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THE EFFECTS OF STUDENT AND/OR TEACHER LATERALITY
UPON JUNIOR HIGH INDUSTRIAL ARTS STUDENT
PSYCHOMOTOR SKILL DEVELOPMENT

DISSERTATION
Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By
Lyle Robert Schroeder, B.S., M.S.

* * * * *

The Ohio State University
1976

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>ii</td>
</tr>
<tr>
<td>VITA</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>ix</td>
</tr>
<tr>
<td><strong>Chapter</strong></td>
<td></td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Orientation to the Problem</td>
<td></td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>1</td>
</tr>
<tr>
<td>Objectives</td>
<td>4</td>
</tr>
<tr>
<td>Significance of the Problem</td>
<td>5</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>6</td>
</tr>
<tr>
<td>Assumptions</td>
<td>7</td>
</tr>
<tr>
<td>Review of Related Literature</td>
<td>7</td>
</tr>
<tr>
<td>II. THE EXPERIMENT</td>
<td>17</td>
</tr>
<tr>
<td>Methodology</td>
<td>17</td>
</tr>
<tr>
<td>The Sample</td>
<td>21</td>
</tr>
<tr>
<td>Laterality Grouping</td>
<td>23</td>
</tr>
<tr>
<td>Statement of Hypotheses</td>
<td>25</td>
</tr>
<tr>
<td>Definition of Variables</td>
<td>26</td>
</tr>
<tr>
<td>Instructional Procedures</td>
<td>29</td>
</tr>
<tr>
<td>Performance Activity</td>
<td>34</td>
</tr>
<tr>
<td>Evaluation Procedures</td>
<td>36</td>
</tr>
<tr>
<td>Chapter Summary</td>
<td>37</td>
</tr>
<tr>
<td>III. ANALYSIS OF THE DATA</td>
<td>39</td>
</tr>
<tr>
<td>Assembling of Groups</td>
<td>39</td>
</tr>
<tr>
<td>Overall Performance</td>
<td>43</td>
</tr>
<tr>
<td>Hypothesis I</td>
<td>50</td>
</tr>
<tr>
<td>Hypothesis II</td>
<td>56</td>
</tr>
<tr>
<td>Hypothesis III</td>
<td>62</td>
</tr>
<tr>
<td>Hypothesis IV</td>
<td>68</td>
</tr>
<tr>
<td>Progression</td>
<td>74</td>
</tr>
<tr>
<td>Chapter Summary</td>
<td>77</td>
</tr>
</tbody>
</table>
### LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time Allotments of Study</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>Student Classification by School and Class Period</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>Student Classification by Grade Level</td>
<td>41</td>
</tr>
<tr>
<td>4</td>
<td>Student Classification by Sex</td>
<td>41</td>
</tr>
<tr>
<td>5</td>
<td>Student Classification by Laterality of Presentation Observed</td>
<td>42</td>
</tr>
<tr>
<td>6</td>
<td>Student Classification by Laterality</td>
<td>43</td>
</tr>
<tr>
<td>7</td>
<td>Frequency of Students Not Completing Successive Evaluation Points</td>
<td>45</td>
</tr>
<tr>
<td>8</td>
<td>Frequency of Smoothness Evaluations</td>
<td>46</td>
</tr>
<tr>
<td>9</td>
<td>Frequency of Correctness Evaluations</td>
<td>47</td>
</tr>
<tr>
<td>10</td>
<td>Frequency of Re-Starts</td>
<td>48</td>
</tr>
<tr>
<td>11</td>
<td>Frequency of Speed Evaluations</td>
<td>49</td>
</tr>
<tr>
<td>12</td>
<td>Frequency of Progression Evaluations</td>
<td>50</td>
</tr>
<tr>
<td>13</td>
<td>Tightness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Presentations for Left-Handed Students</td>
<td>51</td>
</tr>
<tr>
<td>14</td>
<td>Smoothness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Presentations for Left-Handed Students</td>
<td>52</td>
</tr>
<tr>
<td>15</td>
<td>Correctness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Presentations for Left-Handed Students</td>
<td>53</td>
</tr>
<tr>
<td>16</td>
<td>Re-Start Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Presentations for Left-Handed Students</td>
<td>54</td>
</tr>
<tr>
<td>Table</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>17</td>
<td>Speed Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Presentations for Left-Handed Students</td>
<td>55</td>
</tr>
<tr>
<td>18</td>
<td>Tightness Means, Standard Deviations, and t-test Results of Left-Handed and Right-Handed Presentations for Right-Handed Students</td>
<td>57</td>
</tr>
<tr>
<td>19</td>
<td>Smoothness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Presentations for Right-Handed Students</td>
<td>58</td>
</tr>
<tr>
<td>20</td>
<td>Correctness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Presentations for Right-Handed Students</td>
<td>59</td>
</tr>
<tr>
<td>21</td>
<td>Re-Start Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Presentations for Right-Handed Students</td>
<td>60</td>
</tr>
<tr>
<td>22</td>
<td>Speed Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Presentations for Right-Handed Students</td>
<td>61</td>
</tr>
<tr>
<td>23</td>
<td>Tightness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Students for a Right-Handed Presentation</td>
<td>63</td>
</tr>
<tr>
<td>24</td>
<td>Smoothness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Students for a Right-Handed Presentation</td>
<td>64</td>
</tr>
<tr>
<td>25</td>
<td>Correctness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Students for a Right-Handed Presentation</td>
<td>65</td>
</tr>
<tr>
<td>26</td>
<td>Re-Start Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Students for a Right-Handed Presentation</td>
<td>66</td>
</tr>
<tr>
<td>27</td>
<td>Speed Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Students for a Right-Handed Presentation</td>
<td>67</td>
</tr>
<tr>
<td>28</td>
<td>Tightness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Students for a Left-Handed Presentation</td>
<td>69</td>
</tr>
<tr>
<td>Table</td>
<td>Smoothness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Students for a Left-Handed Presentation</td>
<td>Page</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>29</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Correctness Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Students for a Left-Handed Presentation</td>
<td>71</td>
</tr>
<tr>
<td>31</td>
<td>Re-Start Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Students for a Left-Handed Presentation</td>
<td>72</td>
</tr>
<tr>
<td>32</td>
<td>Speed Means, Standard Deviations, and t-Test Results of Left-Handed and Right-Handed Students for a Left-Handed Presentation</td>
<td>73</td>
</tr>
<tr>
<td>33</td>
<td>Yates' Corrected Chi Square of Progression by Student Laterality</td>
<td>75</td>
</tr>
<tr>
<td>34</td>
<td>Yates' Corrected Chi Square of Progression by Presentation Laterality</td>
<td>76</td>
</tr>
<tr>
<td>35</td>
<td>Significance of the Variables for Hypothesis I with Left-Handed Students</td>
<td>78</td>
</tr>
<tr>
<td>36</td>
<td>Significance of the Variables for Hypothesis II with Right-Handed Students</td>
<td>79</td>
</tr>
<tr>
<td>37</td>
<td>Significance of the Variables for Hypothesis III with a Right-Handed Presentation</td>
<td>80</td>
</tr>
<tr>
<td>38</td>
<td>Significance of the Variables for Hypothesis IV with a Left-Handed Presentation</td>
<td>80</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Experimental Design</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Pre-Punched Leather</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>Tightness Measuring Instrument</td>
<td>37</td>
</tr>
<tr>
<td>4</td>
<td>Evaluation Scheme for Student Performance</td>
<td>44</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

Orientation to the Problem

The preference of a living organism to use one side of the body more than the other is evident in all forms of life. For example, one of a lobster's claws is larger than the other one. Another example is the overlapping of the cricket's wings when it is not in flight so the same one is always on top (Milne, 1948, p. 46). There are a large variety of motor activities evident in the human being which express the characteristic of sidedness. Some of the most common ones are things such as handedness, eyedness, and footedness. Laterality, preference, dominance, and many other terms have been used to denote this characteristic.

Handedness is socially and educationally one important factor of sidedness. During the Bronze Age, superstitions relating left-handedness to evilness resulted in the development of a social code which made the practice of sinistrality (left-handedness) punishable (Hildreth, 1950, p. 39). Although society favors right-handedness, left-handedness exists and has been increasing in incidence for the past several years. Clark (1951, pp. 118-27) reports that four to six per cent of the people in Britain, France, Greece, and the United States are left-handed. Other reports indicate that as many as
30 per cent are inclined to be left-handed in certain activities (Clem, 1954, p. 16). Groden (1969, pp. 213-4) conducted a handedness test consisting of writing, drawing, throwing, and cutting using five to eleven year old subjects. The data consistently produced 81 per cent right-handed responses. The other 19 per cent were either left-handed or of mixed laterality.

Dayhaw (1953, pp. 196-9) says that the left-handed person suffers many frustrations throughout the day because society has provided more for right-handed individuals. Very few schools have an adequate number of left-handed desks and other equipment with practically no demonstrations being presented specifically for the left-handed student. Leading school furniture dealers report less than one per cent of orders are for left-handed students (McNamee, 1968, p. 35). A Detroit study of elementary school children revealed that 6.4 per cent were left-handed, and that 62 per cent of these were boys (Dell, 1941, pp. 481-7). McNamee's (1968, p. 34) research indicated that 11 per cent of the students are left-handed, of which 56 per cent were boys. Since the typical industrial arts class today consists predominately of boys, it appears evident that there should be some attention directed towards the performance of the left-handed industrial arts student.

There is much concern in education for the disadvantaged and minority students. One type of disadvantaged or minority group relative to educational practice may be left-handed learners. Little if anything special is being done for them. They are usually subjected to educational experiences that are slanted towards right-handed
individuals. They belong to a minority group whose members at most, if they are lucky, will be given desks designed for their sidedness.

Enstrom (1969, p. 43) advocates grouping left-handed students in the front, right corner of the classroom facing the chalkboard or overhead projection screen. In this position the left-handed students will be more likely to be observing the graphic presentations in a manner that is most similar to the way they observe their own papers. This grouping also allows the left-handed student to obtain emotional reinforcement from those close to him.

Is the left-handed student's writing technique the mirror image or an inverted adaptation of the right-handed style? By the junior high school level, most students will have mastered their own style of writing to a suitable degree of perfection. But, will they attempt to apply the same technique in performing the various motor skills required in the typical industrial arts learning activities?

External pressures and conditions unique to the industrial arts classroom may be a more influential determinant of hand preference in some activities than in others. Specific tools, machines, and their safety precautions sometimes dictate their usage. Many tools can be used efficiently with either hand. Some may present very little problem to the "mirror image performer" (reversed handedness), while others might be somewhat more confusing. A hammer can be used with either hand when driving a nail. However, when using a brace and bit to bore a hole the rotation must be in a clockwise motion regardless of which hand applies the rotating force. The portable electric saw presents many more frustrations. The left-handed operator must either
cross his arms, stand in line with the chip removal, or use his non-preferenced hand. This not only presents an efficiency problem, but a safety problem as well.

There are some activities which deal primarily with the procedure of actions without the use of tools. Sorting items by various lengths should not present a problem to the left-handed student. But the tying of knots could be a more frustrating experience. For example, does the student try to model a teacher's demonstrated performance while making an underwriter's knot or use a "mirror image performance."

**Statement of the Problem**

The purpose of this research study is to present evidence about the effects of student and/or teacher laterality upon junior high school student psychomotor skill development. It is not known whether the mirror image which a student sees in a teacher presentation handicaps him in the performance of the motor skills required in typical industrial arts learning activities.

**Objectives**

The specific objectives of this study shall be limited to the following:

1. To ascertain which presentation laterality (left or right-handed) is best for the left-handed industrial arts student.
2. To ascertain which presentation laterality (left or right-handed) is best for the right-handed industrial arts student.

3. To determine if the left-handed industrial arts student is handicapped by observing a right-handed presentation.

4. To determine if the right-handed industrial arts student is handicapped by observing a left-handed presentation.

**Significance of the Problem**

Since it is evident that approximately 11 per cent of the population is left-handed, one can assume that the same percentage of left-handedness will be represented by junior high students and their teachers (McNamee, 1968, p. 34). This produces classes composed of students from both laterality groups. Some will possess the same laterality as the teacher, others will not. It is not known whether these laterality differences are an important factor in the teaching and/or learning of selected industrial arts activities.

If student or teacher laterality is a disadvantage to some learners, there is a need to modify the teaching methods and procedures to lessen such a disadvantage. More specifically, the analysis of data from this study will enable the researcher to describe either the left-handed students' or the right-handed students' performance after observing either left-handed or right-handed instructional presentations.
**Definition of Terms**

Commonly used terms often represent different meanings to different people. The following terms are to be used in this study in reference to the following definitions.

1. **Left-handed student**: a student who uses his left hand, in preference to his right, in performing habitual tasks such as writing his name.

2. **Right-handed student**: a student who uses his right hand, in preference to his left, in performing habitual tasks such as writing his name.

3. **Laterality**: a common term used to denote the characteristic of sidedness.

4. **Right-handed presentation**: a technical skill demonstrated by a right-handed teacher.

5. **Left-handed presentation**: a technical skill demonstrated by a left-handed teacher.

6. **Mirror image**: a true representation or description but portraying reversed laterality.

7. **Mixed-hand dominant**: an individual who does not exhibit a preferred handedness laterality for performing a specific task.

8. **Ambidextrous**: the ability to use either hand equally well for performing any specific task.
Assumptions

All research is based on some assumptions. The major assumptions for this study are as follows.

1. Neither the mental nor the physical ability of the student is dependent upon his laterality.

2. Both the equipment and the procedure variables can be controlled in a selected industrial arts learning situation that is based on a psycho-motor activity.

3. Clustered sampling will provide a number of subjects who are representative of the total population.

Review of Related Literature

Man is born into the world as a small helpless baby, usually weighing between five to ten pounds. He has no learned or unlearned skills as such, but relies on inborn inherited traits and characteristics and a few natural instincts. He grows and develops physically, mentally, and emotionally through time. Man is "built" to be symmetrical about a vertical plane with respect to his external features. Physiologically, he has a "choice" of using either his left or right hand (arm), foot (leg), eye, and ear. This option of usage is classified as laterality. George (1972, p. 157) calls this laterality an awareness of space with reference to left and right sides of the body.
Laterality. The most common way of looking at man's laterality is to categorize him as either right-hand dominant, left-hand dominant, or of mixed dominance. Hubbard (1971, p. 276) has combined the research of others on the incidence of left-handedness which lends support to the belief that handedness is not determined through inheritance or birth order.

Infants show no hand preference, usually using whichever hand is most convenient at the moment (Seth, 1973, p. 35). At about the 3rd quarter of the 1st year the use of their left hand gives way to the right-hand dominance in a maturational form of development. Handedness, which is a part of the motor functioning, continues as a maturational factor in children of mental ages up to seven or eight years of age (Bannatyne, 1969; Sakano, 1970).

Some individuals fail to establish a firm unilateral preference. They are uncertain which hand they will use from task to task. These individuals are categorized as being mixed-or crossed-dominant. O'Donnell (1970) identifies a small number of individuals in this category as being ambidextrous. Those who, in addition to showing the lack of strong unilateral preference, can perform given tasks equally well with either hand. Ambidexterity increases with age (Govatos, 1967, p. 598). This appears to make it a learned skill.

Left-Handedness. In addition to the right-handed dominant and mixed-hand dominant classification there is the left-handed dominant. The literature does not agree as to why they exist. The transmission of left-handedness through inheritance is not accepted by most researchers (Kock, 1933; Penfield and Roberts, 1959; Rife, 1951).
The notion of the dominant cerebral hemisphere determining handedness is rejected by many (Palmer, 1963; Penfield and Roberts, 1959; Zangwill, 1960). For example: Penfield and Roberts (1959) suggest that a psychological factor is one of the multiple determinates of handedness. Kildreth (1949) says that left-handedness is caused by emotional resistance, the refusal to function like the majority of society. Wile (1934) also thinks that there is a tendency not to conform to social conventions which causes some left-handedness. Some researchers even hint the emergence of left-handedness to personality characteristics such as the qualities of behavior aimed at achieving a personal identify (Finn and Neuringer, 1968). The theory that a cerebral hemisphere can become damaged at any time during an individual's life and cause him/her to be left-handed is supported by Reitan (1970, pp. 17-9). Using six to eight year age-range children Reitan found a significantly greater proportion of left-handedness in the group with known cerebral damage than in the normal group of children.

With all the challenging research directed against the widely held assumption that handedness is a unitary phenomenon, it appears that handedness might very well be a more complex phenomenon stemming from several aspects of motor and psychological differentiation.

**Population Classification.** The classifying of the population into the previously mentioned three groups varies somewhat. Annett (1974, p. 327) says that mixed-handers represent about one-third of the population, with the greater portion of them being questionable left-handers rather than right-handers. Some researchers indicate a left-handedness frequency as high as 30 per cent. However McNamee's (1968,
11 per cent figure for left-handedness seems to be a more universal figure.

Role of Schools. Schools go about the business of educating the youth in a "cultured" right-handed environment. Yet we have the 11 per cent of the population who are left-handed. deKay (1966) points to this situation with the following words:

Here, at last, is a KAPOW! to society from one of its most neglected, put-down minority groups: the left-hander. Everywhere he turns he finds the world and its artifacts arrayed against him. In this courageous expose, which pulls no punches, the author pitilessly strips bare the unscrupulous under-handed tactics of the right-handed majority, from the time of the Romans to the time of the Freudians...(p. back cover).

The forcing of a switched handedness can really depress a learner's ego if he/she seems unable to function satisfactorily. He/She can do very little to express or reduce this frustration if he/she cannot communicate fluently with the teacher. Because of this, Khvatsev (1968, pp. 38-43) advocates the retraining of the left-handed to right-handed at about age six to seven years. By this time it is presumed that their speech and mind will have been developed to a measure past the harmful stage because they will be communicating fluently by this time. Still, if the left-hand is quite resistent, he encourages the development of the left-hand with the right-hand being stimulated too because the individual will need to function in a society which is predominantly right-handed.

Enstrom (1968, p. 413) advocates special teaching of a left-handed style for writing by left-handers. He says that there is a need for more examples for the left-hander to observe. Skill needs to be
emphasized in the left-handers style also. Left-handed people should be able to perform tasks "differently" than right-handers. Ramos (1968, p. 47) believes left-handers should hold tools correctly in the opposite hand and move in the opposite direction from right-handers.

**Testing for Laterality.** The identifying of left-handers for research studies has been accomplished primarily through the use of questionnaires and task performance tests. Provins and Cunliffe (1972, p. 148) designed a typical handedness questionnaire for reliable identification of handedness. Different performance tasks can be used to determine the percentage of handedness. The task of unscrewing lids with the left hand denotes mild sinistral trends while operating a right-handed scissors with the left hand shows extreme sinistral traits (Annett, 1967, p. 331). However, seven or more of these tasks such as, throwing a ball, brushing one's teeth, spreading butter on bread, or carrying a heavy suitcase, are recommended to get a reliable handedness reading.

**Academic Achievement.** Much research has been conducted involving the significant difference of academic achievement between laterality groups ranging from infants through college age students. There have also been many clinical (medical) studies dealing with handedness, but they are from a limited population consisting primarily of subjects with damaged cerebral hemispheres, which is not typical to the mass public educational domain. The major studies which are relevant to this study will be summarized in the remainder of this chapter.
Douglas (1967) reported on a study which tested 5,362 British children at ages, 8, 11, and again at age 15. There were some minor differences which were accounted for by social class differences in hand usage. Using 59 Alabama elementary students, Allison (1966) found no significant difference in reading skills, perceptual-motor development, or school achievement between laterality groups. Lateral preference was found by Sabatino (1971) to have little relationship to language, perceptual-motor development, or academic achievement of 472 failing elementary school students. Groden (1969) found that lateral consistency is not necessary for normal academic achievement of five to eleven year olds. Data from 277 Florida students in grades third through twelve tends to indicate significant interaction between I.Q. and reading achievement. The correlation among left-handers was significantly lower than among right-handers (Keller, 1973).

A study of a small sampling of college freshman showed left-handers, as a group, tended to perform more poorly than right-handers on certain perceptual tasks (Silverman and others, 1966). Blai (1972) using another small college freshman sample of girls found left-handers had lower grade point averages (GPA's) after one year of college.

**Hand Efficiency/Speed.** Information regarding handedness obtained by questionnaires only identifies stated hand preferences. However, hand efficiency tests identify hand dominance along with a degree of skill level. Rigal (1974) found that the best skilled hand is not always the dominant hand. The age and growth of an individual will also effect a change in the skills of both hands (Bruml, 1972). Barnsley (1970) hints at these things when he says that the preferred
hand performance is characterized by "automatization" of the skills involved. When doing simple tasks, the non-preferred hand can move at least as fast as the preferred hand in all laterality groups. But as the tasks get more complex, the preferred hand becomes significantly better in performance (Sheridan, 1973).

**Psychomotor.** Using 618 subjects and seven hand performance tasks, Sands and Taylor (1973) found more children than adults showed faster performance with their left-hands. More adults showed equivalent time scores for both hands. He theorizes this is due to social adjustment. Hermelin (1971) has similar results with children reading Braille faster and more accurately with their left-hands, adults showed no difference between hand speeds, but had fewer mistakes with the left-hand.

Salvendy (1970) gathered data from 106 subjects using three experiments with five diversified tasks which supports the hypothesis that right-handed subjects are more likely to have higher performances and to improve more on psychomotor tasks than do left-handed subjects.

A questionnaire study of musicians was conducted by Oldfield (1969). The frequency of left-handedness among the musicians was the same percentage as that of the psychology college undergraduate student population. The musicians indicated that they had no significant difficulty in adjusting to right-handed instruments. However, they expressed a difficulty in conducting with a baton.

Peterson (1974) did an interesting study with architectural students and their faculty. The subjects were to design a spatial maze to specifications and given a chance to solve it at a later date. All
left-handed students' performance were correct, while 50 per cent of the right-handers made mistakes.

Mirror-imaging (reversed laterality) is an important factor found in psychomotor learning. Mirror image lateralizations are found predominantly among younger subjects. With age, there is a change from mirror-imaging to diagonal lateralizations, the adjusting to what appears to be reversed laterality (Gellert, 1967; Wapner and others, 1968). Bakan and Putnam (1974) found no significant difference between laterality groups on the identification of right or left body parts seen on slide projections by college undergraduates.

Another important factor associated with psychomotor learning is the position of the learner. Meyer (1969) using 49 subjects found that a significant time difference exists between learning a perceptual motor skill from the observer's position and the demonstrator's position (mirror-imaging). He found the demonstrator's position to be superior for learning the selected motor skills.

Horine (1968) used 220 ten year old boys to study the effects of laterality on the performance of selected motor tests. His data indicated that there was no significant difference between laterality groups. Ong and Rodman (1972) found no significant difference in the star-tracing performance of fourth grade laterality groups. Seventy-nine four and five year olds were used by Keogh (1972) on a Draw-A-Person Test. She found little significant difference attributable to laterality.

Horton (1972) studied individual letters in the manuscripts of 312 second graders. He found 15 per cent of the letters made by
left-handers to be illegible, while only 10 per cent for the right-handers. Horton's results tend to support the theory that right-handers perform better than left-handers in the making of legible letters.

Tyler (1971) used right-dominant, left-dominant, and mixed-dominant groups in a study which involved the practicing of three selected motor skills using the right hand, the left hand, and both hands. In his study, he found that right-handers outperformed left-handers, but the difference tended to decrease with practice. After six weeks and 18 practice sessions, he concluded that lateral dominance had little significance on the "capability" of learning selected new motor skills. Provins (1967) theorized that the key feature of performing a motor skill is the consistency of the laterality movement pattern.

Chapter Summary

Each student is said to be an individual able to perceive, learn, and perform at his own rate of development. Yet, in education we group students together and categorize them into different grade levels, fast or slow learning classes, right or left-handed laterality groups, etc. Educators continually conduct research dealing with the advantages and disadvantages of these different types of learning groups. Their findings suggest that the effects of laterality, if any, vary with regard to age, tasks performed, and other variables. However, there has been little research done on the effect of laterality in the industrial arts area. This study will attempt to gather data which can shed some light on its effect upon psychomotor achievement which
is so important to this subject.

Definitions, assumptions, and literature review are included in this chapter, along with the problem statement and comments about the significance of the problem. Subsequent chapters present a description of the experiment, analysis of the data, and the study summary, conclusions, and recommendations.
CHAPTER II
THE EXPERIMENT

As stated in Chapter I, the purpose of this study was to gather data to ascertain if the laterality of the industrial arts student and/or teacher has any effect on the teaching and/or learning of selected psychomotor skills. This chapter will describe the experiment that was used for the testing of the null-hypotheses which are stated later in this chapter. The sampling techniques will be defined. How the selected subjects were used and the observation techniques will also be explained.

Methodology

The experimental design used in this study employed the use of two distinct groups of students designated as Group A (the classes of students that observed a left-handed presentation) and Group B (the classes of students that observed a right-handed presentation). The students in Group A were further identified as $A_1$ (Group A who were left-handed) and $A_r$ (Group A who were right-handed). The students in Group B were also similarly identified as $B_1$ (Group B who were left-handed) and $B_r$ (Group B who were right-handed). Therefore, the experiment utilized four basic groups of students. By natural causes Groups $A_1$ and $B_1$ were much smaller in number than Groups $A_r$ and $B_r$. 
Independent variables. The independent variables of this study dealt with the laterality of the presentation. Group A was exposed to a left-handed presentation and Group B was exposed to a right-handed presentation. Each presentation was a mirror image of the other.

Dependent variables. The dependent variables were the performances of the two left-handed groups of students (Groups $A_1$ and $B_1$) and the two right-handed groups of students (Groups $A_r$ and $B_r$).

Controlled variables. To increase the internal validity of this study much consideration was given to controlling as many variables as possible. A "canned" presentation was used so that (1) the visual part was contained in a slide set of 27 frames, and (2) the audio portion was on an eight minute cassette tape. The tape recording was synchronized with the individual frames of the slide set. The left-handed presentation was obtained by using a second set of slides which consisted of the same frames that were used for the right-handed presentation, but the individual frames were turned 180 degrees so as to be projected in reverse. The demonstrator shown in the slide presentations wore no identifying items such as a wrist watch or finger rings. The equipment and materials used in the slide presentation and by the students in all groups were identical. The time factor was controlled by allowing all groups the same allotment of performance time.

The design. This study was a two-group post test only design. It combines good internal validity with adequate external validity. According to Campbell the pretest is not a necessity for
educational research when randomization is used to eliminate biases between groups (Gage, 1963, p. 195). Figure 1 shows a schematic of the experimental design. A verbal description of the design is as follows:

1. The sample was selected from the identified population of all the junior high school industrial arts classes (grades 7, 8, and 9) in the Columbus Public School System.
   a. The junior high schools that had industrial arts classes were identified.
   b. Cluster sampling was applied by randomly drawing three schools.
   c. Cluster sampling was again applied by randomly assigning the normal class units to one of the two laterality presentation groups.

2. Group A received the left-handed presentation and Group B received the right-handed presentation (same, but reversed).

3. Both groups were then given a block of time to practice and complete the selected performance activity.

4. The data were analyzed as follows:
   a. The performance of Groups $B_1$ (18) and $A_1$ (15).
FIGURE 1
THE EXPERIMENTAL DESIGN
b. The performance of Groups $B_r$ (115) and $A_r$ (122).
c. The performance of Groups $B_1$ (18) and $B_r$ (115).
d. The performance of Groups $A_1$ (15) and $A_r$ (122).

Analysis of the data. Several statistical tests were used in analyzing the data collected for this study. The means, standard deviations, and Separate Sample $t$-Tests were all used on the students' achievement for the tightness of the lace, the smoothness (non-twists) of the lace, the correctness of the lace, the number of re-starts, and the speed of lacing. Two Yates' Corrected Chi Squares were used to analyze the progression by laterality and by presentation.

According to Kerlinger (1973, p. 169) and Ferguson (1966, p. 164) it is a common convention in educational research to adopt levels of significance of either 0.05 or 0.01. This researcher has chosen to use the 0.05 level of significance for testing the stated null-hypotheses.

These tests and the variables that are involved will be elaborated upon in Chapter III.

The Sample

The sample was drawn from the Columbus Public School System because of its availability and its reputation of being one of the most representative cities in the United States (Chapman, 1962, p. 72). It was predetermined that the sample would consist of at least one
teacher's schedule of industrial arts classes in each of the three junior high schools. Figuring the frequency of left-handedness at 11 per cent, an N of approximately 27 should be obtained for this group. When groups number over 20 the chance of getting biased results is greatly reduced (Kerlinger, 1973, p. 129).

The three schools used for this group were randomly drawn from the following list of schools in the Columbus Public School System.

<table>
<thead>
<tr>
<th>Barrett</th>
<th>Franklin</th>
<th>Ridgeview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beery</td>
<td>Hilltonia</td>
<td>Roosevelt</td>
</tr>
<tr>
<td>Buckeye</td>
<td>Indianola</td>
<td>Sherwood</td>
</tr>
<tr>
<td>Champion</td>
<td>Johnson Park</td>
<td>Southmoor</td>
</tr>
<tr>
<td>Crestview</td>
<td>McGuffey</td>
<td>Wedgewood</td>
</tr>
<tr>
<td>Dominion</td>
<td>Medina</td>
<td>Westmoor</td>
</tr>
<tr>
<td>Eastmoor</td>
<td>Mifflin</td>
<td>Woodward Park</td>
</tr>
<tr>
<td>Everett</td>
<td>Monroe</td>
<td>Yorktown</td>
</tr>
</tbody>
</table>

The randomly drawn schools, Barrett, Crestview, and Dominion appeared to represent a fairly good cross-section of the total junior high school system. The researcher estimated the percentage of non-white participants for this experiment to be approximately thirty-three and one-third per cent. The 1975 statistics for the Columbus School District was thirty-two and one-half per cent non-white pupil composition (1975-76 Annual Report, 1976, p. 13). The individual school principals determined which teachers' schedules of classes were to be used. Primary consideration was given to obtaining the largest number of students. There were 281 students (Barrett 115, Crestview
79, and Dominion 87) who participated in this study.

**Laterality Grouping**

This experimental study was designed to analyze data from only two laterality groups, left-hand dominant and right-hand dominant. Therefore, a laterality questionnaire was administered at the end of the experiment to identify the subjects as either left-hand dominant, right-hand dominant, or of mixed dominance.

The questionnaire was developed by the researcher and consisted of 21 items. The items were picked from a standardized questionnaire (Provins and Cunliffe, 1972, pp. 148-9). Some items were rewritten into current terminology. The subjects were instructed to circle the correct response that indicated their hand preference in performing each item. The choices were: Right, Either, or Left. The following items were on the handedness questionnaire.

1. With which hand do you prefer to use a spoon when eating?
2. In which hand do you prefer to carry a full glass of water?
3. With which hand do you throw a ball?
4. When cleaning your teeth, in which hand do you hold the toothbrush?
5. In which hand do you hold the pack of matches when striking one?
6. Which hand would you use to put the key in a key hole?
7. When cutting paper, in which hand do you hold the scissors?

8. With which hand do you prefer to use a knife when cutting meat?

9. Which hand would you use to press a thumbtack into a board?

10. In which hand do you prefer to hold the pack when dealing cards?

11. With which hand do you prefer to turn a water faucet?

12. When fixing your hair, in which hand do you hold the comb or pick?

13. With which hand do you put an electrical plug into an outlet?

14. When washing dishes, in which hand do you prefer to hold the dish?

15. When buttering bread, which hand holds the bread?

16. In which hand do you prefer to hold a jar when unscrewing the lid?

17. With which hand do you hold a hammer?

18. With which hand do you write?

19. Which hand do you prefer to use to get a book from a shelf?

20. In which hand would you hold an apple while you were peeling it?

21. When feeling material to determine the texture or thickness, which hand would you use?
To evaluate each subject's handedness characteristics, the number of items answered as left-dominant were subtracted from those answered as right-dominant and the difference then divided by the total number of items asked (21). The result gave a score between +1 (completely right-handed) and -1 (completely left-handed). The researcher arbitrarily predetermined that scores ranging between +.150 and -.150 would identify those subjects who were to be considered of mixed dominance. The results placed eleven of the 281 students (3.9%) in this group. After ejecting these students from the data, the total N of 270 was available for this study.

Statement of Hypotheses

This study will attempt to provide data which test these four null-hypotheses.

1. There is no significant difference between the psychomotor performance of left-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation.

2. There is no significant difference between the psychomotor performance of right-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation.
3. There is no significant difference between the psychomotor performance of left-handed and right-handed students who are exposed to right-handed presentations.

4. There is no significant difference between the psychomotor performance of left-handed and right-handed students who are exposed to left-handed presentations.

**Definition of Variables**

In order for this study to possess good validity it was necessary to clearly define, measure, and control many variables. Through the use of clustered and random sampling such variables as the school, the class period, the grade level, and the sex of the students were considered to be representative of the total population.

**Laterality.** The previously discussed handedness questionnaire was used to classify the students as right-handed (+1 to +.150), left-handed (-1 to -.150), or of mixed dominance (between +.150 and -.150, inclusive).

**Presentation.** Each group (class) received only one treatment, an eight-minute slide presentation synchronized with a cassette tape recording. By random sampling the classes were exposed to either a left-handed presentation or a right-handed presentation. The validity was enhanced by reversing the slides for the different laterality presentations. No audio references were made to indicate handedness.
Tightness. The tightness of the lacing done by the students was checked at three predetermined points. Each check was made by inserting a calibrated, tapered probe with a force of 16-ounces. The ten-point rating scale used at each of the three points was as follows:

0—No lace at the check point.
1—From .000 through .039 of an inch.
2—From .040 through .049 of an inch.
3—From .050 through .059 of an inch.
4—From .060 through .069 of an inch.
5—From .070 through .079 of an inch.
6—From .080 through .089 of an inch.
7—From .090 through .099 of an inch.
8—From .100 through .109 of an inch.
9—From .110 of an inch and greater.

Smoothness. Smoothness was determined by counting the number of non-twisted stitches in the last two inches, or portion thereof, completed by each student. A count of "zero" up through "nine" was possible for the degree of smoothness which provided for a ten-point rating scale.

Correctness. The measure of correctness was ascertained by counting the number of correct "X's" in the last two inches, or portion thereof, completed by each student. A ten-point rating scale was used by counting from "zero" up through "nine".

Re-starts. It was predetermined that if a student removed one or more stitches of lacing he/she was, in a sense, starting over. A tally of the number of times each student re-started his/her lacing
was compiled by trained observers during the experiment.

**Speed.** The amount of time used by each student was observed and recorded by trained observers. A maximum time of 25 minutes was allotted for the performance activity. Two-minute blocks of time made up a ten-point rating scale which is as follows.

- **0**—Less than 10 minutes to complete.
- **1**—10 minutes through 11 minutes, 59 seconds.
- **2**—12 minutes through 13 minutes, 59 seconds.
- **3**—14 minutes through 15 minutes, 59 seconds.
- **4**—16 minutes through 17 minutes, 59 seconds.
- **5**—18 minutes through 19 minutes, 59 seconds.
- **6**—20 minutes through 21 minutes, 59 seconds.
- **7**—22 minutes through 23 minutes, 59 seconds.
- **8**—24 minutes through 25 minutes, 59 seconds.
- **9**—Not completed in the 25-minute block of time.

**Progression.** Progression was identified as 1) performing the lacing operation using the same laterality (direction) as seen in the presentation or 2) reversing the laterality (direction) of the lacing operation with respect to the presentation seen.

The number of re-starts and the speed were the only two evaluations made during the performance of the activity. All the other evaluations were made after the students had completed their participation in the study.
Instructional Procedures

For statistical purposes within groups, it was important that each student in Group A received the same instruction in a left-handed presentation and each student in Group B received the same instruction in a right-handed presentation. Both Groups, A and B, needed to use the same materials and tools in addition to receiving the same instruction. By changing the independent variable, statistical comparisons could be made between the two groups.

The Presentation Instrument. A professional photographer was employed to obtain good quality slides. One set of slides was developed and synchronized with a cassette tape recording for use with Group B. A duplicate set of slides was developed and secured in a reversed position in a slide container for use with Group A. The internal validity was enhanced with this type of "canned" presentation. The transcript of the audio portion of the presentation is as follows.

Frame 1. "Lacing the Double Buttonhole Stitch."
Where is it used? What is it? How is it done?

Frame 2. The double buttonhole stitch is used in leatherworking. This name tag, coin carrier, and pony-tail holder all have lace around their perimeters.

Frame 3. Many hand-carved billfolds are beautified with a laced border. Lacing is also used for holding the various parts of leather products together.
4. Larger leather items such as purses and pocket secretaries need a laced border for durability as well as for beauty.

5. Here is a key case before the lacing has been applied. The product looks much less appealing than all the ones you have just seen which had a double buttonhole stitch lace applied around them.

6. These are the items you will be using to make the double buttonhole stitch: A piece of pre-punched leather, a lacing needle, and a length of leather lace.

7. "Starting to lace". Hold the leather with one hand so the smooth side is facing you. With the other hand grasp the lacing needle so the rough side of the lace is facing up and start the needle through the first hole.

8. Pull all but about two inches of lace through the hold.

9. Bring the needle back over the top in a circular motion, upsetting it so the rough side of the lace is again facing up. Start the needle through the next hole.

10. Pull all the loose lace through the hole.
Frame 11. Bring the needle back over the top in a circular motion, upsetting it so the rough side of the lace is again facing up. Start the needle under the lace on top of the leather.

Frame 12. Pull all the loose lace through. Be sure there are no twists in the lace, then draw the lace snug.

Frame 13. Again, bring the needle back over the top in a circular motion, upsetting it so the rough side of the lace is facing up. Start the needle through the next hole.

Frame 14. Pull all the loose lace through the hole. Be sure there are no twists in the lace, then draw it snug.

Frame 15. Again, bring the needle back over the top in a circular motion, upsetting it so the rough side of the lace is facing up. Start the needle under the last TWO laces on top of the leather. You must go under an X.

Frame 16. Pull all the loose lace through. Be sure there are no twists in the lace, then draw the lace snug. When the lace is drawn snug it will form a smooth straight
edge without wrinkling the leather or leaving any loose loops in the lace.

Frame 17. After several stitches have been correctly made, the lacing starts to form a nice border around the leather. Continue to use a circular motion to bring the needle back over the top and start through the next hole.

Frame 18. Remove any twists and draw the lace snug.

Frame 19. Using a circular motion, bring the needle back over the top and start through under the last X.

Frame 20. Remove any twists and draw the lace snug.

Frame 21. Remember that good lacing is: Not twisted, Drawn snug or tight, and Correctly made.

Frame 22. These are the basic lacing steps:
   1. Through the hole.
   2. Back and through under the X.
   3. Through the next hole.
   4. Back and through under the last X.

Frame 23. Through the hole.

Frame 24. Draw the lace snug without any twists.

Frame 25. Through under the last X.

Frame 26. Draw the lace snug without any twists.
Frame 27. Continue these two basic steps:
Through the hole; Through under the
last X. When you have used all the
holes you will have mastered the double
buttonhole stitch.

Tools and Materials. All students were provided with a
two-inch by four-inch piece of pre-punched 4-5 ounce cowhide, a two-
prong lacing needle attached to a 30-inch piece of 3/32-inch leather
lace. Figure 2 shows an example of the pre-punched piece of leather.

A one-sheet hand-out was given each student as an aid in
performing the activity (See Appendix B). It contained sketches
showing the first seven steps of the lacing activity in the same
laterality that was used in the slide presentation. Therefore the
students did not have to rely on their memory to start the activity.
An additional visual aid sheet titled "Under an X" was used to show
an enlarged "X" from which the double buttonhole stitch gets its name.
One sheet per three students provided everyone with a good view. Thus,
the participation of each student was insured (See Appendix C.).

The researcher operated the slide projector and cassette
tape recorder for all presentations. He made observations during the
performance phase and secured any needles which came loose from their
lace. In this way, no student lost any appreciable amount of time due
to defective materials or equipment.

Handedness Questionnaire. When each student completed his
lacing activity or when the allotted time was consumed, he was given
a pencil and asked to answer the items on the bottom of the hand-out
A, B, and C indicate checkpoints for measuring the tightness of the lacing.

sheet, which was the handedness questionnaire. The laced leather was then collected with the completed questionnaire.

Time Schedule. Each school used for this study operated on a 42-minute class schedule which allowed for an adequate time sequence for the various phases of this research project. Table 1 shows these time allowances. Proper pre-counting and arrangement of materials and equipment made this time allotment very efficient.

Performance Activity

Task. Each class of students observed the "canned" presentation, was given their individual materials and equipment, and their own hand-out sheet. They were then orally given the following instructions.
TABLE 1

TIME ALLOTMENTS OF STUDY

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time in Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seating and Introduction</td>
<td>2</td>
</tr>
<tr>
<td>Presentation</td>
<td>8</td>
</tr>
<tr>
<td>Distribution of Materials</td>
<td>1</td>
</tr>
<tr>
<td>Practice and Performance</td>
<td>25</td>
</tr>
<tr>
<td>Handedness Questionnaire</td>
<td>5</td>
</tr>
<tr>
<td>Collection of Items</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42 Minutes</strong></td>
</tr>
</tbody>
</table>

1. You are to apply the double buttonhole stitch along the pre-punched side of the leather just like you saw it being done in the slide presentation.

2. Each one of you have your own hand-out sheet which shows you the steps that you saw in the slide presentation.

3. Feel free to take a stitch out if it is wrong and start again.

4. When you go under an "X" you MUST go under TWO pieces of lace as shown on the large visual aid.

5. If the needle comes off the lace raise your hand and I will come to you and put it back on again.
6. Let one of the observers know as soon as you are done so they can give you further directions. (Actually, so the amount of consumed time could be recorded.)

**Evaluation Procedures**

In order to evaluate each student's performance, a rating scale was developed for each item. Specific standards were established, with some variance allowances, for the comparison of different groups.

Three of the eight different evaluations made on each student's performance had to do with the tightness of the lace. The researcher designed and manufactured the instrument with which the tightness could be read directly on a ten-point scale (See Figure 3). Each unit covered a space of .010 of an inch. A "zero" reading indicated that there was no lace completed at the established check-point. The tightest measurement recorded was a "one" while a "nine" indicated the least tight measurement. The instrument was inserted with a pressure of 16-ounces between the lace and the leather piece at three different points, each one inch apart. See Figure 2 for the location of these three checkpoints.

A count was made using the last two inches of completed lace to evaluate both the smoothness and the correctness of the lacing. A ten-point scale was used for both of these evaluations. A count of "nine" indicated the best performance and a "one" count the poorest performance on both items. "Zero" was used to record that the student
had not completed any non-twisted stitches (smoothness) or made any correct stitches (correctness).

The students were observed performing their lacing operations so that a tally could be obtained which indicated the total number of times that each student removed one or more stitches to re-start. A ten-point scale was used with "zero" indicating no re-starts. Nine or more re-starts were recorded as a "nine" which was the top of the scale.

Speed was a measure of the time consumed by each student in the performance of the lacing activity. The allotted time of 25 minutes was divided into ten units. "Zero" indicated that the student
required less than ten minutes to complete the lacing activity. "One," "two", "three", "eight" were used to record additional two-minute unit. A "nine" indicated that the student did not complete the activity within the 25 minutes allotted time.

The progression of the lacing was observed and evaluated simply by a "yes" or "no" tally. Yes, if the student's lacing advanced in the same direction as in the presentation. No, if it advanced in the opposite direction from that used in the presentation.

The subjectivity of the observers' evaluations were controlled by applying the counting technique. The specially designed tightness instrument was used for all three measurement evaluations (See Figure 3).

Chapter Summary

This chapter explained the necessary details involved in conducting this study. The methodology of the study was explained, including the selection of the sample, and the developing of the two treatment laterality groups. The important variables were identified and defined. The instructional procedures and the psychomotor performance activity were discussed in detail. Procedures for the evaluation of the activity were elaborated upon for clarification.
CHAPTER III

ANALYSIS OF THE DATA

The data collected in the study are reported in this chapter. The statistical tests which were applied to test the null-hypotheses stated in Chapter II also are described.

Assembling of Groups

Students from the three junior high schools were randomly assigned by classes to Group A (left-handed presentation) or Group B (right-handed presentation). According to Campbell the pretest is not a necessity for educational research when randomization is used to eliminate biases between groups (Gage, 1963, p. 195). As indicated in Table 2, each school contributed approximately the same number of students for this study. Just a little over one-third (40.9%) were from Barrett, with Crestview (28.1%), and Dominion (31.0%) comprising just under one-third each.

The students for this study came from each one of the regular nine periods comprising the normal school day. By using all the students of one teacher's daily schedule, more reliable results were obtained because the early morning "student readiness" compensated for the late afternoon "student tiredness." The "before lunch" period also compensated for the "after lunch" period. Table 2 also shows how each class period was represented in this study. The
### TABLE 2

**STUDENT CLASSIFICATION BY SCHOOL AND SCHOOL PERIOD**

<table>
<thead>
<tr>
<th>School Period</th>
<th>Barrett</th>
<th>Crestview</th>
<th>Dominion</th>
<th>Total Period Frequency</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21</td>
<td>18</td>
<td>14</td>
<td>53</td>
<td>18.9</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>-</td>
<td>25</td>
<td>36</td>
<td>12.8</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>16</td>
<td>-</td>
<td>26</td>
<td>9.3</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>15</td>
<td>5.3</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>-</td>
<td>24</td>
<td>37</td>
<td>13.2</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>23</td>
<td>-</td>
<td>35</td>
<td>12.5</td>
</tr>
<tr>
<td>7</td>
<td>23</td>
<td>-</td>
<td>14</td>
<td>37</td>
<td>13.2</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>22</td>
<td>-</td>
<td>32</td>
<td>11.4</td>
</tr>
<tr>
<td>9</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>10</td>
<td>3.6</td>
</tr>
</tbody>
</table>

|               | 115     | 79        | 87       | 281                    | 100.0%   |

|               | 40.9%   | 28.1%     | 31.0%    |                       |          |

The first period of the school day represented the highest number of students with 53 or 18.9 per cent. The ninth period was the lowest with 10 students or 3.6 per cent followed closely by the fourth period with 15 students or 5.3 per cent. The remaining six period were quite evenly represented.

All junior high grade levels were represented in this study. The largest number of students was in the seventh grade, 104 or 37 per cent. One-third of the students were ninth graders, 94 or 33.5 per cent. The eight grade provided 72 students or 25.6 per cent.
TABLE 3
STUDENT CLASSIFICATION BY GRADE LEVEL

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Frequency</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>7th</td>
<td>104</td>
<td>37.0</td>
</tr>
<tr>
<td>8th</td>
<td>72</td>
<td>25.6</td>
</tr>
<tr>
<td>9th</td>
<td>94</td>
<td>33.5</td>
</tr>
<tr>
<td>E.M.R.</td>
<td>11</td>
<td>3.9</td>
</tr>
</tbody>
</table>

N = 281

Eleven students or 3.9 per cent were from an Educable Mentally Retarded (E.M.R.) class. Table 3 indicates the distribution of students by grade level.

Both male and female students were represented in this study. Due to the tradition that boys take industrial arts and girls take home economics, only seven or 2.5 per cent of the students were females. The males dominated the statistics with 274 students or 97.5 per cent. The classification of students by sex is indicated in Table 4.

TABLE 4
STUDENT CLASSIFICATION BY SEX

<table>
<thead>
<tr>
<th>Sex</th>
<th>Frequency</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>7</td>
<td>2.5</td>
</tr>
<tr>
<td>Male</td>
<td>274</td>
<td>97.5</td>
</tr>
</tbody>
</table>

N = 281
The laterality of the presentation shown the students was used as the independent variable for this experimental study. Group A observed a left-handed presentation and Group B observed a right-handed presentation. As explained in Chapter II, the reversing of the video slide frames enabled both presentations to be identical, except for the laterality of performance. Group A and Group B were very nearly equal. One-hundred thirty-eight or 49.1 per cent of the students were in Group A (left) and 143 or 50.9 per cent were in Group B (right). This equality of groups is shown in Table 5.

**TABLE 5**

**STUDENT CLASSIFICATION BY LATERALITY OF PRESENTATION OBSERVED**

<table>
<thead>
<tr>
<th>Laterality of Presentation</th>
<th>Frequency</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A (Left-handed)</td>
<td>138</td>
<td>49.1</td>
</tr>
<tr>
<td>Group B (Right-handed)</td>
<td>143</td>
<td>50.9</td>
</tr>
</tbody>
</table>

N = 281

The laterality of the student was an important part of this study. As stated in Chapter II, the dependent variables were the performances of the two left-handed and two right-handed groups of students. A twenty-one item questionnaire was administered to each of the students after the completion of the experiment. By evaluating the questionnaires according to the formula explained in Chapter II, the students were classified as being left-dominant, right-dominant, or of mixed dominance.
Thirty-three or 11.7 per cent of the students were placed in the left-dominant group. The right-dominant group contained 237 students or 84.3 per cent of the total. Prior to conducting this experiment the researcher decided to exclude the mixed-dominance group of students from the statistical analysis for this study. Eleven students or 3.9 per cent were in this mixed dominance group, thus leaving an N of 270 for this study. Table 6 indicates the laterality of the students in this study.

**TABLE 6**

**STUDENT CLASSIFICATION BY LATERALITY**

<table>
<thead>
<tr>
<th>Laterality</th>
<th>Frequency</th>
<th>Per Cent</th>
<th>Adjusted Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>33</td>
<td>11.7</td>
<td>12.2</td>
</tr>
<tr>
<td>Right-handed</td>
<td>237</td>
<td>84.3</td>
<td>87.8</td>
</tr>
<tr>
<td>*Either (Mixed Dominance)</td>
<td>11</td>
<td>3.9</td>
<td><em>(Rejected)</em></td>
</tr>
</tbody>
</table>

N = 270
*Rejected from statistical analysis

**Overall Performance**

Data to test each of the four major null-hypotheses are analyzed in this section. Each major hypothesis is further analyzed in terms of sub-hypotheses which deal with data that pertain to each of the five variables used to measure the performance of all groups. Figure 4 shows the evaluation scheme for overall performance of the students.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Evaluation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tightness</td>
<td>Mean score of three points</td>
<td>Ten units of clearance, each .010 inch</td>
</tr>
<tr>
<td>Smoothness</td>
<td>Count of number of non-twisted stitches in last two inches of lace or portion thereof.</td>
<td>Ten units</td>
</tr>
<tr>
<td>Correctness</td>
<td>Count of number of correct &quot;X's&quot; made in last two inches of lace or portion thereof.</td>
<td>Ten units</td>
</tr>
<tr>
<td>Re-starts</td>
<td>Tally of number of times student removed one or more stitches.</td>
<td>Ten units</td>
</tr>
<tr>
<td>Speed</td>
<td>Blocks of time units required to complete lacing activity.</td>
<td>Nine two-minute time blocks following a ten-minute base block.</td>
</tr>
</tbody>
</table>

**FIGURE 4**

**EVALUATION SCHEME FOR STUDENT PERFORMANCE**

*Tightness.* As shown in Chapter II, Figure 2, three measures of tightness were evaluated at predetermined points for each student. Thirty-five or 12.5 per cent of the students did not complete the lacing activity to the first evaluation point. Ninety-one or 32.4 per cent did not reach the second evaluation point. Approximately one-half the students, 136 or 48.4 per cent did not complete the lacing through the third evaluation point. Table 7 shows this information.
TABLE 7

FREQUENCY OF STUDENTS NOT COMPLETING SUCCESSIVE EVALUATION POINTS

<table>
<thead>
<tr>
<th>Point of Measurement</th>
<th>Frequency</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>35</td>
<td>12.5</td>
</tr>
<tr>
<td>2nd</td>
<td>91</td>
<td>32.4</td>
</tr>
<tr>
<td>3rd</td>
<td>136</td>
<td>48.4</td>
</tr>
</tbody>
</table>

In order not to contaminate the data which deal with the student's speed, a mean score for the tightness of each student's lace was ascertained in the following manner. The tightness mean was tightness #1, plus tightness #2, plus tightness #3, divided by three. If the third evaluation point was not completed, the mean was tightness #1, plus tightness #2, divided by two. If both the second and third evaluation points were not completed, the mean was tightness #1. If none of the evaluation points was completed, there was no mean computed. Therefore, the tightness variable contains a different number of cases than the other variables.

Smoothness. Smoothness was evaluated by counting the number of non-twisted stitches completed within the last two-inches of lacing, or portion thereof, that each student had completed. Eighteen or 6.4 per cent of the students did not complete any stitches without twists within the last two-inches of lacing. Ninety-seven or 34.5 per cent completed all the stitches within the last two inches of lacing without twists. The smoothness evaluations are recorded in Table 8.
TABLE 8
FREQUENCY OF SMOOTHNESS EVALUATIONS

<table>
<thead>
<tr>
<th>No. of Non-twisted Stitches</th>
<th>Frequency</th>
<th>Per cent</th>
<th>Cumulative Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>18</td>
<td>6.4</td>
<td>6.4</td>
</tr>
<tr>
<td>1</td>
<td>23</td>
<td>8.2</td>
<td>14.6</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>6.4</td>
<td>21.0</td>
</tr>
<tr>
<td>3</td>
<td>22</td>
<td>7.8</td>
<td>28.8</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
<td>6.8</td>
<td>35.6</td>
</tr>
<tr>
<td>5</td>
<td>19</td>
<td>6.8</td>
<td>42.3</td>
</tr>
<tr>
<td>6</td>
<td>23</td>
<td>8.2</td>
<td>50.5</td>
</tr>
<tr>
<td>7</td>
<td>16</td>
<td>5.7</td>
<td>56.2</td>
</tr>
<tr>
<td>8</td>
<td>26</td>
<td>9.3</td>
<td>65.5</td>
</tr>
<tr>
<td>9</td>
<td>97</td>
<td>34.5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Median 6.435

The median of 6.435 indicates that approximately one-half the students completed two-thirds of their last two inches of lacing without any twists (mistakes).

Correctness. The correctness of the lacing was evaluated by counting the number of correctly made "X's" in the last two inches of lacing, or portion thereof, that each student completed. One-hundred nine or 38.8 per cent of the students did not complete any of the stitches correctly. Seventy-one or 25.3 per cent completed all of the last two inches of stitches correctly. The correctness evaluations are recorded in Table 9.
The median of 1.484 indicates that less than one-half the students completed two or more stitches correctly in their last two inches of lacing.

Re-starts. The removing of one or more stitches by the student was considered as if he/she was starting over. Ninety-six or 34.2 per cent of the students did not remove any stitches during the performance of the lacing activity. Ninety or 32.0 per cent started over once. Five or 1.8 per cent of the students started over five or more times. The number of times the students re-started the lacing activity is shown in Table 10.
TABLE 10
FREQUENCY OF RE-STARTS

<table>
<thead>
<tr>
<th>No. of Times Re-started</th>
<th>Frequency</th>
<th>Per cent</th>
<th>Cumulative Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>96</td>
<td>34.2</td>
<td>34.2</td>
</tr>
<tr>
<td>1</td>
<td>90</td>
<td>32.0</td>
<td>66.2</td>
</tr>
<tr>
<td>2</td>
<td>62</td>
<td>22.1</td>
<td>88.3</td>
</tr>
<tr>
<td>3</td>
<td>19</td>
<td>6.8</td>
<td>95.0</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>3.2</td>
<td>98.2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>0.7</td>
<td>98.9</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>0.4</td>
<td>99.3</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>0.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Median 0.994

The median of 0.994 indicates that there was a smaller number of students who started over more than once than there were who did not start over.

**Speed.** Each student's speed was evaluated in terms of the number of two-minute blocks of time that he/she required to complete the lacing activity. Seven or 2.5 per cent of the students completed the lacing activity in less than twelve minutes. One hundred sixty or 56.9 per cent of the students did not complete the lacing activity in the allotted time of twenty-five minutes. Table 11 shows the frequencies for the speed of all students.
## TABLE 11
FREQUENCY OF SPEED EVALUATIONS

<table>
<thead>
<tr>
<th>Code</th>
<th>Time Blocks</th>
<th>Frequency</th>
<th>Per cent</th>
<th>Cumulative Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 min. thru 11 min. 59 sec.</td>
<td>7</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>2</td>
<td>12 min. thru 13 min. 59 sec.</td>
<td>13</td>
<td>4.6</td>
<td>7.1</td>
</tr>
<tr>
<td>3</td>
<td>14 min. thru 15 min. 59 sec.</td>
<td>19</td>
<td>6.8</td>
<td>13.9</td>
</tr>
<tr>
<td>4</td>
<td>16 min. thru 17 min. 59 sec.</td>
<td>12</td>
<td>4.3</td>
<td>18.1</td>
</tr>
<tr>
<td>5</td>
<td>18 min. thru 19 min. 59 sec.</td>
<td>15</td>
<td>5.3</td>
<td>23.5</td>
</tr>
<tr>
<td>6</td>
<td>20 min. thru 21 min. 59 sec.</td>
<td>11</td>
<td>3.9</td>
<td>27.4</td>
</tr>
<tr>
<td>7</td>
<td>22 min. thru 23 min. 59 sec.</td>
<td>13</td>
<td>4.6</td>
<td>32.0</td>
</tr>
<tr>
<td>8</td>
<td>24 min. thru</td>
<td>31</td>
<td>11.0</td>
<td>43.1</td>
</tr>
<tr>
<td>9</td>
<td>Not completed</td>
<td>160</td>
<td>56.9</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Median 8.622

The median of 8.622 indicates that approximately one-half of the subjects completed the lacing activity.

Progression. In addition to the major evaluations to support or reject the four null-hypotheses, a progression evaluation was recorded. As shown in Table 12 only four or 1.4 per cent of the students reversed the direction of the lacing activity with respect to the direction that they observed in the slide presentation.
TABLE 12

FREQUENCY OF PROGRESSION EVALUATIONS

<table>
<thead>
<tr>
<th>Direction of Lacing</th>
<th>Frequency</th>
<th>Per cent</th>
<th>Cumulative Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversed</td>
<td>4</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Not Reversed</td>
<td>277</td>
<td>98.6</td>
<td>100.0</td>
</tr>
</tbody>
</table>

N = 281

Statistical Tests. The means and standard deviations were computed on the students' achievements for the tightness of the lace, the smoothness (non-twists) of the lace, the correctness of the lace, the number of re-starts, and the speed of lacing. A Separate Sample t-Test was then computed using the Statistical Package for the Social Sciences Program (SPSS) at The Ohio State University Computer Center. This statistical package modifies the degrees of freedom when there is a variance between two sample groups of unequal size. This type of t-test has good reliability for this study because the significance of "specific differences" was being tested.

Hypothesis I

There is no significant difference between the psychomotor performance of left-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. This general hypothesis was tested with five specific performance variables.
Sub-hypothesis $I_A$

There is no significant difference in the average tightness of the lacing between the left-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. Table 13 presents the means and standard deviations for these two groups of left-handed students.

\textbf{TABLE 13}

\textbf{TIGHTNESS MEANS, STANDARD DEVIATIONS, AND} \textbf{t-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED PRESENTATIONS FOR LEFT-HANDED STUDENTS}

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>14</td>
<td>4.0357</td>
<td>1.886</td>
</tr>
<tr>
<td>Right-handed</td>
<td>16</td>
<td>3.6458</td>
<td>1.483</td>
</tr>
</tbody>
</table>

\textbf{t Value} = 0.62  
\textbf{Degrees of Freedom} = 24.63  
\textbf{Significant Level} = 0.539

It can be seen from Table 13 that the right-handed presentation group mean was 0.3899 tighter than the left-handed presentation group mean. This places the right-handed presentation group mean in the scale unit from .050 through .059 of an inch clearance. The left-handed presentation group mean is in the scale unit from .060 through .069 of an inch clearance.

Table 13 also shows the \textbf{t-test results of the difference in laterality presentations for left-handed students}. The difference...
was not significant at the .05 level of significance. Therefore, sub-hypothesis $I_A$ is tenable since there is no significant difference.

Sub-hypothesis $I_B$

There is no significant difference in the smoothness (non-twists) of the lacing between the left-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. Table 14 presents the means and standard deviations for these two groups of left-handed students.

**TABLE 14**

SMOOTHNESS MEANS, STANDARD DEVIATIONS, AND t-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED PRESENTATIONS FOR LEFT-HANDED STUDENTS

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>15</td>
<td>6.0667</td>
<td>3.058</td>
</tr>
<tr>
<td>Right-handed</td>
<td>18</td>
<td>5.2222</td>
<td>3.282</td>
</tr>
</tbody>
</table>

$t$ Value = 0.76

Degrees of Freedom 30.58

Significant Level 0.451

It can be seen from Table 14 that the left-handed presentation group mean was 0.8445 smoother (less twists) than the right-handed presentation group mean. This indicates that the left-handed presentation mean is almost one non-twisted stitch more than the right-handed presentation mean.
Table 14 also shows the t-test results of the difference in laterality presentations for left-handed students. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis $I_B$ is tenable since there is no significant difference.

**Sub-hypothesis $I_C$**

There is no significant difference in the correctness of the lacing between the left-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. Table 15 presents the means and standard deviations for these two groups of left-handed students.

### TABLE 15

**CORRECTNESS MEANS, STANDARD DEVIATIONS, AND $t$-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED PRESENTATIONS FOR LEFT-HANDED STUDENTS**

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>15</td>
<td>2.0000</td>
<td>2.591</td>
</tr>
<tr>
<td>Right-handed</td>
<td>18</td>
<td>4.1111</td>
<td>3.969</td>
</tr>
</tbody>
</table>

$t$ Value $= 1.84$

Degrees of Freedom $= 29.47$

Significant Level $= 0.077$

It can be seen from Table 15 that the right-handed presentation group mean was 2.1111 more correct than the left-handed presentation group mean. This indicates that the right-handed presentation mean is just over two correctly made stitches more than the left-handed
presentation mean.

Table 15 also shows the t-test results of the difference in laterality presentations for left-handed students. The difference was approaching the .05 level of significance. Therefore, sub-hypothesis \( H_0 \) is tenable with caution because there very well might have been some effect due to the different laterality presentations.

Sub-hypothesis \( H_D \)

There is no significant difference in the number of re-starts for the lacing activity between the left-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. Table 16 presents the means and standard deviations for these two groups of left-handed students.

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>15</td>
<td>1.2000</td>
<td>1.082</td>
</tr>
<tr>
<td>Right-handed</td>
<td>18</td>
<td>1.2222</td>
<td>1.263</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 0.05 \]

\[ \text{Degrees of Freedom} = 30.96 \]

\[ \text{Significant Level} = 0.957 \]
It can be seen from Table 16 that the left-handed presentation group mean was 0.0222 fewer than the right-handed presentation group mean. This indicates that the left-handed presentation mean represents only a minimal amount of fewer re-starts than the right-handed presentation mean.

Table 16 also shows the t-test results of the difference in laterality presentations for left-handed students. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis $I_D$ is tenable since there is no significant difference.

Sub-hypothesis $I_E$

There is no significant difference in the lacing speed between the left-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. Table 17 presents the means and standard deviations for these two groups of left-handed students.

TABLE 17

SPEED MEANS, STANDARD DEVIATIONS, AND t-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED PRESENTATIONS FOR LEFT-HANDED STUDENTS

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>15</td>
<td>7.4667</td>
<td>2.642</td>
</tr>
<tr>
<td>Right-handed</td>
<td>18</td>
<td>7.0000</td>
<td>2.765</td>
</tr>
</tbody>
</table>

$t$ Value $= 0.49$

Degrees of Freedom $= 30.38$

Significant Level $= 0.624$
It can be seen from Table 17 that the right-handed presentation group mean was 0.4667 faster than the left-handed presentation group mean. But, both group means are in the 22-minute through 23-minute, 59-second time block.

Table 17 also shows the t-test results of the difference in laterality presentations for left-handed students. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis I_E is tenable since there is no significant difference.

Hypothesis I Summary

From this analysis, it is evident that for this hypothesis the greatest mean difference was attained by the right-handed presentation group for the correctness variable. With a probability of 0.077, it was approaching the .05 level of significance. The means of the other four variables, tightness, smoothness, re-starts, and speed were no where near the .05 level of significance.

Hypothesis II

There is no significant difference between the psychomotor performance of right-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. This general hypothesis was tested with five specific performance variables.
Sub-hypothesis $II_A$

There is no significant difference in the average tightness of the lacing between the right-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. Table 18 presents the means and standard deviations for these two groups of right-handed students.

TABLE 18

TIGHTNESS MEANS, STANDARD DEVIATIONS, AND $t$-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED PRESENTATIONS FOR RIGHT-HANDED STUDENTS

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>110</td>
<td>3.3227</td>
<td>1.740</td>
</tr>
<tr>
<td>Right-handed</td>
<td>98</td>
<td>3.7483</td>
<td>1.974</td>
</tr>
</tbody>
</table>

$t$ Value = 1.64
Degrees of Freedom = 194.75
Significant Level = 0.102

It can be seen from Table 18 that the left-handed presentation group mean was 0.4256 tighter than the right-handed presentation group mean. But, both group means are in the scale unit from .050 through .059 of an inch clearance.

Table 18 also shows the $t$-test results of the difference in laterality presentations for right-handed students. The difference was approaching the .10 level of significance. However, sub-hypothesis $II_A$ is tenable since there is no significant difference at the .05 level.
Sub-hypothesis $II_B$

There is no significant difference in the smoothness (non-twists) of the lacing between the right-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. Table 19 presents the means and standard deviations for these two groups of right-handed students.

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>122</td>
<td>5.7459</td>
<td>3.284</td>
</tr>
<tr>
<td>Right-handed</td>
<td>115</td>
<td>5.9826</td>
<td>2.985</td>
</tr>
</tbody>
</table>

$t$ Value $= 0.58$

Degrees of Freedom $= 234.70$

Significant Level $= 0.562$

It can be seen from Table 19 that the right-handed presentation group mean was 0.2367 smoother (less twists) than the left-handed presentation group mean. But, both group means represent a little under six non-twisted stitches.

Table 19 also shows the $t$-test results of the difference in laterality presentations for right-handed students. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis $II_B$ is tenable since there is no significant difference.
Sub-hypothesis \( H_{1b} \)

There is no significant difference in the correctness of the lacing between the right-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. Table 20 presents the means and standard deviations for these two groups of right-handed students.

**TABLE 20**

**CORRECTNESS MEANS, STANDARD DEVIATIONS, AND t-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED PRESENTATIONS FOR RIGHT-HANDED STUDENTS**

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>122</td>
<td>3.2787</td>
<td>3.842</td>
</tr>
<tr>
<td>Right-handed</td>
<td>115</td>
<td>4.1130</td>
<td>3.904</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 1.66 \]

\[ \text{Degrees of Freedom} = 233.68 \]

\[ \text{Significant Level} = 0.099 \]

It can be seen from Table 20 that the right-handed presentation group mean was 0.8343 more correct than the left-handed presentation group mean. This indicates that the right-handed presentation mean is almost one correctly made stitch more than the left-handed presentation mean.

Table 20 also shows the t-test results of the difference in laterality presentations for right-handed students. The difference was significant at the .10 level of significance. However,
sub-hypothesis \( I_{1c} \) is tenable since there is no significant difference at the .05 level.

**Sub-hypothesis \( I_{1d} \)**

There is no significant difference in the number of re-starts for the lacing activity between the right-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. Table 21 presents the means and standard deviations for these two groups of right-handed students.

**TABLE 21**

**RE-START MEANS, STANDARD DEVIATIONS, AND \( t \)-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED PRESENTATIONS FOR RIGHT-HANDED STUDENTS**

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>122</td>
<td>1.0410</td>
<td>0.966</td>
</tr>
<tr>
<td>Right-handed</td>
<td>115</td>
<td>1.3217</td>
<td>1.614</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 1.61 \]

Degrees of Freedom = 184.12

Significant Level = 0.108

It can be seen from Table 21 that the left-handed presentation group mean was 0.2807 fewer than the right-handed presentation group mean. This indicates that the left-handed presentation mean represents a minimal amount of fewer re-starts than the right-handed presentation mean.
Table 21 also shows the t-test results of the difference in laterality presentations for right-handed students. The difference was approaching the .10 level of significance. However, sub-hypothesis II_D is tenable since there is no significant difference at the .05 level.

**Sub-hypothesis II_E**

There is no significant difference in the lacing speed between the right-handed students who are exposed to a right-handed presentation and those who are exposed to a left-handed presentation. Table 22 presents the means and standard deviations for these two groups of right-handed students.

**TABLE 22**

SPEED MEANS, STANDARD DEVIATIONS, AND t-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED PRESENTATIONS FOR RIGHT-HANDED STUDENTS

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>122</td>
<td>7.4344</td>
<td>2.332</td>
</tr>
<tr>
<td>Right-handed</td>
<td>115</td>
<td>7.1652</td>
<td>2.599</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 0.84 \]
\[ \text{Degrees of Freedom} = 228.63 \]
\[ \text{Significant Level} = 0.403 \]

It can be seen from Table 22 that the right-handed presentation group mean was 0.2692 faster than the left-handed
presentation group mean. But, both group means are in the 22-minute through 23-minute, 59-second time block.

Table 22 also shows the t-test results of the difference in laterality presentations for right-handed students. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis II_E is tenable since there is no significant difference.

Hypothesis II Summary

From this analysis, it is evident that for this hypothesis the greatest mean difference was attained by the right-handed presentation group for the correctness variable. With a probability of 0.099, it was significant at the .10 level of significance. The means of the tightness and re-starts variables were approaching the .10 level of significance for the left-handed presentation. The other two variables, smoothness and speed were nowhere near the .05 level of significance.

Hypothesis III

There is no significant difference between the psychomotor performance of left-handed and right-handed students who are exposed to right-handed presentations. This general hypothesis was tested with five specific performance variables.

Sub-hypothesis III_A

There is no significant difference in the average tightness of the lacing between the left-handed and right-handed students who
are exposed to a right-hand presentation. Table 23 presents the means and standard deviations for these two groups of right-handed presentations.

**TABLE 23**

<table>
<thead>
<tr>
<th>Student Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>16</td>
<td>3.6458</td>
<td>1.483</td>
</tr>
<tr>
<td>Right-handed</td>
<td>98</td>
<td>3.7483</td>
<td>1.974</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 0.24 \]

\[ \text{Degrees of Freedom} = 24.61 \]

\[ \text{Significant Level} = 0.810 \]

It can be seen from Table 23 that the left-handed student group mean was 0.1025 tighter than the right-handed student group mean. But, both group means are in the scale unit from .050 through .059 of an inch clearance.

Table 23 also shows the \( t \)-test results of the difference in student lateralities for a right-handed presentation. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis III\(_A\) is tenable since there is no significant difference.

Sub-hypothesis III\(_B\)

There is no significant difference in the smoothness (non-twists) of the lacing between the left-handed and right-handed students.
who are exposed to a right-handed presentation. Table 24 presents the means and standard deviations for these two groups of right-handed presentations.

**TABLE 24**

SMOOTHNESS MEANS, STANDARD DEVIATIONS, AND t-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED STUDENTS FOR A RIGHT-HANDED PRESENTATION

<table>
<thead>
<tr>
<th>Student Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>18</td>
<td>5.2222</td>
<td>3.282</td>
</tr>
<tr>
<td>Right-handed</td>
<td>115</td>
<td>5.9826</td>
<td>2.985</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 0.92 \]
\[ \text{Degrees of Freedom} = 21.63 \]
\[ \text{Significant Level} = 0.365 \]

It can be seen from Table 24 that the right-handed student group mean was 0.7604 smoother (less twists) than the left-handed student group mean. This indicates that the right-handed student mean is approximately three-fourths of a non-twisted stitch more than the left-handed student group mean.

Table 24 shows the $t$-test results of the difference in student lateralities for a right-handed presentation. The difference is not significant at the .05 level of significance. Therefore, sub-hypothesis III$_B$ is tenable since there is no significant difference.
Sub-hypothesis IIIc

There is no significant difference in the correctness of the lacing between the left-handed and right-handed students who are exposed to a right-handed presentation. Table 25 presents the means and standard deviations for these two groups of right-handed presentations.

<table>
<thead>
<tr>
<th>Student Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>18</td>
<td>4.111</td>
<td>3.969</td>
</tr>
<tr>
<td>Right-handed</td>
<td>115</td>
<td>4.113</td>
<td>3.904</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 0.00 \]

\[ \text{Degrees of Freedom} = 22.46 \]

\[ \text{Significant Level} = 0.998 \]

It can be seen from Table 25 that the right-handed student group mean was 0.0019 more correct than the left-handed student group mean. This indicates that there was practically no difference in the number of correctly made stitches between the right-handed and left-handed groups.

Table 25 also shows the t-test results of the difference in student lateralities for a right-handed presentation. The difference was not significant at the .05 level of significance. In fact, there
was no difference. Therefore, sub-hypothesis \( III_C \) is tenable since there is no significant difference.

**Sub-hypothesis \( III_D \)**

There is no significant difference in the number of re-starts for the lacing activity between the left-handed and right-handed students who are exposed to a right-handed presentation. Table 26 presents the means and standard deviations for these two groups of right-handed presentations.

**TABLE 26**

RE-START MEANS, STANDARD DEVIATIONS, AND \( t \)-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED STUDENTS FOR A RIGHT-HANDED PRESENTATION

<table>
<thead>
<tr>
<th>Student Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>18</td>
<td>1.2222</td>
<td>1.263</td>
</tr>
<tr>
<td>Right-handed</td>
<td>115</td>
<td>1.3217</td>
<td>1.614</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 0.30 \]

\[ \text{Degrees of Freedom} = 26.55 \]

\[ \text{Significant Level} = 0.768 \]

It can be seen from Table 26 that the left-handed student group mean was 0.0995 fewer re-starts than the right-handed student group mean. This indicates that the left-handed student mean represents only a minimal amount of few re-starts than the right-handed student mean.
Table 26 also shows the $t$-test results of the difference in student lateralities for a right-handed presentation. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis $III_D$ is tenable since there is no significant difference.

Sub-hypothesis $III_E$

There is no significant difference in the lacing speed between the left-handed and right-handed students who are exposed to a right-handed presentation. Table 27 presents the means and standard deviations of these two groups of right-handed presentations.

**TABLE 27**

<table>
<thead>
<tr>
<th>Student Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>18</td>
<td>7.0000</td>
<td>2.765</td>
</tr>
<tr>
<td>Right-handed</td>
<td>115</td>
<td>7.1652</td>
<td>2.599</td>
</tr>
</tbody>
</table>

$t$ Value $= 0.24$

Degrees of Freedom $= 21.96$

Significant Level $= 0.814$

It can be seen from Table 27 that the left-handed student group mean was 0.1652 faster than the right-handed student group mean. But, both group means are in the 22-minute through 23-minute, 59-second time block.
Table 27 also shows the t-test results of the difference in student lateralities for a right-handed presentation. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis IIIe is tenable since there is no significant difference.

Hypothesis III Summary

From this analysis, it is evident that for this hypothesis the greatest mean difference was attained by the right-handed student group for the smoothness variable. However, with a probability of only 0.365, it was not significant at any appreciable level of significance. The means of the other variables, tightness, correctness, re-starts, and speed were nowhere near the .05 level of significance.

Hypothesis IV

There is no significant difference between the psychomotor performance of left-handed and right-handed students who are exposed to left-handed presentations. This general hypothesis was tested with five specific performance variables.

Sub-hypothesis IVa

There is no significant difference in the average tightness of the lacing between the left-handed and right-handed students who are exposed to a left-handed presentation. Table 28 presents the means and standard deviations for these two groups of left-handed presentations.
TABLE 28
TIGHTNESS MEANS, STANDARD DEVIATIONS, AND t-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED STUDENTS FOR A LEFT-HANDED PRESENTATION

<table>
<thead>
<tr>
<th>Student Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>14</td>
<td>4.0357</td>
<td>1.886</td>
</tr>
<tr>
<td>Right-handed</td>
<td>110</td>
<td>3.3227</td>
<td>1.740</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 1.34 \]
\[ \text{Degrees of Freedom} = 15.95 \]
\[ \text{Significant Level} = 0.198 \]

It can be seen from Table 28 that the right-handed student group mean was 0.7130 tighter than the left-handed student group mean. This places the right-handed student group mean in the scale unit from .050 through .059 of an inch clearance. The left-handed student group mean is in the scale unit from .060 through .069 of an inch clearance.

Table 28 also shows the t-test results of the difference in student lateralities for a left-handed presentation. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis IV\textsubscript{A} is tenable since there is no significant difference.

Sub-hypothesis IV\textsubscript{B}

There is no significant difference in the smoothness (non-twists) of the lacing between the left-handed and right-handed students who are exposed to a left-handed presentation. Table 29 presents the means and standard deviations for these two groups of left-handed presentations.
TABLE 29
SMOOTHNESS MEANS, STANDARD DEVIATIONS, AND t-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED STUDENTS FOR A RIGHT-HANDED PRESENTATION

<table>
<thead>
<tr>
<th>Student Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>15</td>
<td>6.0667</td>
<td>3.058</td>
</tr>
<tr>
<td>Right-handed</td>
<td>122</td>
<td>5.7459</td>
<td>3.284</td>
</tr>
</tbody>
</table>

\[
\text{t Value} = 0.38 \\
\text{Degrees of Freedom} = 18.21 \\
\text{Significant Level} = 0.708
\]

It can be seen from Table 29 that the left-handed student group mean was 0.3208 smoother (less twists) than the right-handed presentation group mean. This indicates that the left-handed student mean is only approximately one-third non-twisted stitch more than the right-handed student mean.

Table 29 also shows the t-test results of the difference in student lateralities for a left-handed presentation. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis IV \(_B\) is tenable since there is no significant difference.

Sub-hypothesis \(IV_\text{C}\)

There is no significant difference in the correctness of the lacing between the left-handed and right-handed students who are exposed to a left-handed presentation. Table 30 presents the means and standard deviations for these two groups of left-handed presentations.
TABLE 30
CORRECTNESS MEANS, STANDARD DEVIATIONS, AND t-TEST RESULTS
OF LEFT-HANDED AND RIGHT-HANDED STUDENTS
FOR A LEFT-HANDED PRESENTATION

<table>
<thead>
<tr>
<th>Student Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>15</td>
<td>2.0000</td>
<td>2.591</td>
</tr>
<tr>
<td>Right-handed</td>
<td>122</td>
<td>3.2787</td>
<td>3.842</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 1.70 \]
\[ \text{Degrees of Freedom} = 22.40 \]
\[ \text{Significant Level} = 0.104 \]

It can be seen from Table 30 that the right-handed student group mean was 1.2787 more correct than the left-handed student group mean. This indicates that the right-handed student mean is over one and one-fourth correctly made stitches more than the left-handed student mean.

Table 30 also shows the t-test results of the difference in student lateralities for a left-handed presentation. The difference was approaching the .10 level of significance. However, sub-hypothesis \( IV_C \) is tenable since there is no significant difference at the .05 level.

Sub-hypothesis \( IV_D \)

There is no significant difference in the number of re-starts for the lacing activity between the left-handed and right-handed students who are exposed to a left-handed presentation. Table 31
presents the means and standard deviations for these two groups of left-handed presentations.

TABLE 31
RE-START MEANS, STANDARD DEVIATION, AND t-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED STUDENTS FOR A LEFT-HANDED PRESENTATION

<table>
<thead>
<tr>
<th>Student Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>15</td>
<td>1.2000</td>
<td>1.082</td>
</tr>
<tr>
<td>Right-handed</td>
<td>122</td>
<td>1.0410</td>
<td>0.966</td>
</tr>
</tbody>
</table>

\[ t \text{ Value} = 0.54 \]
\[ \text{Degrees of Freedom} = 16.85 \]
\[ \text{Significant Level} = 0.594 \]

It can be seen from Table 31 that the right-handed student group mean was 0.1590 fewer re-starts than the left-handed student group mean. This indicates that the right-handed student mean represents only a minimal amount of few re-starts than the left-handed student mean.

Table 31 also shows the t-test results of the difference in student lateralities for a left-handed presentation. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis IV<sub>D</sub> is tenable since there is no significant difference.
Sub-hypothesis IV$_E$

There is no significant difference in the lacing speed between the left-handed and right-handed students who are exposed to a left-handed presentation. Table 32 presents the means and standard deviations for these two groups of left-handed presentations.

**TABLE 32**

**SPEED MEANS, STANDARD DEVIATIONS, AND t-TEST RESULTS OF LEFT-HANDED AND RIGHT-HANDED STUDENTS FOR A LEFT-HANDED PRESENTATION**

<table>
<thead>
<tr>
<th>Student Laterality</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-handed</td>
<td>15</td>
<td>7.4667</td>
<td>2.642</td>
</tr>
<tr>
<td>Right-handed</td>
<td>122</td>
<td>7.4344</td>
<td>2.332</td>
</tr>
</tbody>
</table>

$t$ Value $= 0.05$

Degrees of Freedom $= 16.79$

Significant Level $= 0.965$

It can be seen from Table 32 that the right-handed student group mean was 0.0323 faster than the left-handed student group mean. But, both group means are in the 22-minute through 23-minute, 59-second time block.

Table 32 also shows the $t$-test results of the difference in student lateralities for a left-handed presentation. The difference was not significant at the .05 level of significance. Therefore, sub-hypothesis IV$_E$ is tenable since there is no significant difference.
Hypothesis IV Summary

From this analysis, it is evident that for this hypothesis the greatest mean difference was attained by the right-handed student group for the correctness variable. With a probability of 0.104, it was approaching the .10 level of significance. The means of the other four variables, tightness, smoothness, re-starts, and speed were nowhere near the .05 level of significance.

Progression

The direction in which the student progressed in performing the lacing activity was considered as an additional part of this study. It was either the same as observed or reversed. This progression was subjected to two null-hypotheses.

Fisher's Exact Test is recommended for 2 x 2 tables when there are fewer than 21 cases. Although this study produced some small cell frequencies, the total number of cases was 281. Therefore, the Yates' Corrected Chi Square was applied.

Hypothesis V

There is no significant difference between the student laterality and the progression laterality. Table 33 presents the Yates' Corrected Chi Square for these two groups.

It can be seen from Table 33 that all thirty-three left-handed students, or 100 per cent, progressed in the same direction that they observed for this lacing activity. Out of 237 right-handed
### TABLE 33

**YATES' CORRECTED CHI SQUARE OF PROGRESSION BY STUDENT LATERALITY**

<table>
<thead>
<tr>
<th>Progression Laterality</th>
<th>L.H.</th>
<th>R.H.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversed</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.0%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Same</td>
<td>33</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>98.3%</td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>33</td>
<td>237</td>
</tr>
<tr>
<td></td>
<td></td>
<td>270</td>
</tr>
</tbody>
</table>

Corrected Chi Square = 0.00029  
Degrees of Freedom = 1  
Significant Level = 0.9864

students, 233 or 98.3 per cent progressed in the same direction that they observed, while four or 1.7 per cent progressed in the reversed direction.

Table 33 also shows the analysis of the Yates' Corrected Chi Square frequencies for the two student lateralities. There was no significant difference. Therefore, Hypothesis V is tenable since there is no significant difference.
Hypothesis VI

There is no significant difference between the presentation laterality and the progression laterality. Table 34 presents the Yates' Corrected Chi Square for these two groups.

<table>
<thead>
<tr>
<th>TABLE 34</th>
</tr>
</thead>
<tbody>
<tr>
<td>YATES' CORRECTED CHI SQUARE OF PROGRESSION BY STUDENT LATERALITY</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Presentation Laterality</th>
</tr>
</thead>
<tbody>
<tr>
<td>L.H.</td>
</tr>
<tr>
<td>Reversed</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Progression Laterality</td>
</tr>
<tr>
<td>Same</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Corrected Chi Square = 2.39284
Degrees of Freedom = 1
Significant Level = 0.1219

It can be seen in Table 34 that all 143 students who were exposed to a right-handed presentation, or 100 per cent, progressed in the same direction for this lacing activity. Out of 138 students who were exposed to a left-handed presentation 134, or 97.1 per cent progressed in the same direction, while four, or 2.9 percent progressed in the reversed direction.
Table 34 also shows the analysis of the Yates' Corrected Chi Square frequencies for the two presentation lateralities. The difference is approaching the .10 level of significance. Therefore, Hypotheses VI is tenable with caution because there might have been some effect due to the different laterality presentations.

Progression Summary

From this analysis, it is evident that for these hypotheses there appeared to be some degree of significance between the presentation laterality and the progression of the lacing activity. By looking at the frequencies in Tables 33 and 34, it appears that the left-handed students who observed a right-handed presentation progressed in the same direction. But four of the right-handed students who observed a left-handed presentation progressed in the reversed direction.

Chapter Summary

In this chapter, the data derived from this study were analyzed. Frequencies and their percentages were ascertained for the sample by school, class period, grade level, sex, laterality, and the presentation laterality observed. Overall performance frequencies and their percentages were ascertained for each of the variables; tightness, smoothness, correctness, re-starts, speed, and progression.

Each hypothesis stated in Chapter II was broken down into sub-hypotheses and tested for each identified variable. Means and standard deviations were used to describe the data, followed by
t-tests to identify the level of significance.

Table 35 shows the analysis of the data for Hypothesis I.

**TABLE 35**

SIGNIFICANCE OF THE VARIABLES FOR HYPOTHESIS I
WITH LEFT-HANDED STUDENTS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Probability</th>
<th>Evaluation Unit</th>
<th>Presentation Mean R.H.</th>
<th>L.H.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tightness</td>
<td>0.539</td>
<td>.010&quot; Unit</td>
<td>+0.3899</td>
<td></td>
</tr>
<tr>
<td>Smoothness</td>
<td>0.451</td>
<td>Non-twisted Stitch</td>
<td>+0.8445</td>
<td></td>
</tr>
<tr>
<td>Correctness</td>
<td><strong>0.077</strong></td>
<td>Correct &quot;X's&quot;</td>
<td>+2.1111</td>
<td></td>
</tr>
<tr>
<td>Re-starts</td>
<td>0.957</td>
<td>Number of</td>
<td>+0.0222</td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>0.624</td>
<td>2-Min. Unit</td>
<td>+0.4667</td>
<td></td>
</tr>
</tbody>
</table>

**Approached .05 level of significance**

Table 35 reveals that the left-handed students made a more correct lace by observing a right-handed presentation than they did by observing a left-handed presentation. The left-handed student means were better with the right-handed presentation for three of the five variables. However, none of these differences was statistically significant at the .05 level.

Table 36 shows the analysis of the data for Hypothesis II.

Table 36 reveals that the right-handed students made a more correct lace by observing a right-handed presentation than they did by observing a left-handed presentation. However, the tightness of the lace appeared to be of better value and the number of re-starts.
TABLE 36
SIGNIFICANCE OF THE VARIABLES FOR HYPOTHESIS II
WITH RIGHT-HANDED STUDENTS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Probability</th>
<th>Evaluation</th>
<th>Presentation Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Unit</td>
<td>R.H.</td>
</tr>
<tr>
<td>Tightness</td>
<td>*0.102</td>
<td>.010&quot; Unit</td>
<td>+0.4256</td>
</tr>
<tr>
<td>Smoothness</td>
<td>0.562</td>
<td>Non-twisted Stitch</td>
<td>+0.2367</td>
</tr>
<tr>
<td>Correctness</td>
<td>*0.099</td>
<td>Correct &quot;X's&quot;</td>
<td>+0.8343</td>
</tr>
<tr>
<td>Re-starts</td>
<td>*0.108</td>
<td>Number of</td>
<td>+0.2807</td>
</tr>
<tr>
<td>Speed</td>
<td>0.403</td>
<td>2-Min. Unit</td>
<td>+0.2692</td>
</tr>
</tbody>
</table>

*Near the .10 level of significance

appeared to be fewer by observing a left-handed presentation, but with a slightly lower level of significance. The right-handed student means were better with the right-handed presentation for three of the five variables. However, none of these differences was statistically significant at the .05 level.

By combining Tables 35 and 36, it can be seen that the right-handed presentation mean was better than the left-handed presentation mean for six of the ten variables. Again, none of these differences was statistically significant.

Table 37 shows the analysis of the data for Hypothesis III.

Table 37 reveals that there essentially were no significant differences between the psychomotor performance of the left-handed students and the right-handed students who were exposed to a right-handed presentation. However, the right-handed presentation produced
better means with the left-handed students for three of the five variables.

**TABLE 37**

**SIGNIFICANCE OF THE VARIABLES FOR HYPOTHESIS III WITH A RIGHT-HANDED PRESENTATION**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Probability</th>
<th>Evaluation Unit</th>
<th>Student Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
</tr>
<tr>
<td>Tightness</td>
<td>0.810</td>
<td>.010&quot; Unit</td>
<td>+0.1025</td>
</tr>
<tr>
<td>Smoothness</td>
<td>0.365</td>
<td>Non-twisted Stitch</td>
<td>+0.7604</td>
</tr>
<tr>
<td>Correctness</td>
<td>0.998</td>
<td>Correct &quot;X's&quot;</td>
<td>+0.0019</td>
</tr>
<tr>
<td>Re-starts</td>
<td>0.768</td>
<td>Number of</td>
<td>+0.0995</td>
</tr>
<tr>
<td>Speed</td>
<td>0.814</td>
<td>2-Min. Unit</td>
<td>+0.1652</td>
</tr>
</tbody>
</table>

Table 38 shows the analysis of the data for Hypothesis IV.

**TABLE 38**

**SIGNIFICANCE OF THE VARIABLES FOR HYPOTHESIS IV WITH A LEFT-HANDED PRESENTATION**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Probability</th>
<th>Evaluation Unit</th>
<th>Student Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
</tr>
<tr>
<td>Tightness</td>
<td>0.198</td>
<td>.010&quot; Unit</td>
<td>+0.7130</td>
</tr>
<tr>
<td>Smoothness</td>
<td>0.708</td>
<td>Non-twisted Stitch</td>
<td>+0.3208</td>
</tr>
<tr>
<td>Correctness</td>
<td>*0.104</td>
<td>Correct &quot;X's&quot;</td>
<td>+1.2787</td>
</tr>
<tr>
<td>Re-starts</td>
<td>0.594</td>
<td>Number of</td>
<td>+0.1590</td>
</tr>
<tr>
<td>Speed</td>
<td>0.965</td>
<td>2-Min. Unit</td>
<td>+0.0323</td>
</tr>
</tbody>
</table>

*Near the .10 level of significance*
Table 38 reveals that a left-handed presentation appeared to obtain a more correct lace by the right-handed students than it did by the left-handed students. The right-handed student means were better for four of the five variables, but these differences were not statistically significant.

By combining Tables 37 and 38, it can be seen that the right-handed student mean was better than the left-handed student mean for six of the ten variables, although no statistically significant difference was found.

The 2 x 2 tables (Yates' Corrected Chi Square) indicated that a larger percentage of left-handed students attempted to progress in the same lacing direction they observed in the presentation than did the right-handed students. Thus, it appeared that the right-handed students' laterality was less flexible. Once again, these differences were not statistically significant.
CHAPTER IV
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A summary of the study will be given and a review of the findings will be presented in this chapter. Conclusions will be drawn from the study to answer the specific objectives of the problem as stated in Chapter I. Recommendations will be made from these conclusions which should facilitate a more efficient and effective method of teaching and/or learning to perform psychomotor activities.

Summary

Restatement of the Problem

The purpose of this research study was to present evidence about the extent to which the laterality of the industrial arts student and/or teacher has an effect upon the teaching and/or learning of selected psychomotor skills. It is not known whether the mirror image a left-handed student sees in a right-handed presentation handicaps him/her in the performance of the motor skills required in typical industrial arts learning activities.

Review of Literature and Significance of the Problem

Eleven per cent of the population is normally classified as being left-handed. This was the approximate percentage of left-handed students found in the sample used in this study. However some
researchers, such as McNamee (1968, pp. 34), indicate a left-handedness frequency as high as 30 per cent. Considerable educational research tends to indicate that lower achievers have a higher ratio of left-handers and mixed handers. Most of the educational research on left-handers has been in the areas of academic achievement, hand-writing, and physical education. No evidence was found that any research on laterality had been conducted in the industrial arts classroom.

Educational institutions should provide the opportunity for all individuals, whatever their laterality, to develop their abilities to the maximum. Typical industrial arts teaching and/or learning activities often require one to use his/her right hand for the safe and efficient manipulation of tools and machines. Left-handers, as well as right-handers, should be exposed to the most effective method of performing these operations. This study was designed to obtain data which might cause one to modify the teaching and/or learning methods and procedures used with left-handed or right-handed students.

The Experimental Investigation

The design. Two methods of instruction were used in this study which involved 281 junior high school industrial arts students in seventeen classes from three different schools. Each class was given the presentation, "Lacing the Double Buttonhole Stitch", via synchronized slide-cassette tape. One-half the classes (Group B) observed a right-handed presentation. The other one-half (Group A) observed a left-handed presentation by the technique of reversing the
slide frames. A handedness questionnaire was used to identify left-handed, right-handed, and mixed dominance students. Data were analyzed with respect to the following groups: 1) left-handed students with a right-handed presentation, 2) left-handed students with a left-handed presentation, 3) right-handed students with a right-handed presentation, and 4) right-handed students with a left-handed presentation. Those who were identified as mixed dominance were excluded from the study.

**The learning task.** A rather complex psychomotor task was needed because the typical industrial arts learning activity involves the use of the student's neuromuscular system (hands and intellect). With this in mind, the procedure of how to properly make the double buttonhole stitch was selected. It is a specific type of laced border that is applied around the edges of many personal leather products. A four-inch piece of pre-punched leather was to be laced using a 30-inch length of 3/32-inch lace with needle attached. Eight separate evaluations were made to obtain data necessary to analyze the performance of each student with respect to the six performance variables.

**The performance.** Each student's performance was analyzed for tightness, smoothness (non-twists), correctness, re-starts, speed, and progression. This data was further analyzed according to the following groups: 1) left-handed students with a right-handed presentation vs. left-handed students with a left-handed presentation, 2) right-handed students with a right-handed presentation vs. right-handed students with a left-handed presentation, 3) left-handed
students with a right-handed presentation vs. right-handed students with a right-handed presentation, and 4) left-handed students with a left-handed presentation vs. right-handed students with a left-handed presentation. (See Figure 1, p. 21.)

**Summary of the Findings**

The means and standard deviations were computed on the students' achievements for the tightness, smoothness (non-twists), correctness, re-starts, and the speed of lacing. A Separate Sample t-Test was then computed using the Statistical Package for the Social Sciences Program (SPSS) at The Ohio State University Computer Center. The t-test results indicated the following variables to be approaching a meaningful level of significance.

1. The right-handed presentation was better than the left-handed presentation at the .077 level of significance for the left-handed students on the correctness of the lacing.

2. The left-handed presentation was better than the right-handed presentation at the .102 level of significance for the right-handed students on the tightness of the lacing.

3. The right-handed presentation was better than the left-handed presentation at the .099 level of significance for the right-handed students on the correctness of the lacing.
4. The left-handed presentation was better than the right-handed presentation at the .108 level of significance for the right-handed students on the number of re-starts.

5. The right-handed students were better than the left-handed students at the .104 level of significance with the left-handed presentation on the correctness of the lacing.

However, none of these differences was statistically significant at the .05 level.

Conclusions

The conclusions drawn in this section will be based upon data gathered in the experimental investigation and their computed statistical significance. An attempt will be made to answer questions implied by the specific objectives stated in Chapter 1.

Objective 1:

To ascertain which laterality is best for the demonstrating of psychomotor skills that the left-handed junior high industrial arts student is to learn.

By analyzing data obtained in this study it can be stated that the left-handed junior high industrial arts student achieved as well with either right or left-handed instructor presentation.

Objective 2:

To ascertain which laterality is best for the demonstrating of psychomotor skills that the right-handed junior high industrial
arts student is to learn.

By analyzing data obtained in this study it can be stated that the right-handed junior high industrial arts student achieved as well with either right or left-handed instructor presentations.

Objective 3:

To determine if the left-handed junior high industrial arts student is handicapped in the learning of psychomotor skills by observing right-handed demonstrations of those skills.

By analyzing data obtained in this study it cannot be stated that the left-handed junior high industrial arts student is handicapped in the learning of psychomotor skills by observing right-handed demonstrations of those skills.

Objective 4:

To determine if the right-handed junior high industrial arts student is handicapped in the learning of psychomotor skills by observing left-handed demonstrations of those skills.

By analyzing data obtained in this study it cannot be stated that the right-handed junior high industrial arts student is handicapped in the learning of psychomotor skills by observing left-handed demonstrations of those skills.

Recommendations

Two types of recommendations will be presented in this section. One is to the researcher who may be interested in undertaking additional research in this area of education. The other type of recommendation is to the educator who plans effective and efficient
teaching and/or learning activities for junior high industrial arts students.

Recommendations to the Researcher

From the review of the literature and the analysis of data obtained in this study, it is evident that additional research needs to be conducted in this area of education. Based upon his experience in conducting this study, this researcher offers the following recommendations:

1. Research similar to this study, using other teaching and/or learning psychomotor activities should be conducted in order to further verify or question the findings of this investigation.
   a. Since many of the students in this study successfully completed a single buttonhole stitch instead of the required double buttonhole stitch, this researcher recommends that the single buttonhole stitch be used for the psychomotor activity.
   b. Since many psychomotor activities require the use of complex tools and/or machines, this researcher recommends that the cutting of a rabbet on a piece of wood using a table saw be used for the psychomotor activity.

2. A continuous loop film could be used for the video portion of the presentation and left running throughout the time the students are performing the activity.
3. For this study, data were obtained by the evaluation of each student's psychomotor performance. Pencil and paper tests could be used to collect additional data for analysis.

4. Junior high school students were used in this study. Valuable information could be ascertained from learners of:
   a. Various age levels, particularly those enrolled in grades K-6. It is possible that the junior high age students might have already developed the ability to function adequately when exposed to a laterality different than their own.
   b. Different socio-economic backgrounds.
   c. Different ability levels; above-average, average, and below-average.

**Recommendations to the Educator**

Since none of the statistical tests provided results which were significant at the .05 level of significance, the author recommends that industrial arts teachers need not be unduly concerned whether they or their students are right or left-handed, insofar as they demonstrate tasks which are similar to the kind utilized in this study. However, it should be emphasized that the statistical analysis of several variables produced results very near the .10 level of significance, which indicates there were some differences.
Conceivably, it is quite possible that the learning of a particular psychomotor skill by some students who are experiencing much difficulty might be enriched by one of the following.

1. Receiving special help from a teacher who is able to perform directional activities like lacing or sewing in either direction.

2. Obtaining a different demonstration laterality by reversing slides or using rear projection screens.
BIBLIOGRAPHY


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McNamee, L. V. "On The Other Hand." Texas Outlook, No. 52, 1968, pp. 34-5.


Lacing the Double Buttonhole Stitch. Where is it used? What is it? How is it done?

The double buttonhole stitch is used in leatherworking. This name tag, coin carrier, and pony-tail holder all have lace around their perimeters.

Many hand-carved billfolds are beautified with a laced border. Lacing is also used for holding the various parts of leather products together.

*Note: All frames in the treatments were colored photographs of actual objects.
Larger leather items such as purses and pocket secretaries need a laced border for durability as well as for beauty.

Here is a key case before the lacing has been applied. The product looks much less appealing than all the ones you have just seen which had a double buttonhole stitch lace applied around them.

These are the items you will be using to make the double buttonhole stitch: A piece of pre-punched leather, a lacing needle, and a length of leather lace.
"Starting to lace." Hold the leather with one hand so the smooth side is facing you. With the other hand grasp the lacing needle so the rough side of the lace is facing up and start the needle through the first hole.

Pull all but about two inches of lace through the hole.

Bring the needle back over the top in a circular motion, upsetting it so the rough side of the lace is again facing up. Start the needle through the next hole.
10 Pull all the loose lace through the hole.

11 Bring the needle back over the top in a circular motion, upsetting it so the rough side of the lace is again facing up. Start the needle under the lace on top of the leather.

12 Pull all the loose lace through. Be sure there are no twists in the lace, then draw the lace snug.
13 Again, bring the needle back over the top in a circular motion, upsetting it so the rough side of the lace is facing up. Start the needle through the next hole.

14 Pull all the loose lace through the hole. Be sure there are no twists in the lace, then draw it snug.

15 Again, bring the needle back over the top in a circular motion, upsetting it so the rough side of the lace is facing up. Start the needle under the last TWO laces on top of the leather. You must go under an X.
16. Pull all the loose lace through. Be sure there are no twists in the lace, then draw the lace snug. When the lace is drawn snug it will form a smooth straight edge without wrinkling the leather or leaving any loose loops in the lace.

17. After several stitches have been correctly made, the lacing starts to form a nice border around the leather. Continue to use a circular motion to bring the needle back over the top and start through the next hole.

18. Remove any twists and draw the lace snug.
19 Using a circular motion, bring the needle back over the top and start through under the last X.

20 Remove any twists and draw the lace snug.

21 Remember that good lacing is: Not twisted, Drawn snug or tight, and Correctly made.

GOOD LACING IS:
1. NOT TWISTED
2. TIGHT
3. CORRECTLY MADE
These are the basic lacing steps:

1. Through the hole.
2. Back and through under the X.
3. Through the next hole.
4. Back and through under the last X.

Draw the lace snug without any twists.
<table>
<thead>
<tr>
<th>FRAME NO.</th>
<th>AUDIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Through under the last X.</td>
</tr>
<tr>
<td>26</td>
<td>Draw the lace snug without any twists.</td>
</tr>
<tr>
<td>27</td>
<td>Continue these two basic steps:</td>
</tr>
<tr>
<td></td>
<td>Through the hole; Through under the last X.</td>
</tr>
<tr>
<td></td>
<td>When you have used all the holes you will</td>
</tr>
<tr>
<td></td>
<td>have mastered the double buttonhole stitch.</td>
</tr>
</tbody>
</table>
APPENDIX B
Please circle the correct response for each of the following questions.

**Right**  **Either**  **Left**  **1.** With which hand do you prefer to use a spoon when eating?  
**Right**  **Either**  **Left**  **2.** In which hand do you prefer to carry a full glass of water?  
**Right**  **Either**  **Left**  **3.** With which hand do you throw a ball?  
**Right**  **Either**  **Left**  **4.** When cleaning your teeth, in which hand do you hold the toothbrush?  
**Right**  **Either**  **Left**  **5.** In which hand do you hold the pack of matches when striking one?  
**Right**  **Either**  **Left**  **6.** Which hand would you use to put the key in a key hole?  
**Right**  **Either**  **Left**  **7.** When cutting paper, in which hand do you hold the scissors?  
**Right**  **Either**  **Left**  **8.** Which hand would you use to cut meat?  
**Right**  **Either**  **Left**  **9.** In which hand do you prefer to hold the pack when dealing cards?  
**Right**  **Either**  **Left**  **10.** With which hand do you prefer to turn a water faucet?  
**Right**  **Either**  **Left**  **11.** When fixing your hair, in which hand do you hold the comb or pick?  
**Right**  **Either**  **Left**  **12.** With which hand do you put an electrical plug into an outlet?  
**Right**  **Either**  **Left**  **13.** When washing dishes, in which hand do you prefer to hold the dish?  
**Right**  **Either**  **Left**  **14.** When buttering bread, which hand holds the bread?  
**Right**  **Either**  **Left**  **15.** In which hand do you prefer to hold a jar when unscrewing the lid?  
**Right**  **Either**  **Left**  **16.** With which hand do you hold a hammer?  
**Right**  **Either**  **Left**  **17.** With which hand do you write?  
**Right**  **Either**  **Left**  **18.** Which hand do you prefer to use to get a book from a high shelf?  
**Right**  **Either**  **Left**  **19.** In which hand would you hold an apple while you were peeling it?  
**Right**  **Either**  **Left**  **20.** When feeling material to determine the texture or thickness, which hand would you use?
Please circle the correct response for each of the following questions.

Right  Either  Left  1. With which hand do you prefer to use a spoon when eating?
Right  Either  Left  2. In which hand do you prefer to carry a full glass of water?
Right  Either  Left  3. With which hand do you throw a ball?
Right  Either  Left  4. When cleaning your teeth, in which hand do you hold the toothbrush?
Right  Either  Left  5. In which hand do you hold the pack of matches when striking one?
Right  Either  Left  6. Which hand would you use to put the key in a key hole?
Right  Either  Left  7. When cutting paper, in which hand do you hold the scissors?
Right  Either  Left  8. With which hand do you prefer to use a knife when cutting meat?
Right  Either  Left  9. Which hand would you use to press a thumbtack into a board?
Right  Either  Left 10. In which hand do you prefer to hold the pack when dealing cards?
Right  Either  Left 11. With which hand do you prefer to turn a water faucet?
Right  Either  Left 12. When fixing your hair, in which hand do you hold the comb or pick?
Right  Either  Left 13. With which hand do you put an electrical plug into an outlet?
Right  Either  Left 14. When washing dishes, in which hand do you prefer to hold the dish?
Right  Either  Left 15. When buttering bread, which hand holds the bread?
Right  Either  Left 16. In which hand do you prefer to hold a jar when unscrewing the lid?
Right  Either  Left 17. With which hand do you hold a hammer?
Right  Either  Left 18. With which hand do you write?
Right  Either  Left 19. Which hand do you prefer to use to get a book from a high shelf?
Right  Either  Left 20. In which hand would you hold an apple while you were peeling it?
Right  Either  Left 21. When feeling material to determine the texture or thickness, which hand would you use?
LACED

UNDER AN ‘X’
LACED UNDER AN 'X'
March 30, 1976

Mr. Lyle R. Schroeder
652 Seabury Drive
Worthington, Ohio 43085

Dear Mr. Schroeder:

The Department of Evaluation, Research, and Planning has reviewed your request to do research in the Columbus Public Schools. Based on its recommendation, I find that I am in position to give central office approval to your study.

Central office approval attests to the fact that your work has met certain standards in regard to methodology, design and instrumentation. It will still be necessary for you to secure permission from the principals of the buildings in which you wish to conduct your study.

Thank you for submitting the necessary materials that enabled us to reach a decision.

Best wishes for successful completion of your project.

Sincerely yours,

Joseph L. Davis
Assistant Superintendent

cc: Mr. Robert Rodosky
    Dr. David Williams