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The purpose of this study was to investigate the relationship between hand preference and the acquisition of beginning foil fencing skill.

The subjects included two classes of beginning fencing at the University of North Carolina at Greensboro in the fall semester 1974-75. The morning class had 18 subjects and the afternoon class had 14 subjects.

The hand preference score for each subject was determined at the beginning of the semester by administering the Crovitz and Zener Handedness Questionnaire. The morning class subjects were assigned to use the nonpreferred hand as the fencing hand for the entire semester while the afternoon class subjects were assigned to use the preferred hand.

To determine foil fencing skill, the Bower General Fencing Ability Test was administered twice during the semester. At the end of the semester, round robin tournaments were held in each class to get another indicator of fencing skill.

The relationship between the hand preference scores and the fencing skill test scores was analyzed by using the Pearson product-moment method of correlation. The significance level was set at a 0.05 critical value for a two-tailed test. No correlation coefficients were found to be significant in either group.

The relationship between the hand preference scores and the standings from the round robin tournaments was analyzed using Spearman Rho. The significance level was set at a 0.05 critical value for a two-tailed test. The only correlation coefficient which was significant was from the nonpreferred handed males' data. The relationship indicated that the fencers in this group with higher tournament rankings had a lesser tendency to rely on the use of just one hand, than the fencers with the lower tournament scores.

The top fencers from both classes met after the round robin tournaments to bout against one another. The top three female fencers from the preferred handed class won five of nine bouts against the top three female fencers from the nonpreferred handed class. The female competition was extremely close as both groups had 24 touches against each other. The two top male fencers from the nonpreferred class won all five bouts against the top three male fencers from the preferred handed class. The nonpreferred handed male fencers dominated the competition.

HAND PREFERENCE IN THE ACQUISITION OF BEGINNING FENCING SKILL

by

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APPROVAL PAGE

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CHAPTER I

INTRODUCTION

The sport of fencing is a unimanual sport involving the use of one hand to manuever a weapon. Several top competitive fencers are able to interchange the weapon between the hands and thereby practice with either hand. Fencing is one sport in which the object controlled by the hand is so light that it can be manuevered fairly easily with either hand.

An important factor in any sport skill involving the use of one hand is which hand to use when first acquiring the skill. In beginning the sport skill of dart throwing, a person usually uses the preferred hand to throw the dart to the target. There are a few ambidextrous persons who can throw the dart equally well with either hand but the majority of people have a definite preference for one hand.

If people were told that it was possible to acquire a sport skill equally well with either hand, they might be inclined to experiment with the nonpreferred hand. Unfortunately, such information has not been shown which may be because of the lack of research in the area. Studies concerning the use of the nonpreferred hand or the preferred hand in acquiring a sport skill are needed to help bring

light on this matter. Information from this research may be useful for the coach, physical educator, and student in deciding which hand to use in first acquiring proficiency in a sport skill.

Statement of the Problem

The problem in the study was to investigate the relationship between hand preference and the acquisition of beginning foil fencing skill. The sport of foil fencing was highly suitable for this study as only one hand may be used to hold the foil. The study sought to answer the following questions.

1. What is the relationship between the preferred handed fencer's results on the hand preference questionnaire and: (a) the fencer's score from the second administration of a fencing skill test; (b) the fencer's ranking in a round-robin tournament?

2. What is the relationship between the nonpreferred handed fencer's results on the hand preference questionnaire and: (a) the fencer's score from the second administration of a fencing skill test; (b) the fencer's ranking in a round-robin tournament?

3. Is there a statistical difference in the results of the two administration of the fencing skill test between and within the preferred handed group and the nonpreferred handed group?

Definition of Terms

Beginning Fencer: A college student with no previous experience in the sport of fencing.

Hand Dominance: The comparative dexterity of the two hands determined by testing each hand in the same skills. (Hildreth, 1950)

Handedness: The common usage of one hand over the other. (Wile, 1934)

Hand Preference: Preference or choice of one hand for unimanual tasks and the hand chosen for the major role in bimanual tasks. (Hildreth, 1950)

Index of Handedness: A continuum which differentiates degrees of handedness. (Crovitz & Zener, 1962)

Assumptions Underlying the Research

The study assumed that the two classes of students represented an unbiased sample who signed up to take a beginning fencing course at the University of North Carolina at Greensboro in the fall semester 1974-1975. A final assumption was that the subjects had had no previous fencing experience (inclusive of foil, epee, and sabre) prior to enrollment in the class.

Scope of the Study

The study was limited to students who enrolled in each of the two beginning fencing classes taught by the investigator in the fall semester 1974-1975 at the University

of North Carolina at Greensboro. The small number of subjects in the investigation did not allow for any generalizations to be made of all members of similar fencing classes.

The two fencing classes were limited to foil fencing rather than epee or sabre fencing. The foil was selected as the weapon because it is the only weapon of the three utilized by both men and women.

The degree of hand preference was obtained by administering the Crovitz and Zener Handedness Questionnaire. The measure of general fencing ability was ascertained by just two administrations of the Bower Test. Finally, the fencer's ranking was determined in one round-robin tournament at the end of the semester.

Significance of the Study

Hand preference plays a role in the majority of sports --whether it be serving a tennis ball, pitching a softball, or releasing a bowling ball.

One of the earliest studies on hand preference and its relationship to a sport skill was done by Margaret Fox. The study's purpose was to determine whether students should use their preferred hand or their dominant hand as the hand to use in bowling (Fox, 1957).

Later, researchers dealt with handedness in swimming (Sinclair, 1957); in archery, badminton, bowling, and tennis (Way, 1958); and in basketball (Shick, 1971). In none

of these studies did the researcher investigate acquiring a sport skill with a change of hand preference.

Fencing is a sport in which only one hand is actively involved. The present investigation had one group of subjects attempt to acquire foil fencing skill with the nonpreferred hand while another group tried to acquire foil fencing skill with the preferred hand. Not only was the nonpreferred handed group attempting to acquire a new sport skill but it was also letting the nonpreferred hand assume a primary role rather than a secondary role in manipulating the blade to the opponent's target.

There have been very few studies on the relationship of hand preference to the acquisition of sport skills. This gap in research needs to be filled because it may help one to understand if the proficiency of one or both hands is needed in certain sport skills. The present investigation was considered capable of contributing to the knowledge of the value of hand preference in acquiring sport skills.

CHAPTER II

REVIEW OF LITERATURE

Available literature was reviewed with four objectives in mind. The first objective was to determine what theories there were on handedness in order to better understand the concept of handedness.

The second objective was to survey the types of tests used to determine handedness because the proposed study involved the use of a handedness test.

The third objective was to review the fencing skill tests as the study also involved the use of a skill test to measure fencing skill.

The fourth objective was to determine what, if any, studies had already been done relating sport skill to handedness so that the study would not duplicate any previous research.

Theories Related to Handedness

Several studies on the ages of man conclude that there has been a gradual change from the equal use of both hands to the predominant use of one hand to accomplish a task. Parson (1924) developed a concept that the ape-like ancestors of man were ambidextrous. As man's brain developed through the ages, reasoning developed. The crudely made

weapons and tools forced primitive man to use one hand. Parson (1924) concluded that ". . . this concentration and development of manual superiority in one favored hand alone suffice to distinguish man, the artisan, from his purely brutish kinsmen (p. 9)." Lund (1932) stated that the population is 5% left-handed, 5% ambidextrous, and 90% right-handed. In noting the large proportion of right-handers, Hildreth (1949) stated:

> Most experts agree that the strong tendency toward right-handedness is of social origin, a custom probably started in religious ceremonies or in military organization as the weapons used required more manual skill (p. 207).

One of the earliest sociological theories of handedness deals with the nature of the warrior. The warriors tended to hold the shields with their left arms so as to better protect their most vital organ, the heart. The right hand assumed the responsibility for holding the weapon and so "Right-handedness thus had an important relationship to fighting for survival (Milne & Milne, 1948, p. 40)." Another extension of this social theory regarding ambidexterity was proposed by Wile (1934) who stated:

> True ambidexterity probably is exceedingly uncommon among civilized peoples. What is known as ambidexterity is, to a large extent, the result of the social conformity of naturally left-handed individuals (p. 61).

Cuff (1928) reported that the custom of wearing the engagement ring on the left finger can be traced back to an early religious belief that this would drive all the evils and

temptations away from the unlucky side of the body. A general belief by people through the years has been to give a positive value to right-handedness and a negative value to left-handedness. At the beginning of the twentieth century, von Bardeleben observed:

> That a few great men, such as Leonardo da Vinci, were left-handed, does not neutralize the prevalent belief--in all ages--that left-handedness implies a sub-standard subject (Left-handedness, 1914, p. 132).

Other theories on the reason for handedness deal with the physiological make-up of men. One of the theories was concerned with the visceral distribution in the body. It was felt that the body organs in the right half of the body weighed more than the body organs in the left half of the body. (Milne & Milne, 1948). Parson (1924) summarized Dr. Andrew Glasgow's 1862 theory of handedness: ". . . right handedness is caused by a shifting of the center of gravity of the body toward the right, due to the greater weight of the liver and the lungs on that side (p. 9)." Some theorists thought that the uneven flow of blood to the brain accounted for the predominance of right-handedness. Judd, a proponent of this thought, stated:

> The two sides of the brain received their blood supply through arteries which are asymmetrical. Where the blood supply is larger to the left side of the brain, the right hand is naturally developed to a higher degree of dexterity; where the right side of the brain receives the greatest supply, the person is naturally left-handed (Monroe, 1925, p. 108).

Wile (1934) refuted this idea by saying that man's Circle of Willis gave an equal supply of blood to both hemispheres in the brain. Another physiological theory dealt with the position of the foetus in uterine life--"Before birth the left arm lies posteriorly and this position might give the right hand greater facility of movement than the left (Hildreth, 1949, p. 257)."

The theory of heredity has been accepted by many as the reason for a particular hand preference. Lund (1932) cited two early studies which were based on the heredity theory. One was by Jordan who stated that handedness followed Mendelian laws so that right-handedness was a 4 : 1 ratio to left-handedness. The second study was by Parson who insisted that the ratio of right to left-handedness was on the order of 3 : 1. Lund estimated that the ratio was closer to 9 : ½ : ½ (right-handed : ambidextrous : left-handed). In extending the heredity theory, Fitt and O'Halloran (1934) investigated the relationship between handedness and both the psychopathy and the intelligence factors of over 200 junior high school students. One of their major findings was that the left-handed children were more psychopathic than the right-handed children. Another result was that the average intelligence score of the left-handed children was lower than the average intelligence score of all children tested. Fitt's and O'Halloran's findings

> . . . support the view that handedness is in the main an inherited tendency. Such relations between it, scholastic ability and psychopathy would seem to have little meaning on any other view (p. 296).

Merrell (1957) investigated hand dominance in an attempt to gather more information on the influence of heredity. Merrell studied over 100 sets of parents and their children to find the exact handedness involved in each mating. He found that when both parents were left-handed only 20% of their offspring were left-handed. When one or both parents were left-handed, then 35% of their offspring were left-handed. Merrell discussed a study on twins by Rife in 1940. Rife found that there were several cases of identical twins where one was right-handed and one was left-handed. Rife also discovered a greater frequency of left-handedness in twins (fraternal and identical) than in the single-born population. Merrell concluded from the results of his study and similar studies:

> It is clear that neither hereditary nor environmental factors alone suffice to account for the genesis of handedness. The discordance between identical twins proves the importance of environmental factors while the discordance between a left-handed child and his completely right-handed cultural and familial environment indicates the importance of innate factors in the development of handedness (p. 325).

Handedness Tests

The large number of theories on handedness has led to a proliferation of handedness tests. One of the earliest twentieth century classification systems of handedness was

proposed by Downey (1927). Each subject was observed performing three unimanual tasks (eating, writing, and throwing) and three bimanual tasks (batting, sweeping, and spading). A subject who was determined to be right-handed on all of the tasks was classified RRR. A subject who showed right-handedness on the unimanual tasks and left-handedness on the bimanual tasks was classified RLL. A subject who was determined to be right-handed for the unimanual tasks and had a divided preference for the bimanual tasks was classifies RRL. This classification system showed a continuum for handedness.

Haefner (1929) investigated the nature of handedness extensively in over 100 subjects. In the past, it was assumed by many researchers that the hand with which one writes was the dominant hand. This assumption failed to take into account the fact that social pressure may have changed a naturally left-handed person into a right-handed person early in life. Haefner established a classification system to eliminate this problem by differentiating: unchanged left-handers (L), changed left-handers (L-), unchanged right-handers (R), and changed right-handers (R-). One manual task the subjects were required to perform was one of drawing a horse first with the dominant hand and then with the non-dominant hand

> The child was credited with the use of the one hand in the normal bisymmetrical fashion if the horse faced the left as drawn with the right hand and

> faced to the right as drawn with the left hand (Haefner, 1929, p. 16).

Haefner's other manual tasks included: throwing with one hand, receiving an object, easy reaching, energetic reaching, interclasping hands, batting with a baseball bat, and sweeping with a broom. For the last two tasks, the investigator determined that the hand nearest the batting end of the bat and the sweeping end of the broom was the dominant hand. Haefner concluded from this testing:

> . . . if one can observe the throwing activity of an individual, he can obtain an index to dominant handedness which is correct in about nine cases out of ten for both left- and right-handed people. Easy reaching would be a correct index in eight cases out of ten, receiving in seven cases out of ten, and energetic reaching in seven to eight cases out of ten (pp. 18-19).

Ojemann (1930 a, b) studied both unimanual handedness and bimanual handedness. For unimanual handedness, the investigator used five tests: (a) ball throwing; (b) needle threading; (c) tapping; (d) paper cutting; and (e) block packing. In the last four tests, the subject was timed using each hand. Ojemann felt that these five tests taken singly could not be used to accurately determine the unimanual handedness but all of them taken together would result in a viable measure of handedness. For the bimanual handedness, the investigator had four tests: (a) sweeping; (b) raking; (c) shoveling; and (d) batting. The investigator noted the position of the hands in each of the tests and the side of the body the instrument was used on. Ojemann

concluded after testing over 500 subjects that the degree of bimanual handedness found in the sweeping test was more closely related to that found in the raking and shoveling tests than to that found in the batting test.

Cuff (1931) used several tests when he investigated the relationship between eyedness and handedness. His handedness tests consisted of (a) manoptometer; (b) throwing; (c) batting; (d) sweeping; (e) receiving objects; (f) easy reaching; (g) energetic reaching; (h) interclasping hands; and (i) writing. The manoptometer was an instrument used to determine the preferred hand through unilateral sighting. Cuff used these tests to find that 94% of his elementary-aged subjects were right-handed and 93% of his college-aged subjects were right handed.

Van Riper (1934) thought that the majority of handedness tests involving the accuracy, speed and strength of the hand were all controlled by environmental factors and training. He devised a test in which a blindfolded subject would draw a figure using a bimanual stylus. The subject was asked to draw the same figure as quickly as possible with each hand. In testing over 100 subjects, Van Riper found that the right-handers would draw the mirror-image of the figure with the left hand and the left-handers would do the same thing with the right hand.

Fitt and O'Halloran (1934) reported three separate studies which used three different approaches to determine

handedness. In the first study, the subjects had to perform a number of tasks: scissor-cutting, winding a cord around a stick, throwing a ball, receiving a ball, easy reaching, strenuous reaching, interclasping hands, batting, dynamometer grip test, and tapping. Haefner's scale was used to rate the subjects handedness. The tasks of interclasping hands and easy reaching proved to be least satisfactory. A second study involved an interview process to determine handedness. The subjects, 200 junior-high youngsters, were asked how they performed seven tasks: sawing, chopping, batting, bowling, taking food, sewing, and scissor cutting. If the subject used the left hand predominantly in at least two of these activities then the subject was classified as being left-handed. In the third study, a lengthy questionnaire was given to a group of 12 to 13 year old children in order to determine their handedness.

Buxton (1937) felt that handedness would best be determined through the use of performance tasks rather than the questionnaire. The investigator selected eight manual tasks: (a) throwing; (b) brushing lint from a cloth; (c) reaching; (d) placing pegs in holes; (e) dynamometer; (f) pursuit rotor; (g) motility rotor; and (h) triple plate tapping. At the end of his investigation, Buxton concluded:

> The reliabilities of the three motor skill ratios (rotor, drill, and tapping) were relatively satisfactory; the brushing and dynamometer tests were not so satisfactory as to reliability, but the throwing

> reaching, and peg-board reliabilities were high (p. 469).

Davison (1948) studied the relationship between unimanual and bimanual handedness. He grouped his subjects at the start of his investigation by administering a questionnaire for unimanual handedness. Next, he had his subjects perform twenty bimanual tasks. From these tasks, he condensed his bimanual test into four tasks: (a) using a knife and fork; (b) batting; (c) peeling a potato; and (d) hanging a coat. Davison felt that these four tasks could adequately measure right- and left-bimanual handedness.

In discussing the testing for handedness, Hildreth (1950) stated:

> Two phases of laterality should be tested and observed in all cases: (a) preference or choice of hand for unimanual acts or the hand chosen for the dominant role in bimanual acts; (b) the relative dexterity of the two hands determined by testing each hand in the same skills (p. 90).

Hildreth thought that the testing for handedness should include practiced and unpracticed tasks, unimanual and bimanual tasks, and fine and gross motor coordination tasks. Her formula for an index of handedness was R-L/R+L

> . . . the proportion that the difference in achievement of the two hands is to the total achievement represented by the sum of the scores of the two hands. It gives the percentage of right- and left-hand preference (Hildreth, 1950, p. 86).

Fox's study (1957) of lateral dominance in bowling employed the use of Hildreth's formula for the index of handedness. To measure hand dominance, she used five tests:

(a) reaching; (b) striking a match; (c) threading a needle; (d) placing pegs on a pegboard; and (e) using a hand dynamometer.

Merrell (1957) investigated subjects' hand dominance with four tests: (a) throwing; (b) writing; (c) striking a match; and (d) threading a needle. Merrell considered the task of threading a needle the most important because it required a high degree of manual skill.

Crovitz and Zener (1962) compiled a questionnaire for handedness which contained fourteen items. This questionnaire is shown in Appendix A. The subjects were to give one of six responses for each item. Points were assigned according to the particular response given to each item. The investigators developed a continuum of handedness ranging from fourteen points (strongly right-handed) to seventy points (strongly left handed). They felt that this test could beat be used as a screening test to select groups for experiments in which handedness was a factor.

Belmont and Birch (1963) tested over 100 elementary students for hand preference. The investigators had the children: (a) pantomine throwing a ball; (b) turn a door knob; (c) cut paper with scissors; and (d) write. If all four tasks were performed with one hand, then that hand would be considered the preferred hand. If fewer than four tasks were performed with one hand, then the subject would be classified as having "mixed handedness."

Palmer (1963) wanted a manual task that would involve complex spatial movement and would use the gross arm and shoulder musculature. Palmer had his subjects balance a dowel on the forefinger of the preferred hand and then the nonpreferred hand. Each subject's score of "hand specialization" was the proportion of the total time using the preferred hand to the total time using the nonpreferred hand.

Cunliffe and Provins (1972) combined a thirty-one item questionnaire with a seven item battery of manual tasks to determine the subject's handedness. The battery consisted of: (a) dexterity task--placing pins and collars using tweezers into four rows of slots with each hand timed; (b) dart throwing; (c) tapping; (d) ratchet task--number of rotations made in two five-second periods; (e) handwriting--writing the alphabet six times with each hand timed; (f) hand-grip strength using the hand dynamometer; and (g) grip-strength endurance which is 80% of the mean grip strength must be maintained for as long as possible.

Studies of Fencing Skill Tests

Very few skill tests have been devised in fencing and even fewer have been tested for reliability, objectivity and validity. One skill test devised by Safrit (1962) consisted of a square target with four distinct areas on it. In this accuracy test, the experimenter would call out a number

associated with one of the target areas and the subject would attempt to hit a blank space in the center of that area. The reliability was 0.71 and the researcher concluded that there was very little evidence that this test correlated with bouting ability.

Fein (1964) attempted to measure more than just accuracy in her fencing skill test. In the test, the subject had to advance, lunge at a target of numbered concentric circles, recover, and retreat. The subject went through this progression as many times as possible in a fifteen second period. Fein's study of this test showed a fairly high reliability (0.88 when stepped up by Spearman Brown Prophecy Formula) but the validity was extremely low at 0.13.

Speed and accuracy in fencing were the two factors to be analyzed in a fencing skills test by Cooper (1968). The equipment needed was more elaborate than used in previous fencing tests. The subject would begin in an on guard position facing the target which had a wooden arm attached to a foil mounted beside it. The subject would begin as soon as a neon light, placed above the target, came on. The task involved one advance a beat of the foil, and a lunge at the target. The first score was the time it took the subject to hit the target after the light came on. The second score was the location on the target hit by the point of the foil. With the test-retest scores, Cooper found a poor reliability

of 0.75 on the time score and a questionable reliability of 0.63 on the accuracy trial.

Busch (1966) went a step further in her attempt to devise a good fencing skill test. In order to place the subject in a fencing situation, Busch set up a target which moved back and forth. The subject advanced toward or retreated from the moving target and lunged at the area on the target which the instructor called out. The accuracy of the hit and the extension of the fencing arm were checked. The reliability for this test was found to be fairly good (0.83 using the Spearman Brown Prophecy Formula) but the validity was below 0.15 for four different ranking methods.

Bower (1961) placed the subject in a bout-like situation in her fencing skill test. Unlike Busch's test, the attacker was attacking a stationary target but the target was an actual fencer. Two subjects participated in the test at the same time with one designated as the attacker and one designated as the defender. The test is described fully in Appendix C. The investigator found a fairly high reliability of 0.82 and a very high validity of 0.80.

Studies Relating Sport Skills to Handedness

One basic factor found in an abundance of sport skills is the role of the hand in the performance of the skill. There have been very few attempts to research the

relationship of a sport skill to the nature of the handedness of the participant.

Vogel (1935) studied the relationship of hand dominance to throwing and batting a baseball. Dominance was found by administering an order of response flexion test. The subjects consisted of twenty varsity baseball players. The investigator found that those subjects whose test results showed right hand dominance played with a right hand preference. Those subjects who were determined to have left hand dominance performed with either the left or the right hand though most preferred to use the right hand. The few who were experimentally ambidextrous preferred to use the right hand.

Irwin (1938) attempted to relate dominance to the performance of physical education activities. The investigator determined foot and hand dominance through the use of an order of response test. His subjects consisted of over 200 elementary and high school boys. The younger boys (younger than ten years) were given a battery of nine simple skills tests to determine athletic dominance. The older subjects were given a questionnaire asking which foot/hand was used in certain athletic situations. Irwin found that the Athletic Dominance Test rated more subjects right-handed than the order of response test. The order of response test rated five times more subjects ambidextrous than the Athletic Dominance Test did. Another finding was the near

agreement between the subjects' statements of hand preference and actual performance in the tests.

Sinclair and Smith (1957) investigated the relationship between hand, eye, and foot dominance to laterality in swimming. The two strokes which were studied were the crawl and the sidestroke. The researchers concluded: "The factor of laterality in swimming was found to vary in the two strokes, and no relationship to the dominance of handedness or footedness was evident (p. 400)." The tests for hand dominance consisted of: (a) subject was asked which hand he used for eating, writing, and throwing; (b) subject was asked how he batted; and (c) subject was asked to perform a sweeping task.

Fox (1957) investigated whether an individual should be encouraged to learn bowling with the preferred hand or the dominant hand. The hand dominance was determined by giving the subjects five tasks to perform. The investigator only studied a small number of subjects but from this research she concluded: "It would appear that the preferred hand rather than the dominant hand should be used as the bowling hand (p. 330)."

Way (1958) investigated over 400 college women to find out if there was a relationship between lateral dominance and motor ability and skills tests scores. Way measured each subject's eye, hand, and foot dominance. The hand dominance score was determined from a dartboard test.

The investigator found no significant difference in the motor ability scores of the separate eye and hand dominance groups though she found that foot ambidexterity resulted in higher motor ability scores. Way summed up her motor ability findings by stating: "Women who have mixed eye, hand, and foot dominance are superior in motor ability to those who have homolateral or contralateral preference (p. 369)." In this study, "mixed" meant one variable had right dominance, one had left dominance and the third had no specific dominance; "contralateral" meant that two variables had the same dominance while the third had an opposite dominance; and "homolateral" meant that all three variables had the same dominance. Way studied the subjects' scores on skills tests in archery, badminton, bowling, and tennis. She concluded from the results: "Laterality seems to be of more importance in activities stressing accuracy of direction toward a fixed target (archery and bowling) than in activities which do not (p. 369)."

Horinne (1968) researched the relationship of laterality to the performance of motor ability tests. The investigator used a number of tests to determine the foot, hand, and eye dominance of each subject. For the handedness, the individual was scored on writing, cutting, performing a cartridge speed test, threading a needle, marking x's, hanging a coat on a hanger, and tossing a ring. The motor ability tests included a mat test, shuttle run, and

balance beam test. Over 200 young boys were divided into four laterality groups: (a) Pure right-sided; (b) Predominantly right-sided; (c) Mixed; and (d) Pure and predominantly left-sided. His findings did not contradict the null hypothesis of no difference in the performance of the motor ability tests by the four different groups. There was a slight tendency for the pure sided groups to perform better than the mixed groups.

Tyler (1971) investigated the relationship of lateral dominance to learning motor skills. The investigator determined lateral dominance by giving the subjects tests for the eyes, the feet, and the hands. For the handedness score, the test included placing objects in a pegboard, stylus tapping, hand movement time in throwing switches, and shuffling discs in a pre-arranged pattern. The three motor skills which the subjects tried to learn were: the Purdue Pegboard Assembly, Disc Sort, and Mallet-Ball Volley. The investigator found that there was a small tendency for the mixed dominant subject (one who did not show complete dominance for at least one of the body parts) to perform worse than the unilateral subject (one who was either right dominant or left dominant for each of the three body parts).

CHAPTER III

PROCEDURES AND METHODS

At the beginning of the semester, the fencing instructor gave each class a brief outline of her thesis study. She told the classes that one class would use the nonpreferred hand and the other class would use the preferred hand.

The instructor arbitrarily chose the morning class to be the class whose subjects would use the nonpreferred hand. The instructor added that if this change of hand preference presented any problems after a few weeks, any student was free to switch back to the preferred hand. This flexibility in the study's design was felt to be necessary in the case of a subject who felt that learning to fence with the nonpreferred hand was too difficult or in the case of a subject who wanted to learn to fence with the preferred hand. During the first class period, the students filled out the Crovitz and Zener Handedness Questionnaire. The scores were totaled by the instructor and at the second class meeting the students were told which hand they would hold the foil with. Of the twenty-two students, twenty were assigned to use the left hand and two were assigned to use the right hand.

The afternoon class was the class whose subjects would use the preferred hand. The class completed the Crovitz and Zener Handedness Questionnaire during the first class period. At the beginning of the second class period, each student was assigned which hand to use according to the scores from the questionnaire. Of the twenty-two students, all were assigned to use the right hand.

Each class was presented with the same weekly lesson plans during the entire semester. The morning class met three times a week for one hour while the afternoon class met twice a week for one and one-half hours. An outline of the lesson plans for both classes is given in Appendix D.

At the end of the third week, the Bower General Fencing Ability Test was introduced. The scoring and the set-up of the skill test was discussed by the instructor. The technique of the Bower test was adjusted slightly in order to improve the judging of it. Instead of having just one judge, there were two judges. One judge would specifically watch the attacker's rear foot as well as the overall action. The second judge would be in charge of the scoring and would watch the overall action. After the attacker completed the attack, both judges would decide on who would receive the point. The judges were positioned to the right and the left side of the attacker. Each student was allowed to practice the skill's test for a few minutes during this class period.

The students were told that they would undergo the skill test during the next class period.

Because two students dropped out of the morning class, the Bower skill test was administered to twenty participants. The instructor assigned the subjects alphabetically into four groups of five subjects each. Scorecards were given to each group with a random order of bouting on the cards. The morning class was able to complete the skill test in two class sessions. The afternoon class had sixteen participants. The instructor assigned the subjects into four groups of four subjects each. Scorecards were given to each group. The afternoon class was able to complete the Bower skill test in one class session. The results of the skill test for both classes were tabulated and shown to the participants in the class sessions following the completion of the test.

At the beginning of the eleventh week of the semester, a round robin tournament was started in each class. Because the number of hits and the time limit in a bout are different for each sex, a male round robin tournament and a female round robin tournament were set up for each class. The morning class had one round robin tournament with thirteen females competing and one round robin tournament with six males competing. The males acted as one group with two fencing, three judging, and one directing. The females were divided into three groups or two groups depending on

the number in attendance. If a group had only four members, two fenced while the remaining two judged and tried to determine the right-of-way. The instructor assisted by judging in some of the small group bouts. At the beginning of the tournaments, the instructor set up bouts to be run that day. Near the end of the tournaments, a list of the remaining bouts was posted and the subjects divided up into groups by themselves in order to finish the bouts. The two round robin tournaments were completed by the end of the twelfth week.

The afternoon class had one round robin tournament with nine females and one round robin tournament with six males. The females were divided into one group of five and one group of four. In each group there were two fencers, at least two judges, and one director for each bout. In the group of four participants, the instructor acted as a judge. The order of bout was on the scorecards for each group. Both tournaments were completed in one and one-half weeks.

At the beginning of the thirteenth week, each class performed the Bower skill test again. The instructor went over the procedure and each student was allowed a few minutes practice in the class period before the testing. The instructor attempted to place the students in the groups that they were originally in. The morning class had nineteen participants. The numbers of the four original groups remained the same except that one group had only four

subjects instead of the original five. The original order of bouting remained the same on the new scorecards. The skill test was completed in two class sessions.

The afternoon class had fifteen participants. The four original groups of four each were set up though one group had only three subjects. Since the instructor wanted each subject to participate against at least three subjects, the group of three subjects was assigned a fourth. The instructor selected a member from the other three groups who had most nearly the same score on the first administration of the Bower test as the missing member of the original group. This special member first performed the skill test within her own group and then proceeded to the group of only three and performed the test again. This subject's score was the total number of points attained when she was with her original group. The skill test was completed in one class session.

The last phase of the study consisted of bringing the top fencers in each class together for interclass competition. The distinction of being a top fencer was based on the standings of the fencers from the round robin tournaments. The top three female fencers in the morning class met the three top fencers from the afternoon class at the beginning of the fourteenth week. The competition took place at a time other than the two class periods in order to minimize the number of distractions. Of the three fencers

from the morning class, two fenced left-handed and one fenced right-handed. Of the three fencers from the afternoon class, all fenced right-handed. The instructor acted as the director for all nine bouts and the subjects alternated between judging and fencing. The competition took forty-five minutes.

Due to the lack of parallel free time among the top male fencers, their competition was changed slightly. The instructor set up one early evening time when the three fencers from the afternoon class could participate though only one of the top three fencers from the morning class could participate. The instructor served as the director for all three bouts. The two fencers not fencing plus one volunteer from the afternoon class served as judges. A second competition time was set up for the following afternoon during the afternoon class's period. Another of the top male fencers from the morning class competed against two of the top male fencers from the afternoon class (the third fencer was absent for this competition time). The instructor served as director for the bouts. The judges included the non-fencing competitor plus three members from the class chosen by the instructor as being efficient in judging. The schedule of the third fencer from the morning class prevented him from competing in this interclass competition. The two fencers from the morning class fenced left-handed while the three fencers from the afternoon class fenced right-handed.

CHAPTER IV

THE DATA AND ANALYSIS

The purpose of the study was to compare hand preference and the change of hand preference with the acquisition of foil fencing skill.

Two classes of beginning fencing at the University of North Carolina at Greensboro were used in the study. The subjects of one class used the nonpreferred hand as the fencing hand while the subjects of the second class used the preferred hand as the fencing hand. The hand preference of each individual was determined by tallying the scores from the Crovitz and Zener Handedness Questionnare which the subjects filled out on the first day of classes.

The nonpreferred handed class, with twenty-two subjects, had a range of scores on the questionnaire from fourteen to forty-five. In using an Index of Handedness for the questionnaire: eight subjects were classified as "strongly right-handed," ten subjects were "right-handed," and four subjects were classified as "ambidextrous." Of the four "ambidextrous" subjects, two whose scores were near the right-handed section of the continuum were asked to fence with the left hand and the two subjects whose scores were near the left-handed section of the continuum were asked to

fence with the right hand. All of the eighteen subjects who were classified as "strongly right-handed" or "right-handed" were asked to fence with their left hand.

In the preferred handed class, seventeen subjects completed the Crovitz and Zener Handedness Questionnaire. The range of scores of the questionnaire was from thirteen to forty-eight. Using an Index of Handedness: seven subjects were classified as "strongly right-handed," nine subjects were "right-handed," and one subject was classified as "ambidextrous." The sixteen subjects who were classified as either "strongly right-handed" or "right-handed" were asked to fence with the right hand. The one "ambidextrous" subject performed right-handed in all sport skills but left-handed in all other activities. The "ambidextrous" subject was asked to fence with the right hand.

The scoring on the Bower General Fencing Ability Test followed the same system that Bower had devised. Each subject's score was the total number of points achieved against the first three opponents.

The eighteen subjects of the group using the nonpreferred hand who took part in the entire investigation had a mean score of 14.67 on the first administration of the Bower test. On the second administration of the test, the subjects' mean score was 13.56.

The fourteen subjects in the preferred handed group took part in the entire investigation. The subjects' mean

score on the first administration of the Bower Test was 14.29. Their mean score on the second administration of the skill test was 15.36.

Preferred Handed Group

Relationship of Hand Preference to Fencing Skill

The hand preference score was determined by the total number of points each subject had from the Crovitz and Zener Handedness Questionnaire. The score for the fencing skill was the total number of points from the Bower General Fencing Ability Test (second administration). The relationship between the two scores was found by using the Pearson product-moment method of correlation. The correlation coefficient for the fourteen pairs of scores was 0.245. The correlation coefficient was far too low to be a statistically significant value.

By dividing up the data according to sex, one finds even lower correlation coefficients. The correlation coefficient for the males (n = 6) was 0.151 and the correlation coefficient for the females (n = 8) was 0.069. Neither of these values was statistically significant at the five per cent level of confidence.

Table 1

Correlation Coefficient of Hand Preference and Fencing Skill

Group	n	r*
Preferred Handed	14	0.245
Males	6	0.151
Females	8	0.069

* $r_{05}(14) = 0.532$; $r_{05}(6) = 0.811$; $r_{05}(8) = 0.707$
Source for significant values: (Owen, 1962, p. 510)

Relationship of Hand Preference to Tournament Standing

The data from the handedness questionnaire was divided according to sex. The hand preference score of each fencer was ranked by giving the lowest score the number one ranking and the highest score the highest ranking. The ranking of the two round-robin tournaments was based on the number of wins. If two subjects had the same number of wins, then the one with the least number of touches against him/her would have the better ranking. The male subjects and the female subjects were ranked separately because they bouted in two separate tournaments. The relationship between the two rankings of the subjects was found by using Spearman Rho. From the data on the females (n = 8), Spearman Rho was 0.452. From the data on the male subjects (n = 6), Spearman Rho was -0.600. The male rank correlation

showed an inverse modest correlation. Neither of the rank correlation coefficients was significant at the five per cent level of confidence.

Table 2

Rank Correlation Coefficient of Hand Preference to Tournament Standing: Sum of Squares of Rank Differences, Spearman Rho, Cumulative Probability Distribution of d^2

Group	n	d^2	R_g	CP
Males	6	56	-0.600	0.913
Females	8	46	0.452	0.134

Source for CP: (Owen, 1962, pp. 401-402)

Comparison of the Two Administrations of the Bower General Fencing Ability Test

The scoring for the Bower test followed Bower's own scoring method. The first three trials of each fencer were totaled to give the final score for each administration. In order to compare the results of the two administrations, the t test for related samples was used. (See Table 3)

From the results of the t test, the null hypothesis was retained. The difference between the two administrations of the Bower General Fencing Ability Test was not statistically significant in the preferred handed group.

Table 3

Significant Difference Between the Two Bower Test Scores

Group	n	M.D.	t*
Preferred Handed	14	1.07	1.07

* $t_{05}(13df) = 2.160$

Nonpreferred Handed Group

Relationship of Hand Preference to Fencing Skill

The hand preference score was determined by the score on the Crovitz and Zener Handedness Questionnaire. The fencing skill score was determined by the total number of points achieved on the Bower General Fencing Ability Test (second administration). The relationship between the two scores was found by using the Pearson product-moment method of correlation. The coefficient of correlation for the pairs of scores of the eighteen subjects was 0.219. The correlation was too low to be of significant value at the five percent level of confidence.

By dividing the data according to sex, there were higher correlation coefficients. The correlation coefficient for the females (n = 13) was 0.304. The correlation coefficient for the males (n = 5) was 0.876. Though the two correlations are higher than the entire group's correlation,

neither value was statistically significant at the five per cent level of confidence.

Table 4

Correlation Coefficients of Hand Preference and Fencing Skill

Group	n	r*
Nonpreferred Handed	18	0.219
Males	5	0.876
Females	13	0.304

* $r_{05}(18) = 0.468$; $r_{05}(05) = 0.878$; $r_{05}(13) = 0.553$
Source for significant values: (Owen, 1962, p. 510)

Relationship of Hand Preference to Tournament Standing

The ranking of the scores from the Crovitz and Zener Handedness Questionnaire was determined by giving the best ranks to the lowest scores and the worst ranks to the highest scores. The ranking of the round-robin tournament was based on the number of wins. In the case of two subjects winning the same number of bouts, the one with the least number of touches against would have the better ranking. The male subjects and the female subjects were ranked separately for both scores.

The relationship between the two rankings was determined by Spearman Rho. From the data of the female subjects (n = 13), Spearman Rho was -0.243. The rank correlation

coefficient for the females was too low to be statistically significant at the five per cent level of confidence. The Spearman Rho for the male subjects (n = 5) was -0.800. From the table of critical values for Spearman Rho (Owen, 1962, p. 401), the rank correlation coefficient for the males was statistically significant. It can be concluded from this that a lesser tendency toward preference for just one hand in the males might mean a higher acquisition of fencing skill using the nonpreferred hand.

Table 5

Rank Correlation Coefficient of Hand Preference to Tournament Standing: Sum of Squares of Rank Differences, Spearman Rho, Cumulative Probability Distribution of d^2

Group	n	d^2	R_g	CP
Males	5	36	-0.800	0.958
Females	13	453	-0.243*	---

* For R_g to be significant at the 5% level of confidence, it have to be greater than or equal to the critical value of 0.566. Source for the critical values: (Hammond, 1970, p. 394).

Comparison of the Two Administrations of the Bower General Fencing Ability Test

The scoring for the Bower skill test followed the scoring system that Bower devised. The first three trials of each fencer were added to give the final score for each

administration of the test. In order to compare the results of the two administrations, the t test for related samples was used.

Table 6

Significant Difference Between the Two Bower Test Scores

Group	n	M.D.	t*
Nonpreferred Handed	18	-1.11	1.11

* $t_{05}(17df) = 2.110$
Source for the critical value of t: (Weber & Lamb, 1970, p. 229)

From the result of the t test, the null hypothesis was retained. The difference between the two administrations of the Bower General Fencing Ability Test was not statistically significant.

Interclass Competition

During the fourteenth week of the semester, a competition was held between the top fencers in each of the two classes. The ranking of the subjects was based on the subject's tournament standing within their respective classes.

The top three female fencers from the morning (nonpreferred handed) class competed against the top three female fencers from the afternoon (preferred handed) class. The pool of morning class fencers consisted of two subjects fencing left-handed and one subject fencing right-handed.

The pool of fencers from the afternoon class consisted of right-handed fencers. Of the nine bouts, the afternoon class's pool won five bouts and the morning class's pool won four bouts. Both pools had an equal number of touches against them. (See Table 7)

The competition of the top male fencers was slightly different because of the subjects' schedule conflicts. The top three fencers from the afternoon (preferred handed) class competed against the number three fencer from the morning (nonpreferred handed) class at an evening session. On the next day, the number two and three fencers in the afternoon class competed against the number two fencer from the morning class. Both subjects from the morning class fenced left-handed and all three fencers from the afternoon class fenced right-handed. Of the five bouts, all were won by the morning class pool of fencers. It was clear that the morning class's male representatives were superior to the afternoon class's male representatives. (See Table 8)

Comparison of the Nonpreferred Handed
and the Preferred Handed Groups
in Their Results From
the Bower Test

One of the facets of the Bower test which can be used to compare the two groups is the ratio of points achieved by the attacker to the points achieved by the defender. At the beginning of each trial of the Bower test, one participant was designated the attacker and the other participant was

Table 7

Interclass Bout Results--Females

Nonpreferred Handed Pool					Preferred Handed Pool				
Rank	Hand	Wins	Losses	T.A.	Rank	Hand	Wins	Losses	T.A.
#1	R.H.	0	3	12	#1	R.H.	2	1	6
#2	L.H.	1	2	9	#2	R.H.	2	1	7
#3	L.H.	3	0	3	#3	R.H.	1	2	11
Totals		4	5	24			5	4	24

Table 8

Interclass Bout Results--Males

Nonpreferred Handed Pool					Preferred Handed Pool				
Rank	Hand	Wins	Losses	T.A.	Rank	Hand	Wins	Losses	T.A.
#2	L.H.	2	0	8	#1	R.H.	0	1	5
#3	L.H.	3	0	6	#2	R.H.	0	2	10
Totals		5	0	14	#3	R.H.	0	2	10
					Totals		0	5	25

designated the defender. The attacker could attack the defender five times. After the fifth attack, the participants switched positions so that the attacker became the defender and the defender became the attacker. The new attacker also had five attacks to make. At the end of this attacker's fifth attack, the trial ended. For each trial a participant could receive a maximum of ten points--five points as an attacker with five successful attacks and five points as a defender with five successful parries.

For the purposes of analyzing the data, points achieved by the attacker will be denoted "offensive points" and points achieved by the defender will be denoted "defensive points."

In the first administration of the Bower skill test, the nonpreferred handed group scored double the number of defensive points as compared to offensive points with the ratio of 2.64 defensive points for every offensive point. By the time of the second administration of the Bower skill test, the number of defensive points in the ratio had fallen 0.70 points to 1.85 defensive points for every offensive point.

The preferred handed group had a ratio of 3.35 defensive points for every offensive point in the first administration of the Bower skill test. The number of defensive points in the ratio decreased by 0.69 points in the second

administration of the skill test to a ratio of 2.66 defensive points for every offensive point.

The two groups were different in the number of defensive points for every offensive point but the decline from the first to the second administration of the skill test in the number of defensive points in the ratio was 0.010 points from being the same. Over the eight week span of time between the two administrations of the skill test, the two groups changed their approach to the test to nearly the same extent.

Another variable to be investigated is the statistical difference between the preferred handed group and the nonpreferred handed group in their results of the two administrations of the Bower fencing skill test. In order to compare the results between the two groups of the first administration of the Bower test, the t test for independent samples was used. (See Table 9) From the result of the t test, there was no statistically significant difference between the results of the two groups at the five percent level of confidence.

The results of the second administration of the Bower fencing skill test were analyzed to compare the results of the nonpreferred handed group and the preferred handed group. The t test for independent samples was used. (See Table 9) From the result of the t test, there was no statistically significant difference between the results of the two groups at the five percent level of confidence.

Table 9

Statistical Difference Between the Nonpreferred Handed Group and the Preferred Handed Group on Results from the Bower Skill Test

Bower Test	n	*t
1st Administration	32	0.26
2nd Administration	32	1.08

* $t_{05}(30df) = 2.042$

Source for the critical value of t: (Weber & Lamb, 1970, p. 229)

CHAPTER V

DISCUSSION

The findings of the investigation appear to be just a grouping of low insignificant values but a closer examination may help to clarify some of the major points of the study.

The scores of each subject's hand preference rested solely on how the subjects marked the fourteen items on the Crovitz and Zener questionnaire of handedness. A possible criticism of the questionnaire would be that the fourteen items did not represent unbiased selections of a population of hand preference tasks. The investigator was not attempting to find the precise hand preference of each subject but only a general score for hand preference. A practical aspect of the questionnaire was to allow the subjects to complete it in one class period and to find out the results in the same period. One could have given a longer questionnaire plus some hand preference tasks in order to focus on a truer hand preference score. The longer study would have been impractical from the teaching point of view because one to two periods would have been needed to gather the data before obtaining any results. This would have meant that it might not have been until the third class meeting that the

students could have looked at the results. The lack of preciseness in the hand preference score might have been the reason for the low correlation coefficients in both groups between the questionnaire and: (a) the fencing skill test; (b) the round robin tournament.

The scores from the two administrations of the Bower General Fencing Ability Test should have given a true picture of each subject's general fencing ability. The test was thoroughly discussed in the class prior to the testing date and each subject was allowed to go through one practice trial. On the day of the testing, the test was discussed once more and each testing group was given a card which listed all of the pertinent rules for scoring. Bower found very high reliability and validity correlations with coed college groups so there was no reason to suggest that the subjects' scores in the present investigation were not good indicators of general fencing ability.

The rankings for the round robin tournaments provided another indicator of fencing ability though it may not have been as good as the Bower test scores. The subjects had practiced judging and directing for several weeks prior to the tournaments. Some fencing experts feel that it takes years to become a good director. The investigator observed an adequate degree of directing among the subjects during the tournaments. This "adequateness" rather than

"excellence" in directing might have been another factor causing low correlation coefficients.

The correlation coefficients of hand preference and fencing skill for the preferred handed group were extremely low. When comparing the results of the preferred handed group to the results of the nonpreferred handed group, one finds nearly the same correlation coefficient for both full groups. When dividing the data according to sex, the nonpreferred handed males and females had far higher correlations. By dividing up the data in this way, the number of subjects, n, for each correlation becomes smaller and the results become less important. Since neither of the correlation coefficients for the groups was significant, no definite relationships could be found to exist between the hand preference scores from the questionnaire and the scores from the fencing skill test.

The rank correlation coefficients between hand preference and tournament standing for the preferred handed group only showed very modest relationships for the males and the females. The rank correlations were higher for the males in the nonpreferred handed group than the males in the preferred handed group but the rank correlations for the females of the nonpreferred handed group were lower than those for the preferred handed group of females. The correlation coefficient for the males in the nonpreferred handed group was high enough to be significant at the 5% level of

confidence. Both correlation coefficients for the nonpreferred handed group showed negative values. This result was expected because it meant that a subject who did not rely on one hand would acquire the sport skill more quickly with the nonpreferred hand than the subject who relied on one hand all of the time. An inverse correlation also appeared with the preferred handed males. The small number of males within this group might explain the inverse relationship.

At the beginning of the investigation, the investigator guessed that the nonpreferred handed group would have great difficulty in acquiring the sport skill during the first few weeks. With this assumption, a t test was added to the data analysis in order to show any significant difference between the first and the second administrations of the Bower test, the t test revealed no significant difference between the scores of the two test administrations for either group. This seemed to suggest that the subjects in the nonpreferred handed group had mastered enough fencing skill by the fourth week to score fairly well on the Bower skill test.

One of the most revealing pieces of data for comparison of the two groups was the interclass competition. The female competition was extremely close. The nonpreferred handed group had two left-handed fencers and one right-handed fencer, whereas the preferred handed fencers all fenced right-handed. The nonpreferred handed group had had

a chance during the semester to fence against at least one right hander. The preferred handed group had had no experience bouting against left handers. Fencing is a sport in which one needs to change bouting strategy when fencing against a left handed opponent after fencing against a right handed opponent. The preferred handed females won all three bouts against the one right hander from the nonpreferred handed group. The preferred handed females, on the other hand, lost four of six bouts against the two left-handed female fencers from the nonpreferred handed group. The reason for this may be that the preferred handed group had had no opportunity to bout against left handed opponents before the nonpreferred handed females had had only limited opportunities to bout against right handed opponents. The competition between the top females in each group was very close as can be seen in the five to four split in the bouts and in the equal number of touches against each group.

The male competition was slightly different. The investigator was forced to split the competition over two days. Due to the number of schedule conflicts, only five bouts were completed. The nonpreferred handed group won all five of the bouts. The number of touches against the preferred handed males was nearly double the number against the nonpreferred handed males. The reason for this overwhelming edge might be that the preferred handed males could not adjust to facing an opposite handed opponent as easily as

the nonpreferred handed males did. The nonpreferred handed group had had some experience bouting against a right-handed opponent whereas the preferred handed group had never faced a left hander before.

The close nature of the female interclass competition and the overwhelming edge that the nonpreferred handed males had over their preferred handed opponents might be interpreted as a positive comparison between the two groups. The results of this interclass competition showed that trying to acquire fencing skill with the nonpreferred hand did not act as a major deterent to success in this endeavor. One could not conclude from this study that if the nonpreferred handed fencers had begun to fence with their preferred hand at the beginning of the semester that they would have been better or worse by the time of the interclass competition. From the interclass competition, the top fencers appeared to have an equal amount of fencing ability in bouting.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary

The purpose of the study was to investigate the relationship between hand preference and the acquisition of foil fencing skill.

Data were obtained from two beginning coeducational foil fencing classes at the University of North Carolina at Greensboro during the fall semester 1974-1975.

One of the classes was asked to fence with the nonpreferred hand and the other class with the preferred hand for the entire semester. Hand preference was determined by having the subjects fill out the Crovitz and Zener Handedness Questionnaire.

The investigator ascertained the subjects' fencing ability by administering the Bower General Fencing Ability Test. The test was administered at the end of the first third of the semester and again at the end of the semester. It was given at two different points in the semester to determine if there was any improvement in either group.

The bouting ability of the subjects was determined at the end of the semester by holding round robin tournaments in both classes.

Following the round robin tournaments, the top three male fencers and the top three female fencers from each class met in an interclass competition. In the female competition, the females using the preferred hand (afternoon class) won five bouts while the females using the nonpreferred hand won the four remaining bouts. In an incomplete competition for the males, the males using the nonpreferred hand won five bouts while the males using the preferred hand failed to win one bout.

Correlation coefficients were determined to find the relationship between the questionnaire scores and the scores from the second administration of the Bower skill test. Correlation coefficients were also obtained to determine any relationship between the questionnaire scores and the tournament standings. Of all of the correlations, the only significant correlation coefficient was the nonpreferred handed males' questionnaire scores and their tournament standings. All of the other correlation coefficients were not statistically significant at the 0.05 level of confidence.

Conclusions

The following conclusions follow from the study:

Preferred Handed Group

1. There was no relationship between the group's hand preference scores and the fencing skill test scores.

The same was true for both the males and the females when separating the data according to sex.

2. The males' hand preference scores and their rankings in the round robin tournament showed no relationship.

3. The females' hand preference scores were not related to their round robin tournament rankings.

4. The difference between the scores from the two administrations of the fencing skill test was not significant.

Nonpreferred Handed Group

5. There was no evidence of a relationship between the group's hand preference scores and the fencing skill test scores. The same was true for both the male and female subjects when separating the data according to sex.

6. The males' hand preference scores had a high degree of relationship to the round robin tournament rankings. The relationship indicated that fencers with high tournament rankings had a lesser tendency toward preference for just one hand than the fencers with lower tournament rankings.

7. The females' hand preference scores and their tournament rankings showed no relationship.

8. The difference between the scores from the two administrations of the Bower fencing skill test was not significant.

Comparison of Both Groups

9. There was a close relationship between the two groups in a decline in the number of defensive points in the ratio of defensive points to offensive points from the first administration of the Bower fencing skill test to the second administration.

10. The top female fencers from the preferred handed group bouted on an equal level against the top female fencers from the nonpreferred handed group.

11. Two top male fencers from the nonpreferred handed group dominated all of the bouts fought against the top male fencers from the preferred handed group.

12. There was no statistically significant difference between the preferred handed group and the nonpreferred handed group on their results from the first administration of the Bower fencing skill test.

13. There was no statistically significant difference between the preferred handed group and the nonpreferred handed group on their results from the second administration of the Bower fencing skill test.

Suggestions for Further Study

The following suggestions might be used in further research:

1. One could study transfer by having a group of subjects acquire skill in fencing with the nonpreferred hand for

the first half of the study and with the preferred hand for the second half of the study.

2. One could find a more accurate hand preference score by using several manual tasks as measures of hand preference. This could be implemented in a similar study as the present one.

3. One could study the relationship between hand preference and the acquisition of skills in other sports such as golf, softball, or archery.

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APPENDIX A

CROVITZ AND ZENER HANDEDNESS QUESTIONNAIRE

CROVITZ AND ZENER HANDEDNESS QUESTIONNAIRE

Directions: Answer the following questions carefully. Imagine yourself performing the activity described before writing down the most appropriate response.

Six possible responses:
Ra--right handed always
Rm--right handed most of the time
E --both hands equally often
La--left handed always
Lm--left handed most of the time
x --do not know which hand

1. ____ is used to write with
2. ____ is used to hold a nail when hammering
3. ____ is used to throw a ball
4. ____ is used to hold a bottle when removing the top
5. ____ is used to draw with
6. ____ is used to hold a potato when peeling
7. ____ is used to hold a pitcher when pouring
8. ____ is used to hold scissors when cutting
9. ____ is used to hold a needle when threading
10. ____ is used to hold a knife when cutting food
11. ____ is used to hold a drinking glass when drinking
12. ____ is used to hold a toothbrush when brushing teeth
13. ____ is used to hold a dish when wiping it dry
14. ____ is used to hold a tennis racket when performing a forehand stroke.

APPENDIX B

SCORING FOR THE HANDEDNESS QUESTIONNAIRE AND THE INDEX OF HANDEDNESS

SCORING FOR THE HANDEDNESS QUESTIONNAIRE AND THE INDEX OF HANDEDNESS

Scoring:

On items 1, 3, 5, 7, 8, 10, 11, 12, 14, the points are as follows:

Ra=1pt.
Rm=2pts.
E =3pts.
Lm=4pts.
La=5pts.

On items 2, 4, 6, 9, 13, the points are as follows:

Ra=5pts.
Rm=4pts.
E =3pts.
Lm=2pts.
La=1pt.

A response of X was scored with zero points in all cases.

Index of Handedness:

14 - 20 points.....strongly right handed

21 - 30 points.....right handed

31 - 50 points.....ambidextrous

51 - 60 points.....left handed

61 - 70 points.....strongly left handed

APPENDIX C

BOWER GENERAL FENCING ABILITY TEST

BOWER GENERAL FENCING ABILITY TEST

Materials needed: Chalk, pencils, running scoresheets, one master scoresheet for each class, 3" x 5" cards, and regulation fencing equipment.

Duties of the Participants: Class works in groups of four. The defender is required to come on guard with the back foot against the wall. The defender must try to defend against five attacks with any parry or parries. After five attacks, the defender becomes the attacker.

The attacker has to determine the fencing distance by finding how far from the defender to stand in an on guard position and still reach the defender's target with a full lunge. When this distance is determined, the scorer draws a chalk line along the inner border of the attacker's rear foot. Another line is drawn five inches nearer the wall from the line. This is designated the "foul line."

The attacker has to come on guard with the back foot behind the starting line. The attacker is required to make five attacks at any time, provided the attack is made with a continuous motion. This means the attack, once started, has to be continuous. There can be no false starts, although feints are allowed provided that they are a part of the attack.

At the conclusion of each attack, the rear foot has to be on the floor behind the foul line. This is to insure a proper lunge attack.

After five attacks, the attacker changes places with the defender. Two practice attacks may be made before scoring.

One of the scorers marks the chalk line. Each scorer is responsible for judging the target area. The scorer makes sure that the rear foot remains behind the foul line, and that the attack is continuous. The scorer should call out the scores as they are recorded.

Reliability: It was determined from the correlation of the scores resulting from two consecutive days of testing, using fifty-one subjects. Reliability obtained by Pearson product-moment method of correlation--$r = 0.821 \pm 0.046$.

Validity: It was obtained by comparing results with a round robin tournament--using the Pearson product-moment method of correlation the validity is 0.802 ± 0.063.

Scoring:

1. One point is awarded to the attacker for each attack which results in a valid hit before the parry is executed. The blade cannot be replaced after a parry or a miss. A hit has to be made with the tip of the point against a valid target.

2. One point is awarded to the defender for each parry which successfully deflects the attack so that the point does not land. If the blade lands on a foul area after being deflected from the target it is counted as a successful parry.

3. A zero is awarded if the attack fails to reach the target or lands on a foul area without being parried. If the attacker's foot passes over the foul line, and the attack is good, a zero is recorded. If a faulty attack is parried, the point is awarded to the defender.

APPENDIX D

WEEKLY LESSON PLAN FOR BOTH CLASSES

WEEKLY LESSON PLAN FOR BOTH CLASSES

1st Week: History, equipment, grip, on guard, advance and retreat, development, and hit.

2nd Week: Review of first week, explanation of the target area, parry, and disengage.

3rd Week: Review, direct attack, lateral parry, semi-circular parry, riposte, some bout techniques, introduction of the Bower skill test.

4th Week: Bower test, circular parry, review ripostes, one-two attack.

5th Week: Review all attacks and defences, cutover attack, beat attack, loop films, free fencing, press.

6th Week: Review of attacks and defences, set up bout, bouting.

7th Week: Coule, remise, renewed attacks, and bouting.

8th Week: Drill on lunging, point-control drill, beat drill, bouting, introduction of electrical equipment.

9th Week: Demostration of a fencing teams warm-up routine, review of all simple and compound attacks, bouting.

10th Week: Bouting rules, bouting, emphasis on directing.

11th Week: Tournament

12th Week: Tournament

13th Week: Bower test, evaluation of judging and directing, use of electrical equipment.

14th Week: Evaluation of judging and directing, use of electrical equipment.

15th Week: Team Competition.

16th Week: Written Evaluation

APPENDIX E

RAW DATA FOR THE PREFERRED HANDED GROUP

Raw Data for the Preferred Handed Group

Subjects	Q	B1	B2	T_m	T_f	FH
a	21	12	9		3	R
b	14	9	9		7	R
c	18	19	18		1	R
d	24	17	20		5	R
e	13	12	14		2	R
f	27	12	7		8	R
g	20	12	17		6	R
h	23	13	13		4	R
i	24	12	16	4		R
j	27	23	19	5		R
k	20	17	24	2		R
l	14	10	15	6		R
m	30	16	14	3		R
n	48	16	20	1		R

Q--the questionnaire score for handedness
B1--first administration of the Bower fencing skill test
B2--second administration of the Bower test
T_m--the standings from the male round robin tournament
T_f--the standings from the female round robin tournament
FH--the fencing hand

APPENDIX F

RAW DATA FOR THE NONPREFERRED HANDED GROUP

Raw Data for the Nonpreferred Handed Group

Subjects	Q	B1	B2	T_m	T_f	FH
a	28	9	14		12	L
b	16	14	9		6	L
c	25	13	17		2	L
d	22	12	10		9	L
e	25	13	8		5	L
f	24	10	17		10	L
g	20	9	12		13	L
h	22	11	10		7	L
i	41	20	20		1	R
j	17	12	14		4	L
k	33	13	5		8	L
l	24	18	15		3	L
m	18	14	11		11	L
n	24	21	22	1		L
o	23	19	19	3		L
p	15	17	11	5		L
q	22	23	16	2		L
s	14	16	14	4		L

Q--the questionnaire score for handedness
B1--first administration of the Bower fencing skill test
B2--second administration of the Bower test
T_m--the standings from the male round robin tournament
T_f--the standings from the female round robin tournament
FH--fencing hand