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We hereby recommend that the THESIS prepared under  
our supervision by ROBERTA ANN GARRISON

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CERTAIN TRAITS OF LATERALITY AND THE  
TAKE-OFF FOOT IN SELECTED SKILLS  
OF LOCOMOTION

be accepted as fulfilling this part of the requirements for the Degree of

Committee:

Bert E. Lyle Jr.  
Chairman  
Paul R. Brown  
Frank C. Hostetler

Accepted:

S. L. Morrison  
Dean of Graduate Studies

THE STUDY OF THE RELATIONSHIP BETWEEN  
CERTAIN TRAITS OF LATERALITY AND THE  
TAKE-OFF FOOT IN SELECTED SKILLS  
OF LOCOMOTION

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A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF MASTER OF ARTS IN PHYSICAL  
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COLLEGE OF  
HEALTH, PHYSICAL EDUCATION, AND RECREATION

BY  
ROBERTA ANN GARRISON, B. A.

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## CHAPTER I

### ORIENTATION TO THE STUDY

#### Introduction

The establishment of lateral preference, dominance, or "handedness" is one of the normal patterns of the developmental process. A difficulty that many experience, however, is that most training is aimed toward the person orientated totally to the right side of the body.

Williams<sup>1</sup>, in an article for grade school teachers, states, "Too many of us have been teaching primarily to the right-handed student, leaving the left-handed student to shift for himself." Wills<sup>2</sup>, reporting on handedness, wrote, "Estimates of the incidence of left handedness range from 2 to 8 per cent in the current literature." Clark reports that four to six per cent of the people of Britain, France, Greece, and the United States show preference for the left hand.<sup>3</sup> The fact that such children represent a small per cent of the school population does not lessen their need

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<sup>1</sup>W. Neil Williams, "Teaching the Left-Handed Child," Peabody Journal of Education, XL (Summer, 1962), p. 77.

<sup>2</sup>Betty J. Wills, "Handedness," Encyclopedia of Educational Research, Third edition, pp. 613-615.

<sup>3</sup>M. M. Clark, "Left-handed Problems," Health Education Journal, IX (July, 1951), p. 117.

for help. Sinclair and Smith suggested that lateral dominance should be of great interest to all teachers of physical education. "Of all educators, they have the best opportunity for significant observations in a wide variety of situations yet they have made few contributions to the scientific literature dealing with dominance."<sup>4</sup>

Detailed information about the use of the hands, feet and eyes may have considerable importance, particularly in the teaching of activities in which motor learning is involved. This investigation, which purports to study the relationship of certain traits of laterality and the take-off foot in selected skills of locomotion, is an attempt to aid in the discovery of such knowledge.

#### Statement of the Problem

The investigation entailed a comparative study of certain traits of laterality and the preferred take-off foot in hopping, running, long jumping, high jumping, and lateral movement from a stride position. Tests of laterality and tests for the take-off foot in these selected locomotor skills were administered to seventy seventh grade boys in Denton, Texas during the spring semester of the academic year of 1968-1969.

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<sup>4</sup>Caroline B. Sinclair and Inez M. Smith, "Laterality in Swimming and Its Relationship to Dominance of Hand, Eye, Foot," Research Quarterly XXVIII (December, 1957), p. 395.

### Definitions and/or Explanations of Terms

For purposes of clarification, the investigator established the following definitions and explanations of terms for use in the study:

1. Laterality: Laterality refers to the tendency to use one side of the body in preference to the other.<sup>5</sup>

Certain terms are used synonymously with laterality and, in this regard, the investigator accepts the opinion of Wills<sup>6</sup> who states,

Sidedness is evidenced in the human in a variety of motor activities . . . Many terms are used to denote this characteristic, the most common of which are laterality, preference, and dominance.

2. Dominant Hand: In bimanual activities, the dominant hand is the hand which performs the more delicate work or supplies the power.<sup>7</sup>
3. Dominant Eye: The investigator accepts the definition of Slutsky<sup>8</sup> who defines dominant eye as the eye that dominates or leads the other " . . . both in fixation and in attentive or perceptive function."

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<sup>5</sup>Margery J. Milne and Lorus J. Milne, "Right Hand, Left Hand," Scientific American, CLXXIX (October, 1948), p. 46.

<sup>6</sup>Wills, "Handedness," p. 613.

<sup>7</sup>Arthur H. Davidson, "The Relationship Between Unimanual and Bimanual Handedness," Journal of Comparative Psychology, XLVIII (1955), p. 137.

<sup>8</sup>Jerome Slutsky, The Optometrist's Dictionary, First edition, 1949.



4. Dominant Foot: The investigator uses the term synonymously with footedness which is defined in the Dictionary of Education<sup>9</sup> as  

preference for either the right or the left foot in tasks performed with one foot, such as kicking a ball or operating a treadle, or in the more difficult or skilled parts of tasks requiring the use of both feet.
5. Take-off Foot: When referring to jumping or hopping, the investigator accepts the explanation of Scott and Crafts<sup>10</sup> who state that the take-off foot is the "foot from which jumper leaves ground." When referring to running skills, the investigator uses this term in the connotation of lead preference and, according to Bresnahan, Tuttle, and Cretzmeyer,<sup>11</sup> lead preference is the foot on which the first step is taken.
6. Locomotion: Wells<sup>12</sup> states that, "By locomotion we mean the progressive movement of the body as a whole from one place to another."

#### Purposes of the Study

The general purpose of the investigation was to study the relationship of certain traits of laterality and the

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<sup>9</sup>Carter V. Good, ed., Dictionary of Education (Second Edition, 1959), p. 234.

<sup>10</sup>Phebe M. Scott and Virginia R. Crafts, Track and Field for Girls and Women (New York: Appleton-Century-Crofts, 1964), p. 212.

<sup>11</sup>George T. Bresnahan, W. W. Tuttle, and Francis X. Cretzmeyer, Track and Field Activities (Saint Louis: The C. V. Mosby Company, 1964), p. 56.

<sup>12</sup>Katharine F. Wells, Kinesiology (Philadelphia: W. B. Saunders Company, 1950), p. 361.

take-off foot in selected skills of locomotion. Specifically, the investigator proposed:

1. To study the relationship between hand dominance and the take-off foot in selected skills of locomotion.
2. To study the relationship between eye dominance and the take-off foot in selected skills of locomotion.
3. To study the relationship between foot dominance and the take-off foot in selected skills of locomotion.
4. To study the relationships between hand dominance and eye dominance, between hand dominance and foot dominance, and between eye dominance and foot dominance.

#### Delimitations of the Study

The study was subject to the following delimitations:

1. Approximately eighty selected subjects enrolled in the seventh grade of Congress Avenue Junior High School, Denton, Texas during the academic year of 1968-1969.
2. The validity and reliability of the test items administered.
3. The unknown past training of the subjects

#### Survey of Related Literature

Several theories of laterality exist. One theory is that of heredity. As an example of this theory, Wills refers to an article by Rife and writes, "Rife points to the

higher incidence of left-handed offspring of left-handed parents: where one parent is left-handed, one out of six is left-handed; where neither parent is sinistral, one out of sixteen is left-handed."<sup>13</sup> Another theory is that of handedness as a developmental process.

Gesell and Ames noted a definite relationship between the tonic-neck reflex ( TNR ) and hand dominance. A preference for a head position to the right at all stages of development of the TNR was observed, and in fourteen of nineteen subjects Gesell and Ames were able to predict handedness from the direction of the TNR.<sup>14</sup>

"The developmental theory is also supported by the fact that the newborn exhibits no hand dominance but the school-age child does."<sup>15</sup>

Blau sets forth another theory as he explains left-handedness as a deviation in the learning process which would normally result in right-handedness. He considers three possible deviations:

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<sup>13</sup>"Heredity and Handedness," Scientific Monthly New York, Vol. LXXIII, 1951, cited by Betty J. Wills, "Handedness," Encyclopedia of Educational Research, Third edition, p. 614.

<sup>14</sup>Gesell, Arnold, and Ames, Louise B., "Tonic-Neck-Reflex and Symmetro-Tonic Behavior," Journal of Pedagogy, XXXVI, 1950, cited by Betty J. Wills, "Handedness," Encyclopedia of Educational Research, Third edition, p. 614.

<sup>15</sup>Hildreth, Gertrude, "The Development and Training of Hand Dominance," Pedagogical Seminary LXXV, 1950, cited by Wills, "Handedness," p. 614.

(a) physical or mental defects either congenital or resulting from accident or disease; (b) actual encouragement of left-handedness or lack of educational opportunities which would stress right-handedness; (c) a negative response on the part of the infant toward the parent, similar to a temper tantrum or refusal to eat.<sup>16</sup>

Innumerable relationships with laterality have been studied. Stephens, Cunningham and Stigler<sup>17</sup> investigated the relationship of reading readiness and eye-hand preference patterns.

To assess the idea that mild neurological dysfunction, as evidenced by crossed eye hand preference patterns, interferes with the learning of reading skills, comparisons were made of reading readiness test results for eighty-nine first grade children. Comparisons on the basis of sex and of eye hand preference patterns yielded no significant differences in levels of reading readiness. Findings suggest that minimal brain dysfunction theories may be unsuitable for explaining reading disability.<sup>18</sup>

Flick's<sup>19</sup> study dealt with perceptual motor functioning.

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<sup>16</sup>Blau, Abram, The Master Hand, Research Monograph Orthopsychiatric Association, No. 5, 1946, cited by Wills, "Handedness," p. 614.

<sup>17</sup>Wyatt E. Stephens, Ernest S. Cunningham, and B. J. Stigler, "Reading Readiness and Eye Hand Preference Patterns in First Grade Children," Exceptional Children, March, 1967, pp. 481-488.

<sup>18</sup>Ibid., p. 481.

<sup>19</sup>Grad L. Flick, "Senistrality Revisited: A Perceptual Motor Approach," Child Development, July, 1966, pp. 613-622.

This study reports the relation between perceptual-motor functioning and hand-eye dominance on 237 female and 216 male Negro forty-eight-month-old subjects. Performances of subjects falling into five hand-eye-dominance categories were compared on two perceptual-motor tasks and Stanford-Binet I.Q. Results showed that left-hand-left eye-dominant subjects gave significantly poorer performances on perceptual-motor and intellectual measures than all other hand-eye-dominant subjects except left-hand-right-eye-dominant subjects.<sup>20</sup>

Wilson and Dolan<sup>21</sup> presented certain facts concerning the relation of handedness to intelligence and achievement scores in a group of 975 6-A pupils. The Otis Self-Administering Test of Mental Ability, Intermediate Examination; the Stanford Achievement Test, Reading Examination; and the Compass Survey Arithmetic Test, Advanced Examinations were administered. Teachers' ratings were also obtained. All of these were expressed in raw scores and G-scores. "For the groups of dextrals and sinistrals under consideration, there is a universal superiority of the dextrals in intelligence, achievement, and teachers' ratings. The superiority is slight, however."<sup>22</sup> The investigators found sinistrals 3.32 points lower in intelligence, 0.20 lower in reading, 0.23 lower in arithmetic, and 0.20 lower in teachers' ratings than dextrals. Sinistral girls were found slightly superior to sinistral boys.

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<sup>20</sup>Ibid., p. 613.

<sup>21</sup>M. O. Wilson and L. B. Dolan, "Handedness and Ability", American Journal of Psychology, XLIII (April, 1931), p. 261.

<sup>22</sup>Ibid., p. 268.

Smith and Lewis<sup>23</sup> probed hand steadiness. Hand laterality was determined and then a hand steadiness test which incorporated static neuromuscular control was given to thirty boys aged seven to ten. Each subject was given one-minute trials and the results from these trials were averaged to obtain the contact scores and the contact times.

The hypothesis that there would be a significant difference between the contact times of the preferred and non-preferred hands was substantiated; however, the prediction that there would be a difference between the contact scores did not eventuate.<sup>24</sup>

While investigating grip strength as compared to physical education achievement grades for 635 college men, Tinkle and Montoye<sup>25</sup> found a significantly larger proportion (44.7 per cent) of left-handed men have a stronger right grip as compared to right-handed men (10.1 per cent) with a stronger left grip. The relationship between grip strength and physical education achievement grades was found to be significant and positive.

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<sup>23</sup>Leon E. Smith and Floyd Dwain Lewis, "Handedness and Its Influence Upon Static Neuromuscular Control," Research Quarterly, XXXIV (May, 1963), p. 206.

<sup>24</sup>Ibid., p. 206.

<sup>25</sup>Wayne F. Tinkle and Henry J. Montoye, "Relationship Between Grip Strength and Achievement in Physical Education Among College Men," Research Quarterly, XXXII (May, 1961), p. 238.

Although various laterality relationships have been investigated in numerous studies, a comprehensive review of the related literature revealed that the proposed investigation was not identical with any previous study. Most studies examined handedness while eyedness and footedness were included to a lesser extent. The following review of completed research was confined to closely related studies which were of assistance to the investigator in the development of the study.

Horine<sup>26</sup> sought to investigate the relationship of laterality to performance on selected motor ability tests to determine the implications of laterality to the physical education curriculum, and possible associations of laterality to motor-based learning problems. Batteries of tests for footedness, handedness and eyedness were administered to 220 ten-year-old boys and on the basis of the results, the subjects were classified into four laterality groups: (1) pure or homolateral right sided, (2) predominantly right, (3) mixed and (4) pure left and predominantly left.

To test motor ability, the following four tests were used: (a) the Matheny revision of the Johnson Mat Test, (b) the shuttle-run as administered in the American Association of Health, Physical Education and Recreation Physical Fitness Test was used to measure explosive strength and ability to change direction, (c) a test to measure arm

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<sup>26</sup>Lawren E. Horine, "An Investigation of the Relationship of Laterality Groups to Performance on Selected Motor Ability Tests," Research Quarterly, XXXIX (March, 1968), p. 90.

movement completion time, and (d) an adoption of the Seashore beam-walking test to measure dynamic balance. The arm movement completion time was measured by the use of the American Automobile Association reactive-time device. Performances on each of these motor ability tests were compared to the four laterality groups.

The findings did not show sufficient evidence at the five per cent level of significance to refute the null hypothesis. Homolateral individuals outperformed mixed individuals. The homolateral right-sided group surpassed the other three groups in the shuttle and movement completion time tests. In the remaining two tests, the pure predominantly left-sided group scored highest.

This investigation resembles Horine's study in that both sought to determine the relationships of handedness, eyedness, and footedness with other criteria of motor ability. The two studies differ with respect to the tests used to determine laterality, the number and age of the subjects, and the hypothesis tested.

Irwin<sup>27</sup> studied the physiological dominance of the upper and lower extremities as related to the performance of physical education activities. This involved the study

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<sup>27</sup>Leslie W. Irwin, "A Study of the Relationship of Dominance to the Performance of Physical Education Activities," Research Quarterly IX (May, 1938), p. 98.



of the order of response when two members of the body respond to the same stimulus.

The 239 subjects were elementary and high school boys ranging in ages from six to eighteen years. For purposes of comparison, four age groups were used. Group one consisted of pupils six to nine years inclusive; group two, pupils ten to twelve years inclusive; group three, pupils thirteen to fifteen years inclusive; and group four, pupils sixteen to eighteen years inclusive.

The order of response was obtained in six situations. In situation one the right arm was tested against the left; in situation two, the right foot against the left; in situation three, the right arm against the right foot; in situation four, the right arm against the left foot; in situation five, the left arm against the left foot; and in situation six, the left arm against the right foot.

The apparatus used in obtaining the order of response when two members of the body responded to the same stimulus consisted of a stimulus unit, a response unit, and a recording unit. The reliability of the order of response test was determined in each of the six situations by a second administration of the tests to seventy-six subjects.

A second test, an athletic dominance index test covering a wide range of activities, was constructed for subjects in

the upper age groups. Dominance of subjects under the age of ten was secured by the administration of a number of simple physical performance tests.

In securing an indication of athletic dominance for the older groups, a list of twenty-four questions pertaining to the hands and twenty-two questions pertaining to the feet were developed. This list of questions was selected after considerable experimentation in administering the questions relating the pupil response of various age levels to the actual performance suggested by the questions.

For boys in the lower age group, simple physical performance tests were given to secure an indication of arm and foot dominance. The number of right foot and left foot performances in ten trials of each test was totaled.

The author drew the following conclusions: (1) the results of both the athletic dominance index and the order of response test showed that handedness did not approximate a normal distribution; (2) the scores for footedness were more evenly distributed than those for handedness; (3) there was close agreement between subjects' statements of handedness and actual performance. The reverse was true for footedness; (4) A majority of the subjects were ambidextrous with regard to footedness; (5) when the arms and feet were tested against each other, the arms tended to show dominance over the feet; (6) a lower percentage of right-handed subjects in each age group level was obtained through

administration of the order of response test than by the athletic dominance index.

This study is similar to that of Irwin in that both used tests to establish the dominance of the upper and lower extremities. The study is different from that of Irwin with respect to the nature and scope of the problem investigated, the number and age of the subjects, the hypotheses tested, and the statistical procedures employed.

Way<sup>28</sup> investigated the incidence of various laterality preferences among college women. The investigator also sought to establish the relationship of lateral dominance with general motor ability and laterality with skill test scores in archery, badminton, bowling, and tennis.

The study was limited to 410 freshmen and sophomore women enrolled in the required program of physical education at the University of Washington. All subjects were between the ages of seventeen and twenty-five and enrolled in one of the beginning sections of archery, badminton, bowling, or tennis.

Instruments used were The Scott Motor Ability Test, the Miles A-B-C Test of Ocular Dominance, a modification of the Johnson dart board test, and the footedness test by Turner. These were given during a three-week period of time. The subjects did not complete these tests in any definite order.

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<sup>28</sup>Eunice E. Way, "Relationships of Lateral Dominance to Scores of Motor Ability and Selected Skill Tests," Research Quarterly, XXIX (October, 1958), p. 360.

Frequency distributions and histograms of the scores on eye dominance, hand dexterity, and foot dexterity were made. Laterality groups were compared to determine the significance of the difference between the mean scores for the general motor ability test. The comparisons were made between the various eye-hand preferences, the eye-foot preferences, and the hand-foot preferences.

All differences between the mean scores of motor ability were tested by the t-ratio to determine the significance of the difference. The groups were equated on the basis of motor ability test scores. Equated laterality groups were compared by means of the t-ratio to determine the significance of the difference between the mean scores of skill in each activity.

The authors drew the following conclusions: (1) definite eye, hand, and foot preferences were exhibited by the majority of college women; (2) motor ability seemed to be related to foot ambidexterity; (3) women with mixed eye, hand, and foot dominance were superior in motor ability to those who had homolateral or contralateral preference; (4) eye dominance and lateral dexterity appeared to have some relationship to skill in archery, badminton, bowling and tennis; (5) laterality tended to be of more importance in the activities stressing accuracy of direction toward a fixed target than in activities which did not.

This investigation is similar to that of Way in that both sought to determine laterality preferences and relationships of lateral dominance with other criteria of motor ability. The study is different from that of Way with respect to the tests used for determining laterality, the locomotor skills surveyed, the age and sex of the subjects, the hypotheses tested, and the statistical procedures employed.

Singer<sup>29</sup> studied the relationship of preferred and non-preferred hand and foot skills in an effort to determine general motor ability. Simple skill tests were used to compare: (a) throwing skill of the preferred arm with the nonpreferred arm; (b) kicking skill of the preferred leg with the nonpreferred leg; and (c) arm skill with leg skill.

Thirty-eight male college freshmen were used as subjects in the study. All were enrolled in required physical education programs.

Reliability coefficients were obtained from the test-retest method for skill performance of each limb, with the subject being tested on succeeding days. The investigator computed intercorrelations for each of the limb performances using the Pearson Product Moment Coefficient Correlation and the coefficient of alienation.

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<sup>29</sup>Robert N. Singer, "Interlimb Skill Ability in Motor Skill Performance," Research Quarterly, XXXVII (October, 1966), p. 406.

Correlations between arms, legs, preferred arm and preferred leg, nonpreferred leg and nonpreferred arm, and preferred arm and nonpreferred leg were positive and significant. All possible limb combinations of the movements investigated indicated extreme specificity of performance rather than generality. The highest generality was obtained with leg performance.

The present study is similar to that of Singer in that both utilized simple performance tests in the establishment of laterality preferences. The two studies differ with respect to the nature and scope of the problems, the tests administered, the hypothesis tested, the treatment of the data, and the selection of the subjects.

## Summary

Laterality should be of interest to all educators, especially those in the field of physical education. This investigation, which is a study of the relationship of certain traits of laterality and the take-off foot in selected skills of locomotion, attempts to provide further information about the way in which hands, feet and eyes are used.

The preceding chapter contains a statement of the problem, definitions and/or explanations of terms, and purposes of the study. Delimitations of the study are also listed, followed by a survey of related literature.

In the related literature division theories of laterality are discussed briefly. There is a discussion of numerous studies in which laterality relationships have been investigated. Previous studies closely related to this investigation are summarized.

The next chapter contains the methods and procedures used in the present study. It includes sources of data, preliminary procedures, procedures followed in the collection of data, and testing methods.

## CHAPTER II

### METHODS AND PROCEDURES

The general purpose of the investigation was to study the relationship of certain traits of laterality and the take-off foot in selected skills of locomotion. Specifically, the investigator proposed: (a) to study the relationship between hand dominance and the take-off foot in selected skills of locomotion; (b) to study the relationship between eye dominance and the take-off foot in selected skills of locomotion; (c) to study the relationship between foot dominance and the take-off foot in selected skills of locomotion; (d) to study the relationships between hand dominance and eye dominance; between hand dominance and foot dominance, and between eye dominance and foot dominance.

The present chapter contains the methods and procedures used in the fulfillment of the purposes of this study. It includes sources of data, preliminary procedures, selection and description of instruments, selection of subjects, and procedures related to the collection of data.



Both human and documentary sources were utilized in the investigation. Human sources comprised seventy male, seventh grade pupils of the Congress Street Junior High School in Denton, Texas who served as subjects. Others included the teacher of the seventh grade physical education class and members of the thesis committee.

Documentary sources included books, pamphlets and periodicals. Other published and unpublished reports, microcards, microfilms and research pertinent to the investigation were employed. Published tests which purport to measure laterality were also examined.

#### Preliminary Procedures

The investigator surveyed and assimilated information pertinent to all phases of the proposed study. This information was used in the formulation of a tentative outline.

Items to be used as tests of laterality were determined. Methods for testing the take-off foot in hopping, running, long jumping, high jumping, and lateral movement from a stride position were established.

Permission to conduct the study was secured from Doctor Anne Schley Duggan, Dean of the College of Health, Physical Education, and Recreation at the Texas Woman's University in Denton, Texas. The investigator also obtained approval from the administration of the Denton Public Schools, the principal of the Congress Avenue Junior High School, and the physical education teacher.

The outline was corrected in accordance with the suggestions offered by the members of the thesis committee. On December 18, 1968, the completed tentative outline of the thesis was presented at a Graduate Seminar. In accordance with suggestions offered by those participating, the outline was revised. A propectus of the approved study was filed in the Office of the Dean of Graduate Studies at the Texas Woman's University.

#### Selection and Description of Instruments

After careful examination of available tests, the investigator chose instruments that would provide the information needed to complete the purposes of this study. An original test, developed by the investigator, and the Harris Tests of Lateral Dominance<sup>1</sup> were selected.

Robbins<sup>2</sup> stated, "The Harris series is the best known test of laterality." In describing his own test, Harris said,

The Harris Tests of Lateral Dominance were first assembled in an experimental edition in 1941, and slightly revised in 1956, after ten additional years of clinical try-out. They include a test of knowledge of left and right, five tests of hand dominance, two tests of eye dominance, and a test (now two tests) of foot dominance. Two additional tests in the original battery, one of hand dominance and one of eye

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<sup>1</sup>Albert J. Harris, Harris Tests of Lateral Dominance (New York: Psychological Corporation, 1958), pp. 1-21.

<sup>2</sup>Melvyn P. Robbins, "Study of the Validity of Delacato's Theory of Neurological Organization," Exceptional Children, XXXIII (November, 1966), p. 199.

dominance, have been dropped. The tests can be given from age six up and the complete series takes from ten to fifteen minutes.<sup>3</sup>

One of the problems of developing laterality tests is the difficulty of creating test items which are highly reliable. Harris found that determining the reliability of his series of tests of lateral dominance was difficult.<sup>4</sup> He said,

The split-half technique was employed on Tests two and three, using 100 records of unselected nine-year-old children (fifty boys and fifty girls). The contingency coefficients were .74 for Test two and .78 for Test three. Applying the Spearman-Brown formula, the estimated reliability coefficients are .85 for Test two and .88 for Test three. Lieben<sup>5</sup> computed test-retest reliabilities for Tests three, four, and five on the basis of group administration in college classes, with the groups ranging from sixty-five to 124 subjects. The coefficients of contingency were: Test three, .83; Test four, .76; Test five, with a twenty-second time limit, .75.

The reliability of the eye dominance tests has been determined for the same sample of 100 unselected nine-year-old children. In Test eight, Tests 8.1 and 8.2 agreed in ninety-eight cases, and all three parts agreed in seventy-eight cases, Test 8.3 being obviously influenced by hand dominance in some cases. The two parts of Test nine disagreed in only two cases. The coefficient of contingency between Test eight and Test nine was .71, giving an estimated reliability for the total eye dominance rating of .83 by the contingency coefficient method.

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<sup>3</sup>Albert J. Harris, "Lateral Dominance, Directional Confusion, and Reading Disability," The Journal of Psychology, XLIV (October, 1957), p. 283.

<sup>4</sup>Harris, Harris Tests of Lateral Dominance, p. 19.

<sup>5</sup>Beatrice Lieben, Analysis of Results of the Harris Tests of Hand Dominance Used As Group Tests (unpublished Master's Thesis, Library of The City College of New York, 1951).

Reliability data are not available for Test one and the foot dominance tests.<sup>6</sup>

In the present study, the Harris Tests of Lateral Dominance (See Appendix I, A) was used to establish the validity of the investigator's test.

The investigator decided to develop a simplified and easily administerable test for use in the study (See Appendix I, B), after studying several long and complicated tests of laterality. This test, which shall be referred to as the Garrison Tests for Laterality, was administered on two different occasions in order that the reliability of the test could be established.

The Garrison series consisted of six parts with a total of eight tests of laterality: four for hand dominance, two for eye dominance, and two for foot dominance. Each subject required only two or three minutes for the administration of the entire series of tests.

The investigator also developed a series of tests for determining the take-off foot in selected locomotor skills (See Appendix I, C). Specifically, these locomotor skills were running, hopping, long jumping, high jumping, and lateral movement from a stride position.

#### Selection of Subjects

The investigator chose to use seventh grade boys with no apparent physical handicaps as subjects. A most important

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<sup>6</sup>Harris, Harris Tests of Lateral Dominance, p. 19.

criterion was the skill level of the subjects. Students in the regular physical education classes, rather than those in the athletic training class, were selected to eliminate those subjects with previous or known formal training.

Three seventh grade physical education classes were utilized which provided a total of seventy subjects. The schedule of classes was as follows: class one - 8:50 to 9:45 A.M.; class two - 9:50 to 10:45 A.M.; and class three - 10:50 to 11:45 A.M. All tests were administered during those class periods on Mondays, Wednesdays, and Fridays.

#### Collection of Data

Data for the study were collected through the administration of the Harris Tests of Lateral Dominance, the Garrison Tests for Laterality and the investigator's tests for determining the take-off foot in hopping, running, long jumping, high jumping, and lateral movement from a stride position. This gathering of data covered a two-month period from March 5 to April 30, 1969.

In order to secure the most valid results possible, all tests were conducted in a game-like or contest situation to keep the subjects from suspecting that they were taking laterality tests. A student assisted in each of the three classes by keeping a score sheet, for appearance only, of the game or contest results. While the subjects competed, the investigator recorded the dominant hand, eye, or foot.

The Garrison Tests for Laterality were administered first and were followed by the tests for the take-off foot in the selected locomotor skills. Two days later, the Garrison Tests for Laterality were repeated to establish reliability. The Harris Tests of Lateral Dominance were given last in order to establish the validity of the Garrison series.

Each of the three physical education classes was divided into three groups consisting of eight to eleven students. While one group participated in testing sessions, the remainder of the students continued their regular physical education activities under direction of the physical education teacher.

#### Summary

The general purpose of the investigation is to study the relationship of certain traits of laterality and the take-off foot in selected skills of locomotion. The preceding chapter contains the methods and procedures used in the fulfillment of the purposes of this study.

Both human and documentary sources were utilized in the investigation. The investigator surveyed and assimilated information pertinent to all phases of the study. A tentative outline was written, presented in Graduate Seminar and, in corrected form, filed as a propectus in the Office of the Dean of Graduate Studies at the Texas Woman's University.

After examining available tests, the investigator selected the Harris Tests of Lateral Dominance and the Garrison Tests for Laterality, an original test developed by the investigator, to use in the study. Seventh grade boys who met certain criteria were chosen as subjects. Three physical education classes, providing a total of seventy subjects, were utilized in the study.

The chosen laterality tests, plus the investigator's tests for determining the take-off foot in selected locomotor skills, were used to collect data for the study. All tests were conducted in a game-like or contest situation to keep the students naive as to the actual intent of the investigator.

The next chapter contains a presentation of findings. Included in the chapter are analyses and conclusions based on data obtained.

### CHAPTER III

#### TREATMENT AND FINDINGS

The general purpose of the investigation was to study the relationship of certain traits of laterality and the take-off foot in selected skills of locomotion. Utilizing tests of laterality and selected locomotor skills, the investigator specifically studied the relationship between hand dominance and the take-off foot; the relationship between eye dominance and the take-off foot; the relationship between foot dominance and the take-off foot; and the relationships between hand dominance and eye dominance, between hand dominance and foot dominance, and between eye dominance and foot dominance.

The present chapter contains a presentation of findings. Treatment, results, and interpretations of the data are included in the chapter.

#### Treatment of Data

The analysis of variance technique, based upon the concept of error sum of squares, was utilized to analyze the data in the study. A desk computer, the Wang 380-362E, was used in the statistical treatment of the data.

The technique used allows for the inclusion of complete categorized information on all subjects under consideration



through use of full and unrestricted models. The method used in the development of the full model is illustrated in the following formula:

$$y = m + A + B + e$$

where

$m$  = mean sum of squares

$A$  = laterality measures L (left), R (right), and M (mixed)

$B$  = treatment, or scores, within blocks and 1, 2, and 3, . . . 29 treatments

$e$  = the residual error of the sums of squares

The following steps were followed in the solution of this type of model:

$$M_{ss} = \frac{T^2}{bt}$$

$$B_{ss} = \sum \frac{B^2}{t} - M_{ss}$$

$$T_{ss} = \sum \frac{T^2}{b} - M_{ss}$$

$$E_{ss} = \sum y^2 - M_{ss} - B_{ss} - T_{ss}$$

The analysis of variance method is limited as a means of interpreting data, however, when cell frequencies fall below certain predicted expectations. Since certain of the categories in the data analyzed contained very small or zero frequencies within their cells, the analysis of variance technique was of limited power as a means of interpretation. In order to provide an additional means of interpretation, the Chi-Square technique was applied to certain sections of

the data. The Chi-Square for an  $n \times m$  Contingency Table was run on an Olivetti-Underwood 101 Desk Computer. Differences in the results and interpretations are indicated in the ensuing section.

#### Results and Interpretations

The results of the analysis of the data are shown in tabular form. Table 1, page 30, presents the sets of categorized observations made of seventy students involved in a series of laterality and take-off foot tests. These observations include tests of hand dominance, eye dominance, and foot dominance of both the investigator's original tests and the Harris Tests of Lateral Dominance, and tests for the take-off foot developed also by the investigator. Tests one through sixteen inclusive indicate the results of the first and second administrations of the investigator's tests, the Garrison Tests for Laterality. These odd numbered tests, 1, 3, 5 and 7, are the initial tests and the even numbered tests, 2, 4, 6 and 8, are the re-tests administered to obtain the reliability of the Garrison Tests. Tests seventeen through twenty-two inclusive list the total results of both the Harris and the Garrison series. Tests twenty-three through twenty-nine inclusive show the results of the take-off foot tests.

The Garrison Laterality Tests and the take-off foot tests are described in the Appendices. The source for the Harris Tests for Lateral Dominance is provided there also.

TABLE 1

CATEGORIZED OBSERVATIONS MADE OF SEVENTY STUDENTS  
ON TWENTY-NINE TESTS OF LATERALITY

Test No.	Description	Right		Left		Mixed		Total	
		R	$\sqrt{\quad}$	R	$\sqrt{\quad}$	R	$\sqrt{\quad}$	R	$\sqrt{\quad}$
1	1a Writing hand	61	7.874	9	3.162	0	1.000	70	12.036
2	1b	62	7.937	8	3.000	0	1.000	70	11.937
3	2a Throwing hand	63	8.000	7	2.828	0	1.000	70	11.828
4	2b	63	8.000	7	2.828	0	1.000	70	11.828
5	3ha Pistol hand	63	8.000	7	2.828	0	1.000	70	11.828
6	3hb	63	8.000	7	2.828	0	1.000	70	11.828
7	3ea Pistol Sighting eye	53	7.348	17	4.242	0	1.000	70	12.590
8	3eb	54	7.416	16	4.123	0	1.000	70	12.539
9	4ha Bean bag Pitching hand	61	7.874	9	3.162	0	1.000	70	12.036
10	4hb	61	7.874	9	3.162	0	1.000	70	12.036
11	4ea Bean bag Sighting eye	57	7.615	13	3.741	0	1.000	70	12.356
12	4eb	55	7.483	15	4.000	0	1.000	70	12.483
13	5a Kicking Rolling ball	62	7.937	8	3.000	0	1.000	70	11.937
14	5b	62	7.937	8	3.000	0	1.000	70	11.937
15	6a Punt ball	61	7.874	9	3.162	0	1.000	70	12.036

TABLE 1--Continued

Test No.	Description	R	Right $\sqrt{\quad}$	R	Left $\sqrt{\quad}$	R	Mixed $\sqrt{\quad}$	R	Total $\sqrt{\quad}$
16	6b	61	7.874	9	3.162	0	1.000	70	12.036
17	Garrison Hand	61	7.874	6	2.645	3	2.000	70	12.519
18	Harris Hand	60	7.810	6	2.645	4	2.236	70	12.691
19	Garrison Eye	56	7.549	8	3.000	6	2.645	70	13.194
20	Harris Eye	44	6.708	22	4.795	4	2.236	70	13.739
21	Garrison Foot	61	7.874	8	3.000	1	1.414	70	12.288
22	Harris Foot	47	6.928	8	3.000	15	4.000	70	13.928
23	Hopping Race	53	7.348	17	4.242	0	1.000	70	12.590
24	Hopping Pattern	58	7.681	12	3.605	0	1.000	70	12.286
25	Running	50	7.141	20	4.582	0	1.000	70	12.723
26	Long Jump	39	6.324	31	5.656	0	1.000	70	12.980
27	High Jump	28	5.385	42	6.557	0	1.000	70	12.942
28	Lateral to Left	19	4.472	51	7.211	0	1.000	70	12.683
29	Lateral to Right	57	7.615	13	3.741	0	1.000	70	12.356

Because of the zero factor, one was added to each raw number. R = the raw scores for the Right, Left, Mixed and Total Columns.

Table 2 indicates the values needed for the development of the full model for the statistical treatment of the data

by the analysis of variance technique. The calculations obtained within the sets provide the values for the formula presented earlier.

TABLE 2

VALUES NEEDED FOR THE DEVELOPMENT OF THE FULL MODEL

Source of Variance	df	Ms	ss
Mean	1	M	$M_{ss}$
Blocks	2	B	$B_{ss}$
Treatment	28	T	$T_{ss}$
Residual error	56	E	$E_{ss}$
Total	$\frac{87}{bt}$		$\sum y^2$

The results of the analysis of data obtained from administration of the full model is revealed in Table 3. The analysis of variance model indicates the extent to which there are differences between the tests. The results may be ascertained by examining the F ratio for interaction among the tests. As indicated in Table 3, the F ratio is not significant at the .01 level of confidence. The F ratio obtained is extremely low, indicating a high relationship among all

twenty-nine tests in the series. The results show no significant differences between any tests, even when those with the greatest differential between sums of squares are compared.

TABLE 3  
RESULTS OF THE ANALYSIS OF DATA

	df	Ms	ss	F-ratio	Significance
M	1		1491.228		
B	2	228.293	556.586		
T	28	.100	2.800	.085	NS
E	<del>56</del> 59	1.181	1.181		

Reliability and Validity.--The results of the Chi-Square treatment as applied to the Garrison and Harris Laterality Tests are found in Tables 4, 5, and 6, pages 34 and 35. In order to determine the reliability and validity of the instruments developed by the investigator, and the results of the three tables must be analyzed. The analysis of variance method in Table 3 shows that the Garrison tests were reliable and valid since no significant differences were observed

among any of the test items. That the tests were reliable can be ascertained further by examination of Table 1, page 30.

TABLE 4

CHI-SQUARE CONTINGENCY TABLE FOR GARRISON  
VS. HARRIS HAND LATERALITY TESTS

	Garrison	Harris	Total Rows	df	$\chi^2$	Significance
R	61	61	121			
L	6	6	12			
M	3	4	7			
Total Columns	70	70	140	2	0.1510	NS

TABLE 5

CHI-SQUARE CONTINGENCY TABLE FOR GARRISON  
VS. HARRIS EYE LATERALITY TESTS

	Garrison	Harris	Total Rows	df	$\chi^2$	Significance
R	56	44	100			
L	8	22	30			
M	6	4	10			
Total Columns	70	70	140	2	8.3732	.02

TABLE 6

CHI-SQUARE CONTINGENCY TABLE FOR GARRISON  
VS. HARRIS FOOT LATERALITY TESTS

	Garrison	Harris	Total Rows	df	$\chi^2$	Significance
R	61	47	108			
L	8	8	16			
M	1	15	16			
Total Columns	70	70	140	2	14.0648	.01

The re-tests of the eight test items varied only in one category by as much as two from the first administration. In all other instances, the differences were as low as one or zero. Nor was independence between test administrations found in the Chi-Square analysis. The reliability of the tests as indicated by the results of these two analytical techniques was established.

The findings provided by the Chi-Square technique in the determination of the validity of the Garrison tests when compared to the Harris tests were somewhat different than the results obtained by the analysis of variance method. The Harris tests' results are based upon five separate hand laterality tests, two different eye laterality tests, and two independent foot laterality tests averaged into one score each for the



hand, foot and eye. Each subject's score is categorized by right dominance (R), left dominance (L), and mixed dominance (M). The Garrison tests were administered similarly as four different hand laterality tests, two different eye laterality tests, and two different foot laterality tests. For purposes of comparison these tests were averaged also and one separate score was obtained for each subject on hand dominance, foot dominance, and eye dominance. These subjects were classified likewise as left, right or of mixed dominance.

Table 4 reveals the findings of the 3 x 2 sets of the contingency table for hand laterality comparisons between the Garrison and Harris tests. Since the  $\chi^2$  was very low and found not to be significant, the two tests were found not to be independent and a relationship between the two tests was expected. The comparison of the hand laterality tests was revealed to be valid by both methods of analysis.

The results of Table 5, a comparison of the Garrison and Harris tests for eye laterality by the Chi-Square technique, differed from the above. These tests were revealed to be independent of relationship if the .02 level of significance is accepted as a high indication of independence. Under any circumstance, much less relationship was obtained by the Chi-Square method than by the Analysis of Variance technique in this study.

The Garrison and Harris foot laterality tests were compared in Table 6 by the Chi-Square method. The highly

significant  $\chi^2$  indicated that these two tests were independent. Slight relationship could be expected between these tests. Analysis of the data reveals that the large number of subjects with mixed foot dominance as measured by the "fire stomping" test in the Harris battery contributed to the lack of relationship with the Garrison tests. The validity obtained by the analysis of variance technique was refuted by the Chi-Square application in the analysis of the data presented heretofore.

#### Relationships Between Hand, Eye, and Foot Dominance and the Take-off Foot in Selected Skills of Locomotion

Upon examination of the specific purposes of this investigation, the interpretation of the analysis of variance method used in this analysis revealed no significant differences between certain traits of laterality and the take-off foot in selected skills of locomotion. Great homogeneity was found between hand dominance and the take-off foot, between eye dominance and the take-off foot; and between foot dominance and the take-off foot. Analysis by the Chi-Square technique revealed, however, certain differences which are presented hereinafter.

Table 7, page 38, showed the relationship of hand laterality and the take-off foot in selected locomotor skills. Only two locomotor skills, hopping and lateral movement to the right, indicated relationship with hand laterality. The

other locomotor skills revealed varying levels of independence with hand dominance.

TABLE 7

TWO-WAY CONTINGENCY TABLE FOR HAND LATERALITY AND  
THE TAKE-OFF FOOT IN SELECTED LOCOMOTOR SKILLS

	R	L	df	$\chi^2$	Significance
Hand	62	8			
Hopping	53	17	1	3.9442	.05
Hopscotch	58	12	1	0.9332	NS
Running	50	20	1	6.4284	.02
Long Jump	39	31	1	18.8016	.01
High Jump	28	42	1	35.9642	.01
Lateral to Left	19	51	1	54.1658	.01
Lateral to Right	57	13	1	1.4004	NS

Eye laterality was more closely associated with the take-off foot of certain locomotor skills as observed in Table 8, page 39. A relationship between eye dominance and the take-off foot in the skills of hopping, hopscotch, running, and lateral movement to the right was obtained. No relationship was indicated between eye laterality dominance and the take-off foot of long jumping, high jumping, and lateral movement to the left.

TABLE 8

TWO-WAY CONTINGENCY TABLE FOR EYE LATERALITY AND  
THE TAKE-OFF FOOT IN SELECTED LOCOMOTOR SKILLS

	R	L	df	$\chi^2$	Significance
Hand	55	15			
Hopping	53	17	1	0.1620	NS
Hopscotch	58	12	1	0.4128	NS
Running	50	20	1	0.9522	NS
Long Jump	39	31	1	8.2882	.01
High Jump	28	42	1	21.5724	.01
Lateral to Left	19	51	1	37.1496	.01
Lateral to Right	57	13	1	0.1784	NS

The findings from Table 9, page 40, revealed that foot laterality was related to the take-off foot of hopping, hopscotch, and lateral movement to the right. The take-off foot used in running, the long jump, the high jump, and lateral movement to the left was not related to foot dominance in the subjects tested. These tests revealed varying levels of independence obtained by the Chi-Square application.

Since foot dominance was related to the take-off foot involved in lateral movement to the right and was not related

TABLE 9-

TWO-WAY CONTINGENCY TABLE FOR FOOT LATERALITY AND  
THE TAKE-OFF FOOT IN SELECTED LOCOMOTOR SKILLS

	R	L	df	$\chi^2$	Significance
Foot	61	9			
Hopping	53	17	1	3.0228	NS
Hopscotch	52	12	1	0.5040	NS
Running	50	20	1	5.2624	.05
Long Jump	39	31	1	16.9400	.01
High Jump	28	42	1	33.5886	.01
Lateral to Left	19	51	1	51.4500	.01
Lateral to Right	57	13	1	0.8626	NS

to the take-off foot in lateral movement to the left, a closer analysis of this data was required. Table 1 revealed that sixty-one of the subjects on one test of foot laterality and sixty-two of the subjects on another test were right dominant. This is approximately 88 per cent of the subjects, or approximately 81 per cent, used their right foot as the take-off foot when moving laterally to the right. This would be expected when the right foot is dominant among so many subjects and explains the relationship found in Table 9. The take-off foot movement by these subjects with

right dominance when moving laterally to the left, however, was initiated by the left foot among fifty-one, or 72 per cent, of the subjects. This reveals the lack of relationship between this type of movement and foot dominance, since the far greater proportion of the subjects were right dominant. The findings in Table 10 below reveal that the relationship of the initial take-off foot movement is closely related to the direction of the movement, rather than being determined by foot dominance. Lateral movement to the left and lateral movement to the right was initiated by the foot nearest the direction of movement.

TABLE 10

CHI-SQUARE CONTINGENCY TABLE FOR THE TAKE-OFF FOOT IN  
LATERAL MOVEMENT VS. THE DIRECTION  
OF LATERAL MOVEMENT

Direction of Movement	Lateral Take- off Foot		Total of Rows	df	$\chi^2$	Significance
	R	L				
Leading Take-off Foot	57	51	108			
Trailing Take- off Foot	13	19	32			
Total of Columns	70	70	140	1	1.4582	NS

Relationships Between Hand Dominance and Eye Dominance,  
Between Hand Dominance and Foot Dominance, and Between  
Eye Dominance and Foot Dominance

The findings revealed by the analysis of variance method used in this study indicating the relationships between hand, eye, and foot dominance were substantially the same as those observed when the Chi-Square application was employed. Table 11 below indicates that relationships exist between hand and eye laterality, hand and foot laterality, and eye and foot laterality. Less relationship was obtained between hand and eye laterality; however, all  $\chi^2$  values lacked significance, indicating that these attributes are not independent but are related. This is in agreement with much of the literature reviewed previously in Chapter One.

TABLE 11

CONTINGENCY TABLE FOR HAND DOMINANCE AND EYE DOMINANCE,  
HAND DOMINANCE AND FOOT DOMINANCE, AND EYE DOMINANCE  
AND FOOT DOMINANCE

	R	L	df	$\chi^2$	Significance
Hand	62	8	1	2.5492	NS
Eye	55	15			
Hand	62	8	1	0.0668	NS
Foot	61	9			
Eye	55	15	1	1.8102	NS
Foot	61	9			

### Summary

The preceding chapter presents the treatment of data and the resulting interpretations. Formulas used in the analysis of data and presentations of findings are shown in tabular form.

The analysis of variance technique, based upon the concept of error sum of squares, and the Chi-Square technique for an  $n \times m$  contingency table were utilized to analyze data in the study. A Wang desk computer and an Olivetti Underwood desk computer were used in the statistical treatment of the data.

The values needed for the development of the full model and the results of the analysis of data obtained from administration of the full model are included. The results of the analysis of data are in tabular form.

The analysis of variance method showed that the Garrison tests were highly reliable since no significant differences were observed among any of the test items. The re-tests of the eight test items varied only in one category by as much as two from the first administration. Nor was independence between test administrations found in the Chi-Square analysis. The reliability of the tests was established, as indicated by the results of these two analytical techniques.

Validity of the Garrison tests was indicated by the analysis of variance since no significant differences were



observed among any of the test items. The findings provided by the Chi-Square technique in the determination of the validity of the Garrison tests when compared to the Harris tests were somewhat different than the results obtained by the analysis of variance method. The comparison of the hand laterality tests was revealed to be valid by both methods of analysis; however, the eye and foot laterality tests were revealed to be independent of relationship by the Chi-Square technique.

The specific purposes of this investigation were reviewed and the corresponding data analysis examined. The interpretation of the analysis of variance method used in this analysis revealed no significant differences between certain traits of laterality and the take-off foot in selected skills of locomotion. Great homogeneity was found between hand dominance and the take-off foot, between eye dominance and the take-off foot, and between foot dominance and the take-off foot. Analysis by the Chi-Square technique revealed, however, certain differences. Only two locomotor skills, the take-off foot employed in hopping and lateral movement to the right, indicated relationship with hand laterality. A relationship between eye dominance and the take-off foot in the skills of hopping, hopscotch, running and lateral movement to the right was obtained. Foot laterality was related to the take-off foot of hopping, hopscotch, and lateral movement to the right.

Foot dominance was related to lateral movement to the right but not with lateral movement to the left. The initial foot movement was found, however, to be related to the direction of the lateral movement rather than being determined by foot dominance. Lateral movement to the right as well as lateral movement to the left was initiated by the foot nearest the direction of movement.

The findings revealed that relationships exist between hand and eye laterality, hand and foot laterality, and eye and foot laterality. The results were substantially the same by both the analysis of variance method and the Chi-Square application.

The final chapter consists of a complete summary of this study. Included in the chapter will be a discussion of the limitations of the study and the investigator's conclusions and suggestions for further studies.

## CHAPTER IV

### SUMMARY AND CONCLUSIONS

Laterality should be of interest to all educators, especially those in the field of physical education. Many tend to teach primarily to the right-handed student, thus leaving the left-handed student to adjust for himself. This investigation, which is a study of the relationship of certain traits of laterality and the take-off foot in selected skills of locomotion, is an attempt to aid in the discovery of knowledge about the use of the hands, feet, and eyes.

The investigation entailed a comparative study of certain traits of laterality and the preferred take-off foot in hopping, running, long jumping, high jumping, and lateral movement from a stride position. Specifically, the investigator proposed to study the relationship between hand dominance and the take-off foot in selected skills of locomotion; to study the relationship between eye dominance and the take-off foot in selected skills of locomotion; to study the relationship between foot dominance and the take-off foot in selected skills of locomotion; and to study the relationship between hand dominance and eye dominance,

between hand dominance and foot dominance, and between eye dominance and foot dominance.

Several theories of laterality exist and innumerable relationships with laterality have been studied. Examples of these are discussed briefly in the related literature section. Previous studies closely related to this study are summarized.

Both human and documentary sources were utilized in the investigation. The investigator surveyed and assimilated information pertinent to all phases of the study. A tentative outline was written, presented in Graduate Seminar, and, in corrected form, filed as a prospectus in the Office of the Dean of Graduate Studies at the Texas Woman's University.

After examining available tests, the investigator selected the Harris Tests of Lateral Dominance and the Garrison Tests for Laterality, an original test developed by the investigator, to use in the study. A series of tests for determining the take-off foot in selected locomotor skills was also developed by the investigator.

Seventh grade boys who met certain criteria were chosen as subjects. Three physical education classes, providing a total of seventy subjects, were utilized in the study.

The chosen laterality tests, plus the investigator's tests for determining the take-off foot in selected locomotor skills, were used to collect data for the study. In order to

secure the most valid results possible, all tests were conducted in a game-like or contest situation to keep the subjects naive as to the actual intent of the investigator.

The scores were recorded and tabulated. The analysis of variance technique, based upon the concept of error sum of squares, and Chi-Square technique for the  $n \times m$  contingency table were utilized to analyze the data in the study. The Wang 380-36E, a desk computer, and the Olivetti Underwood 101 desk computer were used in the statistical treatment of the data.

The values needed for the development of the full model and the results of the analysis of data obtained from administration of the full model are included. The results of the analysis of data are in tabular form.

The analysis of variance method showed that the Garrison tests were highly reliable since no significant differences were observed among any of the test items. The re-tests of the eight test items varied only in one category by as much as two from the first administration. Nor was independence between test administrations found in the Chi-Square analysis. The reliability of the tests was established, as indicated by the results of these two analytical techniques.

Validity of the Garrison tests was indicated by the analysis of variance since no significant differences were observed among any of the test items. The findings provided

by the Chi-Square technique in the determination of the validity of the Garrison tests when compared to the Harris tests were somewhat different than the results obtained by the analysis of variance method. The comparison of the hand laterality tests was revealed to be valid by both methods of analysis; however, the eye and foot laterality tests were revealed to be independent of relationship by the Chi-Square technique.

The specific purposes of this investigation were reviewed and the corresponding data analysis examined. The interpretation of the analysis of variance method used in this analysis revealed no significant differences between certain traits of laterality and the take-off foot in selected skills of locomotion. Great homogeneity was found between hand dominance and the take-off foot, between eye dominance and the take-off foot, and between foot dominance and the take-off foot. Analysis by the Chi-Square technique revealed, however, certain differences. Only two locomotor skills, hopping and lateral movement to the right, indicated relationship with hand laterality. A relationship between eye dominance and the take-off foot in the skills of hopping, hopscotch, running, and lateral movement to the right was obtained. Foot laterality was related to the take-off foot of hopping, hopscotch, and lateral movement to the right.

The findings revealed that relationships exist between hand and eye laterality, hand and foot laterality, and eye and foot laterality. The results were substantially the same by both the analysis of variance method and the Chi-Square application.

#### Limitations of the Study

The most significant limitations of the study evolved from the use of the Harris Tests of Lateral Dominance. Harris used five categories in rating his subjects: (a) strong right, (b) moderate right, (c) mixed, (d) moderate left, and (e) strong left. He then totaled the categorical results and marked each subject's dominance as either right, mixed, or left. In the Garrison Tests for Laterality, the investigator used the ratings of right, mixed, and left without any previous categorizing. This difference, in the number of ratings involved, caused some variances in a subject's total Harris rating and total Garrison rating.

It is the opinion of this investigator that, in the Harris series, the latter of the two tests for the dominant foot is inappropriate and confuses the resulting score. This test, by requiring the subject to pretend to be stomping a fire out with his foot or feet, introduces a play factor that provides an inaccurate score which, in turn, affects the total foot dominance rating. As a result, many subjects in the present study received a foot dominance rating of mixed

in the Harris series as opposed to their right or left rating in the Garrison series.

### Conclusions

As stated previously, two different statistical techniques were applied to the results of the analysis. Multiple conclusions have been reached by the investigator and are listed below.

1. The analysis of variance method reveals homogeneity between hand dominance and the take-off foot in all the selected locomotor skills. Only two locomotor skills, hopping and lateral movement to the right, indicates relationship with hand laterality using the Chi-Square technique.
2. The analysis of variance method indicates homogeneity between eye dominance and the take-off foot in all the selected locomotor skills. The Chi-Square technique shows a relationship between eye dominance and the take-off foot in the skills of hopping, hopscotch, running, and lateral movement to the right but no relationship between eye dominance and the remaining selected locomotor skills.
3. The analysis of variance method reveals homogeneity between foot dominance and the take-off foot in all the selected locomotor skills. Foot laterality is related to the take-off foot of hopping, hopscotch, and lateral movement to the right according to the Chi-Square technique; however, no relationship was indicated between foot laterality and the remaining selected skills.



4. The findings revealed by the analysis of variance method used in this study indicates the relationship between hand, eye, and foot dominance is substantially the same as those observed when the Chi-Square application was employed. There is a relationship between hand and eye laterality, hand and foot laterality and eye and foot laterality.

#### Suggestion for Future Study

The investigator suggests the following future studies:

1. The further development of the Garrison Tests for Laterality in order that an easily administerable test battery might be available. Additional test items for the foot and eye sections should be considered.
2. The investigation of the laterality traits of seventh grade girls utilizing a similar design.

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APPENDIX I A

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Harris Tests of Lateral Dominance

Manuel of Directions

for

Administration & Interpretation

Third Edition

By

Albert J. Harris, Ph.D.

Director of the  
Educational Clinic

2nd Professor of  
Education  
Queens College  
New York, N.Y.

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304 East 45th Street  
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APPENDIX I B



## APPENDIX I B

## Garrison Tests for Laterality

The following tests for laterality are brief, easily administered, and simply scored. The series contains six tests utilized in the determination of (a) hand dominance, (b) eye dominance, and (c) foot dominance (see Table 1 A).

TABLE 1 A

## GARRISON TESTS FOR LATERALITY OUTLINE

Test Number	Dominance tested	Description
1	Hand	Write
2	Hand	Throw a softball
3	Hand and Eye	Pitch a bean bag with one eye closed
4	Hand and Eye	Shoot a cork gun, sighting with one eye
5	Foot	Kick a rolling ball
6	Foot	Punt a football

The author suggests that the tests be conducted in a contest or game-like situation to keep the subjects naive to the true intent of the series. The series is flexible in that the contests and/or targets can be adjusted to appeal to the age group being tested.

#### Instructions for Administering the Test

- Test 1 - The subject writes his name at the top of the score card (see Sample). The examiner records the hand used.
- Test 2 - From behind a restraining line, the subject makes an overhand throw with a softball attempting to strike a target taped to a wall. Record the hand used.
- Test 3 - From behind a restraining line, the subject makes an underhand pitch with a bean bag and attempts to hit within a target. The target may be a wastebasket or any suitable receptacle. He is instructed that to make his attempt more difficult he must close one eye. Record the hand used to pitch the bean bag (3h) and the sighting eye (3e).
- Test 4 - From behind a restraining line, the subject shoots a cork pistol at a suitable target. He is instructed to use the gun sight and to take aim by sighting with one eye. Record the shooting hand (4h) and the sighting eye (4e).

Test 5 - The subject stands behind a marked take-off point as a playground ball is rolled toward him. He must run forward and with one kick attempt to hit a target with the ball. Record the foot used.

Test 6 - The subject punts a football at a target. Record the foot used.

#### SAMPLE FORM FOR RECORDING TESTS' RESULTS

Name		Age
1 R L		5 R L
2 R L		6 R L
3h R L	3e R L	
4h R L	4e R L	
INTERPRETATION		
Hand	Eye	Foot
R L	R L	R L

#### Interpreting the Results of the Tests

In interpreting the results, the following ratings are assigned:

R - Right Dominance

M - Mixed Dominance

L - Left Dominance

## HAND DOMINANCE - Tests 1, 2, 3h, 4h

Rate as R if either three or four of the test results are R.

Rate as M if two of the test results are R and the other two are L.

Rate as L if either three or four of the test results are L.

## EYE DOMINANCE - Tests 3e, 4e

Rate as R if both test results are R.

Rate as M if one test result is R and the other is L.

Rate as L if both test results are L.

## FOOT DOMINANCE - Tests 5, 6

Rate as R if both test results are R.

Rate as M if one test result is R and the other L.

Rate as L if both test results are L.

APPENDIX I C

## APPENDIX I C

Tests for the Take-off Foot in Selected  
Skills of Locomotion

The take-off foot in the locomotor skills of hopping, running, long jumping, high jumping, and lateral movement from a stride position was recorded by the investigator. A contest situation was created to keep the subjects ignorant to the true test objective. The running and hopping contests were timed, the jumping events were measured, and the results were recorded on a "dummy score card." The following form was used to record the take-off foot in each incidence.

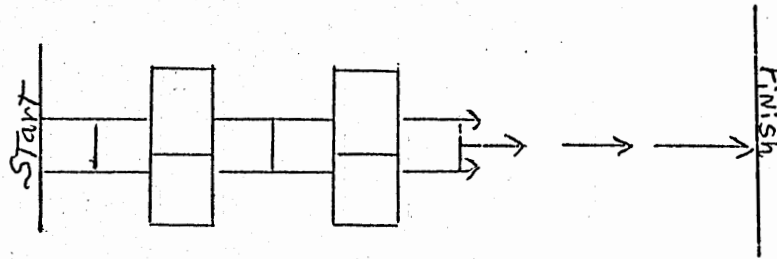
Name		Age
<u>hopping</u>		<u>lateral</u> (direction)
1 R L		1 R L
2 R L	<u>long jump</u>	2 R L
	R L	3 R L
<u>running</u>	<u>high jump</u>	4 R L
R L	R L	5 R L
		6 R L

## Tests

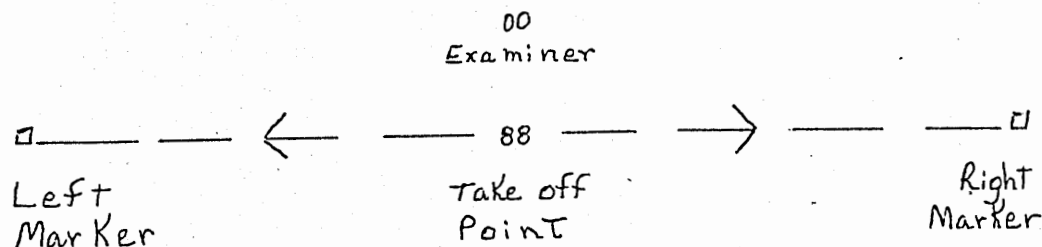
Hopping

Test 1. Hopping race. Twenty yards distance. Stand with feet parallel until start signal.

Test 2. Timed hopping event through a hop scotch pattern.

Lateral Take-off from a stride Position

Subject faces forward with feet in a parallel stride position on a marked take-off point. When the signal is given, the subject runs to a mark directly in line with his starting mark. Repeat six times, mixing left and right side starts. To start the subject, the examiner stands directly in front of him with both hands together at the subject's eye level. By a slight movement of the right or left hand, the examiner signals the direction and the start.



Running

Fifty yard dash.

High Jump

Use scissor jump.

Long Jump

Running jump with a one foot take-off.