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Laterality: Motor Learning & the Non-Dominant Hand

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Nase,

Rella Beth

1977

LATERALITY: MOTOR LEARNING
AND THE
NON-DOMINANT HAND

A Thesis
Presented to
the Faculty of the Department of
Physical Education
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by
Rella Beth Nase

July 1977

LATERALITY: MOTOR LEARNING
AND THE
NON-DOMINANT HAND

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LATERALITY: MOTOR LEARNING
AND THE
NON-DOMINANT HAND

Rella Beth Nase July 1977 37 pages

Directed by: Dr. Shirley Laney, Dr. Thad Crews, and
R. Burch Oglesby

Department of Physical Education

Western Kentucky University

The cultural design of the United States of America has caught up its left-handed individuals in a right-hander's world. Daily the left-hander or sinistral is forced to cope with problems which present themselves only to sinistrals, posing no difficulty to right-handers or dextrals. It was the intention of this investigation to determine whether, as a result of this emphasis on dextrality training, sinistrals could more quickly learn motor tasks with the non-dominant hand than could dextrals.

The hypothesis upon which the investigation was founded was stated in null form: no significant difference exists between motor learning displayed by sinistrals as compared to dextrals in performing a novel motor task with the non-dominant hand.

The experimental design of the investigation was that of two group, multiple experimental sessions. The subjects were volunteers from the spring semester 1977 physical education classes at Western Kentucky University.

The twelve subjects participating in the experiment were female, non-physical education majors between the ages of eighteen and twenty-one. Six of the subjects made up the right-hand dominant sample, the remaining six subjects made up the left-hand dominant sample.

Subjects were required to complete twelve experimental sessions within a four week period. At each session each subject performed the experimental task of juggling two tennis balls in the non-dominant hand for two periods of three minutes. These performances were scored using the dichotomous factors of catches and trials.

The data collected from the experiment were analyzed by using an analysis of covariance test to ascertain levels of significance reached by each sample group for the factors of catches and trials. An analysis of covariance test was also used to ascertain the levels of significance reached by the twelve sample subjects taken as one group, for the factors of catches and trials. Finally, an analysis of covariance test was used to ascertain whether either sample group learned significantly more than the other group for the factors of catches and trials.

It was found that both sample groups reached significant levels of learning for the factor of catches; however, only the right-hand dominant sample reached significance for the factor of trials. The twelve sample

subjects, taken as one group, reached significant levels of learning for the factor of catches, but not trials. Finally, neither sample group learned significantly more than the other group for the factors of catches and trials.

The analyses of data of this investigation resulted in a failure to reject the hypothesis. Three possible explanations for this failure to reject the hypothesis were advanced: 1) Conditioning of sinistrals to negative self-images, resulting in psychological attitude negatively effecting motor performance. 2) The sample sinistrals, eighteen to twenty-one years of age, did not suffer the process of conversion to dextrality training that sinistrals of previous decades suffered. 3) The theories of the generality of transfer versus the specificity of transfer of motor skills.

CHAPTER I

EXPERIMENTAL PRELIMINARIES

Introduction

The cultural design of the United States of America has caught up its left-handed individuals in a right-hander's world. Daily the left-hander or sinistral is forced to cope with problems which present themselves only to sinistrals, posing no difficulty to the right-hander or dextral. For example; such things as the winding of a watch, pouring from a ladle, using a pencil sharpener or hand drill, or performing a basketball lay-up drill present no problems to the dextral on the point of handedness. However, the sinistral in each of the above mentioned situations must adapt handedness behavior in order to perform the task mentioned.

In the case of the watch; the sinistral who wears his or her watch on the non-dominant (right) wrist with the watch stem facing up the forearm towards the elbow finds that the watch cannot be wound in that position, and he or she must adapt handedness behavior in order to accomplish the desired task.

The ladle situation is another difficult one for

sinistrals. The spouts built into ladles are designed to be utilized when the ladle is held in the right hand and tipped towards the holder's body. In this way the pouring operation is visible and utilizes the ladle spout. Left-handers are forced in this situation to either learn to perform the skill with the right hand; use the left hand to pour from the ladle, doing without the spout; or use the left hand to pour from the ladle, using the spout, but pouring blindly away from the body.

The instance of the basketball drill is the most obvious of the previously mentioned enforced non-dominant hand use cases. Most basketball drills are designed to allow performance of shots from the right side of the basket. The sinistral then is quite obvious when he or she uses the left hand to shoot from the right side of the basket. The coach should at that point recognize the athlete's handedness and be aware that the performer needs an opportunity to perform in drills designed for left-handed performance in order to exhibit optimum ability. However, this generally does not occur, (particularly on the high school level). What does usually result is an order from the coach requiring the sinistral to use the right (non-dominant) hand in shooting from the right side of the basket; the coach justifying this action by emphasizing the importance of equal shooting ability in both hands. Yet rarely

does the coach design drills to increase the dextral player's ability to use the left hand.

It was the intention of this investigation to determine whether, as a result of this emphasis on dextrality training, sinistrals could more quickly learn motor tasks with the non-dominant hand than could dextrals.

Purpose

The purpose of this investigation was to determine the differences between the motor learning displayed by sinistrals as compared to dextrals in the performance of a novel motor skill with the non-dominant hand.

Significance

The results and conclusions drawn from this study may be of interest to physical educators in general, and coaches in particular. Should the results of this study demonstrate a positive difference in the motor learning as displayed by sinistrals as compared to that of dextrals in the use of the non-dominant hand, physical educators would be wise to study that difference for methods of increasing student motor potential through increased utilization of the non-dominant hand.

Should the results of this study exhibit no significant difference in non-dominant hand use development, the results may still be of interest to

physical educators, for it may be indicated that in the area of non-dominant hand development sinistrals and dextrals are equal in ability. Therefore neither group would necessarily need special attention due to handedness.

Coaches of sports requiring highly developed use of both the non-dominant and dominant hands may be particularly interested in the results and conclusions drawn from this investigation. Basketball, volleyball, gymnastics, softball and baseball coaches could utilize information concerning non-dominant hand development and motor learning in application to such sport skills as basketball jump shots, volleyball spikes, gymnastics back extensions, and softball or baseball switch hitting as well as a myriad of other skills.

Hypothesis

No significant difference exists in the motor learning displayed by sinistrals as compared to dextrals in performing a novel motor task with the non-dominant hand.

Assumptions

It was assumed that all subjects put forth maximum effort in all experimental trial sessions.

Delimitations

The intention of this investigation was a comparison of the motor learning displayed by sinistrals versus

dextrals in performing a novel motor task with the non-dominant hand.

All members of the experimental groups were female students from Western Kentucky University, non-physical education majors between the ages of eighteen and twenty-one.

Limitations

1. Sample size was too small
2. Number of experimental sessions were too few
3. Conclusions drawn from this investigation may be limited to the age group of the sample
4. Conclusions drawn from this investigation may be limited to the sex of the sample
5. Use of dichotomous scoring techniques

Definitions

Activity session, or experimental session--forty-five minute time period in which the subjects performed the experimental task in a set number of trial sessions.

Catch--one of the scores used to record a subject's performance of the experimental task. A catch consisted of a subject grasping in the non-dominant hand one of two juggled tennis balls and tossing it into the air, or holding it. A catch was not recorded for any ball caught with two hands, or between one hand and any part of the body. The measure was inherently weak as a measure of

performance for it is a dichotomous scoring technique. The measure of catches allowed for the quantification of performances by the subjects, but not qualification of those performances. In other words, scores were awarded for the completion of a catch, but not for the fluency, or quality of the catch.

Dextral--a person who performs the overt single-hand acts of writing, throwing a ball, and picking up objects with the right hand, and has always done so.

Experimental period--length of time between the beginning of the first trial session, and completion of the last trial session of the experiment.

Experimental task--the novel motor task of juggling two tennis balls in the non-dominant hand.

Scoring training session--scheduled gathering of the investigator and all subjects, during which time the investigator performed a juggling task which all subjects scored.

Sinistral--a person who performs the overt single-hand acts of writing, throwing a ball, and picking up objects with the left hand, and has always done so.

Trial--one of the scores used to record a subject's performance of the experimental task. A trial began as the subject tossed one of two tennis balls into the air in an attempt to juggle both of the balls simultaneously. A trial ended as the subject dropped one of the two

tennis balls, or both of them, or did not make a clean catch of the balls. This measure, like the measure of catches, was inherently weak, for it too is a dichotomous scoring technique. It quantified the trials performed by the subjects, but could not be used to qualify those performances.

Trial session--a three minute time period during which the subjects performed the experimental task.

CHAPTER II

REVIEW OF RELATED LITERATURE

A great deal of research has been conducted in the area of laterality. Most of this research has centered about the topics of laterality and academic achievement, laterality and personality characteristics, and laterality and motor skill development.

In the area of laterality as related to academic achievement, completed studies have produced conflicting, contradictory, and confusing results. For example, Wilson and Dolan (1931) completed a study of handedness and ability from which they concluded that left-handedness was at least partly responsible for inferiority in school achievement. Wilson and Dolan also found in that same study that sinistrals scored consistently lower on I.Q. tests than did dextrals, and that a greater percentage of sinistrals was to be found in low ability and remedial work groups than in normal or high achievement groups.

The conclusions drawn by Wilson and Dolan seem supported in part by the results of a study by Annet and Turner (1974).

. . . first, that ability does not vary with laterality in the general sample, but, second, that there is a slight excess of left-handers

among those of low ability.¹

Annet and Turner went on to suggest in their 1974 study that because some left-handers are left-handed as a result of slight or severe brain damage, incurred at some point, this damage may be the cause of reading, verbal, and speech difficulties evidenced by greater numbers of sinistrals than dextrals.

However, the research completed by Wilson and Dolan and Annet and Turner is far from conclusive. Studies completed by Allison (1966) and Groden (1969) found no relationship between academic achievement and laterality. Clark (1970) found no relationship between laterality and reading backwardness. Stephens (1967) found no relationship between laterality and reading readiness; and finally, Brenner and Gillman (1966) concluded from their research that no relationship could be drawn between visuo-motor ability and laterality.

It is obvious at this point that the research presently available in the area of laterality and academic achievement is far from conclusive. The research in the area of laterality and personality characteristics seems more unified in its results than that in the area of laterality and academic achievement. Research of the personality characteristics of converted sinistrals (forced

¹Marian Annet and Ann Turner, "Laterality and the Growth of Intellectual Abilities," British Journal of Educational Psychology, February 1974, p. 43.

to use the right hand in performing skills such as writing, throwing, and eating) performed by Lauterbach (1933) indicates excesses of resignation, anxiety, timidity, and low self-images, as well as tendencies to learn to perform skills with the right hand (which Lauterbach took to be a tacit admission of the embarrassment of being left-handed). These findings were supported by Young and Knapp (1966) in their study of personality characteristics of converted left-handers.

Wegener (1954) completed a study of the personality traits of seventy-three male sinistrals. His conclusions indicated excesses of feelings of cultural rejection and resignation, and what Wegener called compensation--an over-valuation and increased activity to the challenge to adjust in a right-handed world. In other words Wegener discovered two extremes or polarities of sinistral personality traits: extreme resignation, and extreme activity in order to conquer the "problem."

Finally, Palmer (1963) conducted a study of dominants (primarily dextrals) versus ambidextrals (primarily converted sinistrals) concerning personality traits. It was found that the dominant group expressed self-images of attractiveness, 'cool,' and civilized. The ambidextral group, however, viewed themselves as awkward, submissive, moody, peculiar, shy, pessimistic, sensitive, emotional, and inhibited.

A third area of laterality which has been researched a great deal is that of motor skill learning. The research completed by L. F. Beck (1936) was designed and intended to perfect a measurement of handedness test battery. But an interesting side-effect generalization was presented by Beck, based on the data he collected.

. . . in our experiment about half of the subjects who ultimately were classified as left-handed were slightly more proficient with their right hands. The explanation of this apparently paradoxical result is probably to be found in the fact that a left-handed man in this right-handed world is forced to acquire a considerable degree of skill with his right hand.²

Contrarily Barnsley and Rabinovitch (1970), while attempting to standardize a test battery for handedness establishment, drew the following conclusion:

There appears to be no factor or qualitative skill difference between preferred hand performance and non-preferred hand performance. . . Therefore, although the same skills are to be found in either hand, the preferred hand is characterized by better performance in each skill.³

Three other studies of interest concerning laterality and motor skill performance and/or motor learning are those of Tyler (1970), Way (1959), and Horine (1968). All tested motor skill learning rates of left eye-foot-hand dominants versus mixed dominants. All three

²L. F. Beck, "Manual Skills and the Measurement of Handedness," Journal of Psychology 2, (1936): 270.

³Roger H. Barnsley and M. Sam Rabinovitch, "Handedness: Proficiency Versus Stated Preference", Perceptual and Motor Skills, February-June 1970, p. 359.

researchers concluded from their studies that individuals of different dominances are equally capable of learning new motor skills. Way and Horine drew contradictory results from their studies on one point. Way found that persons with a mixed dominance of eye-foot-hand are slightly superior to homogenous dominants in motor skill ability. Horine concluded just the opposite tendency in his study.

In conclusion, several studies in less well researched areas than those previously mentioned should be presented. The field concentrating on the advisability of converting left-handers to right-handed behavior was researched by both Haas (1948) and Blau (1947). Haas stated that the success of learning motor skills in the non-preferred hand "depends entirely on the individual's sincere desire to develop the use of this hand."⁴ He also stated that it is not harmful for a left-handed person to attempt to develop right-handed patterns of action "provided the challenge is accepted with an open mind, and a whole hearted willingness to make the change. . . ."⁵

Blau concluded from his research that

There are no dangers in retraining, but dextrality training is preferable in this right-sided world. Sinistrality may be a neurotic

⁴Louis J. Haas, "Observations on Left-Handedness," Mental Hygiene, April 1948, p. 281.

⁵Ibid.

symptom; in children it may indicate an emotional disturbance; in adults, it may be a relic of a former neurosis or an indication of a present personality disturbance with a negativistic core.⁶

One investigation has been completed concerning the relationship between laterality and sex. Crovity (1974) concluded from the data he collected that males and females differ in relations of hand, sight, and acuity dominances. Crovity recommended at the completion of his own study that future studies be conducted focusing on the sex variable and lateral tendencies.

One investigation has been completed concerning pain tolerances and thresholds of the left and right hands. Murray and Safferstone (1970) found the left hand to be slightly more susceptible to pain, and have a lower pain threshold than the right hand.

Summary

In conclusion then, although a great deal of research has been completed in the area of laterality, very little of the research has been concerned with laterality and motor learning. In contrast to the great amount of research completed concerning laterality and academic achievement, and laterality and personality characteristics, research relating laterality, motor

⁶A. Blau, "The Master Hand; A Study of the Origin of Right and Left Sidedness and Its Relation to Personality and Language," Psychological Abstracts, volume 2, 1947, abstract number 1434.

learning and the non-dominant hand has been virtually non-existent. It was hoped that this investigation would contribute some information to this largely ignored area of laterality, motor learning, and the non-dominant hand.

CHAPTER III

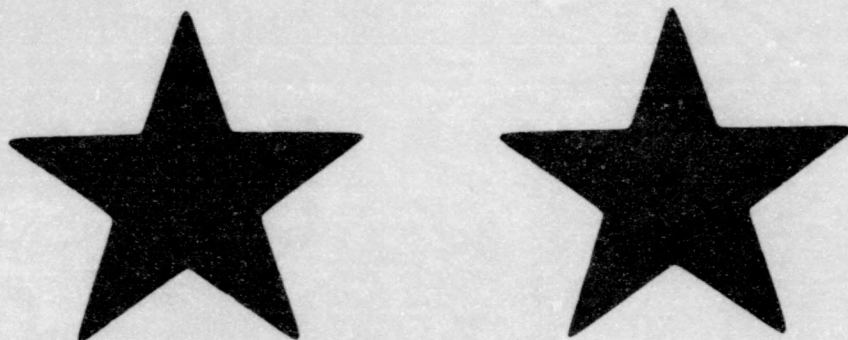
METHODOLOGY

Sample Selection

The sample used in this investigation was obtained by the following process. It was determined that all members of the experimental sample groups were to be female students at Western Kentucky University, non-physical education majors between the ages of eighteen and twenty-one. Therefore, a survey questionnaire was given to each student of Western Kentucky University's 1977 spring semester Figure Improvement classes. Students responded to selected questions and returned the questionnaires to the investigator. This process was conducted from 1-1:10 pm March 21 for the Monday-Wednesday class, and from 2:10-2:20 pm March 22 for the Tuesday-Thursday class.

The survey questions were as follows: 1) With which hand do you throw a ball? 2) With which hand do you write? 3) Have you ever for a prolonged period of time (six weeks or longer) performed throwing, writing, or eating skills with the other hand? 4) Would you be willing to participate in a three week experimental

CORRECTION



***PRECEDING IMAGE HAS BEEN
REFILMED
TO ASSURE LEGIBILITY OR TO
CORRECT A POSSIBLE ERROR***

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The survey questions were as follows: 1) With which hand do you throw a ball? 2) With which hand do you write? 3) Have you ever for a prolonged period of time (six weeks or longer) performed throwing, writing, or eating skills with the other hand? 4) Would you be willing to participate in a three week experimental

research program? 5) Have you ever before juggled two or more objects in either or both hands? 6) Are you free during the 4-4:45 period Monday through Thursday?

The data of the returned questionnaires were reviewed and subjects were selected and assigned to sample groups. The first six students to respond "right-hand" to questions one and two, "no" to questions three and five, and "yes" to questions four and six were selected as members of the right-hand dominant sample. The first six persons classified as right-handers made up the right-hand dominant experimental group. The left-hand dominant experimental group consisted of the five persons responding to the questionnaire "left-hand" to questions one and two, "no" to questions three and five, and "yes" to questions four and six. The sixth member of the left-hand sample group was a volunteer recruited from a Physical Education 100 class at Western Kentucky University.

Two limitations were placed on the sample subjects, 1) no converted left-handers were permitted as part of the sample, and 2) no student who had juggled two or more objects in the dominant, non-dominant, or both hands was permitted to participate in either experimental sample group. Restriction one was applied in order to allow this study to focus on "built in" American culturally designed handedness performance necessities as

experienced by both sinistrals and dextrals: as in the cases of the use of pencil sharpeners, hand drills, or ladles mentioned in Chapter I. A converted left-hander, forced into right-handed behavior in the skills of writing, eating, or throwing, experiences a situation from which the dextral is exempt. Therefore, inclusion of converted sinistrals in either of the experimental groups of this investigation would have introduced an undesirable, uncontrollable, and unmeasurable limitation factor in the study. For that reason then, converted left-handers were not permitted to participate in this experiment.

Restriction two was enforced in order to minimize transfer and/or previous motor learning experiences of subjects in regard to the introduction and performance of the experimental task.

Scoring Training Sessions

Following the selection of the sample an experimental scoring training session was held. The scoring training session was designed to minimize subject random scoring error throughout the experimental period. All sample subjects attended the scoring training session. The session was thirty minutes in length, during which time the investigator juggled two tennis balls in the dominant hand for six periods of three

minutes each.

Prior to the performance of the first of these six trial sessions the investigator explained to the subjects what was expected of them. Each subject was to score each trial session by recording the number of trials and catches made during the trial session. Trials and catches were defined to the subjects (see definitions), and the first trial session was then begun.

Following each three minute trial session the total number of trials and total number of catches recorded by the subjects were compared. Each subject verbally reported the total number of trials and catches she had recorded for the trial session. The goal of the scoring training session was to reach a between scores range of two points or less. This criterion was achieved at the initial session.

Experimental Design

At the scoring training session the investigator randomly assigned subjects to teams for the first experimental session. Three subjects were assigned to each team and each group of three was referred to as a sample team. At each of the following experimental sessions, the investigator again randomly assigned subjects to teams prior to the beginning of the first

trial session. The teams consisted of either three or four subjects, dependent upon the number of subjects attendant at that particular experimental session.

The sample teams were assigned to appear at the experimental station, which was Western Kentucky University classroom 122 in Smith Stadium from 4:00 to 4:45 pm each day Monday through Thursday for a period of three weeks. Each subject was required to complete twelve experimental sessions. In order to take into consideration subjects who could not attend some of the regularly scheduled experimental sessions, a make-up week was utilized following the scheduled three week experimental period. All subjects did complete the required twelve experimental sessions.

Experimental Sessions

Prior to the arrival of the subjects, the investigator prepared the experimental station, room 122. All chairs in the room were pushed to the walls. When the sample group arrived the investigator asked them to stand together in a group in the center of the room until the experimental procedure had been explained to them. Experimental procedure was explained as follows: subjects were told that the experimental task was juggling two tennis balls in the non-dominant hand, and that each subject would perform the task twice, score the task, and act as retriever for the task at each

experimental session. Subjects were then asked to decide among themselves which member of the team would perform first, which would score first, and which would be retriever first.

The investigator then told the subjects that at that first experimental session, and all future experimental sessions, the verbal command "ready" was the signal to select an area of the room for the performance of the experimental task. Subjects were permitted to choose any area of the room for performance of the experimental task so long as a minimum distance of ten feet existed between performers. (The ten foot distance was measured from the heel of one subject to the heel of another.)

Performers were told to stand facing their scorers, scorers were told to get a chair and sit in it facing their performers at a comfortable distance (of not more than ten feet) from their performers. Retrievers were told to stand beside the seated scorers. Performers were told that they were expected to perform the experimental task for two three-minute periods, with a one-minute rest interval between the trial sessions. Scorers were told to score their partner's performance as they had practiced scoring in the scoring training session. Retrievers were reminded to retrieve any balls that were dropped or rolled out of reach of their

performing partners.

The command "ready" was then given, and subjects took their positions to begin the first trial session. Following a one-minute interval after the command "ready" had been given, the investigator distributed to each sample team score sheets for each member of the team (given to the scorer) and three tennis balls. Two of these tennis balls were placed in the non-dominant hand of the performer. The other tennis ball was given to the retriever. The investigator at this time also made any adjustments of positions necessary for performers who were too close to one another.

The investigator then gave the verbal command "set," and the the verbal command "go." On the command "go," the trial session began. It ended when the investigator called "stop." The performers completed two trial sessions with a one-minute rest interval between the trial sessions. Following each subject's second trial session the subjects in each sample team rotated roles in a random fashion, however, each subject juggled twice, scored, and retrieved two or three times as necessary at each experimental session.

Following the completion of the last trial session of the experimental session the investigator collected all score sheets and dismissed the subjects.

At the conclusion of the experimental period the

investigator reviewed and analyzed score sheet data collected. Means and ranges were computed for each trial session and an analysis of covariance was utilized in an attempt to graph and compare the motor learning displayed by sinistrals versus dextrals in performing a novel motor task with the non-dominant hand.

CHAPTER IV

ANALYSIS OF DATA

The data used in this analysis were obtained from two groups of six female subjects from the freshman through senior year classification at Western Kentucky University. The groups were classified as right-hand dominant and left-hand dominant. Each subject performed the experimental task of juggling two tennis balls in the non-dominant hand for two three-minute periods at twelve experimental sessions, yielding a total of twenty-four juggling periods for each subject. The purpose of the study was to determine any differences between the motor learning displayed by sinistrals versus dextrals in the performance of a novel motor task with the non-dominant hand.

Treatment of Data

The data collected from the experiment were analyzed in the following manner. The facilities of the Academic Computing and Research Services Center of Western Kentucky University were utilized for computations. A Statistical Package for the Social Sciences (SPSS) CROSSTAB program was used to compute means for each sample group for the factors of catches and trials for each trial session

of the experimental program.⁷

In order to analyze differences between the performances of the two sample groups over the experimental period the means of each group for the factors of catches and trials for the first and last days of the experiment were computed. In order to analyze the overall differences in the performance of the twelve sample subjects, taken as one group, across the experimental period, the means of the subjects' performances of both catches and trials on the first and last days of the experiment were computed. Finally, an analysis of covariance test was run to determine the relation of catches to trials and trials to catches. For all analyses the .05 level of significance was selected as the minimum acceptable level.

Results and Discussion

Both sample groups exhibited a significant positive change in the performance of the factor of catches over the experimental period. However, only the right-hand dominant sample reached a significant level of improvement for the factor of trials over the experimental period. The left-hand dominant group did not begin to approach the .05 level of significance in the performance of the factor of trials (Tables 1 and 2). This would seem to indicate

⁷Norman H. Nie, Dale H. Bent and C. Hadlai Hull, SPSS: Statistical Package for the Social Sciences, (New York: McGraw-Hill Publishing Co., 1970), p. 4.

TABLE 1. ANALYSIS OF COVARIANCE: CATCHES
DAY 1 VS. DAY 12

	Mean Square	Degrees of Freedom	F-Ratio	P
left-hand sample	11812.69	1.0	15.305	0.0118
right-hand sample	9268.5	1.0	63.619	0.001

TABLE 2. ANALYSIS OF COVARIANCE: TRIALS
DAY 1 VS. DAY 12

	Mean Square	Degrees of Freedom	F-Ratio	P
left-hand sample	10.08	1.0	0.21	0.67
right-hand sample	180.89	1.0	6.97	0.045

that the factor of catches measured something slightly different from that measured by the factor of trials in this juggling task. An analysis of covariance was computed between the two experimental groups for the factor of catches in order to determine differences in the amounts of motor learning displayed by the groups. The results of this analysis revealed that neither group displayed a greater amount of motor learning than did the other (Table 4).

The level of significance reached by the twelve sample subjects, taken as one group, was significant for the factor of catches but not for trials over the experimental period. It appears that the left-hand dominant sample prevented the measure of trials from reaching an acceptable level of significance. Even so, the level of significance for the factor of trials across the two sample groups was very close to a significant level (Table 3).

Graphs were constructed to illustrate the motor learning displayed by the two sample groups (Figures 1 and 2). Figure 1 is a graph of the mean number of catches per trial session for each sample group. Figure 2 is a graph of the mean number of trials per trial session for each sample group. As can be expected from the previously mentioned results, the two sample groups exhibited similar tendencies in learning the experimental task.

The hypothesis on which this investigation was

TABLE 3. ANALYSIS OF COVARIANCE: SUBJECTS
DAY 1 VS. DAY 12

	Mean Square	Degrees of Freedom	F-Ratio	P
catches	21004.1	1.0	45.78	0.0001
trials	137.76	1.0	3.70	0.080

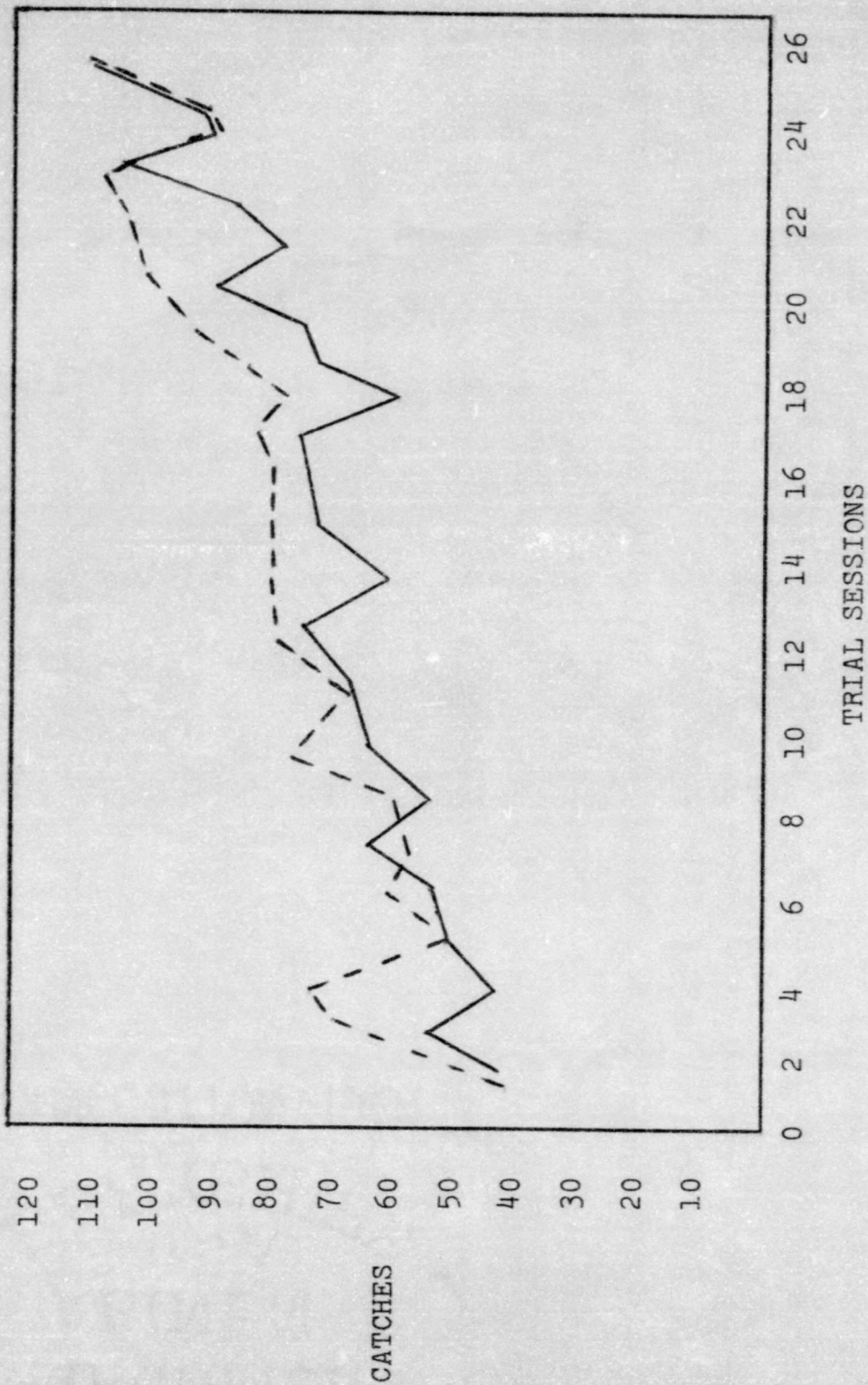
TABLE 4. ANALYSIS OF COVARIANCE: BETWEEN GROUPS
MOTOR LEARNING DISPLAYED BETWEEN SAMPLE GROUPS

	Mean Square	Degrees of Freedom	F-Ratio	P
catches	24.000	1.0	0.010	0.9210
trials	2.3438	1.0	0.022	0.8802

FIGURE 1

CATCHES

Right-hand sample — Left-hand sample - - - -



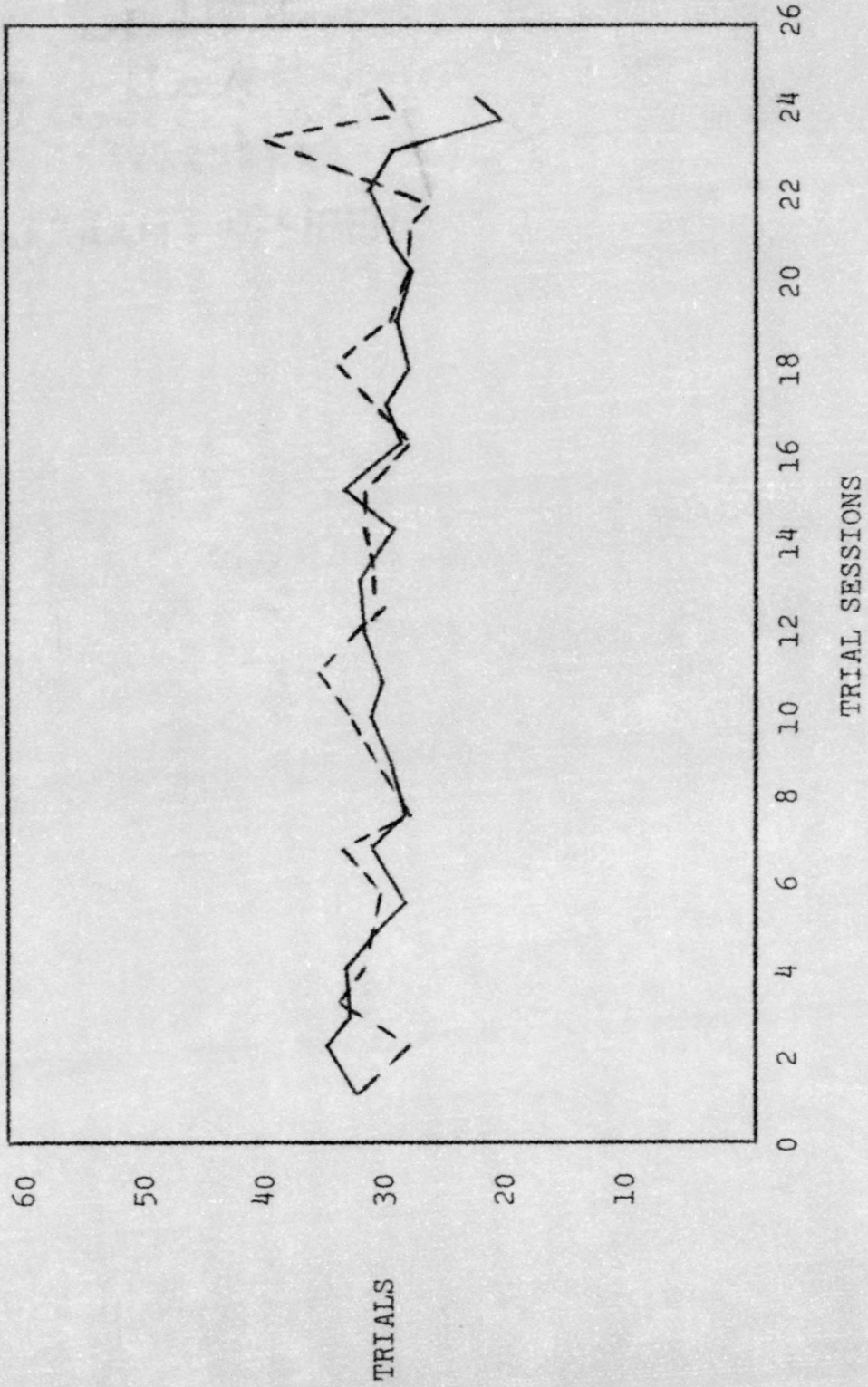
CATCHES

TRIAL SESSIONS

FIGURE 2

TRIALS

Right-hand sample ——— Left-hand sample - - - - -



based was stated in the null form: no significant difference exists between the motor learning displayed by sinistrals as compared to dextrals in the performance of a novel motor task with the non-dominant hand.

The results of the analysis of data seem to support the hypothesis. As can be seen in the graphs in Figures 1 and 2, the motor learning tendencies of the two sample groups were quite similar. Also as can be seen by the information displayed in Tables 1 and 2, both sample groups reached significant levels of learning in at least one of the two scored areas of catches or trials. The right-hand dominant sample displayed significant learning for both factors; however, the left-hand dominant sample displayed significant learning for the factor of catches only. The trials and catches measures therefore appear to measure slightly different variables involved in the task of juggling. Both the factors of catches and trials are dichotomous scoring techniques (Definitions, Chapter I), measures of quantity rather than quality of performances. But it must be acknowledged that the factor of catches appears to be more strongly and directly related to quality of performance of juggling tasks than is the factor of trials; example: the more catches one performs in a specified juggling time period, generally the more smooth, fluent and continuous the juggling motion, hence the greater quality of performance. Contrarily, a low number of trials

performed in a specified juggling time period may not necessarily indicate quality of performance. Instead it may indicate continuous performance of a jerking, sloppy, inconsistent, uncontrolled motion in which the performer barely managed to catch the juggled objects. Therefore it appears that the measure of catches is the finer, more discriminating of the two measures used to score this experimental task.

The analysis of data of this investigation resulted in a failure to reject the hypothesis. Several factors may explain this failure to reject the null hypothesis. First, by age eighteen sinistrals may be so conditioned to failure or inferiority that their psychological attitude may negatively effect their motor performances. For example, a sinistral subject participating in this investigation may have decided "I've been told for years that left-handers are strange, have criminal tendencies, and are inferior to right-handers; and this test will prove it." In such a case the sinistral was resigned to poor performance from the outset of the experiment.

A second possible explanation for the failure to reject the null hypothesis of this investigation is that sinistrals between the ages of eighteen and twenty-one have not suffered the process of forced conversion to dextrality that sinistrals of past decades have suffered, and therefore show no significant motor development over

dextrals in the use of the non-dominant hand.

A third possible explanation of the results of this investigation lies in the theories of generality versus specificity of transfer. The theory of the generality of transfer, upon which the hypothesis of this investigation was founded, implies that motor tasks with similar aspects may be transferred from skill to skill, and/or from dominant to non-dominant hand performance. For example, according to the theory of the generality of transfer, proficiency in the task of the volleyball underhand serve will transfer in some degree to the tasks of the windmill softball pitch, bowling delivery, and badminton underhand serve because all of these tasks have common factors such as ball handling and an underhand motion. Based upon this theory then it was assumed that the experimental task of juggling, although novel to all sample subjects, contained enough factors in common with other skills for some degree of proficiency to be transferred from skill to skill or from dominant to non-dominant hand performance. For example, the basketball drill mentioned in Chapter I has in common with the experimental task of juggling the factors of ball handling and visuo-motor perception.

It was assumed in the hypothesis of this investigation that based on the theory of the generality of transfer sinistrals would develop greater proficiency of

motor task performance with the non-dominant hand than would dextrals because sinistrals have had more, and more varied, experiences with non-dominant hand performance upon which to draw for transfer (Introduction, Chapter I).

The theory of the specificity of transfer, which may be in large part responsible for the results of this investigation, holds that only identical tasks lend themselves to transfer from task to task, or from dominant to non-dominant hand performance. For example, according to this theory proficiency in the task of the underhand volleyball serve may transfer to the task of the badminton serve, but not to the softball windmill pitch or bowling delivery. Considering then that the experimental task of juggling was novel to all sample subjects, the theory of specificity of transfer would indicate that neither experimental group would develop greater levels of proficiency than the other. In conclusion, the results of this investigation seem to support the theory of the specificity of transfer.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this investigation was to determine the differences between the motor learning exhibited by sinistrals as compared to dextrals in the performance of a novel motor task. The experimental design of the investigation was that of two group, multiple experimental sessions. The subjects used were volunteers from the 1977 spring semester Figure Improvement and Physical Education 100 classes at Western Kentucky University. Twelve subjects participated in the experimental program. All were female, non-physical education majors between the ages of eighteen and twenty-one. Six of these subjects made up the right-hand dominant experimental sample and the remaining six subjects composed the left-hand dominant experimental sample.

The experiment consisted of the completion of twelve sessions within a four week period. At each session each subject performed the experimental task of juggling two tennis balls in the non-dominant hand for two periods of three minutes. These performances of the

task were scored using the dichotomous factors of catches and trials. The analysis of data collected from the experiment was completed at the Academic Computing and Research Services Center of Western Kentucky University.

Conclusions

The following general conclusions were drawn from this investigation. These generalizations may apply only to the sex and age group of the sample used in this investigation.

1. No significant difference exists between the motor learning exhibited by sinistrals as compared to dextrals in the performance of motor tasks with the non-dominant hand.

2. The factors of trials and catches measure slightly different variables in the scoring of juggling tasks.

3. The factor of catches may be a finer, more discriminating scoring technique than that of trials for scoring juggling tasks.

Recommendations

1. Further experimentation using a larger sample, subjects of varying ages, and both sexes would be of considerable value in verifying or refuting the results and conclusions of this investigation.

2. The testing of catches versus trials as a more

discriminating factor in the scoring of juggling tasks could be of value in the establishment of a more reliable, more valid factor of measurement for juggling tasks.

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