual-Motor Gestalt Test, Research Monographs, No. 3, American Orthopsychiatric Association, New York, 1946, xii-176 p.

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

31 E.L. French, Psychology Factors in Cases of Reading Difficulties, A Devereux Publication, 1954, Devon, Pa., 7 p.

attributed to a developmental lag and gives the example of the altering of horizontal perceptions to the vertical. He further stated that this is possibly related to Orton's strephosymbolia, that is, the reversal of words and letters.

The performance in other types of visual-motor tasks of the child with this disability has been described as showing confusion in directionality. Monroe[32] reports that in a study done by her on a group of backward readers six to ten years of age in naming rows of pictures, a reverse order was given by backward readers. Macmeeken[33] found that severely retarded readers aged seven to ten reversed the whole or part of one of the Terman-Merrill figures (Designs-Year ix, item 3). Califret-Granjon[34] found a tendency among backward readers to mirror reversal in reconstructing figures with match sticks. Magoroh Maruyami[35] in her test for Word Blindness finds that backward readers with this difficulty are picked out when they reproduce simple two dimensional figures which are rotated or reversed in reproductions.

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32 M. Monroe, Children Who Cannot Read, University Press, Chicago, 1932, xvi-206 p.

33 M. Macmeeken, Ocular Dominance in Relation to Developmental Aphasia, University Press, London, 1939, viii-252 p.

34 N. Califret-Granjon, "Le Probleme de l'Organisation Spatiale dans les Dyslexies d'Evolution", Enfance, Vol. 5, 1951, p. 455.

35 M. Maruyami, "Reading Disability: A Neurological Point of View", Bulletin of the Orton Society, Vol. 8, issue of May, 1958, p. 14-17.

What is true for these visual-motor tasks can also be hypothesized for the visual-motor factors of the WISC. In the next section, the rationale of the performance tasks of the WISC and their visual-motor aspects will be reviewed.

D. Visual-Motor Performance on the WISC.

Cohen,[36] in his factorial study of the WISC, found what he called a Perceptual Organization factor. The subtests loading on this factor are Block Design, Object Assembly, and Mazes. The factors found on the WISC were essentially the same as those which were found for adults on the WAIS.

Wechsler,[37] writing on the Adult Wechsler, described the Picture Arrangement, Block Design, Object Assembly, and Digit Symbol as involving a variety of visual-motor performance. Rapaport[38] describes Block Design, Object Assembly, and Digit Symbol as tests of visual-motor coordination, having two factors: visual organization and motor action. The visual organization is that they imply visual direction

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36 J. Cohen, "The Factorial Structure of the WISC at Ages 7-6, 10-6, and 13-6", in Journal of Consulting Psychology, Vol. 23, No. 4, 1959, p. 285-299.

37 D. Wechsler, Measurement of Adult Intelligence, Third Edition, The Williams and Wilkins Co., Baltimore, 1944, p. 79.

38 D. Rapaport, M. Gill, and R. Schafer, Diagnostic Psychological Testing, The Year Book Publishers, Inc., Chicago, 1946, 249 p.

in their execution. Wechsler says Block Design is primarily a test of spatial perception but also calls for abstract capacity insofar as this capacity is involved in visual motor organization. It entails a certain amount of manipulative ability, spatial orientation, and a capacity to shift. Wherever these abilities are impaired the subject will tend to do badly on the test. On the adult studies he found that Block Design correlates highly with the verbal tests and seems to be tapping some abilities involved in the language faculty. However, it is well to keep in mind that in the correlations done on the WISC, Picture Arrangement shows a higher correlation with Verbal than Block Design at age 7½ and at 10½, while at 13½ there is a drop. Block Design shows a higher correlation at age 10½ than at age 7½ and 13½.[39] Age 7½ shows the lowest correlation which could possibly be explained in developmental terms.

The problem of the effect of directional confusion on the performance of the child now arises. If there are signs of directional confusion in an individual's performance in visual-motor tasks, will these also be found in the individual's oral reading? As is seen in the literature, this connection is hypothesized in a general way but is not

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39 D. Wechsler, Wechsler Intelligence Scale for Children, The Psychological Corporation, New York, 1949, p. 10-12.

specifically tested on a one-to-one basis, i.e., rotation on a plane on the visual-motor task and in oral reading. This study will attempt to find if a significant relationship exists and to what extent directional confusion affects the visual-motor performance in a number of tasks.

# CHAPTER II

## THE EXPERIMENTAL DESIGN

### A. Formulation of the Hypothesis.

As seen in the previous chapter, this study is concerned with the effect of directional confusion on performance. The question is raised that if signs of directional confusion appear in an individual's performance on visual motor tasks, will it also be found in the individual's oral reading. The general hypothesis then stated is: signs of directional confusion in visual motor taks are indicative of reading reversals. The visual motor tasks used were WISC Performance Subtests: Picture Arrangement, Object Assembly and Block Design, and so it was necessary to develop the following specific research hypothesis -- There are no statistically significant differences in the reading reversal tendencies of two groups of students who differ in their degree of rotation on the Picture Arrangement, Object Assembly and Block Design Subtests of the WISC.

In this chapter, the testing of this hypotheeis will be described. The topics to be discussed are the population, the experimental design, and the statistical tools used to evaluate the data. The first to be discussed is the population.

## B. Population.

The selection of the sample was done on the basis of the results from the Performance Subtests of the WISC, Picture Arrangement, Block Design, and Object Assembly.

Instrument and Procedure.- The subject was seated at a table on which lay a 24" by 18" blank paper with the 24" side of the paper parallel to the edge of the table proximate to the subject. The examiner stood to the right and behind the subject. The standard material of the WISC performance subtests of Picture Arrangment, Block Design and three items of the Object Assembly: the Manikin, the Face and the Auto were used. The Horse was omitted as it did not lend itself to a standard base line. Wechsler's[1] standard procedure for the presentation of the WISC material was followed with one alteration. The subject was permitted to attempt as many of the items from which a traceable base line could be made whether these patterns were right or wrong according to the norms. Care was taken to align the Block Design Cards parallel to the edge of the table. All the items were worked on separate sheets of paper. The base line for each pattern was traced onto this sheet by the examiner after the completion of each pattern by the subject.

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1 D. Wechsler, Wechsler Intelligence Scale for Children, New York, The Psychological Corporation, 1949, p. 74-84.

The base line for Picture Arrangement and Block Design consisted of the line traced along the bottom edge of the reproduction of the pattern. On the items of Object Assembly, for the Manikin the base line was that formed by tracing along the cut between the upper half and the lower half of the body. For the Face, the base line was that formed by tracing along the cut through the forehead, pieces number 8 and 7 and the hair pieces number 3 and 5. The base line for the Auto was formed by tracing along the cut through the hood, piece number 3 over the front wheel through the fender, piece number 1.

Measurement and Criteria.- This data was then measured according to the following criteria. On the items of Picture Arrangement, Block Design and Object Assembly, directional confusion occurred when the base line of the reproduction of the pattern was rotated. To measure the degree of rotation of the base line of the items, a line AB was drawn parallel to the 24" edge of the blank paper which had been proximate to the subject. The distance of the line AB from the edge of the paper was calculated from the end of the base line which was point A. See figure 1. The angle CAB formed by the base line AC and line AB was taken as the degree of rotation.

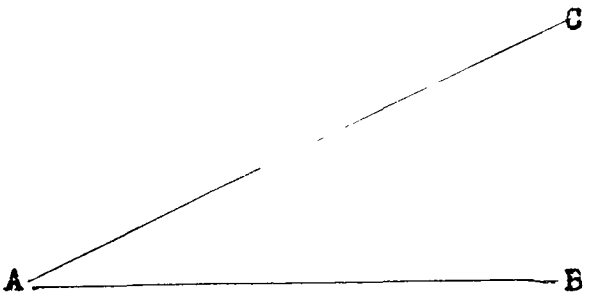


Figure 1 Illustration of scoring procedure for rotation of pattern in the three subtests of the WISC of angle formed by base line of pattern (AC) and edge of paper (AB).

A protractor was used to measure the degrees of rotation. The protractor was placed on line AB and the point of measurement was taken from point A. This gave scores in terms of degrees for each subject on each item.

To eliminate the disproportionate effect of a large amount of rotation of one item on the individual's score, the score was determined in terms of both the amount and the number of times rotations occurred.

Table I shows various combinations of the number of times rotations occurred and the number of degrees considered to constitute a rotation. These are matched with reversals and the results are set up in a contingency table. As is seen in Table IV degrees of rotation occurring seven times gives the most significant results.

Description of the Sample.- The sample of the population consisted of thirty-four school children between the ages of six and thirteen years of age. These were selected from ungraded classes of the University of Ottawa Child Guidance Center and graded and ungraded classes of the Rockcliffe Public School. The intelligence quotients in the sample were in the average to the very superior range as tested on the P.M.A., the Stanford Binet, and the WISC. The intelligence quotients had been obtained by the school psychologist on one of these tests at some time during the child's attendance at school.

Table I.-

Distribution of Subjects on the Basis of Number and Degree of Rotation and the Number of Reversals.

| Rotation | | Reversals | Frequencies | | | |
|---|---|---|---|---|---|---|
| N | Degrees | N | Rotate Reverse | No Rotate No Reverse | Rotate No Reverse | No Rotate Reverse |
| 3 | 4 | 4 | 16 | 4 | 12 | 2 |
| 3 | 5 | 4 | 14 | 6 | 10 | 4 |
| 3 | 6 | 4 | 14 | 10 | 6 | 4 |
| 4 | 4 | 4 | 16 | 4 | 12 | 2 |
| 4 | 5 | 4 | 13 | 7 | 9 | 5 |
| 4 | 6 | 4 | 11 | 11 | 5 | 7 |
| 5 | 4 | 4 | 15 | 7 | 8 | 4 |
| 5 | 5 | 4 | 10 | 11 | 5 | 8 |
| 5 | 6 | 4 | 8 | 12 | 4 | 10 |
| 6 | 4 | 4 | 14 | 11 | 5 | 4 |
| 6 | 5 | 4 | 9 | 12 | 4 | 9 |
| 6 | 6 | 4 | 6 | 14 | 2 | 12 |
| 7 | 4 | 4 | 13 | 13 | 3 | 5[a] |
| 7 | 5 | 4 | 7 | 13 | 3 | 12 |
| 7 | 6 | 4 | 4 | 14 | 2 | 14 |

a Most significant.

In this sample of thirty-four, Table II shows that twenty-six were males and eight were females. The females had a mean of 8.12 rotations with a range extending from 4 to 15 rotations. The males had a mean of 5.76 rotations with a range extending from 0 to 12 rotations which is not a significant difference. Table III shows that, of this group, nineteen were above nine years of age and had a mean of 5.84 rotations with a range extending from 0 to 15 rotations. Fifteen were below nine years of age with a mean of 7.46 rotations and a range extending from 2 to 12 rotations which is not a significant difference.

By means of the criteria of four rotations, the sample was divided into two groups, those rotating and those not rotating. Table IV shows that in the group not rotating there were fourteen subjects with a mean age of nine years six months, with a range in age extending from seven years three months to twelve years nine months. In the group rotating there were twenty subjects with a mean age of eight years five months with a range in age extending from six years four months to twelve years nine months.

## C. The Experiment.

Instrument and Procedure.- When the subjects had completed the WISC, they were asked to read the Gray

Table II.-

Mean, Standard Deviation and Range of the Number of Rotations On WISC of 34 Subjects Distributed by Sex.

| Sex | Number | Mean | SD | Range |
|---|---|---|---|---|
| Female | 8 | 8.12 | 3.31 | 4-15 |
| Male | 26 | 5.76 | 3.16 | 0-12 |
| Both | 34 | 6.31 | 3.16 | 0-15 |

Table III.-

Mean, Standard Deviation and Range of the Number of Rotations on WISC of 34 Subjects by Age Above and Below 9 Years.

| Age | Number | Mean | SD | Range |
|---|---|---|---|---|
| Above 9 | 19 | 5.84 | 3.74 | 0-15 |
| Below 9 | 15 | 7.46 | 2.64 | 2-12 |
| Both | 34 | 6.55 | 3.34 | 0-15 |

Table IV.-

Mean Age, Standard Deviation and Range in Years and Months for 34 Subjects of the Experimental and Control Groups.

| Group | Number | Mean | SD | Range |
|---|---|---|---|---|
| Control | 14 | 9-6 | 1-9 | 7-3--12-9 |
| Experimental | 20 | 8-5 | 6-1 | 6-4--12-9 |
| Both | 34 | 8-10 | 0-9 | 6-4--12-9 |

Standardized Oral Reading Paragraphs[2] according to the standard procedure. They were also asked to read the three reading cards all of which were 5 inches by 8 inches with the content typed in pica double spaced. The cards were numbered one, two, three and presented in this sequence.

Card I[3] contains the words which are described in the literature as being susceptible to reversal errors. The subject was asked to read, say or sound these words whichever he was capable of doing. Card II[4] contains the scrambled letters of the alphabet similar to that used in the Durrell Analysis of Reading Difficulty[5] test. The subject was also asked to read, say or sound these letters. The second part of Card II contains columns of words and nonsense syllables. The instructions for these were: "Some of these are words and some are not but just groups of letters to be sounded or read. Read down the column." If the directions were not understood they were explained further to the subject.

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2 W.S. Gray, Standardized Oral Reading Paragraphs, Public School Publishing Co., Bloomington, Ill., 1955, see Appendix 4, p. 57.

3 See Appendix 1, p. 54.

4 See Appendix 2, p. 55.

5 D.D. Durrell, Durrell Analysis of Reading Difficulty, Individual Record Blank for Grades 1 to 6, World Book Company, Yonkers-on-Hudson, New York, 1937, p. 11.

Card III[6] contains pairs of numbers which the subject was asked to read. Errors were recorded by the examiner as the subject read the material according to the following criteria.

Criteria.- A reversal in the reading of the Gray Standardized Oral Reading Paragraphs and the reading cards occurred in three ways: 1) when one letter or number was confused for another in such a way as to clearly indicate a reversal, e.g., d for b, b for p, m for w, 9 for 6; 2) when a word or number was read as another with the same letters but transposed, e.g., was for saw, not for ton, three for there, 66 for 99, 96 for 69; 3) when the order of the words in the sentence was reversed, e.g., "Said the little boy", for "The little boy said", or "There once was", for "Once there was".[7]

As seen in Table I, four of the above defined reversals were necessary for the subject to be considered as showing a consistent pattern of reversal in his reading.

## D. Statistical Evaluation.

For the purpose of statistical verification, the hypothesis will be considered in two ways. First, the data

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6 See Appendix 3, p.56.

7 D. Wechsler and M.L. Pignatelli,"Reversal Errors in Reading: Phenomenon of Axial Rotation", in Journal of Educational Psychology, Vol. 28, 1937, p. 215.

given by the subjects' performance will be considered as a whole. This will be concerned with a possible relationship between rotations and reversals and will be done by means of the chi-square technique. Because of the smallness of the group, Yate's correction for continuity will be applied.[8]

$$\text{Chi} = \frac{N\left(AD - BC\right) - \frac{N}{2}\right)^2}{(A+B)\,(C+D)\,(A+C)\,(B+D)}$$

If a significant relationship is found, then the individual items of the WISC Performance Subtests will be examined to find which items are contributing to this relationship. Each item will be considered by means of the chi-square technique with Yate's correction, using as criteria a minimum of four degrees for a rotation and four reversals in reading as a consistent pattern of reversals. For those items having expected frequencies below two, the direct probability technique will be used.[9]

$$P = \frac{(A+B)!\,(C+D)!\,(A+C)!\,(B+D)!}{N!\;A!\;B!\;C!\;D!}$$

In order to further test the relationship between rotations and reversals, the data will be set up and tested

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8 L.T. Dayhaw, Manual de Statistique, Editions de l'Universite d'Ottawa, Ottawa, Canada, 1958, p. 396.

9 Q. McNemar, Psychological Statistics, 2nd Edition, John Wiley & Sons, Inc., New York, 1955, p. 241-242.

by the chi-square technique using the total number of degrees rotated by each subject as a criteria for a rotation. Further, the significance of the difference between the mean degrees of rotation will be compared on each item between the experimental and control groups by means of the *t* test.

# CHAPTER III

## PRESENTATION AND DISCUSSION OF RESULTS

With the descriptions of the experiment and the statistical evaluation of the previous chapter, the presentation of the results and their relevance to the hypothesis remains.

### A. Presentation of Results.

The first chi-square was concerned with the possible relationship between rotations and reversals as seen in Table V. Using as criteria 7 rotations of 4 degrees as a rotation and 4 reversals in reading, this separated a 2 x 2 chi-square as follows: Cell A contained three frequencies; Cell B contained thirteen; Cell C contained thirteen, and Cell D five. The N totalled 34. The resultant chi-square was 7.69, significant beyond the .01 level of confidence utilizing one degree of freedom.

This result indicated some type of relationship existed between reversals and rotations. The hypothesis of independence of the data as classified was therefore rejected.

A significant relationship having been shown between reversals and rotations, the second application of the chi-square technique was made to determine which items were

Table V.-

Frequencies for the Computation of the Chi-Square[a] of Rotations on WISC Items and Reading Reversals.

| Reversals | Rotations | |
|---|---|---|
| | Less than 7 of 4 Degrees | 7 or more of 4 degrees or more |
| 4 or more | 3 | 13 |
| Less than 4 | 13 | 5 |

a Chi-square = 7.69.

contributing to this relationship. Using as criteria a minimum of four degrees for a rotation and four reversals in reading as a consistent pattern of reversals, as seen in Table VI, this gave the following chi-squares. For the items on Picture Arrangement, the results yielded a chi-square of 5.72, significant beyond the .02 level of confidence for item B; a chi-square of 4.39, significant beyond the .05 level of confidence for items 1 and 2; a chi-square of 8.05 significant beyond the .01 level of confidence for item 5; and a chi-square of 8.76 significant beyond the .01 level of confidence for item 7. For the items of Block Design, the results yielded a chi-square of 5.02 significant beyond the .05 level of confidence for item 4; a chi-square of 4.51 significant beyond the .05 level of confidence for item 4; a chi-square of 4.51 significant at the .05 level of confidence for item 5. For the items of Object Assembly, the results yielded a chi-square of 4.23 significant at the .05 level of confidence for item Face.

The results of the chi-squares of the twenty-four items of the WISC Performance Subtests showed a tendency to a negative correlation on four of the items. To test the strength of this negative correlation, a contingency coefficient was calculated. As seen in Table VII, the items with the greatest contingency coefficient were item 3 of Picture Arrangement with .264, and the item Face of Object

Table VI.-

Chi-square of Rotation and Reversals for Each of the Twenty-four Items in the WISC Picture Arrangement (PA), Block Design (BD), and Object Assembly (OA) Subtests (N 34).

| Item | Chi-square[a] | Significance |
|---|---|---|
| PA | | |
| A | .68 | |
| B | 5.71 | b |
| C | 3.37 | |
| D | .46 | |
| 1 | 4.39 | c |
| 2 | 4.39 | c |
| 3 | .25 | |
| 4 | 2.17 | |
| 5 | 8.05 | d |
| 6 | - | e |
| 7 | 8.76 | d |
| BD | | |
| A | .01 | |
| B | 2.13 | |
| C | 2.51 | |
| 1 | 2.35 | |
| 2 | 3.28 | |
| 3 | .73 | |
| 4 | 5.02 | c |
| 5 | 4.51 | c |
| 6 | .80 | |
| 7 | - | f |
| OA | | |
| Manikin | 1.06 | |
| Face | 4.23 | c |
| Auto | 1.89 | |

a 2 x 2.
b Significant beyond .02 level of confidence.
c Significant beyond .05 level of confidence.
d Significant beyond .01 level of confidence.
e Direct probability of .75.
f Direct probability of .30.

Table VII.-

Distribution of Subjects on the Basis of the Number and Degree of Rotation and the Number of Reversals on Each of the Twenty-four Items of Picture Arrangement (PA), Block Design (BD), and Object Assembly (OA) Subtests (N 34).

| Item | Frequencies | | | |
|---|---|---|---|---|
| | Rotate Reverse | No Rotate No Reverse | Rotate No Reverse | No Rotate Reverse |
| PA | | | | |
| A | 7 | 11 | 5 | 11 |
| B | 7 | 16 | 0 | 11 |
| C | 6 | 14 | 2 | 12 |
| D | 4 | 13 | 3 | 14 |
| 1 | 5 | 15 | 1 | 13 |
| 2 | 5 | 15 | 1 | 13 |
| 3 | 3 | 11 | 5 | 14[a] |
| 4 | 3 | 15 | 1 | 15 |
| 5 | 5 | 16 | 0 | 12 |
| 6 | 2 | 12 | 13 | 2 |
| 7 | 5 | 14 | 0 | 9 |
| BD | | | | |
| A | 6 | 10 | 6 | 12[b] |
| B | 9 | 11 | 5 | 9 |
| C | 8 | 12 | 4 | 10 |
| 1 | 5 | 14 | 2 | 13 |
| 2 | 9 | 12 | 4 | 9 |
| 3 | 7 | 11 | 4 | 11 |
| 4 | 8 | 11 | 4 | 5 |
| 5 | 5 | 11 | 3 | 7 |
| 6 | 3 | 5 | 5 | 5[c] |
| 7 | 2 | 9 | 1 | 4 |
| OA | | | | |
| Manikin | 10 | 9 | 8 | 7 |
| Face | 11 | 8 | 6 | 4 |
| Auto | 4 | 6 | 8 | 10[d] |

a Contingency coefficient of .264.
b Contingency coefficient of .014.
c Contingency coefficient of .206.
d Contingency coefficient of .253.

Assembly with .253. These show a slight tendency to a negative correlation.

Having arrived at the above results with the original criteria, the data was again examined by means of the chi-square technique with a new set of criteria. The total number of degrees rotated on all the items by the subject. Table VIII shows the total number of degrees rotated by each subject and the number of reversals made in reading. It was determined that sixty degrees could be used as a cut off score to designate those rotating from those not rotating. Subjects with scores above 60 degrees were designated as rotating on the WISC Performance Subtests. Five reversals in reading were used as the criteria to designate a consistent pattern of reversals.

The chi-square application concerned with a possible relationship between rotation and reversal separated a 2 x 2 chi-square as follows: Cell A contained 4 frequencies; Cell B contained 14; Cell C contained 14; and Cell D contained 2. The N totalled thirty-four. The resultant chi-square was 17.22, significant beyond the .001 level of confidence utilizing one degree of freedom. This is shown in Table IX. This result again indicated some type of relationship existed between rotations and reversals.

A significant relationship having been shown, the difference in t values between the mean scores in degrees

Table VIII.-

Total Number of Degrees of Rotation on the Three Subtests of the WISC and Number of Reading Reversals for Each Individual on Experiment.

| Subjects | Degrees of Rotation | Reading Reversals |
|---|---|---|
| 1 | 46.0 | 2 |
| 2 | 82.0 | 0 |
| 3 | 187.0 | 3 |
| 4 | 27.0 | 3 |
| 5 | 34.5 | 2 |
| 6 | 33.0 | 3 |
| 7 | 41.0 | 3 |
| 8 | 48.0 | 2 |
| 9 | 39.0 | 0 |
| 10 | 49.5 | 3 |
| 11 | 55.0 | 3 |
| 12 | 48.0 | 3 |
| 13 | 16.0 | 0 |
| 14 | 37.5 | 3 |
| 15 | 58.0 | 0 |
| 16 | 39.5 | 3 |
| 17 | 175.5 | 8 |
| 18 | 103.0 | 6 |
| 19 | 66.0 | 7 |
| 20 | 64.5 | 6 |
| 21 | 129.5 | 10 |
| 22 | 50.0 | 7 |
| 23 | 34.0 | 7 |
| 24 | 90.0 | 7 |
| 25 | 58.0 | 9 |
| 26 | 76.0 | 11 |
| 27 | 135.0 | 6 |
| 28 | 82.5 | 9 |
| 29 | 64.0 | 10 |
| 30 | 81.0 | 5 |
| 31 | 74.5 | 6 |
| 32 | 138.0 | 5 |
| 33 | 87.5 | 7 |
| 34 | 64.0 | 8 |

Table IX.-

Frequencies for the Computation of the Chi-Square[a] of Rotations on WISC Items and Reading Reversals.

| Reversals | Rotations | |
|---|---|---|
| | Less Than 60° | 60° or more |
| 5 or more | 4 | 14 |
| Less than 5 | 14 | 2 |

a Chi-square = 17.22.

of rotation of the subjects rotating less than 60 degrees for each of the twenty-four items of the WISC Performance Subtests was determined to find which items were contributing to this relationship.

Table X shows the significance of the difference in t values between the mean scores in degrees of rotations of the subjects rotating less than 60 degrees and those rotating more than 60 degrees for each of the twenty-four items of the Performance Subtests of the WISC. Items C, 2, and 3 of Picture Arrangement; item 5 of Block Design and item Manikin of Object Assembly are significant at the .001 level of confidence using 32 degrees of freedom. Item 4 of Block Design is significant beyond the .01 level of confidence using 26 degrees of freedom. Item A of Picture Arrangement, and items A, B, C of Block Design are significant beyond the .05 level of confidence using 32 degrees of freedom. Item D of Picture Arrangement is significant beyond the .02 level of confidence using 32 degrees of freedom.

## B. Discussion of Results.

This study has shown that there is a significant relationship between reading reversals and rotations on the WISC subtest items. With both sets of criteria used for scoring, this significant relationship appeared. There appears to be a common underlying process involved in the

Table X.-

Significance of the Difference in t Values Between the Mean Scores in Degrees of Rotation of the Subjects Rotating Less Than 60 degrees and Those Rotating More Than 60 Degrees for Each of the Twenty-Four Items on the Picture Arrangement(PA), Block Design (BD), and Object Assembly (OA)(N 34).

| Item | Dm | $\sigma$Dm | Obtained t Values | Significance |
|---|---|---|---|---|
| PA | | | | |
| A | 5.12 | 2.25 | 2.27 | a |
| B | .27 | .87 | .31 | |
| C | 2.87 | .62 | 4.63 | b |
| D | 2.26 | .92 | 2.46 | c |
| 1 | 1.04 | .71 | 1.46 | |
| 2 | .27 | .53 | 5.09 | b |
| 3 | 1.79 | .42 | 4.26 | b |
| 4 | .61 | .53 | 1.15 | |
| 5 | 1.33 | .87 | 1.52 | |
| 6 | 1.05 | 1.03 | 1.02 | |
| 7 | .79 | 1.23 | .64 | |
| BD | | | | |
| A | 2.97 | 1.38 | 2.15 | a |
| B | 4.67 | 1.38 | 2.15 | a |
| C | 2.74 | 1.15 | 2.38 | a |
| 1 | 4.97 | 2.42 | 2.05 | |
| 2 | 4.89 | 2.37 | 2.06 | |
| 3 | 1.79 | 1.56 | 1.15 | |
| 4 | 6.65 | 2.23 | 2.98 | d |
| 5 | 4.64 | 1.09 | 4.25 | b |
| 6 | 3.03 | 2.83 | 1.07 | |
| 7 | 3.24 | 2.02 | 1.60 | |
| OA | | | | |
| Manikin | 1.29 | 2.33 | 5.54 | b |
| Face | 4.38 | 2.34 | 1.87 | |
| Auto | .13 | 2.04 | .64 | |

a Significant beyond .05 level of confidence.
b Significant beyond .001 level of confidence.
c Significant beyond .02 level of confidence.
d Significant beyond .01 level of confidence.

performance of these two types of tasks. To attribute this to inconsistent learning or training would not be an adequate explanation as Schilder[1] has pointed out. Reinhold's[2] point that directional qualities are attributed to sensations by the perceiving individual by which adequate spatial and temporal relationships are acquired which are necessary for reading, writing, and other performance skills is borne out by the results of this study. Reversals in reading in this group are not solely the result of training or learning inconsistency or of language difficulty, but to a more basic process which permeates the visual motor performance of the individual. Bender's[3] description of this as a difficulty in perception of orientation in terms of rotation and plane and angular distance, would more adequately describe what is seen to occur in this study and in Fabian's[4] study with the

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1 P. Schilder, "Congenital Alexia and Its Relation to Optic Perception", Journal of Genetic Psychology, Vol. 65, 1944, p. 67-88.

2 M. Reinhold, "An Analysis of Agnosia", in Neurology, Vol. 4, 1954, p. 128.

3 The Orton Society 1st Annual Program Meeting, New York, October 27, 1952, Research Studies from Bellevue Hospital on Specific Reading Disabilities, by Lauretta Bender, (Resume), from Bulletin of the Orton Society, Vol. 1, June, 1951, p. 3-5.

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

Bender Visual Motor Gestalt Test. Not only is the difficulty found in dealing with written language symbols, but it is also found in the individual's performance on visual motor tasks.

In considering a neurological basis for this malfunctioning, a broader view should be taken than has been pursued, in view of the findings of the work done at l'Hospital Henri Rouselle[5] and by Hermann[6] in Denmark. In studies done on localization of brain damage on either cerebral hemisphere.[7] it has been found that those with damage on the right cerebral hemisphere showed lowered Performance subtest scores on the WAIS; those with damage on the left hemisphere showed lowered Verbal subtest scores on the WAIS. It is hypothesized from this that those with right cerebral damage show a disturbance in their spatial and motor performance, while those with left hemisphere damage show a language impairment. Only a very small per cent of the subjects used in this study showed evident brain

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5 J.R. Gallagher, "Part II, Reports on Medical Research, European Research in Reading Disability, Report of Personal Visits in England, France, and Denmark", in Bulletin of the Orton Society, Vol. 8, issue of May, 1958, p. 11-14.

6 K. Hermann, Reading Disability, Springfield, Illinois, Charles C. Thomas, 1959, 183 p.

7 Rosemary Stark, An Investigation of Unilateral Cerebral Pathology, with Equated Verbal and Visual-Motor Task, unpublished doctor's dissertation from Wayne State University, Detroit, Michigan, 1960.

damage. The group rotating and reversing contained one or two subjects with evident brain damage. The distortions in this group's performance were in both the spatial motor function, as seen in the performance on the WISC subtests and in the language function, as seen in the oral reading. The performance in oral reading produced strephic confusions of letters which produced new gestalts. Larger units in oral reading, words and sentences, were similarly distorted. While in the reproductions of the WISC Performance subtests, the gestalt was not changed but was misorientated in space, i.e., the same pattern was reproduced but rotated. Whatever the process malfunctioning, it appears that the figures are distorted but maintain a meaningful content.

In the oral reading, the sequence of the figures was the factor that was distorted to produce the directional confusion. While in the reproduction of the WISC Performance subtests the distortion did not involve sequence but a disturbance in the horizontal vertical axis. According to Wechsler and Pignatelli[8] the disturbance in sequence in reading can be reduced to the horizontal-vertical dimension. The question may be raised as to whether size alone or whether the need to produce a meaningful form or both together

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8 D. Wechsler and M.L. Pignatelli, "Reversal Errors in Reading: Phenomenon of Axial Rotation", in Journal of Educational Psychology, Vol. 28, 1937, p. 215.

were affecting the difference in the form of distortion of the stimulus.

In the oral reading, there was visual-oral performance while the reproduction of the WISC items involved visual-manual performance. Further, the check for correctness in the oral reading was an auditory one; in the reproductions of the WISC Performance subtests the check for correctness was visual. The common factor involved in these two types of tasks is in the visual process and the directional confusion is a misinterpretation of the spatial aspect of the task. This would indicate that the disturbance does not lie in the motor expressive process but rather in either the sensory perception or the integrative process. In considering the perceptive process, the first possibility of distorting the image is in the retina where it has been observed that under normal conditions of observation the retinal image is a shifting, fluctuating pattern of intensity gradients caused by the constant fluttering motion of the eyeballs. The second possibility is in the transmission of the impulse to the Brain Centers, there is a temporal dispersion in a single stimulus reaching the higher centers, suggesting the possibility that all the parts of the stimulus do not reach the brain centers at the same time leaving the chance of misinterpretation by sequence. There is also the possibility of distortions at the optic

chiasma and at the synaptic junctions of the genticulates and in the higher brain centers. The differences in distortions of the two types of materials and the differences in sizes should lead to a study of a wider sample of tasks, an analysis of the distortions of these by a normal group who do not show directional confusion and a group that does show directional confusion. These groups could be further studied to find if they do show any neurological disturbance in the areas where possible distortions of the visual stimulus might occur.

While the most significant relationship appeared when the data was examined using as a criteria the cumulative degrees of rotations, some individual items showed a significant relationship, but not as great as would be expected from the significance of the overall chi-squares. The individual items that showed a significant rotation were Picture Arrangement items B, 1, 2, 5, and 7; Block Design items A, B, C, D, 4, and 5; Object Assembly items Manikin and Face. If these are re-examined using the level of confidence obtained in the overall chi-squares which, for the first set of criteria was .01 and for the second set of criteria was .001, the items which are significant are: Picture Arrangement items C, 2, 3, 5, and 7; Block Design item 5; and Object Assembly, item Manikin. On these items there appears to be a difficulty in maintaining the

horizontal-vertical axis when a change in size occurs. This is seen in Picture Arrangement items C and 5 where there is a change in the length from the previous items. On Block Design item 5, the size of the reproduction of the pattern is increased by the use of additional blocks. This can be interpreted as a difficulty in shifting which disrupts the ability to maintain the horizontal-vertical axis and thereby producing a rotation.

On Object Assembly the item Manikin was significant beyond the .001 level of confidence. This is a change in the material and type of task but also is the only obvious involvement of body image in the tasks. Schilder[9] has hypothesized that perceptual and motility disturbances arise from cerebral dysfunction which adversely affects the body image which may be what is happening here.

Other items which showed a significance but below that of the level of confidence set were Block Design item 4 which showed significance on both the chi-square and the *t* test; Picture Arrangement items A, B, D, and 1; Block Design items A, B, and C; Object Assembly item Face.

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9 P. Schilder, Image and Appearance of the Human Body, New York, International Universities Press, 1950, v-353 p.

Picture Arrangement items A, B, are the first items of this type of material and again suggest a difficulty in shifting. This is also seen in Block Design items A, B, and C.

It is of interest to note that the items of Block Design in which diagonals are used in the pattern were lacking in significance. These items are especially difficult for brain damaged subjects as reported in Goldstein's study.

Item four of Block Design is a diamond figure on a square background which Goldstein[10] found to be difficult for his population of brain damaged subjects to produce. Fuller[11] found that on his variation of the Bender Visual Motor Gestalt Test this type of pattern also produced rotation in his population of neurotics and schizophrenic children. In Fuller's study, the rotations would appear to be the result of a psychogenic process and not brain damage.

Anxiety has been shown to affect cue utilization and interferes with the perceptive process. Shapiro and Yates[12]

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10 K. Goldstein and M. Scheerer,"Abstract and Concrete Behavior, An Experimental Study with Special Tests", Psychological Monographs, Vol. 53, No. 2, 1941, p. 36-41.

11 J.R. Fuller, Factors Influencing Rotation on the Bender Gestalt Performance of Children, unpublished doctor's dissertation, University of Ottawa, Ottawa, 1960, p. 69.

12 M.B. Shapiro,"Experimental Studies of a Perceptual Anomaly, Part I, Initial Experiments", Journal of Mental Science, Vol. 97, 1951, p. 90-110.

in their studies with adults showed that when cues from the environment were taken away, even normals rotated on the Kohs Blocks. Considering the differential diagnosis of poor readers by Rabinovitch, Drew, et al,[13] both types of rotations would fit and the question would arise of how these could be differentiated whether quantitatively or qualitatively.

In dealing with poor readers, it is vital to successful treatment to differentiate diagnostically as to the cause of the disability. Poor readers who have shown this difficulty with language symbols have been taught with methods that concretize the mentation of the individual. Compulsivity, rigidity in patterning of language skills and concreteness are induced to correct the disability sacrificing the higher forms of abstract mentation. While this results in moderate success in the early grades, it impedes further progress when more abstract mentation is required.

As the process is more basic than that involved in language the means of correcting it should be more direct and basic avoiding the connection with the abstraction involved in the use of language symbols and reading. The

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13 R.D. Rabinovitch, A.L. Drew, R.N. DeJong, W. Ingram, and L. Withey, "A Research Approach to Reading Retardation", in Neurology and Psychiatry in Childhood, Proceedings of the Association for Research in Nervous and Mental Disease, Vol. 34, 1956, p. 363-396.

ability to deal with the horizontal-vertical axis and the perceiving of directional qualities should be strengthened by reinforcing the sensations through which these are perceived. To avoid the additional complication with the language, a period of training involving the sensation of directional qualities should be attempted before emphasizing the letter-sound relationship and the association of meaning with the visual symbols.

# SUMMARY AND CONCLUSIONS

The purpose of this study was to investigate whether or not a relationship existed between rotations on the visual motor tasks of the WISC Performance subtests and reversals in reading. Previous studies have not been concerned with this relationship but only describe these as occurring concurrently. The conclusions of the study are: 1) there is a significant relationship between rotations on the WISC Performance subtests and reversals in oral reading; 2) items that involve a change in size produce rotations more consistently than the other items; 3) the subjects evidencing rotation are likely to rotate on any type of item found in the WISC Performance subtests.

The problem of whether the underlying process is organic or psychogenic remains to be solved. The performance of the subjects rotating and reversing in this study resembled that of brain damaged individuals and also that of individuals with psychogenic disburbances.

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# APPENDIX

# APPENDIX 1

## Reading Card No. 1

| | | | |
|---|---|---|---|
| clot | bread | rat | bay |
| ran | on | who | slept |
| day | shoe | earth | calm |
| clam | ground | bump | red |
| flower | now | blue | there |
| left | colt | oh | pump |
| form | smell | sky | meat |
| beat | three | from | but |
| dump | grey | try | yellow |
| how | but | felt | beard |

# APPENDIX 2

## Reading Card No. 2

s t c p e d f r i m l a b  T S A I L E P N R G B C U

w g o n h y u v j k z q x  O K F M Q D H W Y Z V X J

c l a s i b r t j u m h p  e f o g x n v q d w y k z

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| sam | nem | pub | nez | bew | sab | web | men |
| dup | tob | saw | sam | dog | net | god | bot |
| weh | mir | num | ten | nir | num | rin | rim |
| mun | owl | hew | bas | wem | mas | mew | low |
| was | neh | pud | deb | ton | zen | not | hen |
| ton | zen | not | hen | bup | deb | run | bed |
| wem | mas | new | low | was | neh | pud | bas |
| nir | num | rin | mun | num | low | hew | ten |
| dog | net | bod | bot | weh | mir | num | ams |
| bew | sab | web | men | dup | tob | saw | nur |

# APPENDIX 3

## Reading Card No. 3

| | | | | | | |
|---|---|---|---|---|---|---|
| 12 | 98 | 54 | 22 | 43 | 72 | 21 |
| 93 | 17 | 41 | 63 | 15 | 33 | 83 |
| 53 | 62 | 32 | 51 | 64 | 96 | 42 |
| 84 | 73 | 33 | 94 | 31 | 74 | 91 |
| 16 | 82 | 65 | 84 | 61 | 52 | 76 |
| 81 | 13 | 75 | 18 | 86 | 71 | 87 |
| 11 | 25 | 14 | 97 | 19 | 95 | 92 |

# APPENDIX 4

Gray Oral
Reading Paragraphs
Test

THE PUBLIC SCHOOL PUBLISHING COMPANY
TEST DIVISION OF
THE BOBBS-MERRILL COMPANY, INC.
ASSOCIATED WITH HOWARD W. SAMS & CO., INC.

Printed in U. S. A.

## STANDARDIZED ORAL READING PARAGRAPHS

By William S. Gray

Name..... Age Today..... Years Months

Race..... Sex..... Grade.....

City..... State..... Date.....

School..... Teacher.....

### Directions to the Teacher

Each child should be tested apart from the others in a room by himself. Give him an unused folder. Take another folder and fill in the above blanks before beginning the reading. As the child reads, record his efforts, using the marks presented on the class record sheet, and following the directions printed there as accurately as possible.

## APPENDIX 4

### 1

A boy had a dog.
The dog ran into the woods.
The boy ran after the dog.
He wanted the dog to go home.
But the dog would not go home.
The little boy said,
"I cannot go home without my dog."
Then the boy began to cry.

### 2

Once there was a little pig.
He lived with his mother in a pen.
One day he saw his four feet.
"Mother," he said, "what can I do with my feet?"
His mother said, "You can run with them."
So the little pig ran round and round the pen.

### 3

Once there was a cat and a mouse. They lived in the same house. The cat bit off the mouse's tail. "Pray puss," said the mouse, "give me my long tail again."
"No, "said the cat, "I will not give you your tail till you bring me some milk."

### 4

Once there lived a king and a queen in a large palace. But the king and queen were not happy. There were no little children in the house or garden. One day they found a poor little boy and girl at their door. They took them into the beautiful palace and made them their own. The king and queen were then happy.

## APPENDIX 4

5

One of the most interesting birds which ever lived in my bird-room was a blue-jay named Jackie. He was full of business from morning till night, scarcely ever still. He had been stolen from a nest long before he could fly, and he had been reared in a house long before he had been given to me as a pet.

6

The part of farming enjoyed most by a boy is the making of maple sugar. It is better than blackberrying and almost as good as fishing. One reason why a boy likes this work is that someone else does most of it. It is a sort of work in which he can appear to be very industrious and yet do but little.

7

It was one of those wonderful evenings such as are found only in this magnificent region. The sun had sunk behind the mountains, but it was still light. The pretty twilight glow embraced a third of the sky, and against its brilliancy stood the dull white masses of the mountains in evident contrast.

8

The crown and glory of a useful life is character. It is the noblest possession of man. It forms a rank in itself, an estate in the general good will, dignifying every station and exalting every position in society. It exercises a greater power than wealth, and is a valuable means of securing honor.

## APPENDIX 4

9

He was approximately six feet tall and his body was well proportioned. His complexion inclined to be florid; his eyes were blue and remarkably far apart. A profusion of hair covered the forehead. He was scrupulously neat in his appearance; and, although he habitually left his tent early, he was well dressed.

10

Responding to the impulse of habit Josephus spoke as of old. The others listened attentively but in grim and contemptuous silence. He spoke at length, continuously, persistently, and ingratiatingly. Finally exhausted through loss of strength he hesitated. As always happens in such exigencies he was lost.

11

The attractions of the American prairies as well as of the alluvial deposits of Egypt have been overcome by the azure skies of Italy and the antiquities of Roman architecture. My delight in the antique and my fondness for architectural and archaeological studies verges onto a fanaticism.

12

The hypotheses concerning physical phenomena formulated by the early philosophers proved to be inconsistent and in general not universally applicable. Before relatively accurate principles could be established, physicists, mathematicians, and statisticians had to combine forces and work arduously.

APPENDIX 5

Table XI.-

Range, Mean and Standard Deviation of the Degree of Rotation On Each of the Items of Picture Arrangement (PA), Block Design (BD) and Object Assembly (OA) Subtests for Those Subjects Rotating Less Than 60 Degrees.

| Item | Range | Mean | SD | N |
|---|---|---|---|---|
| PA | | | | |
| A | 0-11 | 1.80 | 2.65 | 15 |
| B | 0-7 | 1.86 | 2.01 | 15 |
| C | 0-2 | .05 | .07 | 15 |
| D | 0-35 | 1.00 | 1.01 | 15 |
| 1 | 0-60 | .96 | 1.54 | 15 |
| 2 | 0-5 | 1.83 | 1.73 | 15 |
| 3 | 0-4 | 1.21 | 1.51 | 14 |
| 4 | 0-5 | 1.20 | 1.52 | 15 |
| 5 | 0-4 | 1.17 | 1.38 | 14 |
| 6 | 0-3 | .57 | 1.01 | 13 |
| 7 | 0-35 | 1.57 | 1.02 | 13 |
| BD | | | | |
| A | 0-10 | 1.63 | 2.65 | 15 |
| B | 0-12 | 2.40 | 3.12 | 15 |
| C | 0-9 | 1.70 | 2.65 | 15 |
| 1 | 0-2 | .26 | .09 | 15 |
| 2 | 0-5 | 1.16 | 1.73 | 15 |
| 3 | 0-40 | 4.30 | 3.87 | 15 |
| 4 | 0-6 | 1.42 | 1.73 | 14 |
| 5 | 0-1 | .08 | .35 | 12 |
| 6 | 0-11 | 2.85 | 4.24 | 10 |
| 7 | 0-5 | .88 | 1.41 | 9 |
| OA | | | | |
| Manikin | 0-27 | 4.23 | 6.85 | 15 |
| Face | 0-20 | 3.79 | 5.66 | 12 |
| Auto | 0-15 | 4.16 | 3.87 | 12 |

APPENDIX 6

Table XII.-

Range, Mean and Standard Deviation of the Degree of Rotation On Each of the Items of Picture Arrangement (PA), Block Design (BD) and Object Assembly (OA) Subtests for Those Subjects Rotating More Than 60 Degrees.

| Item | Range | Mean | SD | N |
|---|---|---|---|---|
| PA | | | | |
| A | 0-36 | 6.92 | 9.06 | 19 |
| B | 0-11 | 2.13 | .92 | 19 |
| C | 0-7 | 2.92 | .85 | 19 |
| D | 0-20 | 3.26 | 4.58 | 19 |
| 1 | 0-9 | 2.00 | 3.01 | 19 |
| 2 | 0-8 | 2.10 | 2.24 | 19 |
| 3 | 0-7 | 2.00 | 2.65 | 19 |
| 4 | 0-7 | 1.81 | 2.24 | 19 |
| 5 | 0-15 | 2.50 | 3.33 | 19 |
| 6 | 0-5 | 1.62 | 1.74 | 16 |
| 7 | 0-11 | 2.36 | 3.01 | 15 |
| BD | | | | |
| A | 0-13.5 | 4.60 | 5.02 | 19 |
| B | 0-26 | 7.07 | 8.31 | 19 |
| C | 0-16 | 4.44 | 3.87 | 19 |
| 1 | 0-45 | 5.23 | 10.20 | 19 |
| 2 | 0-27 | 6.05 | 9.59 | 18 |
| 3 | 0-19 | 6.09 | 5.91 | 16 |
| 4 | 0-26 | 8.07 | 7.87 | 14 |
| 5 | 0-12 | 4.72 | 3.46 | 11 |
| 6 | 0-24 | 5.88 | 6.93 | 9 |
| 7 | 0-14 | 4.12 | 5.20 | 8 |
| OA | | | | |
| Manikin | 0-23 | 5.52 | 6.08 | 19 |
| Face | 0-21-5 | 8.17 | 6.40 | 17 |
| Auto | 0-19 | 4.03 | 6.25 | 15 |

APPENDIX 7

## Table XIII.-

Range, Mean and Standard Deviation of the Degree of Rotation On Each of the Items of Picture Arrangement (PA), Block Design (BD) and Object Assembly (OA) Subtests.

| Item | Range | Mean | SD | N |
|---|---|---|---|---|
| PA | | 2.07 | 4.69 | 34 |
| A | 0-36 | 4.60 | 7.48 | 34 |
| B | 0-11 | 2.00 | 3.16 | 34 |
| C | 0-7 | 2.0 | 2.23 | 34 |
| D | 0-20 | 2.3 | 3.60 | 34 |
| 1 | 0-9 | 1.5 | 2.44 | 34 |
| 2 | 0-8 | 2.0 | 2.10 | 34 |
| 3 | 0-7 | 1.7 | 1.91 | 33 |
| 4 | 0-7 | 1.5 | 1.74 | 34 |
| 5 | 0-15 | 1.9 | 2.82 | 33 |
| 6 | 0-5 | 1.2 | 1.70 | 29 |
| 7 | 0-11 | 2.0 | 1.50 | 28 |
| BD | | 2.66 | 6.91 | 34 |
| A | 0-13.5 | 3.3 | 4.31 | 34 |
| B | 0-26 | 5.0 | 7.01 | 34 |
| C | 0-16 | 3.2 | 4.24 | 34 |
| 1 | 0-45 | 3.0 | 8.00 | 34 |
| 2 | 0-27 | 4.4 | 6.70 | 33 |
| 3 | 0-40 | 5.0 | 7.87 | 32 |
| 4 | 0-26 | 4.8 | 6.55 | 28 |
| 5 | 0-12 | 2.3 | 3.31 | 23 |
| 6 | 0-24 | 4.5 | 6.00 | 18 |
| 7 | 0-14 | 2.4 | 4.24 | 16 |
| OA | | 5.18 | 6.17 | 34 |
| Manikin | 0-27 | 5.0 | 5.65 | 34 |
| Face | 0-21.5 | 6.4 | 6.78 | 29 |
| Auto | 0-19 | 4.1 | 5.65 | 27 |

## APPENDIX B

## ABSTRACT OF

## Rotations in Visual Motor Tasks and Reversals in Oral Reading.[1]

The primary aim of this study was to investigate whether or not a relationship existed between rotations on the visual motor tasks and reversals in oral reading. The Gray Standardized Oral Reading Paragraphs and cards containing reading material which is described in the literature as the most common source of difficulty for poor readers were used to test for reversals in reading. The items of the Performance Subtests of the WISC, Block Design, Picture Arrangement, and Object Assembly were used to test for rotations in the visual-motor area.

The population consisted of thirty-four school children from the general Ottawa area. The age range was from seven years three months to twelve years nine months. Twenty-four males and eight females were used.

The accumulated data was classified by two sets of criteria. On the first set, number and size of rotations on the WISC items was compared to the number of reversals in reading. On the second set, the total number of degrees

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1 Robert R. Hartigan, master's thesis presented to the School of Psychology and Education of the University of Ottawa, Ontario, 1961, viii-62 p.

rotated on all the items was compared with the number of reading reversals. This was done by means of the chi-square technique. An item analysis was run on the individual items to find which were contributing to the significance.

A significant relationship was found on both sets of criteria for rotations in the visual-motor tasks and reversals in oral reading. Items which involve a change in size from the previous item produce rotations more consistently than other items. But individuals evidencing rotation are likely to rotate on any type of item.

It was concluded that those evidencing rotations and reversals show performance which is similar to individuals with brain damage and also to those with a psychogenic disturbance.