A STUDY OF THE RELATIONSHIP BETWEEN LATERAL PREFERENCE AND THE PERFORMANCE OF A SELECTED BIMANUAL DEXTERITY SKILL

By

MARY ANN ELIZABETH THOMPSON

Bachelor of Science
Texas Woman's University
Denton, Texas
1969

Master of Education
Central State University
Edmond, Oklahoma
1972

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
DOCTOR OF EDUCATION
December, 1978

A STUDY OF THE RELATIONSHIP BETWEEN LATERAL PREFERENCE AND THE PERFORMANCE OF A SELECTED BIMANUAL DEXTERITY SKILL

Thesis Approved:

Betty Abercrombie
Thesis Adviser

John S. Bayless

Thomas A. Karman

Barbara Peel

Norman N. Durham
Dean of the Graduate College

ACKNOWLEDGMENTS

It is with sincere appreciation that I express my gratitude to the members of my committee: Dr. Betty Abercrombie, Professor in the School of Health, Physical Education and Leisure Services; Dr. John Bayless, Professor in the School of Health, Physical Education and Leisure Services; Dr. Barbara Peel, Assistant Professor in Applied Behavioral Studies; Dr. Thomas Karman, Professor in Educational Administration and Higher Education. Special thanks go to Dr. Abercrombie for her time, concern and encouragement and to Dr. Bayless for his interpretive ability, reinforcement and humor.

This study was aided by the directors of many of the Stillwater nursery schools. Their cooperation is appreciated. I am also very grateful to each of the children who so willingly played with me. Without them, this undertaking would have been impossible.

In addition, I would like to express my gratitude to the following: my parents, who instilled in me the belief that I could accomplish anything I chose to accomplish; my students, who retained their senses of humor; my swimming buddies, who continually encouraged me; Tinker and O.J., who provide me with welcome entertainment breaks; my close friends, who helped me keep body and soul together; and finally, Timmy and Amy, who daily brought home to me the reality of the worlds of young children.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Problem Definition

Laterality, that internal awareness of sides of the body which allows an individual to differentiate right from left, has been a concern of teachers and researchers in the fields of reading readiness, speech disorders, learning disabilities and physical education since Orton first presented his theory of hemispheric dominance and the accompanying strephosymbolia syndrome.[1] Orton proposed two main tenets: 1) hemispheric dominance, in which one side of the brain prevails over the other side in specific functions, was determined to exist in children with established consistent-sided use of both hand and eye on the same side of the body; 2) crossed laterality, in which the preferred hand was consistently opposite the preferred eye, and mixed laterality, in which general confusion within modalities (nondominant preference for right hand and left hand and/or eye) and/or crossing over between modalities existed, were both regarded as indicators of poorly established hemispheric dominance. Lack of established hemispheric dominance was theorized as a probable cause of reading difficulties. Strephosymbolia, reversal of symbols when reading, was regarded by Orton as the perceptual dysfunction most

---

[1]Samuel Torrey Orton, Reading, Writing and Speech Problems in Children (New York and London, 1937), pp. 45-49, 137-138.

characteristic of children exhibiting crossed or mixed laterality.[2]

From 1925 until the present, researchers have investigated the possible connection between laterality and learning. Relationships between laterality and reading disabilities, reading achievement, intellectual abilities, performance of physical education activities, academic failure, brain dysfunction, psychopathy, speech disorders and performance on selected motor ability and skill tests have been researched. In selecting the problem for this study, the writer considered the dirth of well-documented information and research concerning laterality and fine motor coordination performance, the apparent relationship between fine motor coordination and the degree of academic success, and the possibilities for further research.

Need for the Study

It is essential that professional people and parents recognize and understand the complex relationship between laterality and learning. Young children, in developing and refining lateralization, exhibit many transfers of dominance. The normalcy of such shifts between right-sidedness and left-sidedness, with the accompanying spatial disorientation which often results in mirror writing and reversals, must be comprehended.

Purpose of the Study

The purpose of this study was to determine if a significant difference existed among performance scores on a 30-second timed bead-

---

[2]John R. Kershner, "Reading and Laterality Revisited," Journal of Special Education, XI (Fall, 1975), p. 269.

stringing test attained by four-year-old children in three different laterality groups:

1) consistent lateral preference (right hand-right eye or left hand-left eye);
2) consistently crossed lateral preference (left hand-right eye or right hand-left eye);
3) mixed or no preference.

Research Question

Do differences in performance scores on a 30-second timed bead-stringing test exist among those four-year-olds who exhibit consistent lateral preference, those who exhibit consistently crossed lateral preference and those who exhibit mixed and/or no preference?

Hypotheses

1) There is no significant difference in the levels of bead-stringing performance of subjects in the consistent laterality group when compared with the consistently crossed laterality group.
2) There is no significant difference in the levels of bead-stringing performance of subjects in the consistent laterality group when compared with the mixed or no preference laterality group.
3) There is no significant difference in the levels of bead-stringing performance of subjects in the consistently crossed laterality group when compared with the mixed or no preference laterality group.
4) There is no significant difference among groups in the levels of bead-stringing performance of subjects in the three later-

ality groups.

Delimitations

This study was limited to four-year-olds attending Stillwater, Oklahoma nursery schools. These subjects were four years old prior to June 1, 1978 and were not five years old until after July 29, 1978.

Assumption

The assumption made in this study was that four-year-olds would exhibit one of the following in terms of lateral preference: consistent use of right hand-right eye or left hand-left eye; consistently crossed lateral usage; mixed or no lateral preference.

Definition of Terms

Ambidexterity: ability to use either hand with equal skill.

Ambilaterality: no preference in use of hands.

Bimanual: activities involving use of both hands, with one hand assuming a "dominant" role (as in sweeping with a broom).

Crossed laterality: consistent preference for use of right hand-left eye or left hand-right eye.

Expressive aphasia: inability to express ideas effectively in words.

Hemispheric dominance: dominance of one side of the brain over the other side in specific functions.

Homolaterality: consistent preference for use of right hand-right eye or left hand-left eye; unilaterality.

Laterality: internal awareness of the sides of the body, allowing each individual to differentiate right from left.

Lateral preference: side of the body used in activities involving hand-eye coordination.

Manual-ocular dominance: hand-eye dominance.

Mixed laterality: confusion in or crossing over modalities; also no preference in use of hands and eyes.

Strephosymbolia: reversal of symbols when reading.

Unilaterality: consistent preference for use of right hand-right eye or left hand-left eye; homolaterality.

Unimanual: activities involving use of one hand only.

The related literature reviewed in the next chapter may serve to increase the reader's understanding of the complex interrelationship between lateral preference and various aspects of learning.

CHAPTER II

REVIEW OF SELECTED LITERATURE

1929-1938

In the literature regarding laterality, much has been hypothesized, researched, theorized, reinvestigated and rejected during the past 50 years. One of the earliest studies of preferential handedness in children was the 1929 investigation conducted by Heinlein, who proposed the determination of handedness based upon superior right- or left-hand scores in four simple coordination tests involving visual-motor coordination. Over a five year period she administered these motor tests to 60 children ranging from four to twelve years of age. Children were classified as consistently right-handed, consistently left-handed or inconsistent on the basis of the first year test results. Analysis of each child within the respective handedness categories, with reference to consistency of superior handedness, indicated variability of preferential handedness on the individual test items. A predominance of right-hand preferences in all four tests existed.[1] The variation in performance of specific children in yearly retests, with some exhibiting an increase and some a decrease in favored hand superiority as they increased in chronological age, was interpreted by Heinlein as being "suggestive of

---

[1]Julia Heil Heinlein, "A Study in Dextrality in Children," Pedagogical Seminary and Journal of Genetic Psychology, XXXVI (1929), pp. 91-116.

'degree of bias'" with a decrease indicating eventual parallel performance of both hands and an increase indicating superiority of the preferred hand.[2]

Ojemann's 1930 study attempted to develop a technique for testing unimanual handedness. Five tests were administered to 518 third through eighth grade public school children, 256 boys and 264 girls. Scores obtained on these tests were correlated with a criterion of known handedness, using the judgments of parents concerning their children's handedness as the best criterion. The tests employed were ball-throwing, needle-threading, tapping, paper-cutting and block-packing. Ojemann concluded that a single test could not be used to differentiate accurately between handedness groups. When the scores from the five test items were combined and graphed, the distribution was distinctly bimodal, with very few individuals exhibiting ambidexterity. Most had definite right- or left-handed tendencies.[3]

Updegraff expressed concern that parental judgment of children's handedness was often used as the validating criterion for other measures of handedness and noted that no controlled method had been developed for observation of handedness in common daily activities. In her 1932 study she attempted to develop a battery of test items which could serve as a quick, reliable and valid method of testing handedness. Beginning with ten items, Updegraff discarded all but four. Those she retained involved spinning a top, spooning sand, hammering on a block and shaking

---

[2]Heinlein, p. 117.

[3]R. H. Ojemann, "Studies in Handedness: I. A Technique for Testing Unimanual Handedness," Journal of Educational Psychology, XXI (November, 1930), pp. 597-611.

a rattle. The four test items were administered twice to 40 children aged two to five years. Included in the study were eight two-year-olds, eleven three-year-olds, eleven four-year-olds and ten five-year-olds. The data obtained verified Heinlein's conclusion that preference varied in degree. There were no observable age differences, with two-year-olds exhibiting as much dominance as five-year-olds.[4]

A quite different approach to the aspect of handedness was evident in a 1934 study by Fitt and O'Halloran, who investigated the hereditary significance of handedness through correlations of degrees of left-handedness with psychopathic tendency, intellectual ability, speed of tapping and height. They concluded that left-handedness appeared to be associated with relatively low scholastic ability. Left-handed thirteen- and fourteen-year-old boys were found to be slightly shorter than their right-handed classmates. No correlation existed between handedness and speed of tapping. A group of dominantly left-handed twelve- and thirteen-year-olds seemed "to be somewhat more psychopathic" than the dominantly right-handed.[5] This apparent correlation did not imply causation.

In one of the few existing studies of preschool children, Updegraff reported results of testing eye dominance and handedness in seventy-four children, ages two to six. She found that 85 percent of the children were right-handed, 11 percent were left-handed and 4 percent showed no

---

[4]Ruth Updegraff, "Preferential Handedness in Young Children," Journal of Experimental Education, I (December, 1932), pp. 134-139.

[5]Arthur B. Fitt and K. H. O'Halloran, "The Relation Between Handedness and Some Physical and Mental Factors," Journal of Educational Psychology, XXV (April, 1934, pp. 286-296.

preference. In terms of eye dominance 55 percent were right-eyed, 26 percent were left-eyed and 19 percent exhibited no distinct preference. Of the right-handed children, 72 percent were also right-eyed. Of the left-handed children, 66 percent were left-eyed. Of the right-eyed children, 95 percent were right-handed. Of the left-eyed children, 21 percent were also left-handed. Updegraff concluded that a right-eyed child was more apt to be right-handed than a left-eyed child to be left-handed. She further stated that "the concept of unilaterality as varying in degree and of that degree expressed in terms of different manifestations of dominance, of which handedness and eyedness are only two, is the most plausible hypothesis at present."[6]

By 1935 the frequent occurrence of dyslexia and related reading problems in left-handed individuals had been duly noted by Dearborn, Anderson and Kelley, and Hincks. Approximately at the same time, Gates and Bennett, Monroe and Stromberg had associated left-eyedness with poor reading ability. Orton, in 1925 and again in 1928, and Dearborn, in 1931, proposed their theories of reading disability in neurological terms.

In a 1935 study of lead preference in movement and its relation to handedness, Tuttle and Travis concluded that the "precedence of lead in simultaneous contraction of homologous muscle groups [in this case, flexion of the forearms] is determined largely by the instructions given and the task involved," with more complicated instructions yielding responses more consistent with the handedness of subjects in ordinary

---

[6]Ruth Updegraff, "The Correspondence Between Handedness and Eyedness in Young Children," Pedagogical Seminary and Journal of Genetic Psychology, XLII (June, 1933), pp. 490-492.

everyday manual activities.[7]

Research done by Vogel, in conjunction with that of Tuttle and Travis, yielded information on the relationship of dominance to performing acts of skill, in this case, batting and throwing a baseball. Vogel reported that right dominant subjects exhibited mixed responses in throwing and batting, with the majority showing right-handed responses.[8]

In 1936 Witty and Kopel investigated the relationship between ability in reading and various conditions of laterality. Their experimental group consisted of 66 boys and 34 girls in grades three to six whose reading levels were one semester or more below their grade norms. A comparable number of boys and girls in the control group were normal readers whose reading scores on the Metropolitan Achievement Test were equal to or above their grade norms. Subjects were tested on various laterality items and unilateral preference, cross laterality and mixed laterality were noted within the experimental and control groups.[9] No relationship was found between reading ability and handedness or between reading ability and eyedness. It was further determined that conditions of right, left and mixed manual-ocular dominance occurred no more frequently among children with reading problems than among the control

---

[7] W. W. Tuttle and Lee Edward Travis, "The Relation of Precedence of Movement in Homologous Structures to Handedness," Research Quarterly, VI, Supplement (October, 1935), pp. 3-14.

[8] O. H. Vogel, "The Relationship of Dominance to Acts of Skill," Research Quarterly, VI, Supplement (October, 1935), pp. 15-18.

[9] Paul A. Witty and David Kopel, "Sinistral and Mixed Manual-Ocular Behavior in Reading Disability," Journal of Educational Psychology, XXVII (February, 1936), p. 119.

group without reading problems.[10] Witty and Kopel concluded that the data obtained in their study showed a lack of relationship between various lateralities and reading efficiency. The researchers did observe that laterality might be a factor contributing to emotional difficulties associated with poor reading.[11]

In another study conducted in 1936, Hull refers to work done the previous year by Weisenberg and MacBride in the area of aphasia: "speech has a unilateral localization in the cerebral cortex, and . . . this localization is correlated directly with hand preference."[12] It was Hull's desire to devise a questionnaire which would determine the side used in manual activities without having to obtain an actual performance of each activity. Using a test-retest situation, Hull administered a forty item questionnaire to 160 subjects, unselected members of a beginning speech class at the University of Minnesota and members of English classes at the University High School on the same campus. The age range was not great, with a nearly equal number of males and females participating in the study. Following a minimum four-week delay, a performance test of each questionnaire item was administered to each subject. Four weeks later the performance test was readministered. Twelve items were answered identically in over 90 percent of all cases in the test-retest of both questionnaires and performance tests. Hull arranged these items in a sidedness questionnaire:

---

[10]Witty and Kopel, pp. 121-119.

[11]Witty and Kopel, p. 131.

[12]Catharine J. Hull, "A Study of Laterality Test Items," Journal of Experimental Education, IV (March, 1936), p. 287.

1. Which hand holds a hammer while hammering?
2. Which hand holds the scissors while cutting?
3. Which hand distributes cards while dealing them?
4. Which hand spins a top?
5. Which hand winds a watch?
6. Which hand holds a toothbrush?
7. Which hand holds the knife in sharpening a pencil?
8. With which hand do you write?
9. Which hand cuts with the knife when eating?
10. With which hand do you draw a sketch or picture?
11. Which hand throws a ball?
12. Which hand holds a tennis racquet?[13]

One of the earliest articles mentioning consequences of forcing left-handed children to become right-handed appeared in the January, 1936 issue of National Parent-Teacher Magazine. Wile stated that left-handed children, simply by virtue of their handedness, were subjected to various unpleasant experiences by the right-handed world in which they live. Ultimately, left-handed children may exhibit one of several of the following: stuttering, general muscular awkwardness, mirror-writing, reading difficulties, behavior and personality disorders, restlessness and irritability. Wile concluded "natural tendencies should be conserved and developed rather than modified and restricted."[14]

In that same year Johnson and Duke studied the dextrality of six-year-old children in an attempt to construct an instrument which could be used to measure the degree of right-handedness exhibited. They formulated the Iowa Hand Usage Test, which measured "with a very satisfactory degree of reliability" the performance of common unimanual activities.[15]

---

[13]Hull, pp. 287-290.

[14]Ira S. Wile, M.D., "The Facts About Left-Handedness," National Parent-Teacher Magazine, XXX (January, 1936), pp. 8-9, 32-34.

[15]Wendall Johnson and Darlene Duke, "The Dextrality Quotients of Fifty Six-Year-Olds with Regard to Hand Usage," Journal of Educational Psychology, XXVII (January, 1936), pp. 26-36.

The following year Johnson and Davis conducted a study of the dextrality quotients of seven-year-olds in order to improve the Iowa Hand Usage Test and to determine the effect of age by comparing the six-year-old norms with the seven-year-old norms. Johnson and Davis improved the Iowa Hand Usage Test through the use of additional items, the exclusion of invalid items and the scoring of only two responses per item. The scores obtained from the revised form of the Iowa Hand Usage Test suggested that children became more right-handed in terms of hand usage as they grew older.[16]

One of the earliest reports dealing with the relationship of laterality to the performance of physical education activities was completed as part of Irwin's doctoral study in 1938. The purpose of his study was to investigate the physiological dominance of the upper and lower limbs and to determine the relationship of this dominance to performance of physical education activities by comparison of actual performance with the order of response on single stimulus simple response tests.[17] Two hundred thirty-nine elementary and high school boys were tested on an athletic dominance index, an order of response test and several simple physical tests. On the basis of data collected, Irwin concluded that handedness did not approximate a normal distribution, that there was close agreement between subjects' statements of handedness and actual performance on upper limb tests and that the reverse appeared true for

---

[16]Wendall Johnson and Dorothy M. Davis, "Dextrality Quotients of Seven-Year-Olds in Terms of Hand Usage," Journal of Educational Psychology, XXVIII (May, 1937), pp. 346-354.

[17]Leslie W. Irwin, "A Study of the Relationship of Dominance to the Performance of Physical Education Activities," Research Quarterly, IX (1938), pp. 98, 99, 118.

footedness. The results of the order of response test indicated that many subjects actually performing physical education activities right-handed were inherently ambidextrous.[18]

1939-1948

In a 1941 study of 104 children whose reading ability levels were at least eighteen months below their mental age for general intelligence, Schonell examined the relationship between certain types of perceptual errors and left-handedness.[19] From this investigation, Schonell inferred that left-handedness per se was not a cause of reading disability, although he found that the incidence of crossed laterality (right hand-left eye and left hand-right eye) was higher among "backward (readers) than amongst normal readers." He concluded that the disability of a few was due in part to their mixed eyedness and handedness, especially with respect to right-eyed left-handers.[20]

One of the first of Hildreth's numerous investigations into the area of hand-eye dominance and its relation to reading disabilities was published in 1945. In undertaking her study, Hildreth noted the vast number of conflicting results in the published research on hand-eye preference. Being concerned primarily with mixed hand-eye dominance, Hildreth attempted to determine the incidence of mixed dominance in an entire elementary school and the association between mixed dominance and

---

[18]Irwin, pp. 118-119.

[19]Fred J. Schonell, "The Relation of Reading Disability to Handedness and Certain Ocular Factors," British Journal of Educational Psychology, XI (February, 1941), pp. 20, 21, 26.

[20]Schonell, pp. 26-27.

reading disability in the same population.[21] She tested 101 boys and 90 girls from six to eleven years of age, giving four tests of eye dominance, three tests of handedness and one test of reading achievement. Hildreth noted that determination of eye dominance was more difficult and less reliable with the younger children because they had difficulty complying with the directions and because of their concern with irrelevant features of the test situation.[22] Hildreth found no consistent developmental tendency from one age group to the next. Although mixed dominant subjects had more difficulty with reading than did consistently dominant subjects, since fewer than half of the mixed dominant cases were slow in learning to read, Hildreth concluded that mixed hand-eye dominance was neither a prevailing condition in reading disability nor a "dominant causal factor in the majority of disability cases."[23]

Commenting on the incredible number of contradictions present in the literature, Blau concurred with theorists who viewed preferential laterality as an acquired trait which was part of cultural heritage, with dextrality the "conventional orientation, sinistrality . . . (a) developmental abberation [sic]."[24] He stated that although in recent years advocates supporting retention of left-side tendencies had influenced the lay public, he was opposed to this retention. He recommended vigorously encouraging dextrality, although he realized that such a position

---

[21]Gertrude Hildreth, "A School Survey of Eye-Hand Dominance," Journal of Applied Psychology, XXIX (February, 1945), pp. 83-88.

[22]Hildreth, p. 85.

[23]Hildreth, p. 88.

[24]Abram Blau, The Master Hand (New York, 1946), p. 169.

was a radical departure from the current philosophy.

Contrary to the opinions of most neurologists, Blau found evidence which supported the theory that the "side of cerebral dominance is not inherent nor inherited but is determined by the functional interaction between the individual and his environment."[25] He indicated his belief that psychological and cultural influences determine which cerebral hemisphere will dominate. He further stated that "early handedness sets the location (right or left hemisphere) of the cerebral language centers."[26] In reaffirming his position on encouraging dextrality in children, Blau stated that in this right-handed world, children who remain left-handed are at a distinct disadvantage.[27]

Gesell and Ames, in their 1947 treatise on the development of handedness, noted that several investigators had found that the development of lateral dominance "does not take a straight line course."[28] Giesecke found that infants at seven and ten months of age exhibit transfers of dominance. Lesné and Peycelon believed that normal infants are ambidextrous between five and nine months of age, with unidexterity established by ten or eleven months.[29] In an attempt to substantiate or disprove the studies by Giesecke and Lesné and Peycelon, Gesell and Ames utilized cinema and stenographic records of hand posturings and hand

---

[25] Blau, pp. 169-172.

[26] Blau, p. 171.

[27] Blau, p. 172.

[28] Arnold Gesell and Louise B. Ames, "The Development of Handedness," Journal of Genetic Psychology, LXX (1947), p. 155.

[29] Gesell and Ames, p. 155.

movements taken under standardized conditions. Subjects ranged in age from eight weeks to ten years. Detailed cinemanalysis revealed a schematic chronology of the development of handedness:

> 16-20 weeks: Contact unilateral and, in general, tends to be with left hand.
> 24 weeks: A definite shift to bilaterality.
> 28 weeks: Shift to unilateral and oftenest right hand is used.
> 32 weeks: Shift again to bilateral.
> 36 weeks: Bilaterality dropping out and unilaterality coming in. Behavior usually characterized "right or left." Left predominates in the majority.
> 40-44 weeks: Same type of behavior, unilateral, "right or left," but now right predominates in the majority.
> 48 weeks: In some a temporary, and in many a last shift, to use of left hand - as well as use of right - either used unilaterally.
> 52-56 weeks: Shift to clear unilateral dominance of right hand.
> 80 weeks: Shift from rather clearcut unilateral behavior to marked, inter-changeable confusion. Much bilateral, and use of non-dominant hand.
> 2 years: Relatively clearcut unilateral use of right hand.
> 2 1/2 - 3 1/2 years: Marked shift to bilaterality.
> 4-6 years: Unilateral, right-handed behavior predominates.
> 7 years: Last period when left hand, or even both hands bilaterally, are used.
> 8 years: Unilateral right once more.[30]

In one of the relatively few studies dealing with handedness in nursery school children, Hildreth (1948) found left-handedness to be less frequent and less consistent than right-handedness. The children who did tend toward left dominance were, for the most part, younger or new to the school. Eating appeared to be the activity in which the left-handers were most strongly left-dominant.[31]

---

[30] Gesell and Ames, pp. 155-157.

[31] Gertrude Hildreth, "Manual Dominance in Nursery School Children," Journal of Genetic Psychology, LXXIV (1948), pp. 29-45.

1949-1958

Hildreth continued her investigations on handedness, conducting one of the most extensive studies on record. Reported in 1949 and 1950, the study was a five-part investigation of the development and training of handedness. Hildreth reported on characteristics of handedness, developmental tendencies in handedness, origins of handedness and lateral dominance, developmental problems associated with handedness and the training of handedness. She reiterated some of the problems of left-handers, as previously noted by Wile. Her investigations confirmed that a forced change of dominance could cause motor handicaps and problems in social adjustment.[32] Hildreth believed that the development of handedness, which could not take place until the motor apparatus matured, represented "a complex behavior pattern."[33] She noted that most children seven to nine months old began to show some consistent handedness preference, with a pronounced difference around three years of age.[34] Hildreth also concluded that mixed dominance had probably been exaggerated as a causal factor in emotional adjustment problems.[35] She advocated testing two phases of laterality: hand preference for

---

[32]Gertrude Hildreth, "The Development and Training of Hand Dominance: I. Characteristics of Handedness," Journal of Genetic Psychology, LXXV (1949), pp. 197-220.

[33]Gertrude Hildreth, "The Development and Training of Hand Dominance: II. Developmental Tendencies in Handedness," Journal of Genetic Psychology, LXXV (1949), p. 221.

[34]Hildreth, II., pp. 231-254.

[35]Gertrude Hildreth, "The Development and Training of Hand Dominance: III. Origins of Handedness and Lateral Dominance," Journal of Genetic Psychology, LXXV (1949), pp. 255-275.

unimanual activities or dominant hand in bimanual acts; relative dexterity of both hands when performing the same skill.[36]

The necessity for teacher and parental awareness of the evolution of lateral preference in children was an item of singular importance to Martin's 1952 review of the literature regarding the history, development and research of laterality. Understanding transitional phases, such as mirror-writing and left-right confusions which are normal in children who are in the process of developing lateralization, is essential in detecting which stages are manifestations of true academic problems instead of normal variations of development.[37]

An extensive attempt to determine the relationship between indices of laterality and lack of achievement in reading among 100 nine- to eleven-year-old boys of average intelligence was reported by Smith in 1950.[38] Twenty-seven tests were administered in the experimental group of "retarded readers" (those achieving less than sixty percent on reading comprehension tests and isolated word recognition tests for grade one) and a control group of "reading achievers" (those with reading quotients of 100 or more as determined by the Alice Horn Formula:

---

[36]Gertrude Hildreth, "The Development and Training of Hand Dominance: IV. Developmental Problems Associated with Handedness," Journal of Genetic Psychology, LXXVI (1950), pp. 39-100.

[37]Kenneth L. Martin, "Handedness: A Review of the Literature on the History, Development and Research of Laterality Preference," Journal of Educational Research, XLV (March, 1952), pp. 527-533.

[38]Linda C. Smith, "A Study of Laterality Characteristics of Retarded Readers and Reading Achievers," Journal of Experimental Education, XVIII (June, 1950), p. 321.

$$R.Q. = \frac{R.A.}{(2M.A. + C.A.) \div 3}$$ [39]

As a result of her investigation, Smith concluded that retarded readers and reading achievers did not differ significantly in regard to hand, foot, eye, ear combinations of hand and eye preference. However, Smith found that retarded readers made significantly more reversals than reading achievers when reading lower case letters. She also noted that retarded readers and reading achievers differed significantly in their performance on the Van Riper Test of "Central" Dominance at the critical angle of 360 degrees. At this angle the retarded readers reversed more often with the right hand while the reading achievers reversed with the left.[40]

Most reviews of data on handedness had shown that the frequency of left-handedness was much more common among males than among females. However, nearly all the studies of hand preference were conducted in Europe and America. Dennis reported the results of a study conducted in 1955-56 in the schools of Beirut, Lebanon.[41] In observation of 2,656 subjects in grades K-5, the frequency of left-handedness was found to be 5.0 percent among the boys and 4.9 percent among the girls. The difference in frequency was statistically insignificant at the five percent level. Dennis concluded that in the Near East "left-handedness is no more reprehensible in women than it is in men."[42] He suggested that what

---

[39] Smith, pp. 321-322.

[40] Smith, p. 326.

[41] Wayne Dennis, "A Note on Sex Equality in the Incidence of Left-Handedness," Journal of Educational Psychology, XLIX (August, 1958), pp. 209-210.

[42] Dennis, p. 209.

had appeared to be biologically determined differences in handedness might instead be the consequence of stronger social pressures against left-handedness in women in western countries. He cautioned that only further research could identify cultural conditioning and attitudes in this area.[43]

Benton and Menefee, in a 1957 study of handedness and right-left discrimination, hypothesized that an individual who had a decided preference for the use of either hand would show a more developed perceptual capacity than a person without such a preference. The results of their study of sixty-six kindergarten and primary grade children revealed that the relationship between handedness and right-left discrimination was positive, and though small, this positive association was interpreted as providing support for the general hypothesis that degree of unilateral hand preference in motor activity and level of right-left discrimination are related to one another. The authors viewed this small positive association as being of questionable significance.[44]

Clark's research in 1957 indicated that there were differences in the proportion of right dominant and left dominant individuals in the total population, with differences also apparent in hand usage in the same person for different activities. She noted that the preponderance of right preference seemed to be greatest in those activities which were most highly related to school writing. Clark concluded that no one test of hand preference would give an adequate estimation of handedness. She further stated that she had found little connection between

---

[43]Dennis, p. 210.

[44]Arthur L. Benton and Frances L. Menefee, "Handedness and Right-Left Discrimination," Child Development, XXVIII (June, 1957), pp. 236-242.

hand preference and eye preference. She cautioned that the number of pupils tested was limited; therefore, the results should merely suggest lines for further research.[45]

A second major investigation of the relationships of lateral dominance to scores of motor ability and selected skill tests was conducted as part of a doctoral study by Way in 1958. Over 400 freshmen and sophomore college women enrolled in the required physical education program at the University of Washington were administered tests of eye dominance, hand and foot dexterity, the Scott Motor Ability Test and specific skills tests in archery, badminton, bowling and tennis.[46] Way concluded that the majority of college women have definite lateral preferences in hand, eye and foot usage and that laterality appeared to be especially important in activities stressing accuracy of direction toward a fixed target. Within the limitations of her study, Way appeared justified in concluding that women with mixed eye, hand, and foot dominance were superior in motor ability to those with homolateral preference.[47]

1959-1968

Bergquam, in a 1962 article on neural confusion, stated that neural conflict in the language areas of reading, writing and speech was

---

[45] Margaret Macdonald Clark, Left-Handedness: Laterality Characteristics and Their Educational Implications (London, 1957).

[46] Eunice E. Way, "Relationships of Lateral Dominance to Scores of Motor Ability and Selected Skill Tests," Research Quarterly, XXIX (1958), pp. 360-361.

[47] Way, pp. 368-369.

commonly associated with left-handedness or ambidexterity in the family line. Mixed dominance of right and left cerebral hemispheres (often expressed as lack of control by the dominant hemisphere) was seen as the primary cause of neural confusion, with such confusion shown as a strong family trait.[48]

In 1963 Ross reviewed Delacato's theory that reading problems are at least partially due to inadequate neurological organization, including lack of an established handedness pattern by age five or six. Delacato's research revealed that young children, with whom normal remedial reading procedures had failed, exhibited eye-hand dominance conflict. He further related this lack of a dominant eye-hand coordination pattern to disoriented sleep positioning, both of which appeared to be symptomatic of potential reading problems in preschoolers.[49]

In a 1963 study which investigated visual orienting behavior and its relation to hand-eye preference in prereading children ages three years seven months to six years three months, Muehl found that left-lateral children made more errors in word recognition than consistent right-lateral subjects, confirming prior evidence that left laterality in prereaders is associated with "unique patterns of visual or perceptual behavior."[50]

---

[48]Hazel H. Bergquam, "Neural Confusion and Academic Failure," Education, LXXXII (February, 1962), pp. 362-365.

[49]Eli T. Ross, "Can Potentially Poor Readers Be Detected During Pre-School Years?" Journal of Developmental Reading, VI (Autumn, 1962-Summer, 1963), pp. 270-272.

[50]Siegmar Muehl, "Relation Between Word-Recognition Errors and Hand-Eye Preference in Preschool Children," Journal of Educational Psychology, LIV (1963), pp. 316-321.

In 1963 Belmont and Birch reported results of a study concerned with the analysis ages at which various aspects of lateralization were established in children. Using a criterion of 100 percent consistency in the four handedness tasks, the researchers concluded that age nine represented a "useful indicator for the existence of reliably established preferential hand usage."[51] In determining consistent preference in monocular eye usage, Belmont and Birch found statistically significant differences between the younger and older children, using age ten as the cut-off point. They also noted that no simple relation was found to exist between the ability to differentiate right from left and the establishment of preferential hand usage. As a result of these findings, the researchers concluded that the development of right-left awareness was basically independent of consistent lateralization of hand usage, since consistent preferential hand usage occurred two years later than consistent right-left discrimination.[52]

In attempting to answer specific questions concerning the origin of manual preference, Hécaen and Ajuriaguerra indicated their belief that heredity occupied a place secondary to environment in the determination and establishment of hand usage. Studies of historians and ethnologists apparently concurred in this belief that hand preference was the result of a given culture, with preferential lateralization appearing only with

---

[51] Lillian Belmont and Herbert G. Birch, "Lateral Dominance and Right-Left Awareness in Normal Children," Child Development, XXXIV (1963), p. 264.

[52] Belmont and Birch, pp. 257-270.

"Specialization of tools and of the artisan."[53] Hécaen and Ajuriaguerra recognized that a relationship between cerebral dominance and hand preference did exist, but indicated that this liaison was not regarded as absolute.[54]

One of the more controversial viewpoints was evident in a 1965 article reporting results of a five-year study of "hundreds of girls and boys between the ages of 14-18, born in 27 different countries but living in Israel." They were observed and tested while working in various aspects of agriculture.[55] Weiser also observed these subjects in the classroom, where he found many who wrote Hebrew with their left hand and switched to their right hand for writing English. Since Hebrew is written from right to left, writing with the right hand covers what has already been written. Weiser further indicated his concerns about left-handedness:

> For years there has been a dominant idea that if a child shows a tendency to write or to work with his left hand, he should be allowed to do it. This is a serious mistake... The inborn cases of left-handedness are extremely rare. To allow to develop 12.7 percent of left-handed children because of neglect to control the tendency is perhaps more than a fault.[56]

In a much more humorous vein were Barsley's two books on left-handedness. Being left-handed himself, Barsley had investigated some of the cultural, psychological and sociological aspects of left-

---

[53]Henri Hécaen and Julian de Ajuriaguerra, Left-Handedness: Manual Superiority and Cerebral Dominance (New York, 1964), p. 146.

[54]Hécaen and Ajuriaguerra, pp. 146-147.

[55]Josejf Weiser, "Handedness--Leggedness--Eyedness," Journal of Experimental Education, XXXIII (Summer, 1965), p. 347.

[56]Weiser, pp. 347-350.

handedness. In his book The Other Hand, published in 1967, Barsley presented some of the prejudices regarding left-handedness. The first was a direct reproduction of the Oxford Dictionary definition of left-handed:

> left-handed, a.
> 1) having the left hand more serviceable than the right using the left hand by preference.
> 2) (fig.) a. crippled, defective, Obs. b. awkward; clumsy, inapt. (cf. Latin laevus, French gauche.) c. characterized by underhanded dealing, Obs.
> 3) ambiguous, doubtful, questionable. In medical language: spurious.
> 4) ill-omened, inauspicious, sinister. Of a deity: unpropitious, Obs.[57]

The second prejudice of this nature was a quote from Roget's Thesaurus: "Unskilfulness: clumsy, awkward, gauche, gawkish; stuttering, stammering; tactless, indiscriminating; lubberly, unhandy, all thumbs, butter-fingered, thick-fingered; left-handed . . ."[58]

In 1968 a study was conducted with 220 ten-year-old boys to determine the relationship of laterality to performance on selected motor ability tests. Performances in a shuttle-run test, dynamic balance test, speed of arm movement and motor educability were compared to four laterality groupings.[59] The findings in this doctoral study did not show sufficient evidence to refute the null hypothesis that there was no difference in the level of performance on selected motor tests of subjects in four laterality groups. Horine did observe that the differences

---

[57] Michael Barsley, The Other Hand: An Investigation into the Sinister History of Left-Handedness (New York, 1967), p. 43.

[58] Barsley, pp. 43-45.

[59] Lawrence E. Horine, "An Investigation of the Relationship of Laterality Groups to Performance on Selected Motor Ability Tests," Research Quarterly, XXXIX (1968), pp. 91-94.

followed a definite trend with unilateral individuals out-performing individuals with mixed laterality. His findings supported the need for further research in this area.[60]

1969-1978

In 1969 Taylor and Nolde described the relationships among standardized reading scores and Delacato's measures of laterality, mobility and binocularity. The development of binocularity was not significantly correlated with reading improvement; however, as mobility and laterality improved, reading also significantly improved.[61]

In his book published one year later, Barsley appeared to be trying to repudiate the sinister connotation in sinistrality when he mentioned the following famous left-handers: Alexander the Great, Charlemagne, King David, Hans Holbein, Leonardo Da Vinci, Benjamin Franklin, H. G. Wells, Harpo Marx, Judy Garland, Rod Steiger and Rock Hudson. In addition, three presidents were known to have been left-handed: Monroe, Garfield, Ford. No confirmation existed on the supposition that Jack the Ripper was left-handed.[62]

In O'Donnell's 1970 report of a study to determine the effects of a motor training program on the lateral expression of disabled readers, many previous research studies were cited in an attempt to clarify

---

[60] Horine, pp. 91, 94.

[61] Raymond G. Taylor, Jr. and S. Van L. Nolde, "Correlative Study Between Reading, Laterality, Mobility, and Binocularity," Exceptional Children (April, 1969), pp. 627-631.

[62] Michael Barsley, Left-Handed Man in a Right-Handed World (London, 1970), pp. 77-100.

certain misconceptions which tend to recur in literature on handedness. Estimates of the number of right-handed people in the population vary from 80-95 percent, while other research has shown that 40-50 percent of the population indicate a preference for the left eye. The high incidence of cross-laterality indicated in the literature served to raise some doubts in the implications of the "relationship, if any, between this pattern of lateral expression and various correlated behavioral deficits."[63] Explanations of observed patterns of handedness in experimental populations are included in O'Donnell's report, with social-cultural pressure, hereditary origin and failure to establish cortical hemispheric dominance cited as possible factors.[64]

A discussion of the occurrence of mirror-writing and inverted writing in left-handed children concluded that any functional disorder occurring only in left-handers suggested a reversal of the usual cerebral dominance. In most adults the left hemisphere of the brain is dominant for language functions, though a small percentage of true right-brain dominants exists in the population. Those in the right hemisphere dominant group include adults with genetically determined left-handedness and others who are pathologically left-handed, having suffered damage to the left hemisphere in early development. Mirror writing and inverted writing were reported as occurring most frequently in this group of right-

---

[63]Patrick A. O'Donnell, A Re-evaluation of Research on Lateral Expression," Journal of Learning Disabilities, III (July, 1970), p. 345.

[64]O'Donnell, pp. 344-354.

brain dominant individuals.[65]

Two types of inefficiently functioning brains were tentatively identified by Bannatyne and Wichiarajote in a 1970 study of fifty "normal" third grade children. It was suggested that the less efficient brain reflected by mirror imaging and verbal incompetence was the result of a maturational lag, while the visuo-spatially inept brain, though not necessarily given to mirror imaging, was the result of minimal brain dysfunction. Both these types of inefficiently functioning brains were associated with left-handedness.[66]

In a 1971 article concerned with physical factors possibly responsible for reading problems, Leeds reviewed several studies which contributed to the mass of conflicting research results regarding the relationship between laterality and various reading disabilities.[67] One study by Harris showed a significant relationship between reading and laterality, while studies by Gates and Bond, Woody and Phillips, Smith and Wolfe, using matched pairs, reported no significant relationships between handedness and reversals or between reading disability and hand dominance, eye dominance and hand versus eye dominance.[68]

---

[65] D. Frank Benson, M.D., "Graphic Orientation Disorders of Left-Handed Children," Journal of Learning Disabilities, III (March, 1970), pp. 126-127.

[66] Alex Bannatyne and Penny Wichiarajote, "Hemispheric Dominance, Handedness, Mirror Imaging, and Auditory Sequencing," Exceptional Children, XXXVI (1970), pp. 27-36.

[67] Donald S. Leeds, "Physical Factors in Reading Disability," Journal of the Reading Specialist (October, 1971), pp. 71-86.

[68] Leeds, p. 79.

Bannatyne reiterated his findings in a 1972 article stating that on three separate tests he had obtained positive significant correlations between mirror-imaging and a tendency to left-handedness or actual left-handedness. His findings appeared to confirm Orton's theories regarding hemispheric dominance.[69]

Some of the youngest children studied with regard to handedness were investigated in a 1973 study conducted in Belfast by Seth. Normal infants 20 weeks old and older were observed at monthly intervals during their first year.[70] A marked predominance of the left hand was observed in the youngest age groups. In the nine to twelve month period the initial left-handedness gave way to right-hand dominance, leading Seth to conclude that the shift supported a maturational explanation of lateral asymmetry, rather than a social pressure or learning explanation.[71]

The following year Annett and Turner assessed vocabulary, maze tracing, drawing, and eye, hand and foot laterality in a random sample of over 100 right-handed children and a population sample of over 100 left-handed children ages 5-11. A comparison of the abilities of laterality groups over the total sample yielded no significant differences. However, it was noted that a slight excess of left-handed children existed among those of low ability. The authors further concluded that there was a trend toward greater proportion of children

---

[69]Alex Bannatyne, "Mirrow-Images and Reversals," Academic Therapy, VIII (Fall, 1972), pp. 87-92.

[70]G. Seth, "Eyed-Hand Coordination and 'Handedness' A Developmental Study of Visuo-Motor Behavior in Infancy," British Journal of Educational Psychology, XLIII (Fall, 1973), pp. 35, 37, 38.

[71]Seth, pp. 35, 47-49.

with sinistral or left-side tendencies in those with specific language disabilities.[72]

A study reported early in 1975 by Thomson compared sixty eight-year-olds with reading levels eighteen months below their chronological ages with a control group of the same size with average or above reading levels. Each child was asked to perform several items to determine eye, hand, foot and ear preference. These results were quantitatively scored with ten (10) indicating total lateralization (homolaterality, usually right-sided). Two points were subtracted for any item oppositely lateralized and one point was subtracted for any item performed with the right on one trial and the left on another trial. This scoring system attempted to measure inconsistencies in total laterality as opposed to one feature. Inconsistencies in different aspects of laterality appeared to make connections between laterality and attainment even more complex than first assumed. Thomson concluded that showing a complete set of unilateral characteristics was still the best predictor of reading attainment, with cross-laterality and mixed laterality being associated with retarded reading levels.[73]

A 1975 study of strongly lateralized subjects and subjects with equal preference for either hand revealed that the strongly lateralized group (both right- and left-handers) performed with greater skill (faster speed, equal errors) with their preferred hand than the

---

[72]Marian Annett and Ann Turner, "Laterality and the Growth of Intellectual Abilities," British Journal of Education Psychology, XXXIV (Fall, 1974), pp. 38-45.

[73]M. Thomson, "Laterality and Reading Attainment," British Journal of Educational Psychology, XLV (February, 1975), pp. 317-320.

ambilateral group on a visually controlled aiming test, the Fitts tapping test.[74] There were no significant differences between groups in performance with the non-preferred hand. No marked differences in speed were found on a ballistic rhythmical tapping test (ballistic in that each movement is triggered automatically and is carried out without any form of feedback monitoring once initiated). However, ambilaterals made slightly fewer errors with the preferred hand. Flowers reached three conclusions as a result of his research: 1) that for ballistic movements the hands had equal potential, with skill being a direct function of practice; 2) that the essential dexterity difference between the non-preferred and preferred hands was in the sensory or feedback control of movement; 3) that in continuously controlled movement tasks, ambilaterals (especially those with very mixed preferences) essentially had two non-preferred hands. He further observed that ambilaterals tended to rely upon ballistic movements more than did strongly lateralized individuals. He strongly suggested that the concept of handedness be redefined "in terms of best-hand and worst-hand skill, measured as how well the hands do, rather than in terms of what or how many tasks are carried out with one hand."[75] Flowers further speculated that an individual with some inconsistency of hand preference and usage had a different cerebral organization for sensorimotor control function than did a strongly lateralized subject.[76]

---

[74]Kenneth Flowers, "Handedness and Controlled Movement," British Journal of Psychology, LXVI (1975), pp. 39-40.

[75]Flowers, p. 51.

[76]Flowers, pp. 39-52.

Kershner, in a 1975 report of his studies of laterality conducted the previous five years, noted several interesting findings. Crossed manual-ocular laterality was consistently found to be related to superior spatial ability. A popular conception reappearing in the literature has been that crossed-laterality or mixed laterality was a deviation from the norm. Kershner suggested that much more research in the area of laterality is needed.[77]

In reviewing the literature related to the various aspects of laterality, the researcher became increasingly aware of conflicting research results reported in light of the studies investigating the relationship of laterality to different components and processes within the realm of learning. Very little was discovered in terms of the relationship between lateral preference and the performance of bilateral skills. This study was undertaken to contribute to the existing information in this area.

---

[77] Kershner, pp. 269-279.

CHAPTER III

METHODS AND PROCEDURES

The purpose of this study was to determine if a significant difference existed among performance scores on a 30-second timed bead-stringing test attained by four-year-old children in three different laterality groups: 1) consistent lateral preference (right hand-right eye or left hand-left eye); 2) consistently crossed lateral preference (left hand-right eye or right hand-left eye); 3) mixed or no preference. This chapter will detail the selection of subjects, the selection of instruments, the conditions and procedures used in determining hand preference and eye preference, the procedures used in conducting the timed bead-stringing test and the methods and procedures of statistical analysis.

Selection of the Subjects

The subjects for this study were 45 of the 58 four-year-old children attending Stillwater, Oklahoma nursery schools during the time period of June 15-July 29, 1978. Parents of all four-year-olds participating in this study were required to sign a parental permission form (Appendix, p. 68) prior to any testing session. The subjects ranged in age from four years zero months to four years eleven months and included 21 males and 24 females. Initial contact letters were prepared by the researcher and sent to the directors of thirteen Stillwater nursery schools not

affiliated with Oklahoma State University. These letters (Appendix, p. 67) included a brief explanation of the purpose of this study and the testing procedures involved. Telephone calls to each of the directors were followed by personal visits to the ten directors who indicated their willingness to allow access to the four-year-olds at their nursery schools. Parental permission forms were distributed to these directors, with the request that they be signed by any parent/guardian who wanted her/his child to participate in this study. Dates and times for testing approved subjects were set with each director. All subjects were tested between June 15-July 29, 1978, during the hours of 8:00-11:00 a.m. at their respective nursery schools.

Selection of the Instruments

Two instruments were used to determine eyedness. The Burt Revision of the Hole-in-Card Test was designed specifically for use with nursery school children.[1] The second test, developed by the researcher, involved looking into a kaleidoscope.

The four most reliable test items on Hildreth's list of most frequently used test items for determining hand preference were used. They were spinning a top, spooning sand, hammering a block and shaking a rattle.[2] All were tests of near point lateral preference.

The 30-second timed bead-stringing test (taken from the Frostig Movement Skills Test Battery of 1972 and from Arnheim and Sinclair's

---

[1] Hildreth, IV, p. 98.

[2] Hildreth, IV, pp. 91-94.

Basic Motor Ability Test of 1975)[3] was administered to each subject. Performance norms for four-year-olds are included with the Basic Motor Ability Test.[4]

Conditions and Procedures for Determination of Hand Preference and Eye Preference

The Burt Revision of the Hold-in-Card Test was administered to the approved subjects. This test involved sighting a fire engine through a .5 inch hole in a piece of 8" x 11" cardboard. The fire engine was the middle object of three bright-colored objects spaced five inches apart on a second sheet of cardboard.

The cardboard with the hole was placed in a median plane on the floor directly in front of the subject. The cardboard with the fire engine was held at the subject's eye level by the researcher, approximately five feet from the subject. The directions for each subject were: "This is a piece of cardboard with a hole in the middle. Can you look through the hole to see the fire engine?" Eye preference was determined by the eye used by the subject to sight the fire engine. Shifting the cardboard with the hole from one eye to the other after the initial sighting was taken as an indication of mixed or no preference.

The kaleidoscope test was administered to the approved subjects. The kaleidoscope was placed in a median plane in front of the subjects. The directions included: "This is called a kaleidoscope. When I look

---

[3] Daniel Arnheim and William A. Sinclair. The Clumsy Child: A Program of Motor Therapy (St. Louis, 1975), pp. 79-80.

[4] Arnheim and Sinclair, p. 84.

into this kaleidoscope, I see lots of different colors. Can you look into the kaleidoscope? What do you see?" Eye preference was determined by the eye to which the kaleidoscope was held. Changing the kaleidoscope after the initial sighting was taken as an indication of mixed or no preference.

The first item from Hildreth's list of hand preference items was administered to the approved subjects. Each subject was seated cross-legged on newspapers on the floor. A square plastic container of sand was placed in a median plane on the floor directly in front of the subject. In the center of the sand was an empty plastic bucket. A small plastic shovel was stuck in the sand behind the bucket. The directions were: "Do you like to play in the sand? Do you think you can shovel sand into that bucket? You may put the bucket anywhere you like." Reinforcing remarks, such as "You have a lot of sand on that shovel" and "That bucket is really filling up fast," were provided for each subject. Hand preference was determined by the hand used to shovel the sand, with change of hands during the task taken as an indication of mixed or no preference on that task.

The second item from Hildreth's list of hand preference items was administered to the approved subjects. Each subject was seated cross-legged on the floor. A push-pull metal spinning top was placed in a median plane on the floor directly in front of the subject. The directions were: "This is a spinning top. Can you make this top spin by pushing up and down on the handle?" Occasionally a demonstration was necessary, in which case the researcher used first her left hand, then her right to make the top spin. This demonstration was followed by the remarks "Now can you try it? Very good!" Reinforcing remarks, such as

"Look how fast that top is spinning!" and "You really can make that go up and down," were provided for each subject. Hand preference was determined by the hand used to push the top handle up and down, with change of hands during the task taken as an indication of mixed or no preference on that task.

The third item from Hildreth's list of hand preference items was administered to the approved subjects. Each subject was seated on the floor. A wooden hammer was placed in a median plane on the floor directly in front of the subject. The subject was then asked to pick up the hammer, whereupon a 1" x 4" x 6" block of wood was placed in a median plane directly in front of the subject. The directions were: "Can you hammer on that block of wood?" Reinforcing remarks, such as "You are doing very well hammering on that block of wood!" and "That's a really loud hammer you have there!", were provided for each subject. Hand preference was determined by the hand used to hold the hammer, with change of hands during the task taken as an indication of mixed or no preference on that task.

The fourth item from Hildreth's list of hand preference items was administered to the approved subjects. Each subject was seated cross-legged on the floor. A plastic rattle was placed in a median plane on the floor directly in front of the subject. The subject was asked to pick up the rattle. The directions were: "Can you make noise with that rattle?" Reinforcing remarks, such as "You really are making noise with that rattle!", were provided for each subject. Hand preference was determined by the hand used to hold the rattle while shaking it, with change of hands during the task taken as an indication of mixed or no preference on that task.

On the basis of the results of the hand preference and eye preference tests, each subject was assigned to the appropriate laterality group. Any subject indicating mixed or no preference on either eye test or on any one of the four hand preference tests was assigned to the mixed or no preference laterality group.

Procedures for Timed Bead-Stringing Test

Each subject was seated cross-legged on the floor. A brief explanation of the use of the stopwatch for timing the bead-stringing was given, with time taken to allow each subject to try out the stopwatch. The beads from the Stanford-Binet set were then placed on the floor directly in front of the subject. The string was stretched out in a median plan in front of the subject, just behind the beads. A demonstration of stringing the beads was given by the researcher. Then the subject was asked to pick up the string, then to pick up one bead. The directions were: "Would you like to try to string some of these beads? Let's see how fast you can put the beads on the string." Timing began when the subject's string first contacted the bead in the subject's hand. Reinforcing remarks, such as "Good! Can you put another bead on the string now?" and "You're doing an excellent job of stringing those beads!", were provided for each subject. The number of beads on the string at the end of the 30-second time was noted. Each subject was allowed to continue stringing the beads until the string was full or interest waned and the subject's attention drifted elsewhere, whichever came first. Throughout the entire testing session, the researcher used as much nonverbal reinforcement (primarily smiles and eye contact) as possible to encourage each subject. At the conclusion of the testing

sessions, each subject was thanked for playing with the researcher.

Methods and Procedures of Statistical Analysis

An analysis of variance was used to determine if a significant difference existed among performance scores on a 30-second timed bead-stringing test attained by four-year-old subjects in three different laterality groups. The .05 level of confidence was used as the confidence level for accepting or rejecting the hypotheses. The statistical computations were carried out by the Oklahoma State University Computer Center using the Statistical Program for the Social Sciences (SPSS). SPSS was initially designed by Nie and Bent in 1965 at Stanford University.

CHAPTER IV

RESULTS

The researcher attempted to determine if significant differences existed among performance scores on a 30-second timed bead-stringing test attained by four-year-old children in three laterality groups: consistent lateral preference; consistently crossed lateral preference; mixed or no preference.

Eye Preference

Eye preference was determined through the use of two instruments: the Burt Revision of the Hole-in-Card Test and sighting into a kaleidoscope. On the basis of these tests, 57.7 percent of the subjects were right-eyed, 40 percent were left-eyed and 2.3 percent sighted with one eye, then the other.

Hand Preference

Hand preference was determined through the use of the four most reliable items from Hildreth's list of hand preference items. On the basis of these tests, 53.3 percent of the subjects were right-handed, 6.7 percent were left-handed and 40 percent exhibited mixed usage.

Laterality Groups

Based on the results of the eye preference tests and the hand

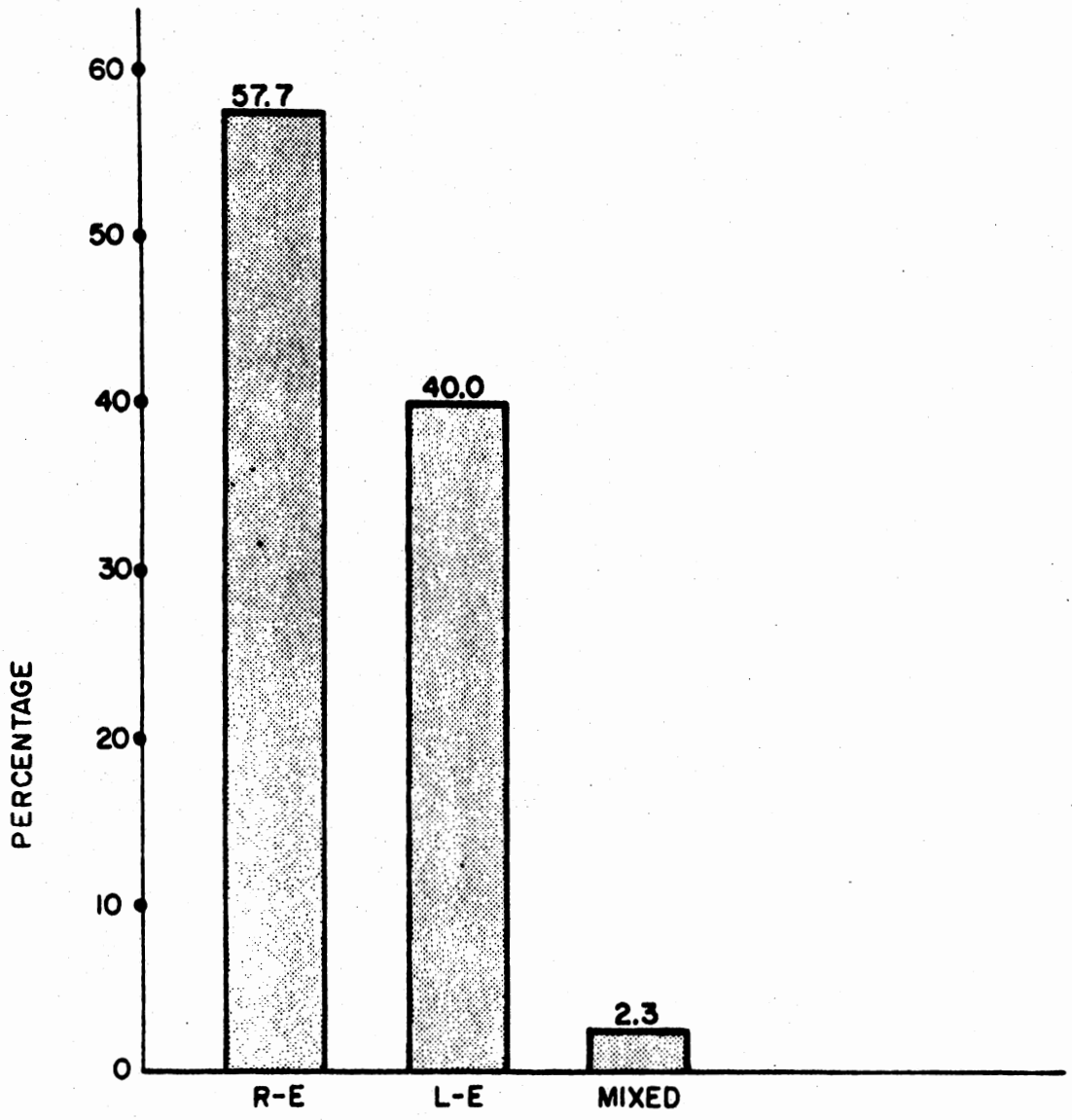

Figure 1. Eye Preference

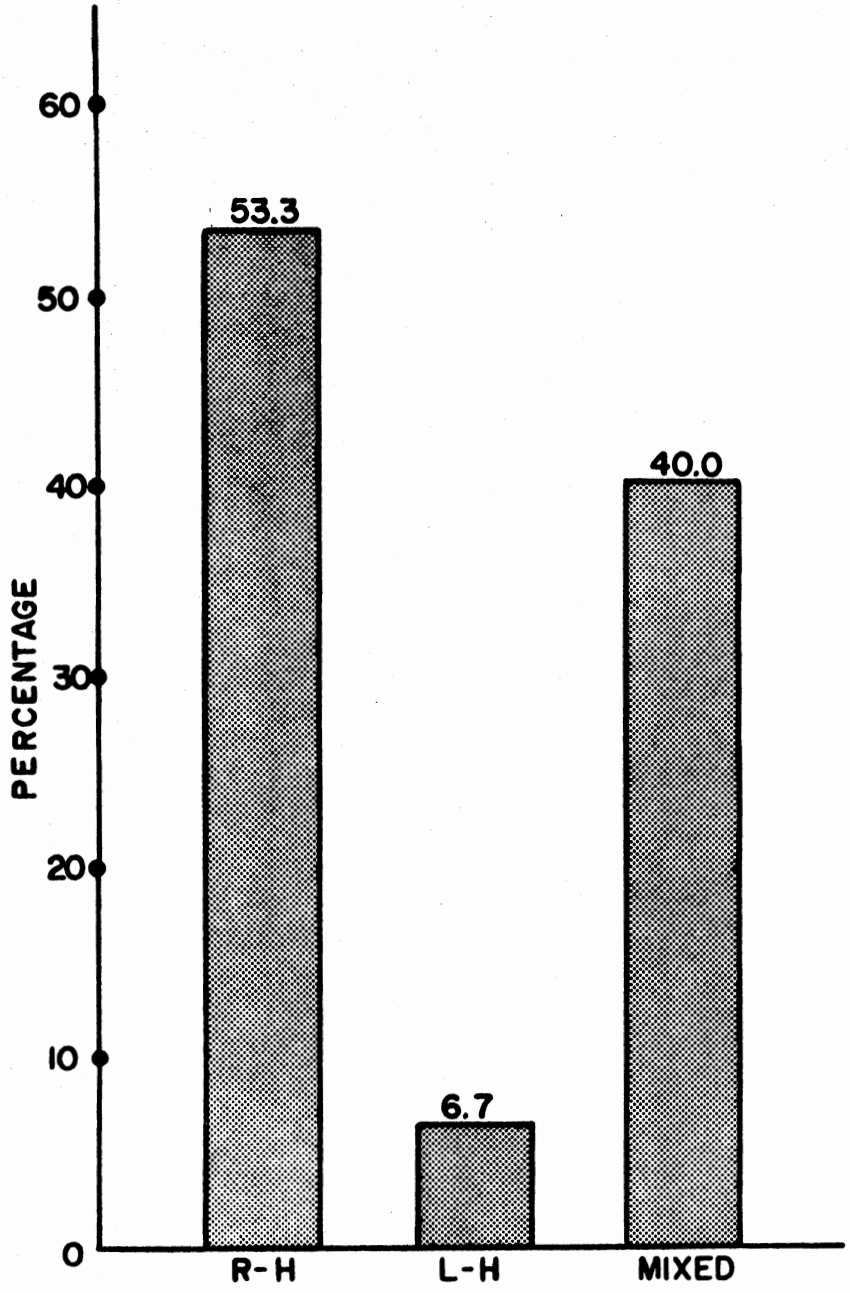

Figure 2. Hand Preference

preference tests, 33.3 percent of the subjects were classified as having consistent lateral preference, 24.4 percent as having consistently crossed lateral preference and 42.2 percent as having mixed or no lateral preference.

Bead-Stringing Performance

The 30-second timed bead-stringing test was administered. The mean for the consistent lateral preference group was 2.93, with a standard deviation of .77 and a range of 4. The mean for the consistently crossed lateral preference group was 3.36, with a standard deviation of 1.30 and a range of 6. The mean for the mixed or no preference group was 3.16, with a standard deviation of .87 and a range of 5.

Analysis of variance was used to determine if significant differences existed among performance scores of subjects in the three laterality groups. The .05 level of confidence was used for acceptance or rejection of the hypotheses. The analysis of variance procedure yielded an F value of .60 with a probability of .55. This F ratio was not significant at the .05 level, indicating that there were no significant differences among performance scores of subjects in the three groups.

Summary

Two tests of eye preference and four tests of hand preference were administered to forty-five four-year-olds enrolled in Stillwater, Oklahoma nursery schools. On the basis of these tests, subjects were assigned to one of three laterality groups: consistent lateral preference; consistently crossed lateral preference; mixed or no preference. A 30-second timed bead-stringing test was administered to the subjects.

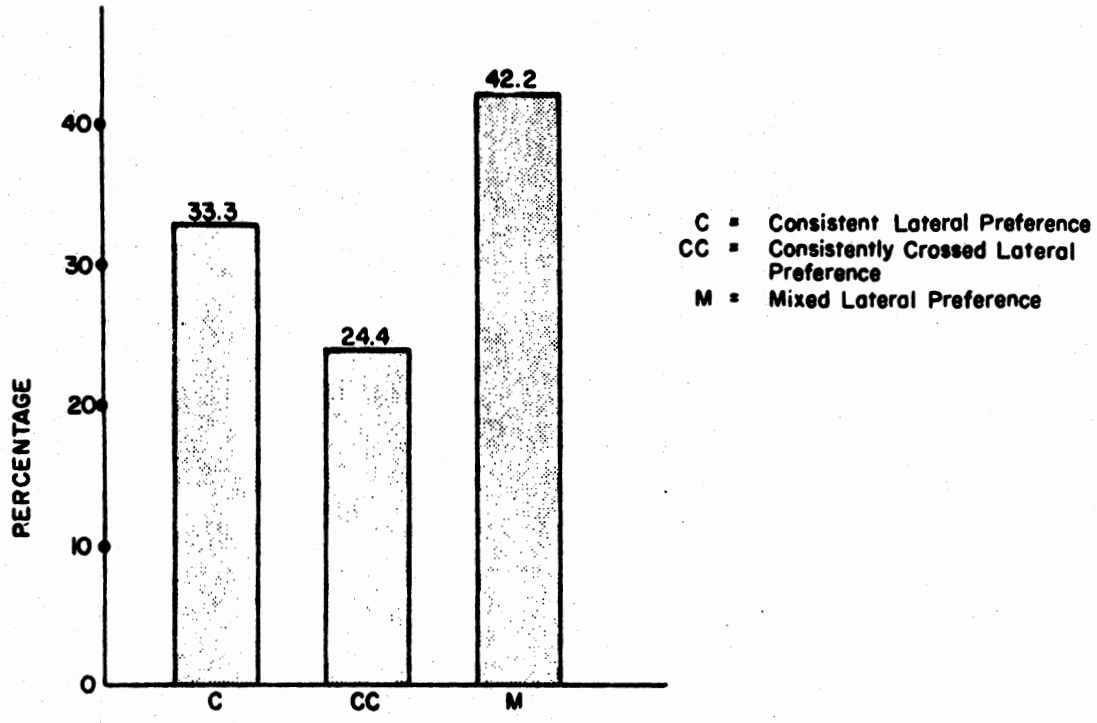

Figure 3. Lateral Preference

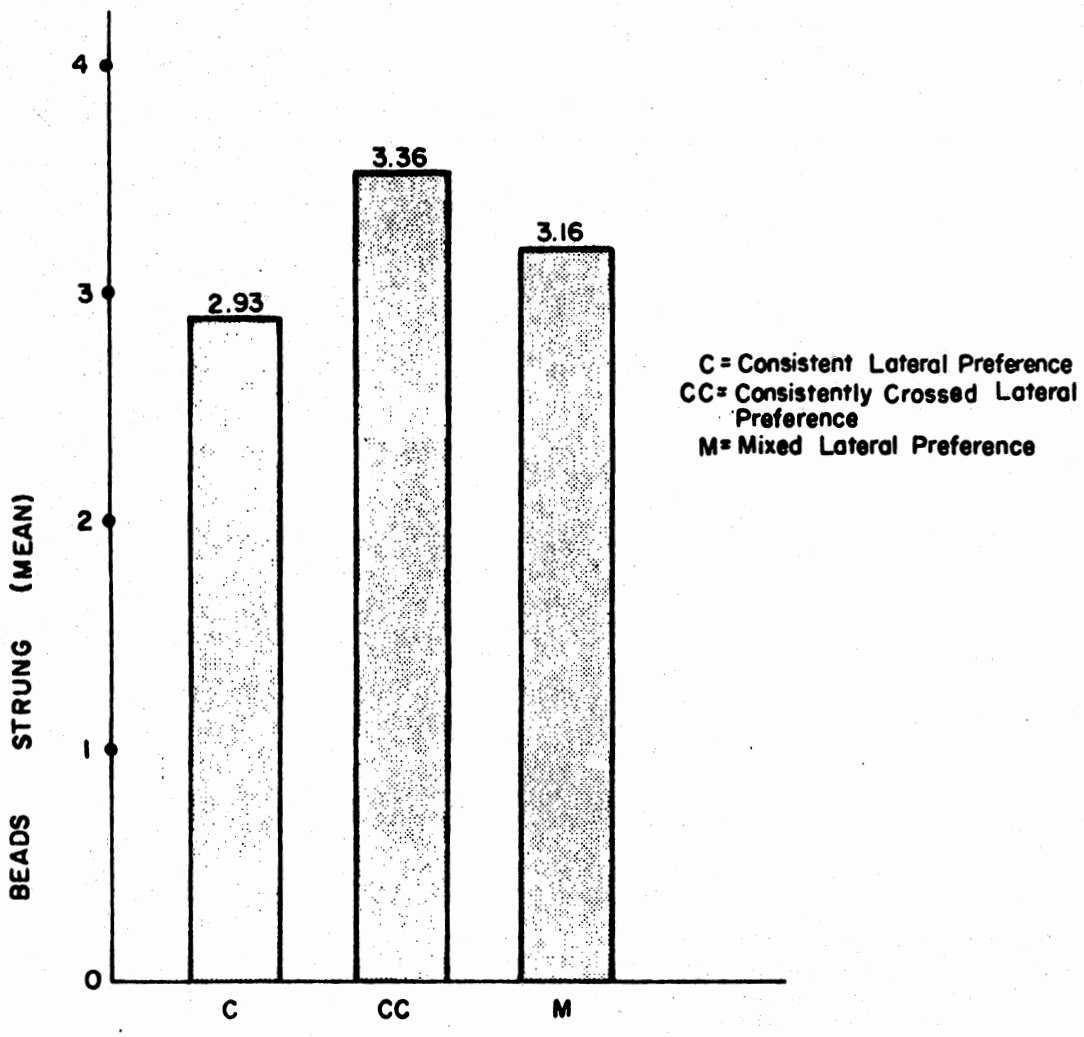

Figure 4. Bead-Stringing Performance

Analysis of variance was used to determine if significant differences existed among performance scores of subjects in the three groups. The significance level of .05 was established as the level of confidence.

Results of the analysis of variance procedure indicated that there were no significant differences among performance scores of subjects in the three laterality groups.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to determine if significant differences existed among performance scores on a 30-second timed bead-stringing test attained by four-year-old children in three laterality groups: consistent lateral preferences; consistently crossed lateral preference; mixed or no preference. Forty-five four-year-olds enrolled in Stillwater nursery schools were given two tests of eye preference and four tests of hand preference. The Burt Revision of the Hole-in-Card Test and sighting into a kaleidoscope were used as tests of eye preference. The tests of hand preference included spinning a top, shoveling sand, hammering a block and shaking a rattle.

On the basis of these tests, each subject was assigned to one of the three laterality groups. A 30-second timed bead-stringing test was administered to every subject. Analysis of variance was used to determine if significant differences existed among performance scores of subjects in the three laterality groups. The significance level of .05 was established as the level of confidence for acceptance or rejection of the previously stated hypotheses.

Conclusions

Using the .05 level of confidence, the conclusions were as follows:

1. There is no significant difference in the levels of bead-stringing performance of subjects in the consistent laterality

group when compared with the consistently crossed laterality group.

Hypothesis one was accepted as there was no significant difference in the performance scores of subjects in these two laterality groups.

2. There is no significant difference in the levels of bead-stringing performance of subjects in the consistent laterality group when compared with the mixed or no preference laterality group.

Hypothesis two was accepted as there was no significant difference in the performance scores of subjects in these two laterality groups.

3. There is no significant difference in the levels of bead-stringing performance of subjects in the consistently crossed laterality group when compared with the mixed or no preference laterality group.

Hypothesis three was accepted as there was no significant difference in the performance scores of subjects in these two laterality groups.

4. There is no significant difference among groups in the levels of bead-stringing performance of subjects in the three laterality groups.

Hypothesis four was accepted as there was no significant difference among groups in the performance scores of subjects in the three laterality groups.

From the results of this study, it was concluded that lateral preference (as determined by eye preference and hand preference only) was not a factor in the levels of bead-stringing performance of four-year-olds enrolled in Stillwater, Oklahoma nursery schools.

Recommendations

The literature is replete with studies of lateral preference and its relationship to various aspects of learning. However, very few studies have dealt directly with the relationship of lateral preference to the

performance of bilateral fine motor coordination skill such as bead-stringing.

In reviewing the methods, procedures and results of this study, the following recommendations appear to this researcher to be in order:

1. The sample group tested should be expanded to include more subjects, as well as those four-year-olds not necessarily enrolled in nursery schools. Since nursery schools often provide fine motor coordination activities which might facilitate performance of a bilateral fine motor skill, such as bead-stringing, a more realistic test group would include those subjects who have not attended nursery schools and therefore, not received additional opportunities for fine motor coordination activity.

2. The subjects should be tested in the same physical setting, removed from their individual nursery schools. This might tend to minimize distractions, making the testing situation more uniform.

3. The subjects should be allowed several practice trials in order that the newness of the bead-stringing activity would not be itself a distraction.

4. The subjects tested should be younger, possibly insuring that the bead-stringing activity would be a new skill for each subject.

5. The bilateral fine motor coordination skill should be a novel one in order that prior experience would not influence test performance.

6. A test-retest situation should be established for both the eye preference and hand preference tests to enhance reliability of the laterality groupings.

7. The two hand preference items of shaking a rattle and spinning a top should be re-examined carefully before inclusion in any further lateral preference testing. Without those two tests, 47 percent of the mixed group in this study would have been classified as having consistent lateral preference, and 26 percent of the mixed group would have been classified as having consistently crossed lateral preference.

8. A left hemisphere task, verbal and/or rhythmic, should be considered as an additional test item.

This research has created sufficient interest to warrant further study on the part of this author in the immediate future.

SELECTED BIBLIOGRAPHY

Annett, Marian and Turner, Ann. "Laterality and the Growth of Intellectual Abilities." British Journal of Educational Psychology, XXXXIV (Fall, 1974), pp. 38-45.

Arnheim, Daniel and Sinclair, William A. The Clumsy Child: A Program of Motor Therapy. St. Louis: The C. V. Mosby Company, 1975.

Bannatyne, Alex. "Mirror-Images and Reversals." Academic Therapy, VIII (Fall, 1972), pp. 87-92.

Bannatyne, Alex and Wichiarajote, Penny. "Hemispheric Dominance, Handedness, Mirror Imaging, and Auditory Sequencing." Exceptional Children, XXXVI (1970), pp. 27-36.

Barsley, Michael. Left-Handed Man in a Right-Handed World. London: Pitman, 1970.

_____. The Other Hand: An Investigation into the Sinister History of Left-Handedness. New York: Hawthorn Books, 1967.

Belmont, Lillian and Birch, Herbert G. "Lateral Dominance and Right-Left Awareness in Normal Children." Child Development, XXXIV (1963), pp. 257-270.

Benson, D. Frank, M.D. "Graphic Orientation Disorders of Left Handed Children." Journal of Learning Disabilities, III (March, 1970), pp. 126-131.

Benton, Arthur L. and Menefee, Frances L. "Handedness and Right-Left Discrimination." Child Development, XXVIII (June, 1957), pp. 236-242.

Bergquam, Hazel H. "Neural Confusion and Academic Failure." Education, LXXXII (February, 1962), pp. 362-365.

Blau, Abram. The Master Hand: A Study of the Origin and Meaning of Right and Left Sidedness and Its Relation to Personality and Language. New York: American Orthopsychiatric Association, 1946.

Clark, Margaret Macdonald. Left-handedness: Laterality Characteristics and Their Educational Implications. London: University of London Press, 1957.

Dennis, Wayne. "A Note on Sex Equality in the Incidence of Left-Handedness." Journal of Educational Psychology, XLIX (August, 1958), pp. 209-210.

Fitt, Arthur B. and O'Halloran, K. H. "The Relation Between Handedness and Some Physical and Mental Factors." Journal of Educational Psychology, XXV (April, 1934), pp. 286-296.

Flowers, Kenneth. "Handedness and Controlled Movement." British Journal of Psychology, LXVI (1975), pp. 39-52.

Gesell, Arnold and Ames, Louise B. "The Development of Handedness." Journal of Genetic Psychology, LXX (1947), pp. 155-157.

Hécaen, Henri and de Ajuriaguerra, Julian. Left-Handedness: Manual Superiority and Cerebral Dominance. New York: Grune and Stratton, 1964.

Heinlein, Julia Heil. "A Study of Dextrality in Children." Pedagogical Seminary and Journal of Genetic Psychology, XXXVI (1929), pp. 91-116.

Hildreth, Gertrude. "A School Survey of Eye-Hand Dominance." Journal of Applied Psychology, XXIX (February, 1945), pp. 83-88.

_____. "Manual Dominance in Nursery School Children." Journal of Genetic Psychology, LXXIV (1948), pp. 29-45.

_____. "The Development and Training of Handedness: I. Characteristics of Handedness." Journal of Genetic Psychology, LXXV (1949), pp. 197-220.

_____. "The Development and Training of Handedness: II. Developmental Tendencies in Handedness." Journal of Genetic Psychology, LXXV (1949), pp. 221-254.

_____. "The Development and Training of Handedness: III. Origins of Handedness and Lateral Dominance." Journal of Genetic Psychology, LXXV (1949), pp. 255-275.

_____. "The Development and Training of Handedness: IV. Development Problems Associated with Handedness." Journal of Genetic Psychology, LXXVI (1950), pp. 39-100.

Horine, Lawrence E. "An Investigation of the Relationship of Laterality Groups to Performance on Selected Motor Ability Tests." Research Quarterly, XXXIX (1969), pp. 91-94.

Hull, Catharine J. "A Study of Laterality Test Items." Journal of Experimental Education, IV (March, 1936), pp. 287-290.

Irwin, Leslie W. "A Study of the Relationship of Dominance to the Performance of Physical Education Activities." Research Quarterly, IX (1938), pp. 98-119.

Johnson, Wendall and Davis, Dorothy M. "Dextrality Quotients of Seven-Year-Olds in Terms of Hand Usage." Journal of Educational Psychology, XXVIII (May, 1937), pp. 346-354.

Johnson, Wendall and Duke, Darlene. "The Dextrality Quotients of Fifty Six-Year-Olds with Regard to Hand Usage." Journal of Educational Psychology, XXVII (January, 1936), pp. 26-36.

Kershner, John R. "Reading and Laterality Revisited." Journal of Special Education, IX (Fall, 1975), pp. 269-279.

Leeds, Donald S. "Physical Factors in Reading Disability." Journal of the Reading Specialist (October, 1971), pp. 71-86.

Martin, Kenneth L. "Handedness: A Review of the Literature on the History, Development and Research of Laterality Preference." Journal of Educational Research, XLV (March, 1975), pp. 527-533.

Muehl, Siegmar. "Relation Between Word-Recognition Errors and Hand-Eye Preference in Preschool Children." Journal of Educational Psychology, LIV (1963), pp. 316-321.

O'Donnell, Patrick A. "A Re-evaluation of Research on Lateral Expression." Journal of Learning Disabilities, III (July, 1970), pp. 344-354.

Ojemann, R. H. "Studies in Handedness: I. A Technique for Testing Unimanual Handedness." Journal of Educational Psychology, XXI (November, 1930), pp. 597-611.

Orton, Samuel Torrey. Reading, Writing and Speech Problems in Children. New York and London, 1937.

Ross, Eli T. "Can Potentially Poor Readers Be Detected During Pre-School Years?" Journal of Development Reading, VI (Autumn, 1962-Summer, 1963), pp. 270-272.

Schonell, Fred J. "The Relation of Reading Disability to Handedness and Certain Ocular Factors." British Journal of Educational Psychology, XI (February, 1941), pp. 20-27.

Seth, G. "Eye-Hand Coordination and 'Handedness': A Developmental Study of Visuo-Motor Behavior in Infancy." British Journal of Educational Psychology, XLIII (Fall, 1973), pp. 35-49.

Smith, Linda C. "A Study of Laterality Characteristics of Retarded Readers and Reading Achievers." Journal of Experimental Education, XVIII (June, 1970), pp. 321-326.

Taylor, Raymond G., Jr. and Nolde, S. Van L. "Correlative Study Between Reading, Laterality, Mobility, and Binocularity." Exceptional Children, (April, 1969), pp. 627-631.

Thomson, M. "Laterality and Reading Attainment." British Journal of Educational Psychology, XLV (February, 1975), pp. 317-320.

Tuttle, W. W. and Travis, Lee Edward. "The Relation of Precedence of Movement in Homologous Structures to Handedness." Research Quarterly, VI, Supplement (October, 1935), pp. 3-14.

Updegraff, Ruth. "Preferential Handedness in Young Children." Journal of Experimental Education, I (December, 1932), pp. 134-139.

_____. "The Correspondence Between Handedness and Eyedness in Young Children." Pedagogical Seminary and Journal of Genetic Psychology, XLII (June, 1933), pp. 490-492.

Vogel, O. H. "The Relationship of Dominance to Acts of Skill." Research Quarterly, VI, Supplement (October, 1935), pp. 15-18.

Way, Eunice E. "Relationships of Lateral Dominance to Scores of Motor Ability and Selected Skill Tests." Research Quarterly, XXIX (1958), pp. 360-369.

Weiser, Josejf. "Handedness-Leggedness-Eyedness." Journal of Experimental Education, XXXIII (Summer, 1965), pp. 347-350.

Wile, Ira S., M.D. "The Facts About Left-Handedness." National Parent-Teacher Magazine, XXX (January, 1936), pp. 8-9, 32-34.

Witty, Paul A. and Kopel, David. "Sinistral and Mixed Manual-Ocular Behavior in Reading Disability." Journal of Educational Psychology, XXVII (February, 1936), pp. 119-131.

APPENDIX A

RESEARCH DATA

TABLE I

EYE PREFERENCE TEST DATA

Subject Number	Burt Revision of Hole-in-Card Test Eye Used	Kaleidoscope Sighting Eye Used
01	left	left
02	right	right
03	left	left
04	right	right
05	right	right
06	left	left
07	left	left
08	left	left
09	right	right
10	left	left
11	right	right
12	right	right
13	right	right
14	right	right
15	right	right
16	right	right
17	left	left
18	right	right
19	right	right
20	right	right
21	left	left
22	right	right
23	left	left
24	left	left
25	right	right
26	right	right
27	left	left
28	left	left
29	right	right

TABLE I (Continued)

Subject Number	Burt Revision of Hole-in-Card Test Eye Used	Kaleidoscope Sighting Eye Used
30	left	left
31	left	left
32	left, right	right, left
33	right	right
34	left	left
35	right	right
36	right	right
37	right	right
38	left	left
39	right	right
40	left	left
41	left	left
42	right	right
43	right	right
44	right	right
45	left	left

TABLE II

HAND PREFERENCE TEST DATA

Subject Number	Spinning Top Hand Used	Spooning Sand Hand Used	Hammering Block Hand Used	Shaking Rattle Hand Used
01	left	left	left	left
02	right	right	right	right
03	right	right	right	right
04	right	right	right	right
05	right	right	right	right
06	right	right	right	right
07	right	right	right	right
08	right	right, left	right	left, right
09	left	left	left	left
10	right	right	right	right
11	right	right	right	right
12	right	right	right	right
13	right	right	right	right
14	right	right	right	right
15	right	right	right	right
16	right	right	right	right
17	right	right	right	right
18	left, right	right	right	right
19	left	left	left	left
20	left	left	right	left
21	right	left, right	right	right
22	right	right	right	right
23	left	left	left	left
24	right	right	right	right
25	right	right	right	right
26	right	right	right	right
27	right	right	right	right
28	right	right	right	right
29	right	right	right	right
30	right	right	right	right

TABLE II (Continued)

Subject Number	Spinning Top Hand Used	Spooning Sand Hand Used	Hammering Block Hand Used	Shaking Rattle Hand Used
31	left	right	right	right
32	right	right	right	right
33	left, right	left, right	left	right
34	right	right	right	right
35	right, left	right	right	right
36	right	right	right	right
37	left	right	right	right
38	left, right	right	right	right
39	right	right	right	right
40	left	right	right	right
41	left, right	right, left	left	left
42	left	left, right	left	right
43	right	right	right	right
44	right	right	right	right
45	left	left	left	right, left

TABLE III

BEAD-STRINGING TEST DATA

Subject Number	Laterality Group	Number of Beads Strung
01	mixed	1
02	consistent	3
03	crossed	1
04	consistent	3
05	consistent	3
06	crossed	3
07	crossed	3
08	mixed	3
09	crossed	6
10	crossed	4
11	consistent	2
12	consistent	4
13	consistent	3
14	consistent	4
15	mixed	3
16	mixed	5
17	mixed	4
18	mixed	2
19	crossed	2
20	mixed	2
21	mixed	4
22	consistent	2
23	consistent	1
24	crossed	3
25	consistent	3
26	consistent	4
27	crossed	3
28	crossed	2
29	mixed	3
30	crossed	4
31	mixed	3

TABLE III (Continued)

Subject Number	Laterality Group	Number of Beads Strung
32	mixed	3
33	mixed	3
34	crossed	5
35	mixed	3
36	consistent	3
37	mixed	3
38	mixed	4
39	consistent	3
40	mixed	3
41	mixed	4
42	mixed	3
43	consistent	3
44	consistent	3
45	mixed	3

TABLE IV

TEST DATA SUMMARY

Subject Number	Eye Preference	Hand Preference	Laterality Group	Bead-Stringing Score
01	left	mixed	mixed	1
02	right	right	consistent	3
03	left	right	crossed	1
04	right	right	consistent	3
05	right	right	consistent	3
06	left	right	crossed	3
07	right	mixed	mixed	3
08	right	mixed	mixed	3
09	right	left	crossed	6
10	left	right	consistent	4
11	right	right	consistent	2
12	right	right	consistent	3
13	right	right	consistent	3
14	right	right	consistent	4
15	right	mixed	mixed	3
16	right	mixed	mixed	4
17	left	mixed	mixed	4
18	right	right	mixed	2
19	right	left	crossed	2
20	right	mixed	mixed	2
21	left	mixed	mixed	4
22	right	right	consistent	2
23	left	left	consistent	1
24	left	right	crossed	3
25	right	right	consistent	3
26	right	right	consistent	4
27	left	right	crossed	3
28	left	right	crossed	2
29	right	mixed	mixed	3
30	left	right	crossed	4

TABLE IV (Continued)

Subject Number	Eye Preference	Hand Preference	Laterality Group	Bead-Stringing Score
31	left	mixed	mixed	3
32	mixed	right	mixed	3
33	right	mixed	mixed	4
34	left	right	crossed	5
35	right	mixed	mixed	3
36	right	right	consistent	3
37	right	mixed	mixed	3
38	left	mixed	mixed	4
39	right	right	consistent	3
40	left	mixed	mixed	3
41	left	mixed	mixed	4
42	right	mixed	mixed	3
43	right	right	consistent	3
44	right	right	mixed	3
45	left	mixed	mixed	3

APPENDIX B

CORRESPONDENCE

June 11, 1978

Dear Director,

In a continuing effort to improve the quality of instruction in elementary physical education at Oklahoma State, to expand the existing knowledge of motor development in young children and to complete my doctoral study, I am endeavoring to locate and screen four-year-olds in the Stillwater area. My study is attempting to determine if a significant relationship exists between hand-eye preference in four-year-olds and their ability to perform a simple bimanual coordination skill. Each child participating in the study will be asked to do four skills to determine hand preference. These skills include spooning sand, spinning a top, hammering a block and shaking a noisemaker. A simple test of eye preference will involve sighting a colored shape through a hole in a piece of cardboard. From these screening results, three hand-eye preference groups will be formed. Children selected for these three groups will be given a bead-stringing test.

My contact with four-year-olds in the Stillwater area is limited. Through the Stillwater preschool and nursery school directors, I hope to be able to locate four-year-olds whose parents will allow them to participate in this study. Names of the children who participate and their individual results will remain completely confidential. For the study, I will use only number designations for each child.

During the latter part of the week of June 12-16, I will be contacting each individual director. If you have questions concerning the study, I will be happy to answer them. Any cooperation you can give me is appreciated.

Sincerely,

Mary Ann Thompson
Facilitator, Elementary Physical Education
108 Colvin Center 624-5505
Oklahoma State University

June 15, 1978

Dear Parent/Guardian,

In a continuing effort to improve the quality of instruction in elementary physical education at Oklahoma State, to expand the existing knowledge of motor development in young children and to complete my doctoral study, I am endeavoring to locate and screen four-year-olds in the Stillwater area. My study is attempting to determine if a significant relationship exists between hand-eye preference in four-year-olds and their ability to perform a simple bimanual coordination skill. Each child participating in the study will be asked to do four skills to determine hand preference. These skills include spooning sand, spinning a top, hammering a block and shaking a noisemaker. A simple test of eye preference will involve sighting a colored shape through a hole in a peice of cardboard. From these screening results, three hand-eye preference groups will be formed. Children selected for these three groups will be given a bead-stringing test.

If you wish to have your child participate in this study, please complete the second portion of this form and return it to your child's preschool or nursery school director. If you have questions concerning this study, I will be happy to answer them. Your cooperation is appreciated.

Sincerely,

Mary Ann Thompson
Facilitator, Elementary Physical Education
108 Colvin Center 624-5505
Oklahoma State University

Permission Form

My child, _____, has permission to participate in
(name of child)
hand-eye preference screening and the bimanual coordination study. I understand that names of all participating children and their individual results will remain completely confidential.

_____
(name of parent/guardian)

VITA 2

Mary Ann Elizabeth Thompson

Candidate for the Degree of

Doctor of Education

Thesis: A STUDY OF THE RELATIONSHIP BETWEEN LATERAL PREFERENCE AND THE PERFORMANCE OF A SELECTED BIMANUAL DEXTERITY SKILL

Major Field: Higher Education

Minor Field: Health, Physical Education and Recreation

Biographical:

Personal Data: Born in Oklahoma City, Oklahoma, February 16, 1948, the daughter of William Best and Ann Giddings Thompson.

Education: Attended elementary, junior high and high school in Oklahoma City, Oklahoma; graduated from Classen High School in 1966; received the Bachelor of Science degree with honors from Texas Woman's University, Denton, Texas, in 1969 with a major in Health, Physical Education and Recreation; received the Master of Education degree in Health and Physical Education from Central State University, Edmond, Oklahoma, in 1972; completed requirements for the Doctor of Education degree at Oklahoma State University in December, 1978.

Professional Experience: Substitute teacher, Putnam City School System, Oklahoma City, Oklahoma, 1969-1970; elementary physical education teacher, Lake Park Elementary School, Putnam City School System, Oklahoma City, Oklahoma, 1970-1973; instructor in Health and Physical Education Department, Oklahoma City University, Oklahoma City, Oklahoma, 1973-1976; instructor in School of Health, Physical Education and Leisure Services, Oklahoma State University, 1976-present.

Professional Organizations: American Alliance for Health, Physical Education and Recreation; Southern District of the American Alliance for Health, Physical Education and Recreation; Oklahoma Association for Health, Physical Education and Recreation; Oklahoma Association of Physical Education for College Women; Oklahoma Association for Intercollegiate

Athletics for Women; American Red Cross; Oklahoma Association for Retarded Citizens; Oklahoma Association for Children with Learning Disabilities; Delta Kappa Gamma.