

THE INCIDENCE OF PROBLEMS OF LATERALITY,
DIRECTIONAL ORIENTATION, AND BODY INTEGRATION
AS RELATED TO LEARNING DISABILITIES

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF ARTS IN OCCUPATIONAL THERAPY
IN THE GRADUATE SCHOOL OF THE TEXAS WOMAN'S
UNIVERSITY

SCHOOL OF
OCCUPATIONAL THERAPY

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DENTON, TEXAS

MAY, 1975

Texas Woman's University

Deaton, Texas

November 22 19 74

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our supervision by Suzanne Rosamond Tenison

entitled THE INCIDENCE OF PROBLEMS OF LATERALITY,

DIRECTIONAL ORIENTATION, AND BODY INTEGRATION AS

RELATED TO LEARNING DISABILITIES

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Acknowledgement

The writer wishes to express her appreciation to Catherine Currie for her inspiration in making this study possible.

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CHAPTER I

INTRODUCTION

Persons working in the field of normal child development and persons in areas concerned with the deviations from normal growth and development have, for the past two decades, become aware of a large group of individuals with nonspecific diagnostic problems. The individuals have been grouped under varying diagnostic labels. These children have been described as having minimal brain damage, hyperkinesis, the Strauss syndrome, clumsiness, and motor retardation. They also have been described as having learning disorders, perceptual handicaps, strephosymbolia, et cetera. A task force organized by the National Institute of Neurological Diseases and Blindness, the Division of Chronic Diseases of the U. S. Public Health Services, and the National Society for Crippled Children and Adults undertook the job of defining this category of children. The terminology "minimal cerebral dysfunction" came from this task force and is currently considered the best available descriptive nomenclature (U. S. Department of Health, Education, and Welfare, 1966).

A monograph (U. S. Department of Health, Education

and Welfare, 1969) reporting the research of eighteen physicians, educators, psychologists, and health related professionals emphasized the areas of recent investigation in the field. This research endeavored to determine the best possible educational methods for these children, the appropriate type of drug therapy, the earliest age at which a diagnosis could be made, the best diagnostic tools, and in general the best type of long range management plans.

Even though much research has taken place in the general area of minimal cerebral dysfunction, including studies of motor performance of children exhibiting this dysfunction, little information has been reported which related the incidence of dominance and directional problems with learning disorders. According to work done at the Boston Research Center, a direct relationship between the maturation of motor skills and the development of cerebral dominance had been noted (Benson, 1968).

The Problem

Importance of the Study--In evaluating and planning remedial or enrichment programs for children, the therapist or educator could better understand learning problems if the role of dominance and laterality formation in developmental disorders were clarified.

Assumptions--The following assumptions served as a basis for the present study:

1. Laterality is an acquired skill and leads to dominance.
2. Handedness is the most overt manifestation of laterality.
3. The acquisition and development of fine hand skills depends on the establishment of laterality and then dominance.
4. The occupational therapist can assist in the establishment of laterality by the presentation of specific activities.

Hypothesis--The hypothesis for this study was stated as follows: mixed dominance, incomplete dominance or crossed dominance and problems of directional orientation and integration are more prevalent in children with learning problems than in the population of children having no known learning disorder.

Statement of the Problem--It was the purpose of this study to investigate the incidence of problems of laterality, dominance and directional orientation in a sample group of children with learning disorders and to compare this sample group with a normal sample population exhibiting no known learning disorders. The eye, hand, and foot preference

of the children in each group was tested. In addition, observations were made to determine whether confusion in left to right pattern existed, and whether motor acts requiring body integration were difficult to perform.

Definition of Terms

1. Laterality - the functional superiority and preferential knowledge of one of a set of paired anatomical structures (Price, 1954).
2. Dominance - the tendency for one of the cerebral hemispheres to predominate in certain specified functions (Benson, 1968).
3. Hand Preference - strong preferences for consistent use of the same hand in performance of skilled digital movement (Benson, 1968).
4. Foot Preference - consistent preference for use of one foot and leg for activities such as kicking, stamping, and hopping (Benson, 1968).
5. Eye Preference - preference for one eye in performance of one-eyed visual activities such as microscope or telescope (Benson, 1968).
6. Mixed Dominance - performance of some of the skilled activities with one side of the body and performance of other equally skilled activities with the other side of the body (Harris, 1957, 1958).

7. Incomplete Dominance - preference is not established; individual shifts from one side of body to other for performance of one specific activity (Harris, 1957, 1958).
8. Crossed Dominance - eye, hand, and foot preference is not on the same side of the body (Harris, 1957, 1958).
9. Directional Orientation - left-right movement concept in space (Cratty, 1969).
10. Equivocal Neurological Signs - subtle, deviant, functioning of the central nervous system. Among the most frequently observed signs are: dysdiadochokinesia, poor coordination, mixed and confused laterality, slow speech development, awkwardness (Clements, 1962).
11. Body Integration - ability to coordinate the two sides of the body together in space and motion (Ayres, 1969).

Limitation of the Study

The study was limited to a total group sampling of sixty-eight children: thirty-four for the learning disorders group and thirty-four for the normal sample population. Age range included was between seven and nine years. No physical disability was manifest except for the

wearing of glasses.

The children with learning disorders were evaluated through the Department of Pediatrics, University of Texas Southwestern Medical School. The children with no known learning disabilities were enrolled in either Good Shepherd Episcopal Parish Day School, Dallas, Texas or The Texas Woman's University Demonstration School, Denton, Texas.

CHAPTER II

RELATED LITERATURE

Introduction

A review of the available literature concerning dominance, laterality and directional orientation revealed that in almost all cases the writer ended his paper with statements similar to the following: Additional studies should clarify the role of dominance formation in developmental disorders (Benson, 1968). Readers were reminded that the relationship between dominance and motor coordination and reading and writing was presently pure speculation (Werry, 1968). Palmer (1964) stated that at present, the literature on handedness presented more questions than it answered. He observed that hand (eye, foot) lateralization was probably multiply and complexly determined, thus he argued against the notion of a unitary factor underlying all manifestations of lateralization. Price (1959) reported that laterality in children with dysfunction of the central nervous system seemed to be of more consequence than in normal children; however she stated few studies have been made in this area.

According to Silver (1961), Orton became aware of a

definite correlation of reading problems with left handedness as early as 1925. He referred to this as "strephosymbolia". Critchley (1964), a neurologist who had done intensive study in the field of developmental dyslexia, stated that the incidence of left-handedness, ambidexterity and crossed laterality was high in the dyslexia population. The author stated that the question of how or if this inadequate unilateral dominance changed with time had not currently been answered.

Because several factors were considered in the present study, literature review has been organized into the following divisions: (a) discussion of ambiguous terminology, (b) importance of establishment of hand preference, and (c) importance of directional orientation and integrated body movements.

Discussion of Ambiguous Terminology

While terminology as defined in Chapter I was the basis for the present study, many inconsistencies were noted in the review of literature regarding common understanding of word meanings. Frostig and Maslow (1970) stated that while laterality, lateral dominance, and directionality were sometimes thought to be synonymous, the belief was erroneous. These authors stated that laterality referred to knowledge

of the difference between left and right sides of the body; directionality, to knowledge of left and right in space; and lateral dominance, to the preferred side of the body.

Price's (1959) definition for laterality was much the same as Harris' (1957) definition for lateral dominance: the preference for, or superiority of one side of the body over the other..

In discussing equivocal neurological signs associated with minimal brain dysfunction, Clements (1962) reported that laterality referred to the ability to distinguish right from left. Kephart (1969) and Hunter (1968) referred to laterality as a map of inner space or an awareness within the body of the difference between right and left. Kephart and Hunter also agreed that directionality referred to the map of outer space or a projection of concepts into space and away from the body.

Frostig and Maslow (1970) stated that directionality and laterality had an effect on learning, but that lateral dominance did not. Eyre (1933) said that hand preference was an overt manifestation of general lateral dominance.

A brief review of some of the Ayres tests (1962, 1964, 1966) indicated the importance of hand preference to interpretation of test instruments. Ayres stressed the need to understand the terms hand preference, handedness, and

hand dominance. All literature reviewed referred to handedness and hand preference interchangeably. The term dominance, however was used interchangeably with the other two terms only by Gesell (1928, 1940), Ayres (1972), and Goldberg (1968). Price (1959) clearly stated in her article that she would avoid using the term dominance because it implied an erroneous relationship between parts and was burdened with too many connotations in other disciplines, notably in the field of genetics.

Kephart (1960) and Chaney and Kephart (1968) stated that after learning the two sides of the body, a child learned to keep the relationship straight by developing one side as a leading side, which could lead to dominance and to handedness.

Touwen and Precht1 (1970) emphasized the importance of a careful distinction between the terms dominance and preference. According to the authors, dominance implied neurological organization suggesting superiority of one hemisphere over the other in controlling motor function; preference described the hand, eye, or foot the child preferred to use for particular tasks.

O'Donnell (1970) referred to dominance as only one of many expressions of laterality and suggested that the use of the term could perpetuate archaic notions of the

relationship between observed hand preference and cortical hemispheric dominance.

Importance of the Establishment
of Hand Preference

Gesell (1940) stated that the initial unilateral use of one hand resulted as the young child learned that two hands obscured the view of the reached-for object, and he discovered that the single hand grasp was more efficient. Gesell considered this to be the beginning of unilaterality.

Ayres (1972) observed that establishing one hand as dominant was a developmental aspect holding significance for total sensory integration. Price (1954) related that laterality, overtly manifest as handedness, was the key to acquisition of fine skills.

Clark (1957) reported an intimate connection was evident between the development of speech and dominant handedness. The author further stated that a relationship between retarded speech and lack of dominance was probable.

Illingworth (1967) mentioned that ambidexterity and mixed handedness could only be associated with incomplete dominance which produced general immaturity in motor and/or linguistic functions.

Frostig and Maslow (1970) observed that unestablished dominance may have had an indirect effect upon learning be-

cause the lack of preference inhibited the knowledge of right and left and caused directional problems related to learning ability.

Cratty and Martin (1969) mentioned that even though there was lack of evidence related in the literature to the importance of establishing a hand preference, it was true that many unilateral tasks required the preferential selection of one hand.

Importance of Directional Orientation
and Integration of Body Movements

Barsch (1962), Getman (1965), and Kephart (1964) were proponents of the theory that an individual must have acquired certain motor and perceptual skills in order to read adequately. Lewis, Bell, and Anderson (1970) attempted to quantify the relation between reading and motor ability, and to determine which, if any, motor act was the most significant in determining reading skill. The authors used the Lincoln Oseretsky Motor Development Scale (Sloan, 1954, 1955) as one instrument in their study and reported that 71% of the retarded readers tested had difficulty with tasks involving bilateral and synchronous movements. These findings tended to support the positions of Kephart (1964), Barsch (1962), and Getman (1965) in the belief that the retarded reader had more problems with

bilateral than unilateral movements. Harmon (1958) believed that the human body was bilaterally organized and that individuals had to establish a bilateral symmetry in order to function effectively in activities such as reading and writing.

Ayres (1972) suggested that right-left discrimination matured only after occurrence of integration of the two sides of the body. Ayres further stated that establishing one hand as dominant was significant for total sensory integration. Ayres (1969, 1971, 1972) also stated that individuals who failed to establish integration of the two sides of the body tended to use each side of the body independently of the other. By avoiding the establishment of a preferred and an assisting hand, such individuals developed similar degrees of coordination in the two hands. The terms ambidexterity or ambilaterality have been used to indicate this condition of equally strong preference for either hand, or either side of the body. However O'Donnell (1970) emphasized that these terms should be used to denote the lack of strong unilateral preference and thus equally weak preference for either side.

Knickerbocker (1968) in her Longitudinal Progression Chart illustrated a central approach to the development of spatial and temporal concepts. The eight areas she listed

were body schema, body image, directionality, spatial relations, spatial sequence, temporal sequence, synchrony, and continuity. Three of the eight areas--body image, directionality and spatial relations--were concerned with the following: (a) identifying the body in near and far space; (b) orienting the body in relation to up, down, right, left, top, bottom; (c) providing a meaningful constant point of reference for the individual; and (d) increasing the awareness of body movement and positioning. The author felt that awareness within the body allowed for the transition from an internal to an external awareness of positions of other persons or objects, which facilitated the child's ability to organize, integrate, and generalize new information in relation to prior experiences.

CHAPTER III

PROCEDURE

Subjects between the ages of seven and nine years who had been referred for occupational therapy evaluations, because of school problems, were selected to be the experimental population of this study. The control group of subjects within the same age range was selected from The Texas Woman's University Demonstration School, Denton, and Good Shepherd Episcopal Parish Day School, Dallas. All testing and observation was performed by the author of this study. The recording form is included in Appendix A. Each subject was evaluated individually in one continuous session.

There were twenty-eight females and forty males included in the study. The experimental group and the control group were divided by sex and subdivided into four matched age groups:

- (a) 7 years to 7 years, 5 months,
- (b) 7 years, 6 months to 7 years, 11 months,
- (c) 8 years to 8 years, 5 months,
- (d) 8 years, 6 months to 8 years, 11 months.

Multiple activities were observed in evaluating the

children's function and they were grouped under the following categories:

- (1) Hand, eye and foot preference.
 - (a) Writing the name and alphabet.
 - (b) Eating with a utensil.
 - (c) Throwing a ball.
 - (d) Looking through a kaleidoscope.
 - (e) Kicking a ball.
 - (f) Stamping one foot.
- (2) Integration of body movements in gross and fine motor skills.
 - (a) Ability to hold paper while writing (fine).
 - (b) Winding thread on a spool (fine).
 - (c) Skipping (gross).
- (3) Directional orientation--consistency of left to right pattern in performing graphic tasks.
- (4) Visual-motor integration--completion of Developmental Test of Visual-Motor Integration. (Beery and Buktenica, 1967).

The scores obtained on the Test of Visual-Motor Integration for the experimental and the control groups were compared by t-test (Koenker, 1961). Chi square (Koenker, 1961) was used to analyze the quality of performance of the experimental and the control groups in the remaining observed

activities. Performance comparisons were grouped as follows:

- (a) Problems of crossed, mixed or incomplete dominance.
- (b) Problems of fine motor integration.
- (c) Problems of gross motor integration.
- (d) Problems of directionality.

In addition to the Developmental Test of Visual-Motor Integration (Beery and Buktenica, 1967), the following materials were required for the observation:

- (a) Pencil and paper.
- (b) Tennis ball.
- (c) Spoon and pudding or ice cream.
- (d) Kaleidoscope.
- (e) Spool with 2 yards of thread.

CHAPTER IV

PRESENTATION OF DATA

Data have been divided into and presented in four categories: (a) laterality preference, (b) body integration, (c) directional orientation, and (d) visual-motor integration. See Appendix B for table of raw data.

Laterality Preference

Hand, eye and foot preference was observed and recorded on the sixty-eight children included in the study. Hand preference was determined by observing writing, eating with a spoon and throwing a ball. Eye preference was determined by the subject holding and looking into a kaleidoscope. The foot preference was tested by kicking a ball and stamping on an imaginary bug.

All subjects who expressed hand, foot and eye preference on the same side of the body were classified as possessing complete unilaterality. Subjects who performed some of the tested activities with one side of the body and some with the other side were classified as exhibiting mixed dominance. Those children who shifted from one side of the body to the other for the same activity were determined to have incomplete

dominance. The classification of crossed dominance was assigned to those subjects whose hand, eye and foot preferences were not on the same side of the body. For the purpose of this study any child possessing crossed, mixed or incomplete dominance was classified as exhibiting a problem of dominance.

In the experimental group there were twenty-three children exhibiting problems. In the control group there were nine children with this type of problem. Analysis of data in Table 1 revealed a chi square value of 11.57 with a $p < .001$.

Table 1.--Incidence of Subjects with
and without Problems of Dominance
by Group

	Experimental	Control
Problem	23	9
No Problem	11	25

Body Integration

The second functional problem to be investigated was the integration of body movements in fine and gross motor skills. Fine motor integration was evaluated by two activities. First, the subject was observed winding two yards of thread on a spool with the preferred hand winding and the auxiliary hand holding the spool relatively still,

as required in The Lincoln-Oseretsky Motor Development Scale (Sloan, 1954). Secondly, the child's ability to use the non-dominant hand for holding the paper while performing graphic activities was observed. Failure to perform either of these two activities resulted in the child's classification as having a problem with fine motor integration.

In the experimental group there were thirty children exhibiting this problem. In the control group there were eleven. Analysis of data shown in Table 2 revealed a chi square value of 22.18 with a $p < .001$.

Table 2.--Incidence of Subjects with and without Problems of Fine Motor Integration by Group

	Experimental	Control
Problem	30	11
No Problem	4	23

Gross motor integration skills were evaluated by observing each child skip. A child who could not perform reciprocal skipping for a twelve-foot distance, given two trials, was classified as exhibiting a problem in gross motor integration. There were twenty-five experimental subjects and eight control subjects exhibiting problems

with skipping. Analysis of data in Table 3 revealed a chi square value of 17.02 with a $p < .001$.

Table 3.--Incidence of Subjects with and without Problems of Gross Motor Integration by Group

	Experimental	Control
Problem	25	8
No Problem	9	26

Directional Orientation

The activity observed to determine the presence of directional orientation was the consistency of a left to right pattern in performing graphic tasks. This included observation of the subject writing his name, the alphabet, and the completion of the Developmental Test of Visual-Motor Integration (Beery and Buktenica, 1967). A child was classified with a problem in directional orientation if he failed to copy the test symbols in a left to right sequence or if he failed to write from the left to the right side of his paper.

There were thirty-one experimental subjects who exhibited this problem. There were six control subjects who exhibited the problem. Analysis of data in Table 4 revealed a chi square value of 37.05 with a $p < .001$.

Table 4.--Incidence of Subjects with and without Problems of Directionality by Group

	Experimental	Control
Problem	31	6
No Problem	3	28

Visual-Motor Integration

The Developmental Test of Visual-Motor Integration

(Beery and Buktenica, 1967) was administered to all subjects and was scored according to the specifications stated in the manual. All subjects whose visual-motor integration age was below their chronological age were classified as having problems with visual-motor integration. In the experimental group there were thirty-four with problems and in the control group there were nineteen with problems. Table 5 compares the two groups using t-test.

Table 5.--Comparison of Mean Scores on Visual-Motor Integration Test

	Number	Mean	S. D.	<u>t</u> -test	P
Control	34	99.06	14.32		
Experimental	34	77.59	10.94	10.90*	<.001

*t-test table value for .001 level and df 66 is equal to 3.46.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the incidence of problems of dominance, directional orientation and body integration in children with learning disorders and to compare the results with the incidence of the same problems in normal children. The hypothesis was that these problems were more prevalent in the learning disorder group than in the population of children having no known learning disorder.

Conclusions

The data presented in the previous chapter indicated that in each tested area of performance there was a significantly greater incidence of problems in the learning disorder group than in the normal sample population. The significance at the .001 level of probability, as reported in Tables 1 through 5, indicated that the high incidence of problems in the learning disorder population did not occur by chance. Activities chosen for inclusion in this study appear to be discriminatory for identifying children with

learning disabilities.

Recommendations

It is this experimenter's recommendation that replication of this study utilizing these same activities, but matching the control and experimental groups in regard to intelligence and more closely matched age pairs, might result in a simple screening procedure which could denote the potential learning disorder child prior to the third grade. Because of the developmental level of activities, they are not suitable for pre-school age children. Additional investigation could determine which activities might have the greatest potential for identification of problems.

APPENDIX A
DATA RECORDING FORM

CONTROL GROUP

TEST GROUP

I. Q. _____

No. _____

B. D. _____

C. A. _____

Sex _____

Race _____

Hand preference

Writing _____

Eating _____

Throwing Ball _____

Eye Preference

Kaleidoscope _____

Foot preference

Kicking Ball _____

Stamping _____

Directionality and Integration

Skipping _____

Holding paper _____

Winding thread _____

Left to right pattern _____

Beery Visual Motor Integration _____

APPENDIX B
DATA OF RAW MATERIAL

APPENDIX B
DATA OF RAW MATERIAL

SUB- JECT	AGE	SEX	TEST	CON- TROL	QUOTIENT	DOMINANCE				INTEGRATION		DIREC- TION
						INC.	MIX.	CROSS.	COMP. UNIL. R. L.	GROSS SKIP- PING	FINE WINDING THREAD	
1	7-5	F		X	89				X	YES	NO	YES
2	7-4	F		X	98				X	YES	YES	YES
3	7-1	F		X	101				X	YES	YES	YES
4	7-0	F		X	94				X	YES	YES	YES
5	7-5	F		X	107				X	YES	YES	YES
6	7-1	F	X		74			X		NO	NO	NO
7	7-0	F	X		75		X			NO	NO	NO
8	7-0	F	X		75	X				NO	NO	NO
9	7-1	F	X		71		X	X		NO	NO	NO
10	7-0	F	X		86				X	NO	NO	NO
11	7-6	F		X	82			X		YES	YES	YES

APPENDIX B - Continued

SUB- JECT	AGE	SEX	TEST	CON- TROL	QUOTIENT	DOMINANCE				INTEGRATION		DIREC- TION
						INC.	MIX.	CROSS.	COMP. UNIL. R. L.	GROSS SKIP- PING	FINE WINDING THREAD	
12	7-6	F		X	116			X		YES	YES	YES
13	7-7	F		X	94				X	YES	YES	YES
14	7-9	F		X	92				X	YES	YES	YES
15	7-11	F	X		59				X	NO	NO	NO
16	7-6	F	X		88				X	NO	NO	NO
17	7-8	F	X		61		X			NO	NO	YES
18	7-11	F	X		74				X	YES	NO	NO
19	8-2	F		X	88				X	YES	YES	YES
20	8-4	F	X		74				X	NO	NO	NO
21	8-6	F		X	102				X	YES	NO	YES
22	8-6	F		X	77				X	YES	NO	YES
23	8-6	F		X	112				X	YES	YES	YES

APPENDIX B - Continued

SUBJECT	AGE	SEX	TEST	CONTROL	QUOTIENT VISUAL- MOTOR INTEGRATION	DOMINANCE				INTEGRATION		DIRECTION
						INC.	MIX.	CROSS.	COMP. UNIL. R. L.	GROSS SKIP- PING	FINE WINDING THREAD	
24	8-6	F		X	112		X			YES	NO	YES
25	8-11	F	X		80				X	YES	NO	NO
26	8-6	F	X		86		X	X		NO	NO	NO
27	8-10	F	X		70			X		NO	NO	NO
28	8-11	F	X		65			X		YES	YES	YES
29	7-5	M		X	99				X	NO	YES	NO
30	7-5	M		X	81				X	NO	NO	NO
31	7-1	M		X	96			X		YES	YES	YES
32	7-4	M		X	107				X	YES	YES	YES
33	7-5	M		X	99		X			YES	YES	YES
34	7-3	M	X		83			X		YES	YES	YES
35	7-4	M	X		93				X	NO	NO	NO

APPENDIX - Continued

SUB- JECT	AGE	SEX	TEST	CON- TROL	QUOTIENT	DOMINANCE					INTEGRATION		DIREC- TION	
						VISUAL- MOTOR INTEGRATION	INC.	MIX.	CROSS.	COMP. UNIL.		GROSS SKIP- PING		FINE WINDING THREAD
										R.	L.			
36	7-1	M	X		79			X			NO	NO	NO	
37	7-0	M	X		86	X					NO	NO	NO	
38	7-3	M	X		89	X					NO	NO	NO	
39	7-9	M		X	111		X	X			NO	YES	YES	
40	7-8	M		X	102					X	YES	YES	YES	
41	7-10	M		X	100				X		NO	YES	YES	
42	7-7	M		X	95				X		YES	YES	YES	
43	7-7	M		X	90				X		NO	YES	NO	
44	7-8	M	X		57				X		NO	NO	NO	
45	7-6	M	X		80		X				NO	NO	NO	
46	7-6	M	X		91	X					NO	NO	NO	
47	7-7	M	X		74				X		NO	NO	NO	

APPENDIX B - Continued

SUB- JECT	AGE	SEX	TEST	CON- TROL	QUOTIENT	DOMINANCE				INTEGRATION		DIREC- TION
						INC.	MIX.	CROSS.	COMP. UNIL. R. L.	GROSS SKIP- PING	FINE WINDING THREAD	
48	7-9	M	X		88		X			YES	NO	NO
49	8-3	M		X	104				X	YES	YES	YES
50	8-2	M		X	114				X	NO	NO	YES
51	8-5	M		X	140				X	YES	YES	YES
52	8-3	M		X	132				X	YES	YES	YES
53	8-0	M		X	85				X	YES	YES	YES
54	8-0	M	X		80				X	NO	NO	NO
55	8-0	M	X		92		X	X		NO	NO	NO
56	8-0	M	X		92			X		NO	NO	NO
57	8-4	M	X		63				X	NO	YES	NO
58	8-2	M	X		64	X				NO	NO	NO
59	8-9	M		X	107				X	YES	NO	NO

APPENDIX B - Continued

SUB- JECT	AGE	SEX	TEST	CON- TROL	QUOTIENT	DOMINANCE				INTEGRATION		DIREC- TION
						INC.	MIX.	CROSS.	COMP. UNIL. R. L.	GROSS SKIP- PING	FINE WINDING THREAD	
60	8-9	M		X	98				X	YES	NO	YES
61	8-6	M		X	86			X		NO	NO	NO
62	8-7	M		X	85			X		YES	NO	NO
63	8-9	M		X	73		X	X		YES	YES	YES
64	8-9	M	X		73			X		YES	NO	NO
65	8-10	M	X		97			X		YES	NO	NO
66	8-7	M	X		70				X	YES	NO	NO
67	8-11	M	X		63		X	X		NO	YES	NO
68	8-6	M	X		86	X				YES	NO	NO

LITERATURE CITED

- Ayres, A. Jean. Ayres Space Test. Beverly Hills, California: Western Psychological Services, 1962.
- Ayres, A. Jean. Southern California Motor Accuracy Test. Beverly Hills, California: Western Psychological Services, 1964.
- Ayres, A. Jean. Southern California Kinesthesia and Tactile Perception Tests. Beverly Hills, California: Western Psychological Services, 1966.
- Ayres, A. Jean. "Deficits in Sensory Integration in Educationally Handicapped Children." Journal of Learning Disabilities, Vol. 2 (March, 1969), 160-168.
- Ayres, A. Jean. "Characteristics of Types of Sensory Integrative Dysfunction." American Journal of Occupational Therapy, XXV (Oct., 1971), 329-334.
- Ayres, A. Jean. Sensory Integration and Learning Disorders. Los Angeles, California: Western Psychological Services, 1972.
- Barsch, Ray H. "Evaluating the Organic Child: the Functional Organizational Scale." Journal of Genetic Psychology, Vol. 100 (1962), 345-354.

- Beery, Keith E. and Buktenica, Norman A. Developmental Test of Visual-Motor Integration. Chicago: Follett Educational Corp., 1967.
- Benson, D. Frank and Geschwind, Norman. "Cerebral Dominance." in Symposium on Developmental Disorders of Motility and Language, Edited by Harry Bakwin. Vol. 15, No. 3: The Pediatric Clinics of North America. Philadelphia: W. B. Saunders Co., 1968.
- Chaney, Clara M. and Kephart, Newell C. Motoric Aids to Perceptual Training. Columbus, Ohio: Charles E. Merrill Publishing Co., 1968.
- Clark, M. M. Left Handedness. London: University of London Press, 1957.
- Clements, Sam D. "Minimal Brain Dysfunction in the School-Age Child." Archives of General Psychiatry, Vol. 6 (March, 1962), 185-197.
- Cratty, Bryant J. and Martin, Sister Margaret Mary. Perceptual-Motor Efficiency in Children. Philadelphia: Lee and Febiger, 1969.
- Critchley, MacDonald. Developmental Dyslexia. Springfield, Illinois: Charles C. Thomas, 1964.
- Eyre, M. C. and Schmeckle, M. M. "A Study of Handedness, Eyedness and Footedness." Child Development, Vol. 4 (1933), 73-78.

- Frostig, Marianne and Maslow, Phyllis. Movement Education Theory and Practice. Chicago: Follett Educational Corporation, 1970.
- Gesell, Arnold. Infancy and Human Growth. New York: Macmillan Co., 1928.
- _____, Halverson, H., Ilg, F., Ames, L., Thompson, H., Castner, B., and Armatruda, C. The First Five Years of Life. New York: Harper and Row, 1940.
- Getman, G. N. "The Visuomotor Complex in the Acquisition of Learned Skills." Learning Disorders. Vol. 1. Edited by Jerome Hellmuth. Seattle: Special Child Publications, 1965.
- Goldberg, Herman K. and Drash, Philip W. "The Opthamologist and the Disabled Reader." Learning Disorders, Vol. 111. Edited by Jerome Hellmuth. Seattle: Special Child Publications, 1968.
- Harmon, Darrell B. Notes on a Dynamic Theory of Vision. Vol. 1. Austin, Texas: by the author, 1958.
- Harris, A. J. "Lateral Dominance, Directional Confusion and Reading Disability." Journal of Psychology, XLIV (February, 1957), 283.

- Harris, A. J. Test of Lateral Dominance - Manual of Directions, 3rd ed. New York: Psychological Corp., 1958.
- Hunter, M. C. "The Role of Physical Education in Child Development and Learning." Journal of Health, Physical Education and Recreation, Vol. 39, No. 5 (1968), 56-58.
- Illingworth, R. S. The Development of the Infant and Young Child. Edinburgh: E. and S. Livingston Ltd., 1967.
- Kephart, Newell C. "Perceptual-Motor Aspects of Learning Disabilities." Exceptional Child, Vol. 31 (1964), 201-206.
- Kephart, Newell C. The Slow Learner in the Classroom. Columbus, Ohio: Charles E. Merrill Publishing Co., 1960.
- Koenker, Robert H. Simplified Statistics. Bloomington, Illinois: McKnight and McKnight Publishing Co., 1961.
- Knickerbocker, Barbara. "A Central Approach to the Development of Spatial and Temporal Concepts." Learning Disabilities. Vol. 111. Edited by Jerome Hellmuth. Seattle: Special Child Publications, 1968.

- Lewis, F. D., Bell, D., Anderson, Robert P. "Relationship of Motor Proficiency and Reading Retardation." Perceptual and Motor Skills, Vol. 31 (1970), 395-401.
- O'Donnell, Patrick A. "A Re-evaluation of Research on Lateral Expression." Journal of Learning Disabilities, Vol. 3, No. 7 (July, 1970) 344-350.
- Palmer, R. D. "Development of a Differentiated Handedness." Psychological Bulletin, Vol. 62, No. 4 (1964), 257-272.
- Pasamanick, Benjamin and Knoblock, Hilda. "Retrospective Studies on the Epidemiology of Reproductive Casualty: Old and New." The Multiply Handicapped Child. Edited by James M. Wolf and Robert M. Anderson. Springfield, Illinois: Charles C. Thomas, 1973.
- Price, Antje. "Laterality of Upper Extremity of Physically Handicapped Children." American Journal of Occupational Therapy, VIII (November-December, 1954), 241-259.
- Silver, Archie A. "Diagnostic Considerations in Children with Reading Disability." Bulletin of the Orton Society, XI (May, 1961), 8-17.
- Sloan, William. Manual for the Lincoln-Oseretsky Motor Development Scale. Chicago: C. H. Stoelting Co., 1954.
- Sloan, W. "The Lincoln-Oseretsky Motor Development Scale." Genetic Psychology Monograph, Vol. 51 (1955), 183-352.

- Touwen, Bert C. L. and Precht1, Heinz F. R. The Neuro-logical Examination of the Child with Minor Nervous Dysfunction. London: Spastics International Medical Publications, 1970.
- U. S. Department of Health, Education and Welfare, Public Health Service. Minimal Brain Dysfunction in Children, Terminology and Identification. Washington, D. C. Government Printing Office, 1966.
- U. S. Department of Health, Education and Welfare, Public Health Service, Minimal Brain Dysfunction in Children, Educational, Medical and Health Related Services. Washington, D. C. Government Printing Office, 1969.
- Werry, John S. "Developmental Hyperactivity." in Symposium on Developmental Disorders of Motility and Language, Edited by Harry Bakwin. Vol. 15, No. 3: The Pediatric Clinics of North America. Philadelphia: W. B. Saunders Co., 1968.