

1970

# An Analysis of the Acquisition of Typewriting Skill Through Practice on Assigned Drill and Self-Selected Drill

Susan Lynn Stockdale  
*Eastern Illinois University*

---

## Recommended Citation

Stockdale, Susan Lynn, "An Analysis of the Acquisition of Typewriting Skill Through Practice on Assigned Drill and Self-Selected Drill" (1970). *Masters Theses*. 4026.  
<https://thekeep.eiu.edu/theses/4026>

This is brought to you for free and open access by the Student Theses & Publications at The Keep. It has been accepted for inclusion in Masters Theses by an authorized administrator of The Keep. For more information, please contact [tabruns@eiu.edu](mailto:tabruns@eiu.edu).

PAPER CERTIFICATE #2

TO: Graduate Degree Candidates who have written formal theses.

SUBJECT: Permission to reproduce theses.

The University Library is receiving a number of requests from other institutions asking permission to reproduce dissertations for inclusion in their library holdings. Although no copyright laws are involved, we feel that professional courtesy demands that permission be obtained from the author before we allow theses to be copied.

Please sign one of the following statements.

Booth Library of Eastern Illinois University has my permission to lend my thesis to a reputable college or university for the purpose of copying it for inclusion in that institution's library or research holdings.

June 30 1970  
Date

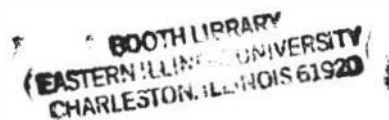
I respectfully request Booth Library of Eastern Illinois University not allow my thesis be reproduced because \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_  
Date

\_\_\_\_\_  
Author



AN ANALYSIS OF THE ACQUISITION OF TYPEWRITING SKILL  
THROUGH PRACTICE ON ASSIGNED DRILL AND  
SELF-SELECTED DRILL

(TITLE)

BY

Susan Lynn Stockdale

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF

Master of Science in Education

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY  
CHARLESTON, ILLINOIS

1970

YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING  
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

*June 30, 1970*  
DATE

*June 30, 1970*  
DATE

### ACKNOWLEDGMENT

The writer expresses sincere gratitude to Dr. George K. Cooper,  
Head of Department of Business Education and Secretarial Studies,  
Eastern Illinois University for the inspiration and encouragement  
offered.



## TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION . . . . .	1
Purpose of this Study . . . . .	2
Design of the Study . . . . .	3
Delimitation . . . . .	3
Hypotheses to be Tested . . . . .	3
Definitions of Terms . . . . .	4
Thesis Organization . . . . .	8
II. RELATED LITERATURE . . . . .	10
Accuracy Development . . . . .	11
Drill Usage and Repetitive Practice . . . . .	15
Copy Difficulty Factors in Relationship to Accurate Evaluation . . . . .	18
Summary . . . . .	20
III. DESIGN OF THE STUDY . . . . .	21
Purpose of the Study . . . . .	21
Selection of the Subjects . . . . .	21
Data to be Collected . . . . .	21
Data Analysis . . . . .	21
Pilot Experiment . . . . .	22
Revised Experiment . . . . .	26

<b>CHAPTER</b>	<b>PAGE</b>
<b>IV. PRESENTATION AND ANALYSIS OF FINDINGS . . . . .</b>	<b>30</b>
Presentation of Raw Data . . . . .	30
Typewriting Speed . . . . .	30
Typewriting Error Incidence . . . . .	32
Analysis of Variance . . . . .	33
Analysis of Variance in Speed . . . . .	33
Analysis of Variance in Error Incidence . . . . .	34
Summary . . . . .	36
<b>V. SUMMARY, CONCLUSION AND RECOMMENDATIONS . . . . .</b>	<b>37</b>
Summary . . . . .	37
Conclusion . . . . .	40
Recommendations . . . . .	43
<b>BIBLIOGRAPHY . . . . .</b>	<b>44</b>
<b>APPENDIX A</b>	
Analysis of Variance Technique . . . . .	46
<b>APPENDIX B</b>	
Computation of Analysis of Variance for Typewriting Speed . . . . .	47
<b>APPENDIX C</b>	
Computation of Analysis of Variance for Error Incidence . . . . .	50

LIST OF TABLES

TABLE	PAGE
1. Experimentor-Assigned Drill Group, Three-Minute Timed Writings of Average and High-Average Difficulty, Typewriting Speed in Gross Words Per Minute . . . . .	30A
II. Student-Selected Drill Group, Three-Minute Timed Writings of Average and High-Average Difficulty, Typewriting Speed in Gross Words Per Minute . . . . .	31A
III. Experimentor-Assigned Drill Group, Three-Minute Timed Writings of Average and High-Average Difficulty, Typewriting Error Incidence . . . . .	32A
IV. Student-Selected Drill Group, Three-Minute Timed Writings of Average and High-Average Difficulty, Typewriting Error Incidence . . . . .	32B
V. Analysis of Variance for Typewriting Speed on Three-Minute Timed Writings of Average and High-Average Difficulty.	34
VI. Analysis of Variance for Typewriting Error Incidence on Three-Minute Timed Writings of Average and High-Average Difficulty . . . . .	35

## CHAPTER I

### INTRODUCTION

How can students be given an adequate amount of the correct type of drill in order to develop accurate stroking control? What type of drill would be most effective? Should drill material be specific or general in nature? Is quality or quantity important? Should the student or teacher select the drill copy? These are just a few of the numerous questions that must be answered in order to assign the correct type of typewriting drill work.

The primary objective of a typewriting course is to learn to solve the problems of communication encountered on a personal basis or in an office situation. Specifically, the goal is to give the student the capability to produce accurate copy at an acceptable rate of speed which can be utilized as an effective communication tool in accomplishing the tasks of life.

Teachers, students, and employers agree that accurate stroking ranks high in typewriting competence. In all stages of learning typewriting skills the problem of accuracy has been of concern to business educators. Typewriting experts emphasize the need to combine speed and accuracy in the ultimate skill. As Lessenberry says:

No teacher of typewriting objects to the development of speed by his students, no matter how emphatic he may be in the support of the goal of accuracy. Similarly, no teacher who believes in speed first objects to the achievement of accuracy.

On the contrary, all of us believe in speed with accuracy even though we are divided on how to achieve this commonly accepted goal.<sup>1</sup>

Authorities in methods of teaching typewriting concur that typewriting success is largely based on the development of correct techniques. One way to develop correct techniques and, thereby, improve both speed and accuracy is through the use of carefully selected drill material intended to act as a catalyst in the development of typewriting skill.

Teachers have always used a variety of drill materials as an aid in assisting students in the development and attainment of correct typewriting technique. As in any area of learning, it is necessary for the teacher to use his best judgment and knowledge in the selection of drills that are most appropriate to his objective and to his particular group of students. In order to determine what type of drill material is most beneficial, the teacher must investigate a variety of drill practices to see what effect they might have on the ultimate attainment of typewriting skill.

Purpose of This Study The purpose of this study is to determine if there is a significant difference in technical performance at the typewriter of two groups of students, one group assigned practice drill chosen by the experimenter according to specific criteria and the other group permitted to select practice drill material according to their own interests and preferences. Measurement of ability is to be determined on the basis of performance on straight-copy timed writings.

---

<sup>1</sup>D. D. Lessenberry, "Some Debatable Issues in the Teaching of Typewriting," National Business Education Quarterly, December, 1943 quoted by Jane E. Glen, Philosophy and Psychology of Teaching Typewriting (2d ed.; New York: Gregg Publishing Division, McGraw-Hill Book Company, Inc., 1955), p. 191.



Design of the Study This study will undertake to determine known research and recommended practice with regard to drill assignment and technique development with particular attention to typewriting accuracy. It will then undertake to set up an experiment in which students will be given varying tasks to perform in preparing for speed and accuracy measurement in the form of three-minute timed writings at different difficulty levels. As a result of reference to known research, recommended practice, and limited experimentation with an intermediate typewriting class, some suggested classroom practices will be outlined to aid teachers to guide students in the development of correct typewriting technique.

Delimitation From the innumerable variables which may be studied in correct technique development, this study concerned itself primarily with the effect of drill assignment measured by technical performance on three-minute timed writings of average and high-average difficulty. Limited study was conducted, but will not be mentioned, concerning the value of the timed writing as an objective means of determining technical ability at the typewriter as a result of measurement of speed and error incidence. No projections are inferred concerning the direct applicability and transfer value of these findings to the solution of the problems of communication encountered on a personal basis or in an office situation. The sample population involved was necessarily small due to total population available, time limitation, and expense. The imposed drill copy was selected on the basis of specific criteria from a supplementary textbook.

Hypotheses to be Tested The following null hypotheses will be utilized to determine significance of test results in the experimental part of

this study.

1. The difference between the treatment means will be equal to zero for speeds as measured by technical performance at the typewriter on three-minute timed writings of average and high-average difficulty. A significance level of .05 will be required to reject the null hypothesis.

2. The difference between the treatment means will be equal to zero for errors as measured by technical performance at the typewriter on three-minute timed writings of average and high-average difficulty. A significance level of .05 will be required to reject the null hypothesis.

#### Definitions of Terms

1. Analysis-of-Variance Technique: "An arithmetic procedure for treating the data for criterion variable; it results in a partition of the total sum of squared deviations (of all observations) from the mean into the sum of squares attributable to the various experimental effects, to the interaction among them, and to sampling error; thus it facilitates tests of the significance of these experimental and interaction effects."<sup>2</sup>

2. Average Difficulty Timed Writing: A timed writing which consists of syllabic intensity of 1.5, a stroke intensity of 5.6, and percent of high frequency words at 75.

3. Copy Difficulty Factors: Copy difficulty factors refers to the elements of the structural characteristics that determine the ease with which material can be reproduced on the typewriter. The three major determinants are syllabic intensity, stroke intensity, and percent of high frequency words.

---

<sup>2</sup>Carter V. Good, ed., Dictionary of Education (2d ed.) New York: Gregg Publishing Division, McGraw-Hill Book Company, Inc., 1959), p. 596.

4. Degrees of Freedom: "Any way an element (such as body, point or statistic) may move or change; in general, any system will have as many degrees of freedom as it contains independent variables."<sup>3</sup>

5. Drill: "(1) A teaching technique intended to bring about automatic accuracy and speed of performance in any subject. (2) Repetitive practice of fundamental skill for purpose of instruction. . ."<sup>4</sup>

6. Drill, Corrective: "(1) Repetitive practice for the purpose of eliminating errors; (2) (business ed.) Practice material and procedures used to help eliminate the most frequent errors of typewriting students. . ."<sup>5</sup>

7. Drill Time (Drill Period): After allowing time for machine preparation, the time allowed to subjects to practice their assigned or selected drills.

8. Experimenter-Assigned Drill: Drill carefully selected by the experimenter from a supplementary textbook on the basis of specific criteria and assigned to one group of students participating in the experiment.

9. Experimenter-Assigned Drill Group: Those individuals working on the drill carefully selected by the experimenter from a supplementary textbook according to specific criteria.

10. F-Ratio: "The ratio of the larger to the smaller of two independent estimates of variance; the distribution of this ratio is known under the assumption that both estimates of variance arise from

---

<sup>3</sup>Ibid.

<sup>4</sup>Ibid., p. 186.

<sup>5</sup>Ibid., p. 186.



the same normally distributed population."<sup>6</sup>

11. High-Average Difficulty Timed Writing: A timed writing which consists of a syllabic intensity of 1.6, a stroke intensity of 5.8, and a percent of high frequency words of 70.

12. High-Frequency Words: These words which appear frequently in business correspondence.

13. Level of Significance (Confidence Level): "The probability of obtaining a value more extreme than that obtained solely on the basis of sampling error."<sup>7</sup> It allows the researcher to make a hypothesis about the interval within which a sample mean will lie. Researchers will generally accept a hypothesis as being correct if the probability of it being incorrect is only five percent.<sup>8</sup>

14. Mean: "A measure of central tendency (2) as commonly used, a synonym for arithmetic mean."<sup>9</sup>

15. Mean, Arithmetic: "A measure of central tendency which is obtained by dividing the sum of the measures, observations, magnitudes, items or scores in a statistical series, divided by their number, or frequency; often shortened to mean."<sup>10</sup>

16. Mean Square: "The term mean square is used to indicate estimates of variance in the analysis-of-variance technique."<sup>11</sup> Synonym for variance.

---

<sup>6</sup>Ibid., p. 116.

<sup>7</sup>Ibid., p. 121.

<sup>8</sup>Freeman F. Elzey, A Programmed Introduction to Statistics (Belmont, California: Brooks/Cole Publishing Company, 1965), p. 159.

<sup>9</sup>Good, Dictionary of Education, p. 336.

<sup>10</sup>Ibid., p. 160.

<sup>11</sup>Ibid., p. 218.

17. Null Hypothesis: "(1) The hypothesis that two or more treatments are equally effective (2) The hypothesis that corresponding parameters of two or more populations are equal."<sup>12</sup>

18. Stroke Intensity: The average number of strokes per word or word length in typewriting copy.

19. Student-Selected Drill: Drill selected by one group of students participating in the experiment on the basis of personal preference and interest.

20. Student-Selected Drill Group: Those individuals working on drills of their own selection on the basis of personal preference and interest.

21. Subject (S): Subject singular form for those participating in the experiment.

22. Subjects (Ss): Subjects plural form for those participating in the experiment.

23. Sum of Squares: The sum of the squared deviation scores of the sample.<sup>13</sup>

24. Syllabic Intensity: The average number of syllables per word in the timed writing copy.

25. Three-Minute Timed Writing: Timed writings three minutes in length used to measure student performance.

---

<sup>12</sup>Ibid., p. 277.

<sup>13</sup>Elzey, A Programmed Introduction to Statistics, p. 142.

26. Timed Writing: "Typewriting of straight copy or other material for a definite period of time to determine typewriting speed."<sup>14</sup>

27. Variance: "A measure of variability equal to the square of the standard deviation; the arithmetic mean of the squares of the deviation from the mean."<sup>15</sup> Synonym for mean square.

28. Variance, Between Group: "In analysis-of-variance, the estimate of variance that is based on differences between (or among) the means of the several groups involved; commonly numerator of the F ratio."<sup>16</sup>

29. Variance, Within Group: "In analysis-of-variance, the estimate of variance that is based on variations within each of several groups involved; almost invariably the denominator of the F ratio."<sup>17</sup>

### Thesis Organization

The first chapter of this study consists of an introduction, purpose of this study, design of the study, and delimitations. Also included is a definition of the terms relevant to this investigation.

Chapter two presents a review of the literature necessary to the development of this study. Presented first is a review of current literature in the area of accuracy development with particular emphasis on the achievement of the proper sense of timing. This is followed by a section on the effects on skill learning of drill usage and repetitive practice and a section briefly discussing the necessity of controlling copy difficulty factors to obtain a reliable measure of typewriting skill development.

---

<sup>14</sup>Good, Dictionary of Education, p. 610.

<sup>15</sup>Ibid., p. 596.

<sup>16</sup>Ibid.

<sup>17</sup>Ibid.

The third chapter consists of a description of the conduct of the study. Included are a discussion of group selection, drill selection and the procedure that was followed. A detailed description of the pilot study, the revisions, and the revised study is also included.

Chapter four presents the findings of the revised experiment and an analysis of the data.

The final chapter presents a summary of the findings, conclusions, and recommendations.

## CHAPTER II

### RELATED LITERATURE

The primary concern of this paper is the development of correct typewriting technique through the use of carefully selected drill material to help students improve their performance at the typewriter. In order to develop a well-planned, logical sequence of drill material, it was necessary to determine the nature of known research findings and other literature related specifically to accuracy development. Therefore, the first section of this chapter will discuss accuracy development. The second section will discuss drill usage and repetitive practice. The third section will briefly present copy difficulty factors to provide insight into the selection of the timed writing material according to pre-determined difficulty levels.

Typewriting accuracy has long been of concern to business educators and the subject of considerable research. The age alone of some of the previous research makes it obsolete and most evidence presented by current writers indicates that much of it is not currently considered valid.<sup>18</sup> The literature cited in this paper is related specifically to the development and logic of this study and is confined particularly to what is currently considered to be valid in classroom instruction to aid students in developing a proper sense of timing.

---

<sup>18</sup>Harves Rahe, "Review of Research in Typewriting, A Classification and Summary of Studies Completed Prior to 1949," (Doctoral dissertation, Indiana University, Bloomington, Indiana, 1950).



## Accuracy Development

Typists are inconsistent in the number of errors they make. Errors fluctuate from moment to moment, day to day, and from one situation to the next. Studies have been conducted to determine ways in which the classroom teacher can develop typewriting accuracy on the part of his students. Many of these studies attempt to prescribe a penance for the development of correct typewriting techniques in order to achieve the ultimate goal of accurate copy produced at an acceptable rate of speed.

Numerous error count and error description studies have been conducted.<sup>19</sup> Some of these use the typescript for evaluation purposes while others evaluate from the standpoint of mental, motor, or physiological processes which cause the error. Largely, as a result of these studies, the most prominent types of errors mentioned in typewriting literature are substitution, omission, dominance, transposition, and anticipation. West believes all errors can be grouped into three major categories—concentration and attention, copy-getting habits, and manipulation and technique habits. These errors appear to be a mixture of product and process.

Errors appear to be a function of a variety of emotional considerations. Fear of making errors cause errors; annoyance at having made an error produces new errors; personal worries about matters having nothing to do with the learning affect accuracy also . . . <sup>20</sup>

---

<sup>19</sup>Ibid.

Harves Rabe, Typewriting Research Index (New York: McGraw-Hill Book Company, Inc., 1963).

Leonard J. West, Acquisition of Typewriting Skills (New York: Pitman Publishing Corporation, 1969).

<sup>20</sup>Leonard J. West, Review of Research in Typewriting Learning with Recommendations for Training, Research Report AFPTRC-TM-57-69, ASTIA Document No. 126 400 (Lackland Air Force Base, Texas: Air Force Personnel and Training Research Center, 1957) p. 35.

There is merit in investigating what has been attempted in the past and been proven to be ineffective in accuracy development so that one recognizes the pitfalls and avoids them. Researchers have evaluated errors and have pointed out a number of techniques believed to be useless in accuracy development. The following techniques have been shown by research to be based on misconceptions: that rhythmic patterns should be metronomical; that there is a tendency for individuals to make particular kinds of errors; and that there is transfer from remedial material to regular material.<sup>21</sup> The practices and procedures listed below summarize those that have been proven ineffective:

1. Technical drills containing nonsense sequences of letters—either for preventative or remedial purposes.
2. Repetitious practice on the particular words mistyped—even in their phrase or line setting.
3. Error analysis charts or technique check sheets.
4. Rhythm drills, typing to music, or any other stroke-by-stroke pacing technique involving equal interstroke time intervals.
5. Concentration drills employing unusual or foreign words or jumbles of letters.
6. Use of 'perfect' copy as a goal and repetition for the sake of perfect copy.
7. Stringent standards of accuracy early in training.<sup>22</sup>

The consensus seems to be that accurate typewriting rarely involves a single letter or an isolated word so that repetitious practice on a single letter or an isolated word has no measurable benefit.<sup>23</sup> Any drill

---

<sup>21</sup>Leonard J. West, Recommendations For Typewriting Training, Development Report APFTRC-TR-57-68, ASTIA Document No. 126399 (Lackland Air Force Base, Texas: Air Force Personnel and Training Research Center, 1957), p. 8.

<sup>22</sup>Leonard J. West, "Implications of Research for Teaching Typewriting," Delta Pi Epsilon Research Bulletin No. 2 (1962) p. 13.

<sup>23</sup>West, Recommendations, pp. 31-32.

or pacing technique based on the premise that typewriting should be at an even tempo also has no demonstrable merit.<sup>24</sup>

After determining that these approaches and procedures have been proven ineffective, the classroom teacher should eliminate these procedures from his practice and attempt to ascertain what might prove to be of value. Logically, there is little hope for developing remedial material for the cure of typewriting error until the basic source of the error can be identified. Yet, error analysis charts and many other mechanical and devised means have proven ineffective.

Proper timing does seem to be an important factor in the development of both typewriting speed and accuracy. The speed at which various sequences of motion are made depends on the difficulty of the motion. "The secret of speed is to crowd to the utmost possible limit the easy sequences of motions. The secret of accuracy is to know when to crowd the stroking and when to slow down for more difficult motions."<sup>25</sup> So proper timing has an effect on both speed and accuracy. How does one develop the sense of when to speed up and when to slow down? There is no one particular method of developing this sense of timing. This will differ from individual to individual . . . "depending on the ease of fingering the particular sequence, on the learner's familiarity with the particular sequence, and on subtle differences among the learners themselves."<sup>26</sup> Anything which aids the learner to find the rate at which he can sense the demands of the copy would prove beneficial.

---

<sup>24</sup>Ibid.

<sup>25</sup>West, Review of Research, p. 31

<sup>26</sup>West, Recommendations, p. 9.



Any activity which aids the learner to find his proper sense of timing would have a beneficial effect. Research has indicated that the following materials and procedures might be helpful in accuracy development because they aid the individual in developing a proper sense of timing:

1. One possible technique particularly applicable to errors which appear to be the result of extremely jerky typing or of bad copy reading habits . . . is to have the typist spell each letter in the copy as he strokes the key . . .

2. A second possibility for materials which can be used on a mass basis to prevent errors is practice on regular word and sentence copy specifically constructed to contain the most frequently substituted letters . . . The use of such material on a regular basis by all learners was found to result in appreciably better error scores than those of a group not using such material . . . The superiority of the special materials group could have arisen from their use of real word and sentence copy instead of nonsense materials . . .

3. A third accuracy-development technique found to be excellent when evaluated experimentally is the use of the tachistoscope to flash on a screen for very brief intervals small sections of the copy . . .

4. Allied to the hypothesis that proper timing is the heart of accurate typing, and clearly the most promising procedure of all, is the use of any technique which aids the learner to gauge his stroking at a known rate slightly below his top rate . . . <sup>27</sup>

Keeping the above materials and procedures in mind, the classroom teacher must select a plan of attack which will provide that practice materials which will best help his students in developing their proper stroking rates. If the teacher decides, as many teachers do, that the drill period is the proper place in the classroom for timing development, he must then know what type of drill work will best aid his students.

---

<sup>27</sup>West, Review of Research, pp. 33-34.

### Drill Usage and Repetitive Practice

The point should be re-emphasized that there is no one particular method of achieving a sense of when to speed up and when to slow down. One possible purpose of repetitive practice or drill is to find a particular timing pattern which results in the best possible pattern. The individual searching for the proper pattern, not trying simply to type with few errors, is the major purpose of repetitive practice.<sup>28</sup> Drill should be used with the understanding of what it is supposed to do in the development of skill. The principles of learning as applied to typewriting should be the basis for all drill use and repetition.

One learns by doing. When automatic action is required, drill is helpful because it provides repetition until a habit is formed or a response is automatized without continuous effort. This habit that the learner attempts to form is one of strengthening his association between seeing the letter and making the correct response. In typewriting, practice strengthens associations but does not speed the finger motions. Transfer would, however, occur in the letter sequences that are the same in different tasks. West, therefore, recommends practice with extensive material.<sup>29</sup> Practice is a means of operation for reinforcement and contiguity. Any practice that incorporates reinforcement and contiguity will result in learning. Transfer should also be of major importance. Task A should have elements in common with Task B. The closer Task A is to Task B the greater the transfer. Therefore, practice material should contain many sequences instead of only a few and should be over a broad range of materials from simple to complex.

---

<sup>28</sup>Ibid., p. 31.

<sup>29</sup>West, Review of Research, p. 20.

West warns against excessive repetitious practice on small amounts of materials. He states that excessive repetition results in the accumulation of inhibitions, causes increases in errors, fixes undesirable responses, and causes fatigue.<sup>30</sup> The interest factor should also be taken into consideration. Students tend to lose interest when practicing a small amount of material over a long period of time. Students must be actively interested in order to gain maximum benefit. Repetitious practice on a small amount of material can lead to passive interest and less learning.

Lessonberry feels that the following factors do not vary greatly between individuals and should be considered in the selection of drill work:

1. The learner must know the goal toward which he is working.
2. The learner must understand the purpose of each practice project and the expected outcomes of the use of a particular practice procedure. This means that he just not only know how he should practice, but also why.
3. The learner must like to work. "Enjoyable learning is essential to efficient learning."
4. Knowledge of progress is essential to the development of skill.
5. Repetitive practice is essential to the development of skill.
6. Practice makes perfect only if there is a definite drive toward perfection.<sup>31</sup>

Beaumont feels the selection of material should take goals into consideration and involves the following three factors:

1. The student must see the goal as both attractive and

---

<sup>30</sup>West, Implications, p. 5.

<sup>31</sup>V. D. Lessonberry, "The Right Kind of Practice to Develop Typing Power," Methods of Teaching Typewriting (South-Western Monographs, No. 72. Cincinnati, Ohio: South-Western Publishing Company, 1949) p. 24.

important, and the special drill as an effective means of achieving it . . .

2. The student must give to the techniques involved the degree of attention required to bring the greatest ultimate goal attainment . . . .

3. The student should be involved in procedures which cause his efforts to be most productive . . . drill procedures used should hold enough interest to bring about continued intensity of student effort . . . In addition, each procedure should provide for a sufficient number of similar attempts to bring a degree of improvement of refinement of effort before the procedure or goal is changed. The procedure should also provide opportunity for the student to evaluate his achievement, to focus on means of improvement, and then to retry until some definite degree of success is attained.<sup>32</sup>

After the selection of the drill material, the teacher must guide the pupils so that the drill activity is conducted in as meaningful a manner as possible. Russon and Wanous offer these suggestions to make the drill as meaningful as possible:

1. The student must use good form in typing the drills.
2. The purpose of each drill should be made clear to the students. Without meaningful practice, there is no improvement.
3. The practice work of the students must be motivated.
4. Practice periods must be well spaced. A drill plan is needed.
5. The drudgery of drill work must be eliminated.
6. The drill work of the student should be individualized.
7. The drills should be selected to match student needs and levels of instruction . . . When drills match student ability and needs, the most rapid progress will be made.<sup>33</sup>

---

<sup>32</sup>Lee R. Beaumont, "The Use of Special Drills in Developing Basic Typing Skill," Practices and Preferences in Teaching Typewriting, Jerry W. Robinson, editor (South-Western Monographs in Business and Economic Education, No. 117. Cincinnati, Ohio: South-Western Publishing Company, 1967) p. 47.

<sup>33</sup>Allien R. Russon and S. J. Wanous, Philosophy and Psychology of Teaching Typewriting (Cincinnati, Ohio: South-Western Publishing Company, 1960) p. 312.



Lessenberry also suggested the following ideas concerning drills and drill usage:

Drill completed without attention to its use or purpose tends to be wasteful . . . . This principle suggests that the drill must represent a meaningful situation . . . when the drill is made meaningful through proper motivation . . . it unquestionably improves typing power . . .

There is no particular merit in doing so many lines of a drill either with or without errors . . .

The completed drill is of little importance; the significant thing is what takes place as the drill work is done.<sup>34</sup>

Authorities concur that typewriting practice must be goal oriented and the student must thoroughly understand these goals and believe that they are realistic and attainable. Practice must be regular and frequent, and the student must be highly motivated to keep his interest high. The student must also be able to see improvement in his skill which he can attribute to his effort on drill work and repetitive practice.

To achieve the best results, the teacher must know the goals to be acquired, the student group to be taught, and the practice that will provide maximum learning. The purposes, materials, and procedures must be combined for the greatest possible achievement. After considering the foregoing material, it is evident that drill material must be selected with great care and be based on the psychological principles of skill development in order to have a positive effect.

#### Copy Difficulty Factors in Relationship to Accurate Evaluation

In order to evaluate performance accurately, one must have a standard measure. "The essence of any measurement is the establishment

---

<sup>34</sup>D.D. Lessenberry, "Basic Principles of Drill in Typewriting," Methods of Teaching Typewriting (South-Western Monograph, No. 71. Cincinnati, Ohio: South-Western Publishing Company, 1949) p. 7.

of a standard 'yardstick' which may be used as a basis for comparison and judgment. Measurement requires the adoption of a uniform system, device, or instrument which will provide consistent, accurate, and comparable results."<sup>35</sup> Copy difficulty has been proven to have a definite effect on typewriting performance as measured by administration of timed writings.

Copy difficulty refers to the elements of the structural characteristics that determine the ease with which material can be reproduced on the typewriter. Research has indicated that the three major determinants of copy difficulty are syllabic intensity, stroke intensity, and high-frequency words.<sup>36</sup>

Research has been conducted to determine the effect of syllabic intensity, stroke intensity, and high-frequency words on typewriting performance. Robinson makes this statement in his study:

. . . the consensus seems to indicate that incidence of high-frequency words, stroke intensity (average word length), and syllabic intensity (average number of syllables per word) are factors of copy difficulty that affect typewriting speed significantly but do not significantly affect typewriting accuracy.<sup>37</sup>

Since all three factors affect copy difficulty and since controlling one of them does not control the other two, it appears that in order to have a reliable measure of copy difficulty all three factors have to be controlled.

Therefore, when using straight-copy timed writings as a measuring device of typewriting ability, copy difficulty must be kept uniform in

---

<sup>35</sup>Lee R. Beaumont, "Copy Counts," The Balance Sheet LI, (March, 1970) p. 292.

<sup>36</sup>Jerry W. Robinson, "Matching Copy Structure to Practice Purpose in Typewriting," Practices and Preferences in Teaching Typewriting, Jerry W. Robinson, editor (South-Western Monographs in Business and Economic Education, No. 117. Cincinnati, Ohio: South-Western Publishing Company, 1967) p. 54.

<sup>37</sup>Ibid., p. 55.

order to obtain consistent, accurate, and comparable results.

### Summary

Accurate typewriting is contingent on the individual typist developing his proper sense of timing—that is, when to speed up and when to slow down. Anything that aids the learner in finding the rate at which he senses the demands of the copy is beneficial.

Teachers are becoming dependent on drill material to aid students in the development and attainment of typewriting skill. Typewriting drill and repetitive practice should be used with an understanding of the manner in which it effects technique development and refinement. The psychological principles of reinforcement and contiguity as well as motivation and interest must be applied in a manner which produces the most favorable results. Drills must be selected on the basis of criteria selected by the teacher as a result of research on the part of business educators. The drill material and specific goals must then be explained to the typewriting student in a manner which is meaningful and motivates him to work diligently toward the desired goal. Finally, the student must be able to recognize definite progress which he can attribute to the drill procedure that caused him to realize his proper sense of timing.

In order to determine if a student's performance is consistent and in order to determine if a student is making progress, it is mandatory to measure performance in a uniform consistent manner. Since research indicates that copy difficulty factors affect typewriting speed but not typewriting error incidence, it is necessary to control copy difficulty level to obtain a reliable measurement of the student's ability.

## CHAPTER III

### DESIGN OF THE STUDY

Purpose of the Study The purpose of this study was to determine whether experimenter-assigned drills or student-selected drills produce a significant difference as measured by performance on timed writings. It was proposed that there would not be a significant difference. If significant difference were found, it would be of value to guide students to greater development of their potentials as typists.

Selection of the Subjects Students involved in the pilot experiment were enrolled in an advanced typewriting class conducted at Eastern Illinois University during Winter Quarter 1968-69. Students involved in the revised experiment were enrolled in an intermediate typewriting class at Eastern Illinois University during Spring Quarter 1970.

Data to be Collected The data needed was the gross words per minute and error incidence on three- and five-minute timed writings of average and high-average difficulty.

Data Analysis The data was subjected to analysis-of-variance technique in order to determine if the difference between the treatment means are significantly greater than zero.

Criteria for Experimenter-Assigned Drill Material The drill material which was imposed by the experimenter was selected from the supplementary textbook. All the material was sentence and paragraph copy. There was



no repetition of copy and no material concentrating on a particular letter or sequence. The material contained no nonsense copy or foreign words. There was such a large quantity of drill material assigned that no subject was able to complete the amount of material assigned. The experimenter-assigned drill group progressed through the supplementary textbook working on copy which met the above qualifications.

### PILOT EXPERIMENT

A pilot experiment was designed and executed in order to establish a concrete foundation for the revised experiment. The pilot study served the purpose of eliminating some preliminary questions pertaining to the size of population, the level of skill development, the length of the drill period, the length of the timed writings, and the selection of the drill copy.

Purpose of the Pilot Study A preliminary investigation was conducted to lay the foundation for the revised experiment. The pilot study was designed in order to answer the following questions:

1. Do individually assigned typewriting drills based on errors in straight-copy five-minute timed writings have an effect on error incidence in material of average and high-average difficulty?
2. How is typewriting speed affected by average and high-average difficulty copy?
3. How is error incidence affected by average and high-average difficulty copy?
4. Is there a pattern or relationship between speed and error incidence that will indicate if an increase in speed will be accompanied by an increase or decrease in errors?

The subjects (Ss) in the pilot experiment were students in an advanced typewriting class (Business Education 210) at Eastern Illinois

University. Members of the class were all college students. The class met for fifty minutes daily Tuesday through Friday. Twenty-two Ss participated in the experiment; twenty of these Ss completed the experiment.

Business Education 210 provides an opportunity for remedial and advanced training in speed and accuracy development on straight copy production work. The textbook used was College Typewriting, Seventh Edition, South-Western Publishing Company, and the workbook that accompanied the text. Typing for Accuracy, Fifth Edition, The H. M. Rowe Co., was used as a supplementary text. The course included six units consisting of thirty-eight lessons. The final grade was based thirty per cent on straight copy speed, accuracy, and techniques and seventy per cent on production work. At the end of the quarter, students were required to type at a minimum speed of forty net words a minute with five errors or less on five minute-timed writings of straight copy material for a passing grade. Tests were given at the end of each of the six sections to indicate progress. The speed standards based on net words a minute were increased at the end of each section for each letter grade. The final test was given over a period of several days in order to determine ability to perform consistently at a given speed for straight copy and production work.

In the explanation of the pilot experiment, the Ss were told they would be working daily on individually assigned drills in order to try to improve their typewriting accuracy rate. The procedure would be to take two five-minute timed writings weekly on Friday. Each S's timed writings would be analyzed and the S would be assigned drill material to begin the following Tuesday and continue until Friday.

On the initial Tuesday of the pilot experiment, the Ss were given two five-minute timed writings. The difficulty of the copy used was determined on the basis of syllabic intensity, stroke intensity, and high-frequency words. The first timed writing was of high-average difficulty (1.6-5.8-70) and the second of average difficulty (1.5-5.6-75). The Ss were not given any information concerning the difficulty of the material. They were instructed to type at a controlled level. Ss took the first timed writing, proofread the copy, took the second timed writing, and proofread. All papers were handed in regardless of the results.

Students in the pilot study were then divided into two groups by random selection. One group was to work on experimenter-assigned drills based on simple analysis of errors on the copy and the second was to work on assigned drills based on criteria established by the experimenter.

In the pilot study, the papers were proofread and the gross words a minute and the number of errors were recorded. An attempt was then made to analyze the errors for one group. Each S of that group was assigned drill material for the following week. The drill material for both groups came from one of two typewriting drill books and consisted of either sentences or paragraphs or both. The length of the drill work varied from eight to eighty lines. Ss typed on their assigned drills for two minutes daily on Wednesday through Friday of the first week.

On each Friday and upon completion of the drills, the Ss in the pilot study were given two different timed writings--one average and one high-average in difficulty in that order. The drill sheet for the week

was turned in with the timings. The procedure remained basically the same throughout the experiment. The Ss drilled Tuesday through Friday and then took the timed writings after drill time on Friday. Drilling time was increased, by one minute weekly, to three, four, and five minutes. On the Tuesday following the completion of the four weeks of the experiment, the Ss were given the two original five-minute timed writings.

The results of the pilot experiment tended to indicate the following:

1. Typewriting speed appears in most cases to increase or remain the same with the decrease in the difficulty of the copy.
2. The incidence of typewriting errors at the two levels of difficulty did not appear to be consistent.
3. Drill usage in some cases appeared to reduce error incidence. This is particularly true in cases in which individuals had particularly high error incidence. However, there was no consistent pattern.
4. There appears to be no relationship between typewriting speed and accuracy.

It appears that the only statement that can be made as a result of the pilot experiment is that the individually-assigned drills did benefit those who were making excessive errors; however, those individuals with nominal error rates did not benefit from the individually-assigned drills due to the tendency for errors to be chance. Therefore, drills of a general nature over a variety of material would probably be more beneficial in aiding the student to develop his proper sense of timing.

#### REVISED EXPERIMENT

On the basis of the pilot study, it was determined that the size of the population, the procedures, and the design of the study did not



produce adequate information; and they needed to be modified. A revised experiment was designed in order to answer the following questions:

1. Is there a significant difference based on the speed performance of the Experimenter-Assigned Drill Group and the Student-Selected Drill Group as measured by straight-copy three-minute timed writings of average and high-average difficulty?
2. Is there a significant difference in error incidence of the Experimenter-Assigned Drill Group and the Student-Selected Drill Group as measured by straight-copy three-minute timed writings of average and high-average difficulty?

Procedures to Remain the Same It was decided to revise the experiment

but to allow the following procedures to remain the same:

1. The Experimenter-Assigned Drill Group was to experience a large quantity of drill material none of which could be completed in the allowed drill time.
2. Drill material was again to consist of sentence and paragraph copy.
3. Timed writing material would again be of average and high-average difficulty in order to have consistent results.

Procedures Revised The following procedures were revised in order to obtain more valid results:

1. The length of the timed writings was changed from five to three minutes because three-minute timed writings have been proven to be as effective as five-minute timed writings in measurement of ability. Also, less time is required in measuring and evaluating results.
2. An intermediate class was used instead of an advanced class because the intermediate class had greater possibilities for improvement.
3. The drill period was changed to five minutes daily for consistency and because there did not appear to be any difference resulting from varying drill time in the pilot experiment.
4. No error analysis would be used.
5. One group of students would be working on drills which

they selected for themselves according to their own interests and preferences.

6. Midpoint in the experiment and after the completion of a week's timings with three errors or less, subjects were instructed to concentrate on rapid stroking.

The subjects in the revised experiment were students in an intermediate typewriting class (Business Education 112) at Eastern Illinois University. The Ss were all college students. The class met for fifty minutes on Monday, Tuesday, Wednesday, and Friday. It was decided to use this class in this experiment because the Ss were still at a level of skill development where the possibility of increases in speed would be greater than at other levels of class work. Thirty Ss participated in the experiment; all of these Ss completed the experiment.

Business Education 112 provides an opportunity for continuation of speed and accuracy development on straight copy material with emphasis on production of business communication. The text used was College Typewriting, Seventh Edition, South-Western Publishing Company, and the workbook which accompanied the text. Typing for Accuracy, Fifth Edition, The M. M. Rove Co., was used as a supplementary text. The course included six units consisting of thirty-eight lessons. The final grade was based fifty per cent on production work and fifty per cent on straight copy speed, accuracy, and techniques. At the end of the quarter, students were required to type a minimum speed of thirty-five gross words a minute with five errors or less on five-minute timed writings of straight-copy material for a passing grade. Tests were given at the end of each of the six sections to indicate progress. The speed standard based on gross words a minute were increased at the end of each section for each letter grade. The final test was given over

a period of several days in order to determine ability to perform consistently at a given speed for straight copy and production work.

To initiate the experiment two three-minute timed writings were given. One timed writing was of average difficulty (1.5-5.6-75) and the other was of high-average difficulty (1.6-5.8-70). The difficulty of the copy used was determined on the basis of syllabic intensity, stroke intensity, and high-frequency words. The Ss were given a copy of the material with the instructions for the length of line and were asked to type the copy line for line on their papers as it appeared on the copy from which they were typing. The Ss were instructed to type at a control level. Ss took the first timed writing, proofread their copy, prepared for the second timing, took it, and again proofread. All papers were handed in regardless of results. The papers were then proofread and the gross words per minute and the number of errors were recorded. No attempt was made to analyze the errors.

The Ss were then divided into two groups by random selection. Half of the Ss were to work on drills imposed by the experimenter and the other half on self-selected drills. The experimenter-assigned drills were selected on the basis of research findings enumerated earlier in this paper. The Student-Selected Drill Group worked on drills they selected according to their own interests and preferences.

The timed writings were returned to the Ss. Each S was then assigned to an Experimenter-Assigned Drill Group or a Student-Selected Drill Group. Those Ss working on assigned drills were given a list of specific pages with reference to specific exercises. These Ss were instructed to type each item once and proceed to the next. The table of contents, drill charts, and index were explained to those students who

were selecting their own drill. Those Ss selecting their own drills were to look at their timed writings and select those drills they felt would be most beneficial to them. These Ss were given no additional directions concerning the number of repetitions or the number of drills.

The Ss were then given some instructions on the procedures they would be following. They were to drill for five minutes daily at the beginning of the class on either their assigned or selected drill material. Weekly, on Friday, they were to take two three-minute timed writings with enough time allowed between timed writings to proofread and prepare for the next timing. The Ss were told that their timings would be evaluated on the basis of the number of errors and gross words a minute. The errors were determined on the basis of the International Typing Rules. Ss were to keep a folder with all their drill material and timed writings as well as a cover sheet which contained the number of the timed writing, the gross words a minute, and the number of errors. After a student had completed several timed writings with three errors or less, he was instructed to concentrate on his speed in his drill work the following week. At the conclusion of the experiment, each S submitted a completed folder.

An analysis of the findings is presented in the chapters that follow. Chapter IV presents the statistical and graphic information and Chapter V presents the summary and conclusions.



## CHAPTER IV

### PRESENTATION AND ANALYSIS OF FINDINGS

The results of the statistical analysis and discussion of the findings are presented in this chapter. Analysis-of-variance technique was used as the principle statistical tool in the examination of collected data. A summary of the findings is presented in tabulated form.

Tables are presented to show the general outcomes as measured by straight-copy timed writings and the specific results of the two groups of subjects for speed and error incidence at the various difficulty levels. Two analysis of variance charts will be presented--one for typewriting speed and one for typewriting error incidence.

This chapter is divided into three major sections: The presentation of the raw data, the analysis of variance for speed, and the analysis of variance for error incidence.

#### PRESENTATION OF RAW DATA

##### Typewriting Speed

Table I presents the gross number of words typed by each student in the Experimenter-Assigned Drill Group on each timed writing in the series of three-minute timed writings.

Table I may be read in the following manner. There were eighteen timed writings. These timed writings were given in alternating order; that is, average and high-average one time, then high-average and average the next.

TABLE I

EXPERIMENTER-ASSIGNED SKILL GROUP  
 Three-Minute Timed Writings of Average and High-Average Difficulty  
 Typewriting Speed in Gross Words Per Minute

STUDENT	1 A	2 HA	3 HA	4 A	5 A	6 HA	7 HA	8 A	9 A	10 HA	11 HA	12 A	13 A	14 HA	15 HA	16 A	17 A	18 HA
1	46	45	46	47	45	48	48	49	46	44	46	55	48	48	45	52	52	49
2	48	44	45	45	43	44	45	49	44	42	39	44	37	43	44	44	45	40
3	63	57	60	59	61	61	57	61	62	61	60	66	59	63	63	69	64	64
4	47	44	49	42	38	42	39	47	44	42	41	46	47	43	44	44	52	45
5	47	44	47	47	46	49	46	50	46	42	45	46	48	50	48	47	51	49
6	50	44	45	46	46	43	40	44	48	45	44	51	43	46	40	46	48	42
7	42	40	50	52	54	50	48	51	48	43	46	51	—	—	37	57	—	—
8	66	63	62	61	60	61	53	62	64	59	62	60	56	62	61	63	65	58
9	38	39	38	39	39	41	39	42	44	38	31	44	40	42	40	42	45	43
10	34	30	39	37	38	35	40	55	44	38	38	42	41	37	38	44	43	40
11	52	50	51	51	51	50	50	55	53	46	50	59	55	53	54	57	56	59
12	45	49	47	50	53	49	49	45	49	51	53	60	49	49	51	59	57	44
13	56	57	60	64	60	58	62	62	61	61	57	69	64	60	56	62	66	60
14	54	51	54	50	54	54	55	58	55	50	52	60	60	57	56	61	57	52
15	60	58	60	57	57	60	61	62	61	56	47	57	56	56	56	62	63	61
TOTAL	748	715	753	746	745	745	732	792	769	718	711	810	705	709	733	809	764	706
N	15	15	15	15	15	15	15	15	15	15	15	15	14	14	15	15	14	14
$\bar{X}$	49.87	47.67	50.20	49.73	49.67	49.67	48.80	52.80	51.27	47.87	47.40	54.00	50.36	50.64	48.87	53.93	54.57	50.43

Subject 1 typed 46 gross words per minute on Timed Writing 1 which was of average difficulty and 45 gross words per minute on Timed Writing 2 which was of high-average difficulty. The TOTAL column represents the total gross words per minute of all the subjects participating in that particular timed writing. There were 748 gross words per minute typed in Timed Writing 1 and 715 gross words per minute typed on Timed Writing 2. The N row signifies the number of students participating in the timed writing. In Timed Writing 1, 15 subjects participated, and in Timed Writing 2, 15 subjects participated. The mean ( $\bar{X}$ ) is the average number of words that were typed. The mean gross number of words typed in Timed Writing 1 was 49.86 and the mean gross number of words typed in Timed Writing 2 was 47.67.

Table II presents the results of the timed writings for those subjects who were in the Student-Selected Drill Group. Table II is interpreted in the same manner as Table I.

The range on mean speed varied from 49.67 to 54.57 or 4.90 words on the Experimenter-Assigned Drill Group and from 44.66 to 54.47 or 9.81 words on the Student-Selected Drill Group on copy of average difficulty. This was a very noticeable difference in range of mean speeds gained by the Student-Selected Drill Group which is possibly due to the fact that the Experimenter-Assigned Drill Group might have been more error conscious.

The range on mean speed varied from 47.40 to 50.64 or 3.24 words on the Experimenter-Assigned Drill Group and from 44.33 to 49.40 or 5.07 words in the Student-Selected Drill Group on the copy of high-average difficulty. The difference in performance was not as evident, but the Student-Selected Drill Group did again exhibit a greater gain. It is interesting to notice that the low mean speed for both groups was experienced on Timed Writing 11.

TABLE II

STUDENT-SELECTED DRILL GROUP  
 Three-Minute Taped Writings of Average and High-Average Difficulty  
 Typewriting Speed in Gross Words Per Minute

STUDENT	1 A	2 HA	3 HA	4 A	5 A	6 HA	7 HA	8 A	9 A	10 HA	11 HA	12 A	13 A	14 HA	15 HA	16 A	17 A	18 HA
1	43	44	43	47	42	44	47	48	50	46	30	51						
2	44	44	40	43	42	44	47	48	47	44	40	42	45	47	46	51	47	47
3	35	35	35	38	41	39	36	40	43	35	40	46	40	49	43	48	47	46
4	70	69	67	70	65	74	63	64	70	71	62	70	60	64	71	68	64	66
5	49	50	57	50	55	53	51	50	49	48	31	59	45	29	51	53	52	48
6	51	50	45	52	55	52	50	56	55	53	49	56	53	41	51	52	54	50
7	50	49	56	53	56	51	50	49	47	53	46	52	47	52	47	52	53	52
8	37	33	34	38	37	37	44	42	37	36	38	41	39	39	39	38		
9		64	64	66	70	71	64	63	65	57	63	68	62	56	65	63	61	64
10	55	54	52	52	52	50	53	55	60	53	50	58	55	55	53	57	51	58
11	47	48	45	44	46	43	43	48	46	43	45	47	46	45	48	50	50	47
12	47	45	50	49	47	47	42	46	47	45	51	53	47	51	50	50	50	49
13	58	57	59	58	56	57	57	50	51	51	56	60	54	62	49	61	62	56
14	42	42	59	40	38	42	42	39	43	42	35	42	38	40	38	45	42	40
15	39	35	32	35	40	37	36	34	33	31	29	42	38	39	35	37	38	37
TOTAL	667	719	718	738	742	741	725	732	743	708	665	787	669	669	684	725	681	662
N	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	14	14
$\bar{X}$	47.64	47.93	47.87	49.20	49.47	49.40	48.33	48.80	49.53	47.20	44.33	52.47	44.60	44.60	45.60	48.33	48.64	47.29

### Typewriting Error Incidence

Table III presents the error incidence of each subject in the Experiment—Assigned Drill Group on each timed writing in the series of three-minute timed writings.

Table III may be read in the following manner. There were 18 total timed writings. These timed writings were given in alternating order—that is average and high-average one time, then high-average and average the next. Subject 1 had 5 errors on Timed Writing 1 which was of average difficulty and 3 errors on Timed Writing 2 which was of high-average difficulty. The TOTAL row represents the total number of typewriting errors made by all the subjects participating in that particular timed writing. There were 116 total errors made on Timed Writing 1 and 90 total errors made on Timed Writing 2. The N row signifies the number of subjects participating in the timed writing. In Timed Writing 1, 15 students participated and in Timed Writing 2, 15 subjects participated. The mean ( $\bar{x}$ ) is the average number of typewriting errors. The mean errors in Timed Writing 1 is 7.73 and the mean errors in Timed Writing 2 is 6.00.

Table IV presents the results of the timed writings for those subjects who were in the Student-Selected Drill Group. Table IV is interpreted in the same manner as Table III.

The range on mean errors varied from 4.80 to 7.31 or 2.51 errors in the Experimenter-Assigned Drill Group and from 5.29 to 8.07 or 2.78 errors in the Student-Selected Drill Group on copy of average difficulty. The range on the mean errors varied from 6.00 to 9.00 or 3.00 errors in the Experimenter-Assigned Drill Group and from 5.93 to 9.13 or 3.20 errors in the Student-Selected Drill Group on the high-



TABLE III

~~EXPERIMENTER ASSIGNED DRILL GROUP~~  
 Three-Minute Taped Writings of Average and High Average Difficulty  
 Typewriting Error Incidence

STUDENT	1 A	2 HA	3 HA	4 A	5 A	6 HA	7 HA	8 A	9 A	10 HA	11 HA	12 A	13 A	14 HA	15 HA	16 A	17 A	18 HA
1	5	3	7	4	5	7	3	5	5	5	1	0	5	4	5	5	3	5
2	6	8	10	6	8	12	6	10	17	6	9	5	8	11	9	7	3	5
3	0	2	2	0	2	2	2	1	6	4	1	1	2	2	3	8	2	3
4	15	18	8	7	8	7	7	17	10	12	6	6	14	10	9	9	3	11
5	10	4	7	4	4	8	9	3	5	5	6	10	8	9	24	5	8	5
6	7	8	5	7	9	7	12	5	8	9	17	11	10	9	1	5	5	3
7	7	7	0	3	9	9	5	3	10	3	5	5		11	5			
8	3	5	5	3	9	1	0	0	6	5	1	3	2	3	5	0	6	4
9	8	0	13	6	11	12	7	7	8	8	6	15	10	10	11	6	8	9
10	7	5	6	7	7	2	5	6	10	8	9	4	5	7	2	7	3	4
11	9	5	6	6	5	4	8	8	14	4	9	6	8	14	14	10	9	10
12	6	12	13	5	8	12	26	22	1	9	8	8	26	30	20	23	13	18
13	11	1	3	2	3	5	2	3	2	1	6	5	2	9	3	5	5	5
14	19	6	5	8	1	2	6	5	3	3	4	4	4	2	7	5	2	4
15	3	6	10	4	6	6	7	7	4	21	5	7	4	4	11	6	3	3
TOTAL	116	90	100	72	95	99	96	102	109	103	93	90	108	124	139	106	73	89
N	15	15	15	15	15	15	15	15	15	15	15	15	14	14	15	15	14	14
$\bar{X}$	7.73		6.67		6.33		6.40		7.27		6.20		7.71		9.00		5.21	
		6.00		4.80		6.60		6.80		6.87		6.00		8.96		7.07		6.36

TABLE IV

STUDENT-SELECTED DRILL GROUP  
 Three-Minute Timed Writing of Average and High-average Difficulty  
 Typewriting Error Incidence

STUDENT	1 A	2 HA	3 HA	4 A	5 A	6 HA	7 HA	8 A	9 A	10 HA	11 HA	12 A	13 A	14 HA	15 HA	16 A	17 A	18 HA
1	10	4	10	5	8	5	8	16	6	13	7	13						
2	5	6	7	1	5	4	10	12	8	11	6	10	4	9	7	11	9	6
3	10	9	6	8	4	7	6	2	8	6	13	16	7	14	20	4	3	4
4	2	9	6	4	10	7	8	8	8	10	3	5	4	4	5	4	3	4
5	5	4	8	15	7	6	5	6	13	17	3	9	16	4	6	7	5	15
6	6	3	7	6	2	7	4	3	6	5	5	4	6	10	6	9	6	5
7	11	6	8	14	11	11	3	9	9	12	8	6	5	2	2	8	11	12
8	7	13	11	9	4	12	11	9	9	10	12	10	8	10	8	15		
9		8	6	5	7	1	3	2	2	12	5	7	3	6	1	3	7	8
10	5	7	10	4	8	4	2	1	4	5	1	3	2	2	4	1	0	3
11	3	6	6	1	4	6	6	3	5	3	3	6	5	7	9	4	4	4
12	12	11	11	8	3	3	6	6	9	11	9	18	9	12	6	9	5	9
13	6	4	10	11	9	8	9	20	18	14	10	5	10	3	10	10	5	9
14	6	3	4	5	5	3	4	6	5	2	8	2	2	3	4	3	2	3
15	4	9	8	7	6	5	13	18	6	6	6	6	9	11	5	6	3	3
TOTAL	92	102	124	103	93	89	98	121	116	137	99	120	90	97	93	105	74	93
N	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	14	14
$\bar{X}$	6.57	6.80	8.27	6.87	6.20	5.93	6.53	8.07	7.73	9.13	6.60	8.00	6.00	6.47	6.20	7.00	5.29	6.64

average timed writings, there was less difference for the Experimenter-Assigned Drill Group.

### ANALYSIS OF VARIANCE

A common statistical technique which permits an analysis of the data in several samples at a time is analysis-of-variance technique.<sup>38</sup>

It is based on the statement of a null hypothesis ( $\mu_a = \mu_b = \mu_c = \mu_d$ ) that the means of the samples are equal.

In order to facilitate the statistical computation of the analysis-of-variance technique, timed writing speed and error scores were arranged in four groups. Group A was the Experimenter-Assigned Drill Group's performance on the timed writings of average difficulty and Group B was the Experimenter-Assigned Drill Group's performance on the timed writings of high-average difficulty. Group C was the Student-Selected Drill Group's performance on the timed writings of average difficulty and Group D was the Student-Selected Drill Group's performance on the timed writings of high-average difficulty.

#### Analysis of Variance in Speed

Statement of the Null Hypothesis The following null hypothesis was tested in this study: There is no significant difference in the type-writing speed achieved by the students in the Experimenter-Assigned Drill Group and the Student-Selected Drill Group on average and high-average difficulty three-minute timed writings.

Analysis of Variance Test in Speed Table VII presents the results of

---

<sup>38</sup>See Appendix A

the computation of the analysis of variance for speed. The statistical computation is found in Appendix B. In order to prove a significant difference, there would need to be an F-ratio of at least 2.62 (3 and 400 degrees of freedom) to be significant at the .05 level.<sup>39</sup> The F-ratio obtained by analyzing the data collected in this study with reference to attainment of speed was .016, which is not large enough to indicate a significant difference. Therefore, it is necessary to accept the null hypothesis that there is no difference in the means. It is impossible to state that either of the groups of students performed at significantly higher speeds on either difficulty level timed writing.

TABLE V

ANALYSIS OF VARIANCE FOR TYPEWRITING SPEED ON  
THREE-MINUTE TIMED WRITINGS OF  
AVERAGE AND HIGH-AVERAGE DIFFICULTY

	Sum of Squares	Degrees of Freedom	Mean Square	F-Ratio
Between Groups	1598.962	3	532.987	.016*
Within Groups	17810128.363	529	33667.539	
Total	17811727.325	532		

\*Not significant at the .05 level

Analysis of Variance in Error Incidence

Statement of the Null Hypothesis An additional null hypothesis was tested

---

<sup>39</sup>Samuel B. Richmond, Statistical Analysis (2d ed.: The Ronald Press Company, New York, 1964). pp. 578-79. Reprinted from George W. Snedecor, Statistical Methods (5th ed.: The Iowa State University Press, 1956)

in this study: There is no significant difference in the typewriting error incidence between the students in the Experimenter-Assigned Drill Group and the Student-Selected Drill Group tested on average and high-average difficulty three-minute timed writings.

Analysis of Variance in Error Incidence Table VIII presents the results of the computation of the analysis of variance in error incidence. The statistical computation is found in Appendix C. In order to prove a significant difference, there would need to be an F-ratio of at least 2.62 (3 and 400 degrees of freedom) to be significant at the .05 level.<sup>40</sup> The F-ratio obtained by analyzing the data collected in this study with reference to error incidence is .1882, which is not large enough to indicate that either group performed with fewer errors on either difficulty level of timed writings.

TABLE VI

ANALYSIS OF VARIANCE FOR TYPEWRITING ERROR INCIDENCE  
ON THREE-MINUTE TIMED WRITINGS OF  
AVERAGE AND HIGH-AVERAGE DIFFICULTY

	Sum of Squares	Degrees of Freedom	Mean Square	F-Ratio
Between Groups	375.984	3	125.328	.1882*
Within Groups	352261.460	529	665.900	
Total	352637.444	532		

\*Not significant at the .05 level

<sup>40</sup>Ibid.



Summary

Through the use of analysis-of-variance technique to analyze the results of a series of eighteen timed writings as performed by an Experimenter-Assigned Drill Group and a Student-Selected Drill Group, it was found that no significant difference exists in the technical performance at the typewriter as measured by speed of stroking or avoidance of errors on three-minute timed writings of average and high-average difficulty.

## CHAPTER V

### SUMMARY, CONCLUSION AND RECOMMENDATIONS

#### SUMMARY

Assigning students an adequate amount of the correct type of drill material in order to develop typewriting technique has long been a concern of business educators. Typewriting teachers have been using drill material to act as a catalyst to aid students in the process of developing their typewriting skill to the maximum level. Typewriting teachers, consequently, have been concerned about selecting the proper quantity and quality of drill material so that the students will receive the most benefit.

The research of the related literature carried out in the development of this study concerning drill usage and repetitive practice indicates the following factors are to be considered by those interested in fruitful classroom practice:

1. Repetitious practice and drill is the individual's search for the proper pattern and is not an effort to type the copy with few errors.
2. Drill should be used with the understanding of what it is supposed to do in the development of skill.
3. Practice material should be of regular word and sentence copy containing many sequences instead of only a few and should be over a broad range of material from simple to complex. This avoids excessive repetition of a small amount of material which leads to passive interest

and less learning.

4. Drill material must be goal oriented and must be conducted in a meaningful manner. The student must be highly motivated, must understand the goal of the drill, and must be able to attribute improvement to the drill.

5. The teacher must know the goal to be acquired, the student group to be taught, and the practice that will provide maximum learning.

The purpose of this study was to determine if a group of students assigned drill material selected by the experimenter according to specific criteria were able to perform significantly better at the typewriter than a group of students who were allowed to select their own drill material. Measurement of typewriting ability of these two groups was determined on the basis of performance on three-minute timed writings of average and high-average difficulty.

A class of thirty intermediate college students at Eastern Illinois University participated in the study. The class met for fifty minutes four days a week. The students were divided into two groups of fifteen each. One group of these students were assigned to drill material selected by the experimenter and the second were allowed to select their own drill material according to their own interests and preferences. The students were given five minutes daily at the beginning of the hour to work on either assigned or selected drills.

Student progress was measured weekly on Friday, measurement being in the form of two timed writings, one selected to be of average difficulty and the other of high-average difficulty. Copy difficulty was determined and classified on the criteria of syllabic intensity, stroke intensity, and high frequency words. The timed writings were

administered in alternating order—that is, average and high-average one time, and then high-average and average the next. The students were not given any information concerning the difficulty of the copy. They were given a copy of the material and instructed to type the copy line for line at a control level. They were given the first timed writing and allowed to proofread; then given the second timed writing and allowed to proofread. All of the papers were collected regardless of the results. These papers were then re-proofread and a record made of the gross words per minute and the number of errors.

The timed writings were returned to the students so that they could see the results. Students were asked to keep a folder which included a cover sheet containing the number of the timed writing, gross words per minute, and the number of errors. The completed drill was also placed in the folder.

At the conclusion of the series of eighteen timed writings (nine average and nine high-average), the thirty students who participated in the study had completed 532 timed writings. In order to facilitate analysis of the results, the timed writings were divided into four groups for both speed and error incidence. Group A was the Experimenters-Assigned Drill Group's performance on the timed writings of average difficulty and Group B was the Experimenters-Assigned Drill Group's performance on the timed writings of high-average difficulty. Group C was the Student-Selected Drill Group's performance on the timed writings of average difficulty and Group D was the Student-Selected Drill Group's performance on the timed writings of high-average difficulty.

Analysis-of-variance technique was used as the principle statistical tool in the examination of the collected data. The initial step was to

state the null hypothesis that there were no differences in the means of the four groups. An F-ratio for typewriting speed and error incidence was determined by analyzing the various raw scores in the samples. The F-ratios were computed by using the variance between the sample means as the numerator and the variance within the samples as the denominator. By using a Table of F Distributions, it was possible to accept both the null hypotheses that there were no differences in the sample means. It was found that no significant differences existed in the technical performance at the typewriter of either the Experimenter-Assigned Drill Group or the Student-Selected Drill Group.

#### CONCLUSIONS

From the data analyzed in this study, several conclusions can be formed:

1. There was no significant difference at the .05 level in the typewriting speed achieved by the students in the Student-Selected Drill Group and the Experimenter-Assigned Drill Group in performance at the typewriter on three-minute timed writings of average and high-average difficulty. The null hypothesis stated that: "There is no significant difference in the typewriting speed achieved by the students in the Experimenter-Assigned Drill Group and the Student-Selected Drill Group tested on average and high-average difficulty three-minute timed writings." The null hypothesis was evaluated using analysis-of-variance technique which produced an F-ratio of .016. An F-ratio of 2.62 was required in order to reject the null hypothesis that there were no differences.

2. There was no significant difference at the .05 level in the typewriting error incidence achieved by the students in the Student-



Selected Drill Group and the Experimenter-Assigned Drill Group in performance at the typewriter on three-minute timed writings of average and high-average difficulty. The null hypothesis stated that: "There is no significant difference in the typewriting error incidence between the students in the Experimenter-Assigned Drill Group and the Student-Selected Drill Group tested on average and high-average difficulty three-minute timed writings." The null hypothesis was evaluated using analysis-of-variance technique which produced an F-ratio of .1882. An F-ratio of 2.62 was required in order to reject the null hypothesis that there were no differences.

3. At the college level in intermediate typewriting, those individuals in the Student-Selected Drill Group were able to select drill material that was as effective as the drill material selected by the experimenter.

4. Tables I-IV indicate that both typewriting speed and error incidence were not consistent in either group. The mean scores fluctuated in both directions.

5. In comparing the mean of the initial and the mean of the final timed writings for both groups at both difficulty levels, the Experimenter-Assigned Drill Group exhibited the greatest gain in mean speed. On the average difficulty timed writings, the Experimenter-Assigned Drill Group went from a mean speed of 49.87 gross words per minute to a mean speed of 54.57 gross words per minute or an increase of 4.70 gross words per minute while the Student-Selected Drill Group went from a mean speed of 47.64 gross words per minute to a mean speed of 48.64 gross words per minute or an increase of 1.00 gross words per minute. On the high-average difficulty copy timed writings, the Ex-

Experimenter-Assigned Drill Group went from a mean speed of 47.67 gross words per minute to 50.54 gross words per minute or an increase of 2.76 gross words per minute while the Student-Selected Drill Group went from a mean speed of 47.93 gross words per minute to 47.29 gross words per minute or a decrease of .64 gross words per minute. Although these gains were not significant at the .05 level, it is important to note the Experimenter-Assigned Drill Group made greater gains than the Student-Selected Drill Group. This could be due to exposure to a larger amount of drill copy and a greater variance in types of drill copy included.

6. An overview of the related literature concerning copy difficulty factors indicates that in order to evaluate typewriting performance accurately on timed writings, one must have a standard measuring device. Since syllabic intensity, stroke intensity, and high-frequency words are determinants of copy difficulty that have an effect on typewriting speed but not typewriting accuracy, these factors must be kept uniform when using straight-copy timed writings as a measuring device of typewriting ability in order to obtain consistent, accurate, and comparable results. These three factors were used in the selection of the timed writing copy for this study.

7. Research as reported in this study indicates that the key to both accurate and rapid typewriting appears to be a proper sense of timing. This involves the ability to sense the demands of the copy to determine when to speed up for easy sequences and when to slow down for the more difficult ones. Any technique, whether selected by the learner himself or by the instructor, which aids the learner to gauge the timing of his stroking will ultimately lead to greater proficiency at the typewriter.

### RECOMMENDATIONS

Similar studies of drill usage conducted for the purpose of aiding in the development of rapid and accurate typists would be of value to typewriting teachers by supplying information concerning the criteria for the proper selection of the appropriate quantity, quality, and type of drill copy. It is suggested that future studies use a much larger population at varying stages in the skill development process. Other researchers will want to control the copy difficulty and perhaps experiment with different difficulty levels of material.

From the conclusions derived from the data analyzed in this study, it would appear that experimenter-assigned drill material based on specific criteria does not produce a significant difference for either typewriting speed or error incidence as measured by performance at the typewriter on three-minute timed writings of average and high-average difficulty. Nevertheless, since the ability to produce accurate copy at an acceptable rate of speed is the measure of typewriting competence and since drill work plays an important part in the development of the necessary correct technique, research should be continued to determine proper selection of the appropriate drill material at varying stages of development so that this carefully selected drill material may be most beneficial to the typewriting student.

**BIBLIOGRAPHY**

BIBLIOGRAPHY

## A. BOOKS

- Clem, Jane E. Techniques of Teaching Typewriting. Second edition. New York: Gregg Publishing Division McGraw-Hill Book Company, Inc., 1955.
- Elzey, Freeman F. A Programmed Introduction to Statistics. Belmont, California: Brooks/Cole Publishing Company, 1965.
- Good, Carter V. (ed.). Dictionary of Education. Second edition. New York: Gregg Publishing Division, McGraw-Hill Book Company, Inc., 1959.
- Rahe, Marvce. Typewriting Research Index. New York: McGraw-Hill Book Company, Inc., 1963.
- Richmond, Samuel B. Statistical Analysis. Second edition. New York: The Ronald Press Company, 1964.
- Russon, Allen R., and Wanous, S. J. Philosophy and Psychology of Teaching Typewriting. Cincinnati, Ohio: South-Western Publishing Company, 1960.
- West, Leonard J. Acquisition of Typewriting Skills. New York: Pitman Publishing Corporation, 1969.
- \_\_\_\_\_. "Psychology of Skill: Principles For Teaching Typewriting." Methods of Teaching Typewriting. The Eastern Business Teachers Association Yearbook, Volume XXVIII. Somerville, New Jersey: Somerset Press, 1965.

## B. PUBLICATIONS OF THE GOVERNMENT

- West, Leonard J. Recommendations For Typewriting Training. Research Report AFPTRC-TN-57-68, ASTIA Document No. 126399. Lackland Air Force Base, Texas: Air Force Personnel and Training Research Center, 1957.
- \_\_\_\_\_. Review of Research in Typewriting Learning with Recommendations for Training. Research Report AFPTRC-TN-57-69, ASTIA Document No. 126400. Lackland Air Force Base, Texas: Air Force Personnel and Training Research Center, 1957.

## C. MONOGRAPHS AND MAGAZINE ARTICLES

- Beaumont, Lee R. "The Use of Special Drills in Developing Basic Typing Skill." Practices and Preferences in Teaching Typewriting. Jerry W. Robinson, editor. South-Western Monographs in Business and Economic Education, No. 117. Cincinnati, Ohio: South-Western Publishing Company, 1967. Pp. 44-47.



- Lessanberry, D. D. "Basic Principles of Drill in Typewriting." Methods of Teaching Typewriting. South-Western Monographs, No. 71. Cincinnati, Ohio: South-Western Publishing Company, 1949. Pp. 7-8.
- \_\_\_\_\_. "The Right Kind of Practice to Develop Typing Power." Methods of Teaching Typewriting. South-Western Monographs, No. 71. Cincinnati, Ohio: South-Western Publishing Company, 1949. Pp. 23-25.
- Robinson, Jerry W. "Matching Copy Structure to Practice Purpose in Typewriting." Practices and Preferences in Teaching Typewriting. Jerry W. Robinson, editor. South-Western Monographs in Business and Economic Education, No. 117. Cincinnati, Ohio: South-Western Publishing Company, 1967. Pp. 53-58.
- Russon, Allien R. "Principles of Learning Applied to Typewriting Skill Development." Practices and Preferences in Teaching Typewriting. Jerry W. Robinson, editor. South-Western Monographs in Business and Economic Education, No. 117. Cincinnati, Ohio: South-Western Publishing Company, 1967. Pp. 35-38.
- Beumont, Lee R. "Copy Counts." The Balance Sheet, LI (March, 1970).
- West, Leonard J. "Implications of Research for Teaching Typewriting." Delta Pi Epsilon Research Bulletin No. 2 (1962).

#### D. UNPUBLISHED MATERIAL

- Rabe, Harves. "Review of Research in Typewriting, A Classification and Summary of Studies Completed Prior to 1949." (Doctoral dissertation, Indiana University, Bloomington, Indiana, 1950).

**APPENDICES**

## APPENDIX A

## ANALYSIS-OF-VARIANCE TECHNIQUE

A common statistical technique which permits an analysis of the data in several samples at a time is analysis-of-variance technique. Analysis of variance is concerned with analyzing the variance of the raw scores in several samples. Two independently computed estimates of the variance, between the sample means and within the samples, are compared by computing an F-ratio. The F-ratio is computed with the variance between the sample means as the numerator and the variance within the samples as the denominator. Through the use of a Table of F Distributions, it is possible to accept or reject the null hypothesis.

In order to facilitate the statistical computation of the analysis-of-variance technique, timed writing speed and error scores were arranged in four groups. Group A was the Experimenter-Assigned Drill Group's performance on the timed writings of average difficulty and Group B was the Experimenter-Assigned Drill Group's performance on the timed writings of high-average difficulty. Group C was the Student-Selected Drill Group's performance on the timed writings of average difficulty and Group D was the Student-Selected Drill Group's performance on the timed writings of high-average difficulty.

The ratio between the mean scores between and the mean square within is the basis of the analysis of variance technique. The initial step is the statement of the null hypothesis ( $\mu_0 = \bar{x}_a = \bar{x}_b = \bar{x}_c = \bar{x}_d$ ) that there is no difference between the mean scores of the four groups. The evaluation of the F-ratio permits the researcher to accept or reject the null hypothesis that there is no difference among the sample means. If the F-ratio found by the researcher is significant at the level pre-determined by him (in this case .05), the researcher concludes that there are significant differences between the sample means.

## APPENDIX B

Computation of Analysis of Variance for Typewriting Speed on  
Three-Minute Timed Writings of Average and High-Average Difficulty.

	Sum of Squares	Degrees of Freedom	Mean Square	F
Between Groups	1598.962	3	532.987	.016
Within Groups	17810128.363	529	33667.539	
Total	17811727.325	532		

Group A	Group B	Group C	Group D
$\Sigma X_A$ 6888	$\Sigma X_B$ 6522	$\Sigma X_C$ 6484	$\Sigma X_D$ 6291
$\Sigma X_A^2$ 5280972	$\Sigma X_B^2$ 4728534	$\Sigma X_C^2$ 4684286	$\Sigma X_D^2$ 4404341
$N_A$ 133	$N_B$ 133	$N_C$ 133	$N_D$ 134

Total

$\Sigma X_T$	26185
$\Sigma X_T^2$	19098133
$N_T$	533

Computation:

1. Correction Factor

$$\begin{aligned}
 C &= \frac{(\Sigma X_T)^2}{N_T} \\
 &= \frac{(26185)^2}{533} \\
 &= \frac{685651225.00}{533} \\
 &= 1286405.675
 \end{aligned}$$

## 2. Total Sum of Squares

$$\begin{aligned}
 SS_T &= \Sigma X_T^2 - C \\
 &= 19098133 - 1286405.675 \\
 &= 17811727.325
 \end{aligned}$$

## 3. Sum of Squares Between

$$\begin{aligned}
 SS_b &= \frac{(\Sigma X_A)^2}{N_A} + \frac{(\Sigma X_B)^2}{N_B} + \frac{(\Sigma X_C)^2}{N_C} + \frac{(\Sigma X_D)^2}{N_D} - C \\
 &= \frac{(6888)^2}{133} + \frac{(6522)^2}{133} + \frac{(6484)^2}{133} + \frac{(6291)^2}{134} - C \\
 &= \frac{474444544}{133} + \frac{42536484}{133} + \frac{42042256}{133} + \frac{39576681}{134} - C \\
 &= 356725.895 + 319823.188 + 316107.188 + 295348.366 - \\
 &\quad 1286405.675 \\
 &= 1598.9620
 \end{aligned}$$

## 4. Sum of Squares Within

$$\begin{aligned}
 SS_w &= SS_t - SS_b \\
 &= 17811727.325 - 1598.962 \\
 &= 17810128.363
 \end{aligned}$$

## 5. Degrees of Freedom - Total

$$\begin{aligned}
 df_t &= N-1 \quad (N = \# \text{ in all groups}) \\
 &= 533-1 \\
 &= 532
 \end{aligned}$$

## 6. Degrees of Freedom - Between Groups

$$\begin{aligned}
 df_b &= k-1 \quad (k = \text{number of groups}) \\
 &= 4-1 \\
 &= 3
 \end{aligned}$$



## 7. Degrees of Freedom - Within Groups

$$\begin{aligned}
 df_w &= df_t - df_b \\
 &= 532 - 3 \\
 &= 529
 \end{aligned}$$

## 8. Mean Square Between

$$\begin{aligned}
 MS_b &= \frac{SS_b}{df_b} \\
 &= \frac{1598.962}{3} \\
 &= 532.987
 \end{aligned}$$

## 9. Mean Square Within

$$\begin{aligned}
 MS_w &= \frac{SS_w}{df_w} \\
 &= \frac{17810128.363}{529} \\
 &= 33667.539
 \end{aligned}$$

## 10. F-Ratio

$$\begin{aligned}
 F &= \frac{MS_b}{MS_w} \\
 &= \frac{532.987}{33667.539} \\
 &= .0158
 \end{aligned}$$

## APPENDIX C

Computation of Analysis of Variance for Typewriting Error  
Incidence on Three-Minute Timed Writings of Average and High-Average  
Difficulty.

	Sum of Squares	Degree of Freedom	Mean Square	F
Between Groups	375.984	3	125.328	.1882
Within Groups	352261.460	529	665.900	
Total	352637.444	532		

Group A	Group B	Group C	Group D
$\Sigma X_A$ 871	$\Sigma X_B$ 929	$\Sigma X_C$ 914	$\Sigma X_D$ 932
$\Sigma X_A^2$ 86279	$\Sigma X_B^2$ 97897	$\Sigma X_C^2$ 94820	$\Sigma X_D^2$ 98582
$N_A$ 133	$N_B$ 133	$N_C$ 133	$N_D$ 134

Total

$$\Sigma X_T \quad 3646$$

$$\Sigma X_T^2 \quad 377578$$

$$N_T \quad 533$$

Computation:

1. Correction Factor

$$C = \frac{(\Sigma X_T)^2}{N_T}$$

$$= \frac{(3646)^2}{533}$$

$$= \frac{13293316}{533}$$

$$= 24940.556$$

## 2. Total Sum of Squares

$$\begin{aligned}
 SS_t &= \Sigma X_T^2 - C \\
 &= 377578.00 - 24940.556 \\
 &= 352637.444
 \end{aligned}$$

## 3. Sum of Squares Between

$$\begin{aligned}
 SS_b &= \frac{(\Sigma X_A)^2}{N_A} + \frac{(\Sigma X_B)^2}{N_B} + \frac{(\Sigma X_C)^2}{N_C} + \frac{(\Sigma X_D)^2}{N_D} - C \\
 &= \frac{(871)^2}{133} + \frac{(929)^2}{133} + \frac{(914)^2}{133} + \frac{(932)^2}{134} - C \\
 &= \frac{758641}{133} + \frac{863041}{133} + \frac{835396}{133} + \frac{868624}{134} - 24940.556 \\
 &= 5704.068 + 6449.03 + 6281.173 + 6482.269 - 24940.556 \\
 &= 375.984
 \end{aligned}$$

## 4. Sum of Squares Within

$$\begin{aligned}
 SS_w &= SS_t - SS_b \\
 &= 352637.444 - 375.984 \\
 &= 352261.460
 \end{aligned}$$

## 5. Degrees of Freedom - Total

$$\begin{aligned}
 df_t &= N-1 \quad (N = \# \text{ in all groups}) \\
 &= 533-1 \\
 &= 532
 \end{aligned}$$

## 6. Degrees of Freedom - Between Groups

$$\begin{aligned}
 df_b &= k-1 \quad (k = \text{number of groups}) \\
 &= 4-1 \\
 &= 3
 \end{aligned}$$

## 7. Degrees of Freedom Within Groups

$$\begin{aligned}
 df_w &= df_t - df_b \\
 &= 532 - 3 \\
 &= 529
 \end{aligned}$$

## 8. Mean Square Between

$$\begin{aligned}
 MS_b &= \frac{SS_b}{df_b} \\
 &= \frac{375.984}{3} \\
 &= 125.328
 \end{aligned}$$

## 9. Mean Square Within

$$\begin{aligned}
 MS_w &= \frac{SS_w}{df_w} \\
 &= \frac{352261.460}{529} \\
 &= 665.900
 \end{aligned}$$

## 10. F-Ratio

$$\begin{aligned}
 F &= \frac{MS_b}{MS_w} \\
 &= \frac{125.328}{665.900} \\
 &= .1882
 \end{aligned}$$