To the Graduate Council:

I am submitting herewith a dissertation written by Esther Naomi Gill entitled "A Comparison of Two Typewriter Keyboards--Dvorak and Sholes." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Vocational-Technical Education.

George A. Wagoner, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

A COMPARISON OF TWO TYPEWRITER KEYBOARDS--

DVORAK AND SHOLES

A Dissertation

Presented for the

Doctor of Education

Degree

The University of Tennessee, Knoxville

Esther Naomi Gill

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E. N. G.

ABSTRACT

The primary problem of this experiment was to compare the effects of the Dvorak and Sholes typewriter keyboard arrangements with skill development in beginning college typewriting. This problem involved four sub-problems: (1) to compare differences in terminal speeds attained on 1-minute straight-copy timed writings; (2) to compare differences in terminal speeds attained on 3-minute straight-copy timed writings; (3) to determine differences, if any, between keyboards in performance production achievements; and (4) to evaluate the predictability of typewriting skill of the Tapping Test for both Dvorak and Sholes Trainees.

A summary of educational literature dealing with typewriter keyboard arrangements and the acquisition of typewriting skill revealed controversial criticism of the universal Sholes keyboard's arrangement relative to finger dexterity utilization as regards letter use frequencies, fatiguing hand motions which relates to production inefficiencies, and finger reaches which has much to do with accuracy. This study attempted to verify or negate these and other criticisms.

The population of the study consisted of 35 beginning typewriting students at Oakwood College, Huntsville, Alabama. Two groups of students were used to compare the effectiveness of teaching beginning typewriting to college students using the Dvorak (Simplified) and Sholes (Universal or Standard) keyboards. The groups were combined for classroom instruction with keyboard presentations including numbers and special characters (20 lessons) given simultaneously (in the same classroom) on two

channels of a four-channel multiple listening Audio Trainer (cassette recorder). These tapes were synchronized for keystroking and carriage returning. The Tapping Test was used as a statistical control for differences in initial levels of students' aptitudes. All students in both experimental (Dvorak) and control (Sholes) groups had no previous (formal or informal) typewriting instruction and were, therefore, labeled true beginners. IBM Selectric typewriters with interchangeable elements were used. All keys were covered (blanked or unlettered).

Data was gathered, tabulated, and utilized in determining differences, if any, in the achievements of trainees using one keyboard arrangement over the other. Analysis of Covariance and correlation procedures were used as statistical tests.

The major findings of the research were that there was no significant difference in terminal speed scores of students using the Dvorak and Sholes typewriter keyboards on 3-minute straight-copy timed writings. There was a significant difference favoring Dvorak on 1-minute straight-copy timed averages, however. There was a difference favoring Dvorak trainees in two of the seven production categories, enumerations and 3-minute straight-copy timed writings. The Tapping Test better predicted typewriting skill development for the Dvorak keyboard trainees than the Sholes keyboard trainess. The Dvorak keyboard arrangement may have a production advantage over the Sholes keyboard arrangement, but this advantage may reveal itself in short-term production typewriting only.

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CHAPTER I

THE PROBLEM

The Dvorak Simplified Keyboard (DSK - 1932), named after its inventor, Dr. August Dvorak (University of Washington, Seattle), is a scientific rearrangement of the alphabet on the typewriter keyboard that purports to reduce fatigue, increase typing speed, improve accuracy, and cut training time.

The Dvorak keyboard has most of the commonly used consonants and all vowels on what is known as the "home row" (where the fingers rest on the typewriter). The rearrangement of the letters to balance the typewriting workload between left and right hands and between strong and weak fingers was based on Hoke's[1] and Riemer's[2] hand tabulations of letter usage in the 1,000 most used words on the Ayres Spelling List. Seventy percent of all typing can be done without having to leave the home row. Over 3,000 common English words--including the commonest "the"--can be typed on the home row, as opposed to 150 on the Sholes Standard Keyboard. The Dvorak arrangement, however has had little impact on businessmen, typewriter manufacturers, or educational institutions.

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[1]R. E. Hoke, The Improvement of Speed and Accuracy in Typewriting (Baltimore: John Hopkins Press, 1922), Passim.

[2]Edwin Riemer, "A Revised Keyboard for the Typewriter" (Master's Thesis, New York University, 1929).

Christopher Latham Sholes' standard or conventional keyboard which begins with the familiar letters Q W E R T Y was invented in 1873 and was specifically designed to be awkward to use so that typists on the old-fashioned machines would not jam the keys. Today with electric typewriters and spring-operated keys, the mechanical problem has been solved (the letters now spring home and stay out of each other's way no matter how fast the keys are struck). The Sholes keyboard is left-handed while most people are right-handed and have more agility and strength in their right hands. The left hand performs 56 percent of all stroking as compared with Dvorak's left-hand load of 46 percent. Over 3,000 entire words are typed by the left hand alone. Between two and three full years--often more--are required for skill mastery utilizing the Sholes' arrangement.

An estimated 50 million typists and writers in the English-speaking world daily perform finger movements that are unnecessarily tiring, mistake-prone, and highly unscientific. In a typical eight-hour day, counting each movement inch by inch, the average typist moves his/her fingers over the keyboard a total of twenty miles. McCauley claims this finger exercise is reducible by a factor of twenty--and yet schools and industry for over two decades have resisted a scientific (Dvorak) keyboard arrangement. Typists using the Dvorak arrangement are reaching 180 words a minute with it.[3]

Retired Naval Commander August Dvorak, the developer of the revolutionary DSK under a Carnegie Foundation grant, discussed the

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[3]Robert McCauley, "Typist, 12, Amazes Experts as She Uses New Keyboard," Toronto Daily Star, Friday, April 2, 1971.

reasons for the non-acceptance of his discovery in The National Business Education Quarterly for December, 1943:

> While readily admitting the superiority of the new invention, schools can't very well teach the DSK because graduates into the business world find standard keyboard typewriters at their desks. Businessmen likewise, endorsing the increased efficiency, can't afford to buy DSK machines because secretaries, typists, and keyboard operators would have to be retrained at company expense.[4]

Those who learn from scratch on the Dvorak keyboard get to 100 words per minute in six months. Retraining, however, is a little more cumbersome--and it is virtually impossible to learn and use both keyboards interchangeably.[5]

Here are some of the objections voiced over the years by opponents, and the answers given by DSK proponents:

1. Objection: You have to learn to type originally on the new keyboard.

   Answer: Not so. The GSA tests showed it was possible to achieve former speeds on the new keyboard in six weeks.

2. Objection: All typists would have to retrain, and business would have to carry both keyboards in inventory.

   Answer: With more and more offices changing over to IBM Selectrics, with the introduction of the element typewriter by Remington, and with the preponderance of computer hardware using the Selectric carriage in input components, none of the preceding or following objections are any longer valid objections.

3. Objection: Typists can achieve 100 words per minute on a standard electric machine--so why try to go faster?

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[4]August Dvorak, "There is a Better Typewriter Keyboard," The National Business Education Quarterly, December 1943, 51-58 and 66.

[5]Waldo Boyd, "Q W E R T Y U I O P ? * ! ?," Writer's Digest, 51 (February 1971).

> Answer: Speed alone is not the chief virtue of the DSK. Accuracy is more important, and the importance of fast, accurate input into EDP systems calls for any improvement possible.[6]

Phil Davis, a former typing teacher who publishes a quarterly newsletter called "Quick Strokes" and operates a typewriter mail-order firm which specializes in simplified keyboard models, contends that most Sholes typing classes do not bring even 70 percent of the students up to a 40 word-per-minute level. The Dvorak record shows nearly 100 percent success in teaching students to type 60 words per minute.[7]

An organization can easily stock a supply of Selectric or Remington elements containing the Dvorak Simplified Keyboard (DSK) configuration. The caps on the typewriter keys can be quickly changed, left blank, covered with adhesive labels, or ignored. A typist trained on a DSK can own a DSK element and carry it from job to job, with the chances being slim that there will not be an IBM Selectric or Remington element machine available on the job.

Arthur P. Wales of New York learned about Dvorak's design when a prototype appeared on the Smith-Corona assembly line on which he was working in 1936, the year Dvorak obtained a patent on his invention. Now the firm's vice president, Wales tracked down Dvorak almost three decades later, when the demand for a better design was sought in the electronic age.

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[6]"The Weak Spot in an EDP System," Data Processing Digest, 17 (February 1971), 54.

[7]Doug Frantz, "Could You Learn to Love This Keyboard?," Cosmopolitan, 180 (February 1976), 118-9.

Wales, with Dvorak in agreement, decided the original Dvorak keyboard terrified most people because it carried the logic of rearranging the alphabet keys to the top row number keys. "Well," Wales said, "no one was going to sit still for relearning his numbers; and no one did." So Smith-Corona's version of the Dvorak simplified keyboard simply put the top row back in sequence and called their arrangement the American Simplified Keyboard (ASK).

Wales, the factory worker turned vice president, predicts half of all typing in the United States of 1990 will be done on ASK keyboards.[8] Dr. Hamden Forkner, the inventor of Forkner Shorthand, pointed out that more people use the typewriter to make a living than any other single business machine in the world today. Because of the psychological problems of "teaching old dogs new tricks," it is felt that the use of the simplified keyboard will flourish best with upcoming generations of typists.

Within the last few years a number of articles have appeared in the news media claiming greater superiority for the simplified keyboard and branding the conventional or standard keyboard as "a horse-and-buggy keyboard in a jet age." According to Robinson[9] it appears, then, that the simplified keyboard is an idea whose time has come again. Insofar as typewriting instruction improvement and performance gains are concerned, this researcher feels that there is justification for a

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[8]Charles Lekberg, "The Tyranny of QWERTY," Saturday Review (September 30, 1972), 37-40.

[9]Jerry W. Robinson, "An Idea Whose Time Has Come . . . Again?," Century 21 Reporter (Spring 1975), 2, 4, and 8.

reassessment of the typewriter keyboard arrangement of both Dvorak and Sholes.

Statement of the Problem

The problem of this experiment was to compare the effects of the Dvorak and Sholes keyboard arrangements with skill development in beginning college typewriting. Answers to the following specific questions were sought:

1. Is there any significant difference between the experimental (Dvorak) and control (Sholes) groups on the basis of terminal speeds attained on 1-minute timed writings?

2. Is there any significant difference between the experimental (Dvorak) and control (Sholes) groups on the basis of terminal speeds attained on 3-minute timed writings?

3. Is there any significant difference between the experimental (Dvorak) and control (Sholes) groups on the basis of performance achievements on a 30-minute production test which included a 2-column table, vertical and horizontal centering, a vertically centered announcement, and an enumeration from script?

4. Can the Tapping Test[10] be used as a predictor of typewriting skill attainment for the Sholes and Dvorak keyboards?

Limitations of the Study

Acknowledged weaknesses in this study involve experiment's one-quarter trial time limit with two or three quarters being more desirable

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[10]John C. Flanagan, The Tapping Test (Pittsburgh: Psychometric Techniques Associates, 1959).

for determining results of basic learnings and in the sample size which again could be more representative of the population if facilities permitted larger enrollments and if Dvorak element cost factors were reduced. Also, the DSK element (which carries the logic of the rearrangement of the alphabet to the top row or number keys) had to be used because of the unavailability of the ASK element (which has the logic of the rearrangement of the alphabet, but retains the top row of numbers in sequence). No attempt was made to retrain students already acquainted with the conventional (standard) Sholes keyboard arrangement. In order to insure time equality of the experimental and control groups, the students were not permitted to do any typewriting outside of the classroom setting.

Need for the Study

This study attempted to replicate the scientific research which resulted in the Dvorak keyboard design and which purported improved accuracy, terminal speed gains, and instruction timesaving. Simultaneous simplified (Dvorak) and standard (Sholes) keyboard instruction (in the same classroom) and the use of Dvorak typewriting elements on IBM Selectric typewriters were new features of this study.

With cost, redesign, and equipment scrapping problems solved, this teaching-learning approach should be reviewed by educational administrators for curriculum implementation and by teachers for typewriting instruction keyboard-arrangement substitutions. The general practitioner who already possesses the skill may also be interested in being retrained for speed and accuracy gains as well as fatigue reduction via energy saving. Prospective students of typewriting may well be offered either

alternative upon enrollment with only minimal if any training differences.

Nature and Sources of Data

A brief overview of the sources of the data and methods of procedure is presented here.

The population of this study consisted of beginning typewriting students at Oakwood College, Huntsville, Alabama. Two groups of students were used to compare the effectiveness of teaching beginning typewriting to college students using the Dvorak simplified and the Sholes standard keyboards.

The groups were combined for classroom instruction with keyboard presentations including numbers and special characters (20 lessons) given simultaneously on two channels of a four-channel multiple listening Audio Trainer (cassette player/recorder). These tapes were synchronized for keystroking and carriage returning.

The Tapping Test was used as a statistical control for differences in initial levels of students' aptitudes. All students in both the experimental and control groups had no previous typewriting instruction.

IBM Selectric typewriters with interchangeable elements were used with all keys covered (blanked or unlettered). Twenty typewriters in all were available. Provisions were made for making up tapes, speed and accuracy drills, and production tests missed because of absences.

Hypotheses Tested

Three major hypotheses were tested in this study.

1. There are no significant differences in net speed scores on one-minute timed writings when students used Dvorak (Simplified) and Sholes (Conventional) typewriting keyboards.

2. There are no significant differences in speed scores on three-minute timed writings when students used Dvorak (Simplified) and Sholes (Conventional) typewriting keyboards.

3. There are no significant differences in the production rates on production tests which included rough drafts, tabulations, vertical and horizontal centering when students used Dvorak (Simplified) and Sholes (Conventional) typewriting keyboards.

Definitions

"Accuracy" as used in this study represents a two-word penalty for each error on one-minute timed writings and a three-error cutoff on three-minute timed writings. The result is known as net words per minute.

The term "ASK" was coined by Smith-Corona typewriter manufacturers and stands for American Simplified Keyboard. This keyboard utilizes the Dvorak alphabetical arrangement but maintains the sequential top-row Sholes arrangement for the numbers (Figure 1).

"Conventional" as used in this study represents the standard Sholes keyboard arrangement which has been sanctioned by general custom (Figure 2).

"DSK" means the Dvorak Simplified Typewriter Keyboard arrangement which utilizes a scientifically arranged keyboard relative to dexterity of hands and fingers (Figure 3).

"Homerow Keys" are the second row from the bottom of the typewriter keyboard where the fingers rest when they are not typing. On the

American Simplified Keyboard (ASK)

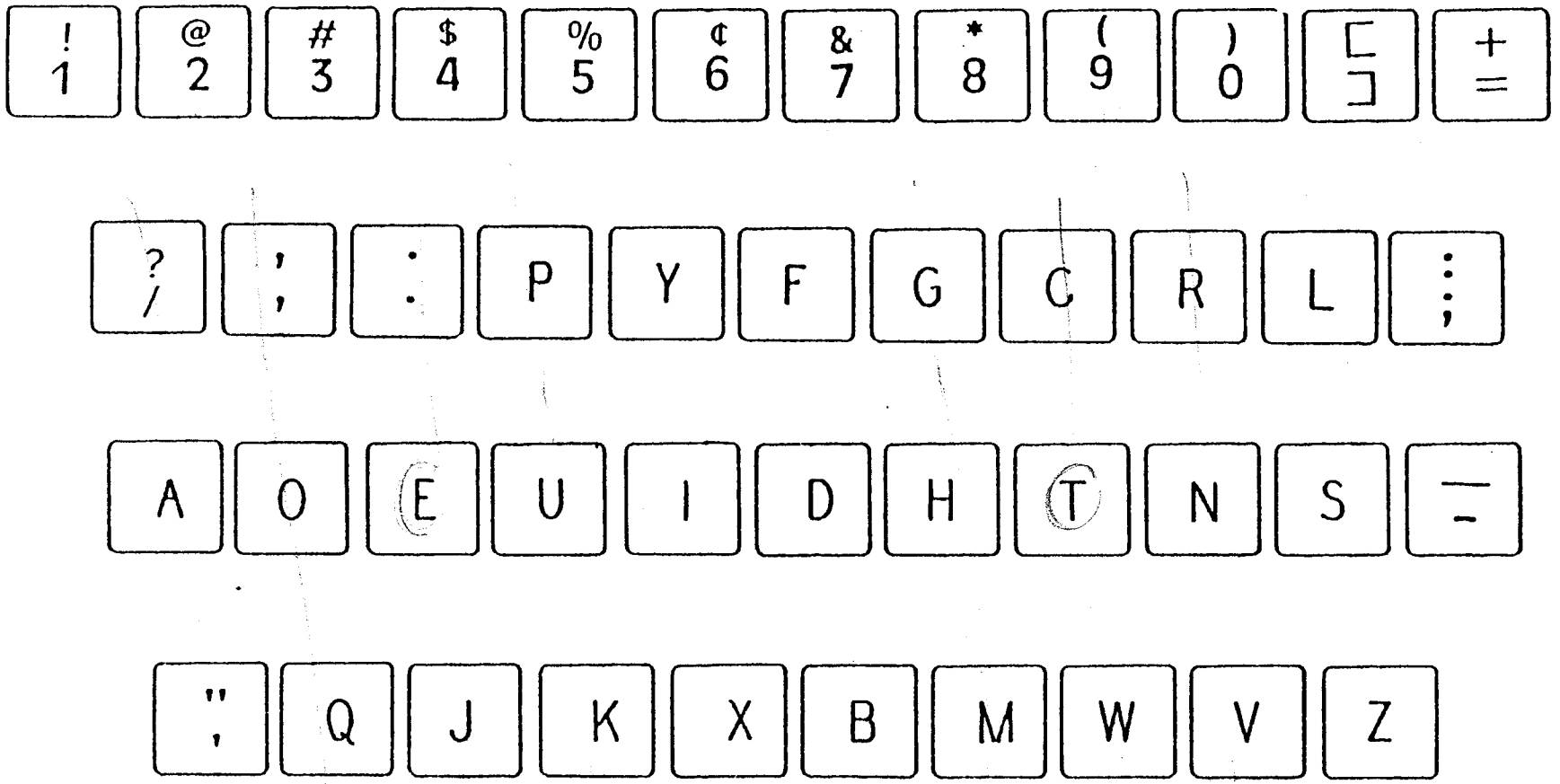


Figure 1. American Simplified Keyboard (ASK).

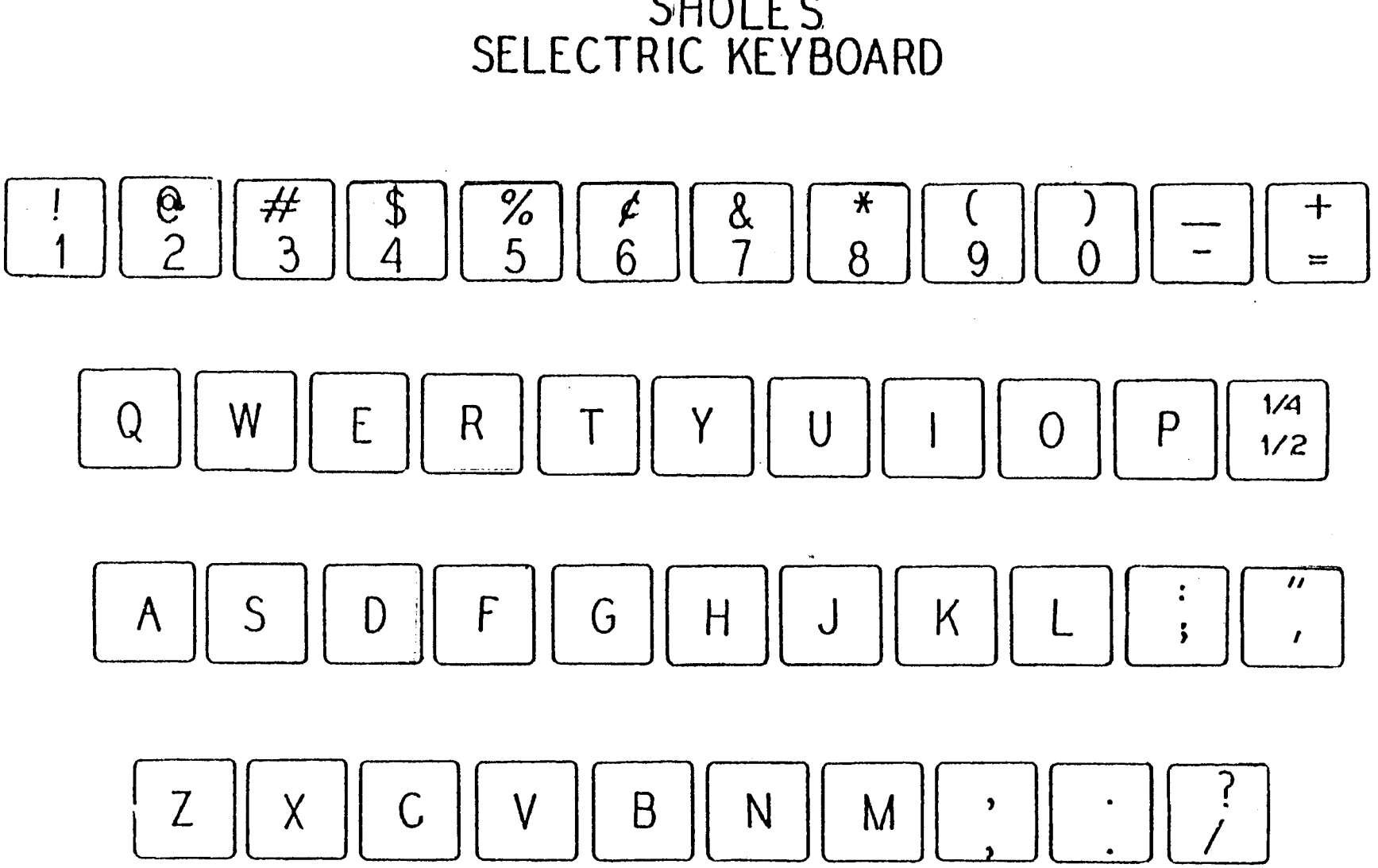


Figure 2. Sholes Selectric Keyboard.

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SELECTRIC KEYBOARD

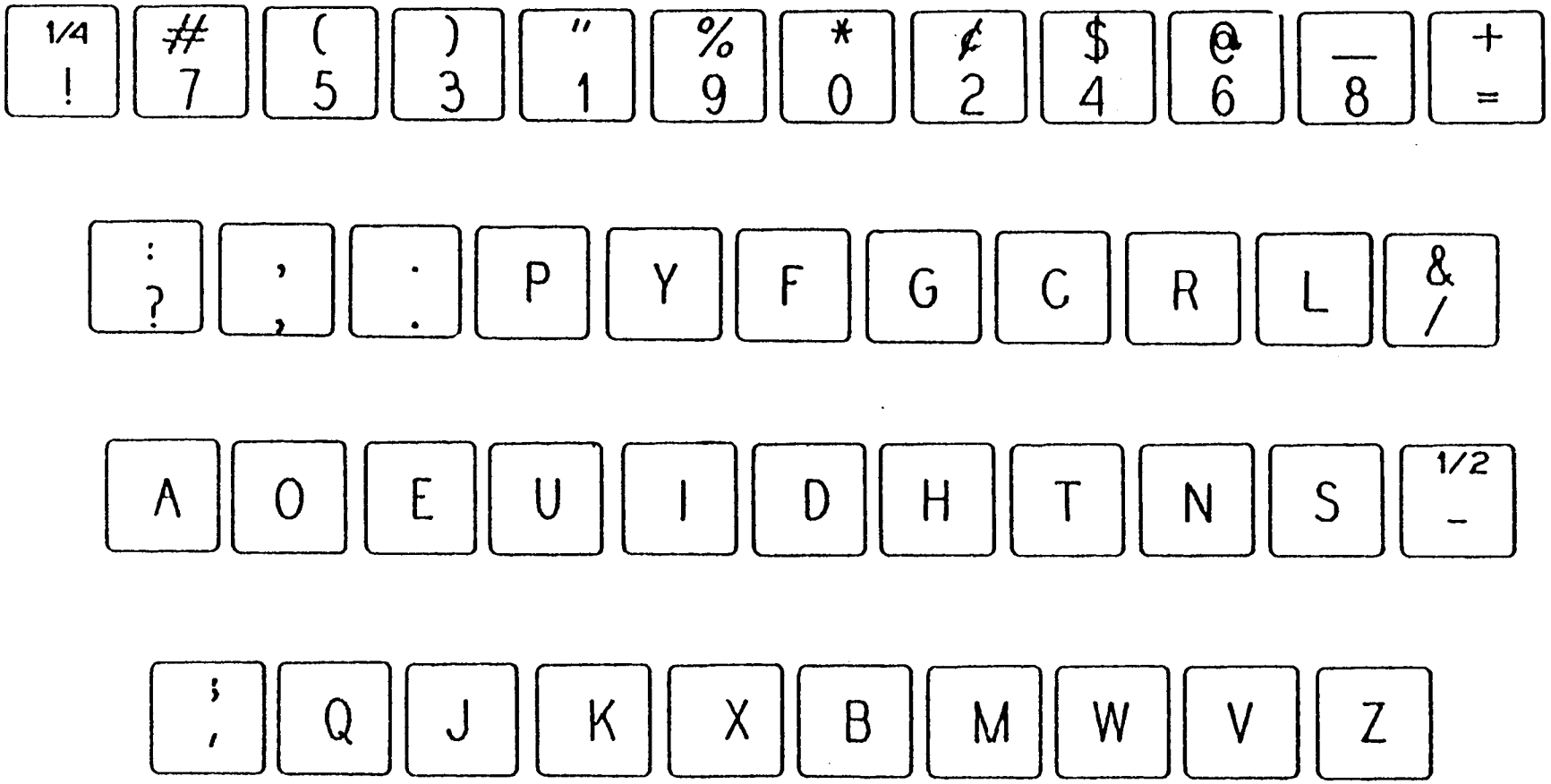


Figure 3. Dvorak Selectric Keyboard (DSK).

Sholes standard typewriter keyboard, these keys are a s d f (left hand) and j k l ; (right hand). On the Dvorak simplified typewriter keyboard, these keys are a o e u (left hand) and h t n s (right hand).

"Net Production Rate A Minute (NPRAM)" refers to the rate on production copy when a number of items are to be typed and when errors are to be penalized. $\text{NPRAM} = \frac{\text{Gross (Total) Words - 2 Words Off For Each Error}}{\text{Length (In Minutes) Of Writing}}$

"Simplified" in this research is a term synonymous with ASK and DSK meaning easy or free from difficulty. Here the ease and uncomplication comes with balanced hand load and keys scientifically arranged according to finger dexterity.

"Standard" as used in this study is synonymous with conventional and Sholes and represents the usual or ordinary keyboard arrangement.

"Straight-Copy Timed Writings" are unfamiliar running texts counted in five strokes per word with speed determined by the total number of words typed with no penalty for errors. This speed is gross words per minute in typewriting.

Organization of the Study

Chapter I gives background information leading up to the problem; states the problem; presents the limitations of the study, the need for the study, the nature and sources of data, hypotheses tested; and defines terms used in the study.

Chapter II presents a review of the related literature.

Chapter III describes the methods and procedures used in selecting trainees, in organizing a controlled classroom, in developing textbooks and tapes, and in establishing measurements and standards for the study.

Chapter IV presents the data results and the statistical methods used in the analysis of the data.

Chapter V contains a summary of the data and the conclusions and recommendations made as a result of the study.

A bibliography which included books, magazines, newspapers, publications of learned organizations and societies, series, and unpublished materials whose works had been quoted, paraphrased or cited in the study were related to the typewriter keyboard comparison.

Appendix A, Introductory Information to Students, included Student Questionnaire, Classroom Explanation, Orientation Letter to Parents and Accompanying Informed Consent Form for Those Participants under 18 Years of Age, Informed Consent Form for those Participants 18 Years of Age or Older, Dvorak Keyboard Arrangement Advantages and Disadvantages, Sholes Keyboard Arrangement Advantages and Disadvantages, and Keyboard Arrangement Preference Form.

Appendixes B through F presented such pertinent items as: Sample Dvorak Lesson, Sample Sholes Lesson, Sample Tests, Dvorak Class Schedule, Speed Standards and Grading Formula, Sholes Class Schedule, Speed Standards and Grading Formula, Universal and Simplified Typewriting Demons, Sholes Students' Tapping Test Scores Compared with Actual Results and Terminal Averages Attained on Straight-Copy and Statistical Speed Drills Taken at Various Levels of Training, Dvorak Pilot-Study Students' Tapping Test Scores Compared with Actual Results and Terminal Speed Averages Attained on Straight-Copy and Statistical Speed Drills Taken at Various Levels of Training, and Dvorak Students' Tapping Test Scores Compared with Actual Results and Terminal Speed Averages Attained on Straight-Copy and Statistical Speed Drills Taken at Various Levels of Training.

CHAPTER II

RELATED LITERATURE REVIEW

Several studies have been conducted in recent years on the typewriting skill-development process. Those by Culkin; Davis; Dvorak; Dvorak, Fird and Davis; Frank and Lillian Gilbreth; Hoke; Langford; Lessley; Long; Riemer; Robinson; Stivers; and Wales are reviewed here.

Culkin Article

Culkin, Executive Director of the Media-Studies Program at the New School of Social Research, remarked that--

> Sholes originally arranged the letters on the typewriter keyboard in alphabetical order, but he encountered serious problems with jamming when adjacent or neighboring keys were struck in rapid succession. He and his brother-in-law then rearranged the keyboard to disperse the most frequently recurring letters. He then fooled the public into accepting this as a scientific advance rather than a nontechnical answer to a problem. So in terms of logic based on use, the Sholes keyboard 'is programmed for inefficiency.'
>
> The next major entry into the typewriter keyboard arrangement came in 1932 with the introduction of the Simplified Keyboard by Dr. August Dvorak who studied letter frequencies and sequences and the digital movements of typists for several years and then produced what was known as the Dvorak Simplified Keyboard. The new arrangement took only three months for beginners to master. Unfortunately, it met with lethargy among practicing typists and teachers of typing.
>
> The latest entry in the field is the PCD-Maltron typewriter keyboard developed by Lillian Malt and Stephen Hobday of England. It supposedly improves statistically on Dvorak's placement of letters and has contoured the keyboard to fit the shape of the hands. Keys for the long middle fingers are set deeper into the keyboard and keys for index and little fingers are at different heights. The thumbs are

> used for eight keys each. This arrangement cuts down on fatigue and makes it almost impossible for the fingers to wander to the wrong row of keys. It is anticipated that speed will be increased by between 20 to 40 percent.[1]

Culkin alluded to the demise of manual typing in the future when we adopt a consistent 40-character alphabet to match the 40 sounds of standard English. Such a phonetically consistent system would make possible the use of voice-activated machines for typing.

Culkin stated that the story of the development of the typewriter and its keyboard evolution illustrated our unwillingness to grow and adapt to change even when those changes are manifestly to our benefit. The amount of human energy being wasted every day as workers continue to plod along with an illogical alphabet and an inefficient typewriter left Culkin with little reason to believe that long-standing habits would be changed quickly.

Davis Studies and Defenses

Davis, a former typing teacher who publishes a quarterly newsletter called, Quick Strokes and who operates a typewriter mailorder firm specializing in simplified keyboard models, gives as a reason for DSK's unpopularity and orphanage existence:

> World War II's breaking out just as manufacturers were starting to manufacture DSK machines and all the plants had to be converted to produce small arms and other war-effort items and by the time the war was over interest had died.[2]

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[1]John Culkin, "QWERTY and Beyond," The New York Times, March 15, 1978.

[2]Philip Davis, Quick Strokes, Volume III, Number 4, Whole Number 9, Winter, 1976.

Whether the new keyboard will become standard remains the question. Critics, on the other hand, argue that if the Simplified keyboard were going to catch on, it certainly would have by now.

Davis refuted some of the statements made by Culkin in his March 15, 1978, New York Times article entitled, "QWERTY and Beyond." He wondered how the PCD-Maltron Keyboard "improves statistically on Dvorak's placement." Davis wrote:

> Statistically, the Maltron is sadly deficient in rhythm. Empirically, it has no Howard and Dan Buxtons' 170 wpm, Barbara Blackburn from Lee Summit, Missouri, who claims the title of "World's Fastest Secretary" at speed from 150 to 170 wpm,[3] or Lenore Fenton MacClain's 1-minute record of 182 wpm set at ASK or DSK keyboard arrangements, or Howard Hudson's (court reporter, Marietta, Georgia) 170 wpm to confirm its efficiency,[4]

On Maltron, every verb that ends in inning, eigning, enning, anning, or inging, and many other words besides, contain six successive strokes with the same hand. The left and the right side have similar concatenations (see Figure 4 of the PCD Design - Copyright, May, 1977).

Dvorak Studies

Dvorak,[5] Professor of Education, University of Washington and Director, Carneigie Foundation for the Advancement of Teaching Study of Typewriting, experimented for twenty years in an effort to find which

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[3] Guinness Book of World Records, 15th Edition, 488.

[4] Davis, Volume VI, Spring, 1978, 2.

[5] August Dvorak, Nellie L. Merrick, Gertrude C. Ford and William L. Dealey, Typewriting Behavior (New York: American Book Company, 1936).

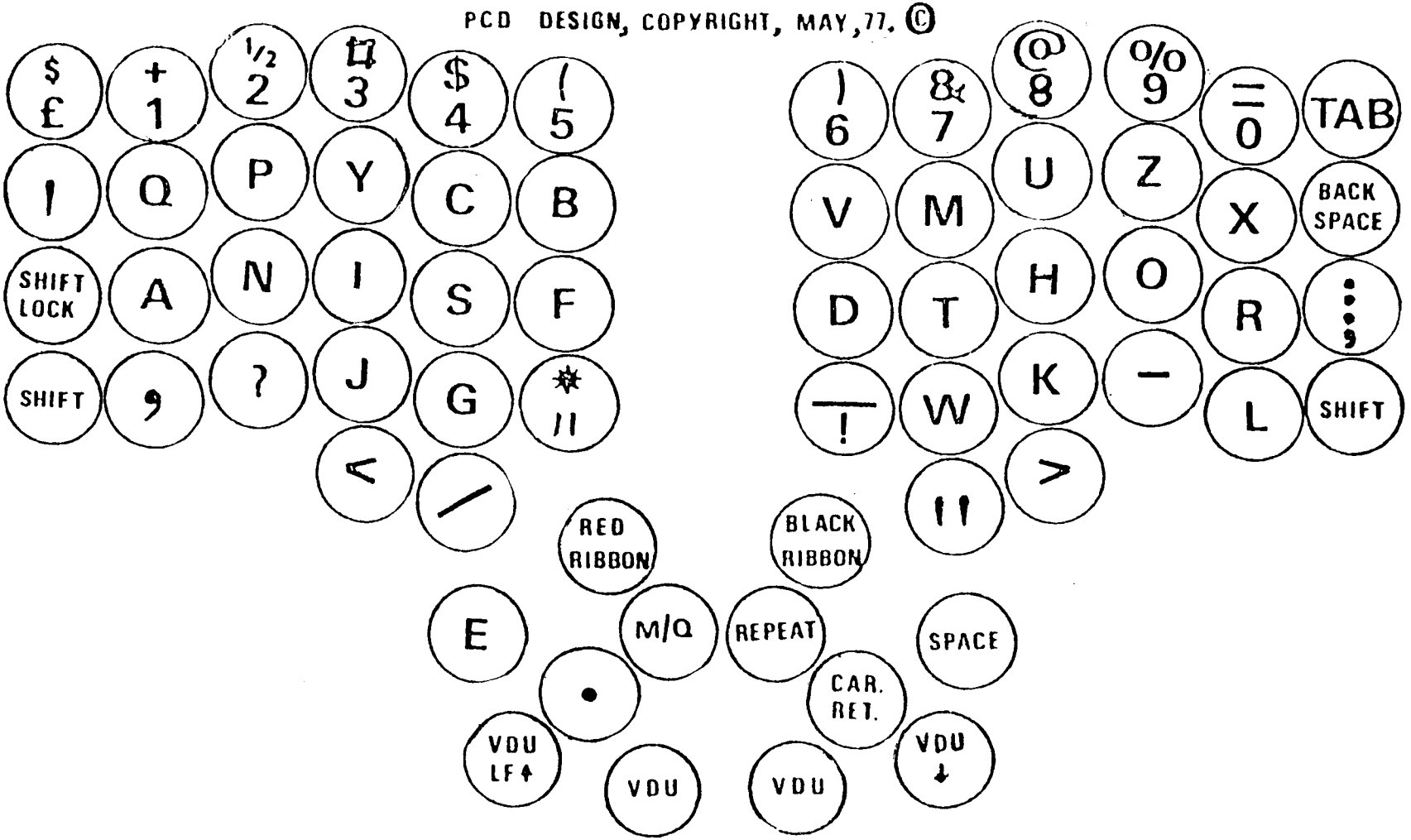


Figure 4. PCD Design, Copyright, May, 1977.

letter or letter combinations typists used most frequently. He found the letter E normally used 1,000 times; T, 815 times; O, 688 times; A, 640 times; and H, 540 times before the letter X is used 10 times; Q, 3 times; and Z, twice. The ten letters A E I O U D H N S and T are used so frequently that alone they constitute 70 percent of ordinary typing. The letters E I O U H N T and G make up 86 percent of ordinary typing. The letters A E I O U D H L N R S and T are found in 75 percent of all copy.

Dvorak,[6] along with others, subsequently wrote a textbook to enable students to learn to type on typewriters equipped with the Standard keyboard. The general plan of the text presented first the eight home row keys for hand and finger location purposes, then the vowels, then the consonants in order of frequency of use, and finally the numbers and special characters. Since every syllable must have a vowel, and since numerous common words can be formed with the vowels and any two or three most-used consonants, this procedure enabled the typist to type sentences in the first lesson. These vowels and consonants were used over and over again in every successive lesson. This repetition led students to a quick mastery of the fundamentals. The text allowed students who used it over five weeks to learn the typewriter keyboard and to become familiar with common words without worry over error penalties.

Dvorak believed that progressive teachers would find in this text much that would make it easier for them to bring students who had

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[6]August Dvorak, Nellie L. Merrick, Gertrude Catherine Ford, and William L. Dealey, Scientific Typewriting, Standard Keyboard Edition (New York: American Book Company, 1949).

some flair for this subject up to the standard of operating efficiency required in business offices. The text also could help nonvocational students to achieve a typing skill adequate to their personal needs in much less time than had hitherto been required for this purpose.

Dvorak[7] eventually rearranged the keyboard to parallel finger dexterity with letters and letter combinations typists used most frequently. He called it the Dvorak Simplified Keyboard (DSK). The resulting arrangement truly was simpler. In DSK all the vowels are placed on the left side of the home row of keys while the most common consonants--h, t, n, and s--are on the right side of home row. This arrangement allows a typist to do about 70 percent of typing on DSK's home row as compared to the roughly 30 percent on "QWERTY's," which means that the fingers must move from the home row far less often. Since the vowels are on one side while the common consonants are on the other, typists tend to alternate hands as they type. Logically then, DSK should cut down fatigue while increasing speed and accuracy.

In the years that followed, Dvorak[8] conducted a series of tests designed to prove the effectiveness of his keyboard arrangement. In one, 14 typists retrained to use DSK produced three-fourths more work and were two-thirds more accurate after using the new keyboard for just one month. During the 1930's DSK's superiority was proven by typists who won dozens

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[7]Dvorak, op. cit.

[8]August Dvorak, "A Practical Experiment in Simplified Keyboard Retraining" (A report of the retraining of fourteen Standard Keyboard typists on the Simplified Keyboard, Navy Department, Washington, D.C., July 1944).

of speed records in typing competition. Tests have also shown that the simplified system is easier to learn than "QWERTY." Children master the keyboard in days; and after several months of practice, most reach speeds of 40 to 50 words per minute.

Dvorak, Fird and Davis Analyses

Dvorak's and Fird's one hundred "Typewriting Demons" on the Universal keyboard[9] and Davis' on the Simplified keyboard[10] can be noted in Appendix E. An examination of these two lists of words discloses that whereas on the Universal keyboard the words most often mistyped are frequently occurring simple words, on the Simplified keyboard the words most frequently mistyped are the longer, more difficult words.

Gilbreths' Studies

Doctors Gilbreth,[11] pioneers in Motion and Work Analysis and in Work Simplification, in publications and conferences suggested the only tenable approach to typewriting simplification. Dr. Lillian Gilbreth gave Dvorak the slow-motion picture films of typing motions by Margaret B. Owens, four-times Champion International Typist, which emphasized the need for further research in typing. These films enabled Dvorak and his

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[9]A. Dvorak and G. C. Fird, "Typewriting Demons," Journal of Business Education, May 1932.

[10]D. W. Davis, "An Evaluation of the 'Simplified' Typewriter Keyboard," Journal of Business Education, May, June, September, and October 1935.

[11]Frank B. and Lillian M. Gilbreth, Scientific Management Course (Easton, Pennsylvania: Hive Publications, 1912).

colleagues to visualize the correct form of typing motions which were too rapid for the unaided human eye to see.

The Gilbreths separated a typewriting class into three motion-study aspects: The variables of (1) one's surroundings, (2) oneself, and (3) one's typing motions. As variables of one's surroundings, the Gilbreths would list the typewriter and its appliances; weights of units moved; comfortable clothing; special fatigue-saving devices; paper and other supplies; easily visible copy, lighting, proper ventilation; unavoidable noise; rhythmic counting or music--even student traditions, rewards and penalties. Nearly everything, advised the Gilbreths, can be important in surroundings.

As variable of oneself, the student typist, the Gilbreths pointed to the size and structure of fingers, hands, arms, and body; muscular strength; one's general health and nutrition and mode of living; experience, prior habits, skill, and training; and the fatigue brought to typing class and the later fatigue from typing; and personality and attitudes, the way a student feels about typewriting and about the relations among students and instructor.

The Gilbreths' listing on the aspect of typing motion suggests an altogether fascinating outlook on the study and invention of better motions--in short, the "one best way" to do typing. What are some of these ways to better motion? The contrast between the beginner's unnecessary motions and the necessary motions of the expert typist shows ways to improve typing motions. Motion, its path, its length, and the balanced keyboard plane are a factor in typing efficiency. Good typing practice should lead to discarding all motions that are awkward and

excessive. Frank Gilbreth[12] believed that what makes a champion is common to all fields. "We have found extreme resemblances between the surgeon's motions and those of the bricklayer, the motions of the pianist and those of the typist." The approach through problem solving is first applied to actual machine operation. A suitable balanced fit between the machine's action and the typist's motions and posture requires skillful comparisons with the limitations in the present typewriters.

The original keyboard is a patchwork spatial pattern, never arranged to fit the framework and common-word pattern of the written English language. The basic handicap intrudes through all efforts to increase speed and lessen errors in typing. For right-handed typists, the overload of the left hand is estimated at 47 percent. The greater share of the typing is assigned to the upper bank of keys. Some 28 percent of all typewriting is forced into awkward finger reaches or hurdles. To correct this handicap, the keyboard pattern has been rearranged into a simplified pattern based upon an exact count of the sequence frequencies in written English. Awkward serial reaches are reduced to about three percent, and the typing is concentrated on the home row and into the faster stroking between fingers of opposite hands. Initial experimental training upon this keyboard assured surprising savings in learning time, fewer errors, and marked speed gains. The Gilbreths were justified in their stress on correct motions first, speed second and accuracy last.

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12 Ibid.

Hoke and Riemer Studies

The so-called "Universal" keyboard is obviously a patchwork, even when scrutinized merely by counting the actual usage of isolated letters in written English and by contrasting the efficiency of isolated fingers in tapping. Such a systematic exposure of the keyboard was made by Hoke[13] fifty-plus years ago. His work has since been repeated by Riemer.[14] By counting the number of key strokes for each letter in copy, the loads carried by each typing finger have been roughly uncovered. Comparison of the weaker little finger of the left hand with the stronger middle finger of the right hand reveals 803 letter strokes plus heavy shift-key strokes all assigned to the weaker little finger, but only 640 strokes assigned to the stronger second finger. The left fourth finger does nearly three times the work that the right fourth finger does. These haphazard finger loads lead to added fatigue, with their errors and breaks in the typing rhythm. Certain fingers appear overloaded 35 percent to 53 percent, while others appear underloaded 25 percent or even 69 percent.

Adding the key-stroke loads of left and right hands showed another imbalance in the old keyboard. The lesser left hand must make perhaps 131 strokes to every 100 by the good right hand. Just how much weaker is a left hand in the face of this added burden? Hoke[15] decided

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[13]R. E. Hoke, The Improvement of Speed and Accuracy in Typewriting (Baltimore: John Hopkins Press, 1922).

[14]Edwin Riemer, "A Revised Keyboard for the Typewriter," (Unpublished Master's thesis, New York University, 1929).

[15]Hoke, Op. Cit., Passim.

to find out by using tapping tests for each finger. Tapping both on typewriting keys and on a desk was timed. High-school and college students made 89,593 taps with the left hand, and in equal time, 100,817 taps with the right hand. These tapping tests showed that the usual left hand possesses only .9 of the speed and strength of the right hand. This analysis of such overloads was enough to condemn the present unbalanced keyboard.

Lessley Study

In his recently completed dissertation entitled, "Keyboard Retraining: Qwerty to Dvorak," Lessley[16] enrolled eight students at Oregon State University in a typewriting course for credit. The arrangement on the keys for seven of them was DSK Camwil elements for IBM Selectric typewriters. The other student used another element obtained by special order from Camwil with an arrangement that was closer to ASK.

Four students used the Dvorak manual titled, Synergistic Typing and completed the first nine lesson in seven hours, with an average speed of 27.5 words per minute. Four others went through the first five lessons in the Simplified Keyboard Supplement in five and a half hours, for an average speed of 25 words per minute.

This course was offered Spring Quarter, 1977. The course was oriented toward the information processing trade. The instructor believed that, because of the frequent breaks between bursts of input, pretrained Dvorak-skilled operators would perform at a pace that was

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[16]Brad Lessley, "Keyboard Retraining: Qwerty to Dvorak" (unpublished Doctoral dissertation, Oregon State University, Corvallis, 1978).

close to their racing paces. He considered the scores on three-minute timed writings were a good measure of attainment.

It was reported that Janet Phillips, an Oregon State University student, clerical worker, and subject in Dr. Lessley's study in retraining on a Dvorak-arranged keyboard, had attained, by April 25, 1977, after 32 1/2 hours of retraining, a score of 60 gross words per minute. On a three-minute timed writing, she made four errors.

After Dr. Lessley's study, the State University of Oregon was impressed with the new method of retraining and the Dvorak keyboard itself. The Governor of the State launched a pilot project to retrain eighty state typists with Dr. Lessley as the project leader, emphasizing the opportunity for increased productivity while reducing fatigue.

Long Study

In an experiment concerning the relative efficiency of various methods of teaching the typewriter keyboard, Long[17] determined that the relations or invisible slopes between all keys are the pattern of the keyboard which determined good form in typewriting. Thus, one learned the relations of individual keys to the whole keyboard. The positions of the various keys could be shifted without injury to learning if the new pattern of changed keyboard was kept throughout the learning. The learning proved superior whenever the new relations were better balanced than in the pattern of the present "standard" keyboard.

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[17]N. C. Long, "An Experiment with the Relative Efficiency of Various Methods of Teaching the Typewriter Keyboard," Monographs in Education, First Series No. II, Research Studies in Commercial Education (University of Iowa, 1929), Volume IV, 34-39.

Whether the simplified or standard keyboard was used, each individual key was of small moment. Any convenient mechanical device could do as well for any typist if the pattern of the keyboard kept the same spatial relations. Should the organization of this pattern be by first adapting to the home keys, then gradually experiencing the new reaches or ratios to other keys? Such piecemeal methods, starting with the home row (horizontal) or with single fingers (vertical), were common. Yet in classes compared by Long, learning the keyboard as one whole while skipping around to type a word or sentence brought distinctly faster speed scores. Learning the keyboard as a whole was 10 percent superior in bringing the right finger to the right key. With the Simplified keyboard, by contrast, so many beginning sentence exercises used the fingers in natural position above the home row that the ability to locate other keys naturally expanded as the demands increased.

Robinson and Langford Studies

In an effort to see whether renewed and seemingly serious interest in the Simplified keyboard was justified, Robinson[18] took another look at its possible theoretical advantages, using computer-tabulated frequency counts based upon computer-analyzed vocabularies of recent vintage. The purpose of this study was twofold: (1) to provide a data base upon which additional analyses could be made and (2) to raise some questions that should be answered before viable conclusions about the "new" keyboard could be drawn.

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[18]Jerry W. Robinson, "An Idea Whose Time Has Come Again?", Century 21 Reporter (Spring, 1975), 2, 4, and 8.

The data base used for comparing the Universal and Simplified keyboards in terms of finger/hand load and of handedness was Silverthorn-Perry's Merged Word List. A total of over 15,000 different words appeared in the 626,053 contextual words that were coded and tabulated. No data were available on the frequency of use of punctuation marks, several of which were relocated in the third and top rows of the Simplified keyboard.

The Universal keyboard assigns 57.8 percent of the letter typing load to the supposedly weaker left hand and 42.2 percent to the right hand. The Simplified keyboard reverses the work load, assigning 45.0 percent to the left hand and 55.0 percent to the right. This work-load reversal was accomplished, however, by assigning more letter typing (10.1 percent) to the less agile fingers of both hands. In addition, almost 20 percent of all stroking is performed by the right-hand thumb, and the right fourth finger returns the electric carriage. It might, therefore, be argued that the right hand and the weak fingers of both hands carry a disproportionate share of the typing work load on the Simplified keyboard.

In the distribution of work load among the three rows of letter keys, the Simplified keyboard increases the amount of typing done on the home row keys by 39.1 percent, reduces that done on the third row by 31.6 percent (excluding the punctuation marks), and reduces bottom-row stroking by 7.5 percent.

No typist or typewriting teacher would question that the bottom-row keys are harder to operate than the home- and third-row keys. Some would question the greater reduction in relatively easy third-row reaches and the loading of them into the home row. Some have already questioned

the location of all vowels (among the most-used letters) in the home row to be typed with only the supposedly less facile left-hand fingers.

Although interesting questions remain to be answered about finger assignments based on individual letter occurrences, alone, the interplay of fingers in keystroking combinations of letters is also important. What effect does the Simplified keyboard have on finger interplay in typing letter combinations? words? and words in context?

The Simplified keyboard reduced left-hand digraph occurrences substantially and increased balanced-hand digraph occurrences by an almost equal percentage. Minimal change was made in occurrences of often troublesome adjacent-keys and consecutive-direct digraphs.

With a substantial increase in weak-finger usage, one is left to question why many of the decreases in one-hand digraph occurrences were made by eliminating one-hand digraphs that were already easy to type. This is a valid question because a study by Langford[19] showed that students learn to make quick serial responses to two-letter "chains" of common one-hand digraphs such as er and re--among those the Simplified keyboard converts to balanced-hand patterns involving a weak finger. At the same time, it converts to one-hand sequences such as balanced-hand, strong-finger digraphs as th and nd which are two of those most often used.

The first 500 most-used words (accounting for about 70 percent of all word occurrences in the Merged List) were analyzed for handedness

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[19]Thomas E. Langford, "Effects of Three Practice Strategies Upon Chaining, Speed, and Accuracy in Typewriting," The Balance Sheet (November 1971), 100-105.

of occurrences. The Simplified keyboard substantially reduced the occurrences of one-hand words but increased only moderately the occurrences of balanced-hand words. An analysis of straight-copy timed writings (triple controlled for difficulty in terms of syllable intensity, average word length, and percent of high-frequency words) and of uncontrolled business-letter copy suggests that the Simplified keyboard may not have great impact on typewritability of typical copy used for training purposes and in business operations.

Robinson's[20] foregoing analyses raised more questions than they answered. Whether or not the Simplified keyboard is <u>really</u> <u>easier</u> to operate can be answered positively only if an affirmative answer can be obtained for each of the following questions:[21]

1. Does the balanced-hand and one-hand interplay in words of "mixed" stroking patterns overcome the added burden of increased use of the supposedly weak fingers?

2. Does the decrease in the mere <u>number</u> of one-hand words decrease the percentage of such words in contextual material sufficiently to increase speed significantly?

3. Is the impact of keystroking skill on production performance sufficient to make a slight improvement in basic skill significant?

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20 Robinson, Op. Cit.

21 Ibid.

Stivers Study

Stivers[22] attempted to find out whether or not it paid to retrain experienced Universal keyboard operators to use the Dvorak keyboard. With Stivers as project director, the Office Management Division of the American Management Association carried out a retraining program in the Chicago area. Six companies agreed to cooperate: Commonwealth Edison Co., Continental Illinois National Bank and Trust Company of Chicago, Kraft Cheese Company, Montgomery Ward and Company, Sears Roebuck and Company, and Jewel Tea Company, Inc.

Women were selected for training (a) whose output had for some time been measured in lines or keystrokes, (b) who had leveled off in production to the extent that their output had not varied more than 5 percent during the previous six months, (c) who would approach the project with an open mind and (d) who would be provided with machines similar to those used prior to training. Better mechanical devices in training machines than the trainee was accustomed to were carefully avoided in order to eliminate from consideration any increases in speed which might possibly be attributed to this factor.

The classes ran for 10 weeks and consumed 90 hours. During the first two weeks, the trainees did no typing at their offices. During the last eight weeks when not in class, the trainees worked at their offices on their regular tasks on typewriters equipped with Dvorak keyboards.

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[22]C. L. Stivers, "Experience in Retraining on the Dvorak Keyboard," American Management Association (April 1941), 2-12.

As would be expected, the study brought out both the advantages and disadvantages of retraining. There were several outstanding advantages.

First, the retrainees were enthusiastic about the new keyboard after they learned how to use it.

Second, an increase in production followed. Four of the six women had surpassed their average output during the 12 weeks prior to retraining by the time the program was concluded. While an increase in output unquestionably resulted, it was difficult to determine from such a small sampling how much might be expected. It was believed that most of the increased output was the result of the improved layout of the Dvorak keyboard. This additional output should continue year after year, as long as the operator continued to work.

Third, less equipment would be needed. The higher the production of the operator, the fewer are needed. A smaller number of operators takes less equipment--fewer typewriters, desks, and chairs. This reduction would be a sizable saving, particularly in large offices.

Fourth, operators would probably make fewer typographical errors. No record was kept of errors made prior and subsequent to retraining. No participating companies, therefore, could state authentically that their typists were more accurate after retraining. On the other hand, no increase in errors was noticed. It seems logical to assume that typographical errors would increase during retraining. Since the keyboard is easier to operate, and since awkward finger sequences and stroking patterns are eliminated, it is equally logical to assume that operators are likely to be more accurate and neat in their work than they were on the standard keyboard.

Some distinct disadvantages were. First, a loss in production while retraining was noted. The retrainees did no typing during the first two weeks. If no additional help was required and if retrainees were assigned other tasks, there would be no payroll loss. If the opposite were true, however, considerable expense could be incurred. The second disadvantage noted was less flexibility. With two keyboard arrangements, it would be more difficult to switch machines among typists. Thirdly, considerable employee opposition to retraining was anticipated. One of the idiosyncrasies of human nature is the aversion to change, and this aversion would not be entirely illogical because it would be more difficult for the retrainees to get positions elsewhere should change be desired or forced upon them. Whether companies would be willing to go to the trouble and expense of retraining their operators and also give them the financial benefits (bonuses) that would result from increased output, was also doubtful.

The following conclusions were drawn from this experience in retraining on the Dvorak keyboard:

1. Those retrained on the Dvorak keyboard were enthusiastic about it and would not like to return to the Universal keyboard. Therefore, could retraining be made general so that operators would not be handicapped when changing positions, the change would, on the whole, be welcomed by the operators.

2. An increase in output followed retraining. However, this increase was not sufficient to provide businesses with the incentive to make the effort to retrain operators and to accept the inconveniences which accompany retraining.

3. All retrainees found the Dvorak keyboard less fatiguing. This reduction in operator fatigue may eventually prove sufficient cause to bring about the general adoption of the Dvorak keyboard and the retraining of operators since the current trend in offices is to accomplish more with less effort.

4. The Dvorak keyboard had all the advantages claimed for it; namely, faster and more accurate typing, less fatigue, and easier mastery than the Universal keyboard. However, retraining seemed not the answer. It was the consensus of participating companies that the initiative in making the change, if it was to be made, must be taken by the high schools, independent business schools, colleges, universities, and junior colleges.

Wales Study

Under Arthur P. Wales, Smith-Corona Executive Vice President, the SCM Division introduced a modified version of the Dvorak Simplified Keyboard (DSK), designed by Dr. August Dvorak some 40 years earlier, as a standard option on two of its electric typewriters. Wales did not hope to convert educators, typists, or any others who type on a standard keyboard but rather to recruit students who wanted to teach themselves to type.

> The problem with self-instruction is that people often give up and look at the keys because it takes them so long to master the standard keyboard. They remain slow typists for life. The equipment never becomes a tool of their thought process.[23]

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[23]Arthur P. Wales, "Ignored Typewriter Plan Gains Interest," The Knoxville News, Sunday, March 30, 1975, B-5.

The ASK was arranged to make typing easy to learn. "Most students," said Wales, "can learn to type 60 words per minute on an American Simplified Keyboard (ASK) in the time it would take them to reach half that speed on a conventional machine."

Wales, with Dvorak's agreement, decided the original Dvorak keyboard terrified most people because it carried the logic of rearranging in the alphabet keys to the top line, too--the number keys. "Well," Wales said, "no one is going to sit still for relearning his numbers; and no one did." So Smith-Corona's version simply puts the top line back in sequence.

If DSK and ASK are so good, why did it take 40 years for it to become a standard option on a manufacturer's typewriter? Said Wales, who had commissioned Dr. Dvorak (whose patent ran out on DSK) to write a 12-lesson self-instruction program to give away with ASK models, "Dr. Dvorak is an efficiency expert, and he made one big error. He put numerals on the keyboard in an efficient arrangement that nobody would bother to master." Needless to say, the numbers go 1, 2, 3, . . . on the Smith-Corona (ASK) version. A Honolulu firm has designed a "golf ball" element which fits the IBM Selectric typewriter, to convert its QWERTY keyboard to an ASK operation.

Summary

This chapter presented a review of selected studies that have been conducted to analyze and compare the two typewriter keyboards--Dvorak and Sholes. There appeared to be unmistakeable clues that point to continued investigation in human resources (typists) input and office production output.

Varied keyboard approaches permitted students to develop usable typing skills claimed Culkins and Long. Dvorak rearranged the keyboard to parallel finger dexterity with letters and letter combinations typists used most frequently. Wales modified Dvorak's arrangement by leaving the top row of figures in numeric order. Stivers and Lessley found out that it paid to retrain experienced standard keyboard operators on the Dvorak keyboard. The Gilbreths, Hoke and Riemer studied the efficiency of fingers--finger loads, typing motions, and finger reaches. Davis explained the reasons and forces which have brought about the unpopularity and orphanage existence of DSK. Davis felt that it is only a matter of time before the Dvorak keyboard will become the keyboard of the future.

While the findings of these tests were quite definitive, Robinson and Langford agreed that important questions should be raised before proceeding to accept the Dvorak keyboard hands down: (1) Does the balanced-hand and one-hand interplay in words of "mixed" stroking patterns overcome the added burden of increased use of the supposedly weak fingers? (2) Does the decrease in the mere number of one-hand words decrease the percentage of such words in contextual material sufficiently to increase speed significantly? and (3) Is the impact of keystroking skill on production performance sufficient to make a slight improvement in basic skill significant?

CHAPTER III

METHODS AND PROCEDURES

Thirty-five students enrolled in various disciplines at Oakwood College, Huntsville, Alabama were selected for the study. These students were enrolled in a one-quarter beginning typewriting class which simultaneously used two keyboard arrangements (Dvorak and Sholes) for instruction and two channels of a four-channel multiple listening Audio Trainer (cassette player/recorder). Tapes were made by the researcher which synchronized Dvorak keyboard instruction with the textbook-prepared tapes of Sholes keyboard instruction for keystroking and carriage returning. Each student selected the keyboard arrangement upon which he/she preferred training. Their progress was monitored and these data were used as the bases for comparison in this study.

Trainee Selection and Description

Permission to invite eligible students of beginning typewriting to participate in the study was first obtained from the Academic Dean and the Head of the Business Education and Secretarial Department of Oakwood College. True beginning typewriting college students were recruited through a Recruitment Questionnaire (see Appendix A) distributed to all admissions at Oakwood College at registration time. Those students were given the opportunity to participate in the experiment.

The subjects for the research were those college students who were recruited and enrolled in the college beginning typewriting class

labeled "Personal Use Typewriting." Only those subjects who had no previous typewriting training were included in the study. Only volunteers were utilized in the experimental group. In order that Dvorak keyboard trainees would not experience any difficulty in locating typewriters with Dvorak keyboards in the future, the Dvorak elements were given to those trainees who completed the training. Volunteers could withdraw from the research experiment at any time.

Informed Consent forms were obtained from the students themselves if they were 18 years of age or older or from their parents or guardians if they were under 18 years of age (see Appendix A).

The purposes of the experiment were read to the students by the researcher and the advantages and disadvantages of the Dvorak and Sholes keyboard arrangement were explained in detail while the students followed handouts (see Appendix A).

Class Organization

An explanation of the research objectives and procedures was orally presented by the researcher (see Appendix A) to all subjects who had signed Informed Consent forms. Potential participants over 18 years of age were asked to sign the appropriate Informed Consent forms. Parental permission was obtained from all participants under 18 years of age. Only those subjects who returned the Informed Consent forms or who had obtained parental permission participated in the study as control or experimental group members.

The Tapping Test,[1] designed to measure aptitude for typing, was administered to all participants. The test required examinees to tap quickly and accurately with one finger at a time and to associate a particular finger movement with a particular letter of the alphabet. Color-saturated felt dots were attached to the index, middle, ring, and baby fingertips; the tapping was done in a test booklet in which printed circles represented the surfaces of eight typewriter keys. The test took about 30 minutes to administer. A reliability coefficient of .90 and a validity coefficient (for two separate criteria) of .39 and .38 were obtained by the authors of the test from using from 5 to 670 beginning typists in from 7 to 12 schools. The measurements taken from this test were used in this study to predict achievement of typing skill. The Tapping Test was used for making some corrections for differences in achievement predictions. The day after the administration of the Tapping Test, the subjects were asked to select in writing the keyboard of their choice for training purposes. (See Keyboard Assignment Preference Form - Appendix A.)

Sholes and Dvorak subjects respectively were issued textbooks. Lessons 1 through 10 and 16 through 25 of College Typewriting by Lessenberry, Wanous, Duncan, and Warner and a paraphrased and synchronized Dvorak textbook (prepared by the researcher) were used in the study. (See Sample Dvorak and Sholes Lessons - Appendix B.) Remaining instruction utilized the 9th Edition of the same textbook, College Typewriting

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[1]John C. Flanagan and Grace Fivars, "The Tapping Test--A New Tool to Predict Aptitude for Typing," The Delta Pi Epsilon Journal, 1964, 33-39.

by Lessenberry, Wanous, Duncan, and Warner, with uniform oral instruction given through Lesson 37 for the rest of the ten weeks of instruction (see Class Schedules - Appendix D).

For the first twenty lessons, students followed this plan of 5 minutes for personal and machine preparation and 35 minutes for taped keyboard instruction and practice. The cassette tapes were synchronized so that carriages were returned simultaneously whether Dvorak or Sholes instruction was being given. Both Dvorak and Sholes instruction were given at the same time in the same classroom via a multi-channeled Audio Trainer (cassette recorder/player).

Tapes used for Sholes instruction were prepared tapes from South-Western Publishing Company which accompany and supplement their textbook. Tapes for Dvorak keyboard instruction were prepared by the researcher and were synchronized to match the Sholes tapes and the Sholes textbook. The letter keys were covered in eight lessons, and some of the points kept in mind in developing these Dvorak lessons were:

1. To avoid presenting more than one key of a pair in a lesson.
2. To avoid teaching more than one new reach per finger each day.
3. To avoid teaching the difficult reaches in the same lesson; such as, the reaches to b, x, ; and f (Dvorak) or the Sholes reaches to b, y, n and z.
4. To avoid teaching adjacent keys in the same lesson.[2]

Use of these guidelines resulted in the keyboard presentations in Table III.1.

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[2]S. J. Wanous, "Typewriting Teaching Philosophy," Personal and Professional Typing Manual (Cincinnati: South-Western Publishing Co., 1962), 3-4.

TABLE III.1
DVORAK AND SHOLES KEYBOARD PRESENTATIONS BY LESSON

Dvorak	Lesson	Sholes
Home Row Keys a, o, e, u; h, t, n, s, and d & l	1	Home Row Keys a, s, d, f; j, k, l, and h & e
i, f, and . (period)	2	i, t, and . (period)
j, r, and k	3	o, r, and n
y, , (comma), and c	4	w, u, and c
Timed Writings (20 wpm required)	5	Timed Writings (20 wpm required)
p, g, and w	6	p, g, and m
q, m, and x	7	q, t, and x
b, z, and ; (semicolon)	8	b, z, and , (comma)
v, ? (question mark)	9	v and ? (question mark)
Summary of Spacing Rules and Timed Writings (25 wpm required for 1 minute and 15 wpm required for 3 minutes)	10	Summary of Spacing Rules and Timed Writings (25 wpm required for 1 minute and 15 wpm required for 3 minutes)

TABLE III.1 (Continued)

Dvorak	Lesson	Sholes
1, 3, and 7	16	1, 3, and 7
9, 5, and : (colon)	17	9, 5, and : (colon)
6, 2, and / (diagonal)	18	6, 2, and / (diagonal)
8, 4, and 0	19	8, 4, and 0
- (hyphen) and Timed Writings with 35 wpm required for 1 minute and 25 wpm required for 3 minutes	20	- (hyphen) and Timed Writings with 35 wpm required for 1 minute and 25 wpm required for 3 minutes
$, ' (apostrophe), and " (quotation)	21	$, ' (apostrophe), and " (quotation)
# (number), & (ampersand), and) (right parenthesis)	22	# (number), & (ampersand), and) (right parenthesis)
%, _ (underline), and ((left parenthesis)	23	%, _ (underline), and ((left parenthesis)
* (asterisk), ½-¼, and ¢-@ (cent or cents and at or each)	24	* (asterisk), ½-¼, and ¢-@ (cent or cents and at or each)
1- and 3-minute Timed Writings (50 wpm required in 1 minute and 40 wpm required in 3 minutes)	25	1- and 3-minute Timed Writings (50 wpm required in 1 minute and 40 wpm required in 3 minutes)

The keys on the typewriter keyboard were covered with adhesive tape in order not to confuse Dvorak students with Sholes letter, special character, and number positions. Neither group, Dvorak or Sholes, had the advantage or disadvantage of looking at their keys for aid in determining letter positions in touch typing skill development.

Each day's lesson ended with a 10-minute self-improvement practice which provided additional exercises on such things as the lesson's new keys, stroking techniques, and spacing rules. Also, by timing these exercises, students began to build production rates necessary for successful typing performance on the job.

The classes met five days a week for 50 minutes each class period and followed the class schedule. Students who missed any session were required to make up the session prior to the next class period or to attend special sessions outside of the class until they were able to catch up to the class. Most students preferred keeping up with the group and so avoided the special sessions.

Measurements and Standards

Tests administered weekly throughout the training period indicated the extent of the student's keyboard knowledge, ability to compute margins, and technical knowledge of lines, spaces, and spacing. (See Appendix C.) These tests gave the instructor insights relative to the adequacy of instructional materials, measures to use for grading purposes, and determinants of theory mastery and skill development.

In skill courses, two types of learnings are measured: Control theory learning and application skill performance. The skill performance was measured by the following standards which had previously been set up

by the Department of Business Education and Secretarial Science at Oakwood College Huntsville, Alabama as the requirements for the course:

3 Minutes	Grade	1 Minute
40 wpm	A	50 wpm
35 - 39 wpm	B	45 - 49 wpm
30 - 34 wpm	C	40 - 44 wpm
25 - 29 wpm	D	35 - 39 wpm

All students must have reached one of these speeds at least three times in order to obtain the grade indicated. A three-error limitation was set on three-minute timed writings with the gross speed taken at the third error. A two-word penalty was deducted for each error on the one-minute timed writings. Students had opportunities daily after Lesson 5 to work on these drills and were asked to submit their best drills of the week for grading.

Problem typing, which included centered announcements, columnar tables, vertical and horizontal centering, enumerations, and rough drafts, was used to determine student's ability to work under pressure, to follow directions, to position copy, and to use manipulative parts. The following production achievement standards were used in determining NPRAM as well as in the grading of the final publisher-prepared examination.[3]

NPRAM	Grade
8 - 10 wpm	A
6 - 8 wpm	B
4 - 6 wpm	C
2 - 4 wpm	D

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[3]D. D. Lessenberry, S. J. Wanous, Charles H. Duncan, and S. ElVon Warner, College Typewriting Manual for Placement and Achievement Tests (Cincinnati: South-Western Publishing Co., 1975), 7-10.

The researcher coordinated all of the instruction. All of the instruction was given by the researcher with the exception of the male voice heard on the Sholes cassette tapes used for keyboard presentation. The training period involved in this experiment was one quarter or ten weeks of instruction.

At the end of the quarter, students in the experiment who did not reach speed goals (if all other work was satisfactory) received a grade of "D". Others received a grade of "C" or better depending upon speeds reached on 1-minute and 3-minute straight-copy timed writings and statistical copy, production rates achieved, and typewriting information acquired.

Pilot Study

A pilot study involving eight students was conducted by the researcher before the actual experiment in order to coordinate tapes and time schedule, edit instructional materials, predict outcomes, and retrain the researcher on the Dvorak keyboard so problem areas might be identified, understood, and minimized. The pilot study involved only the training of Dvorak students. The multichanneled audio trainer was also unnecessary since all students were learning the same keyboard.

Names of students for the pilot study were obtained from the questionnaires given at registration time, the students enrolled in beginning typewriting for the quarter who had had no previous typing training, a college newsletter announcement, and word of mouth.

Students pointed out errors in textbooks or tapes as they came across them in their reading, listening, and/or practice exercises.

These errors were noted by the researcher and corrected before the learning materials were printed. For example, some of the errors noted were words with letters in them not yet presented, sentences or sentence phrases with special characters in lessons that had not been presented for learning, and fingering illustrations that were incorrect. Also noted was the problem of such frequent changing of elements by Dvorak trainees. Two or three students found the tops came off their elements, which had to be reparied at added expense. These elements seemingly were not made for frequent changing which is necessary if a Dvorak typist is to satisfactorily compete in the world of work with Sholes typists. The investigator also felt that perhaps the elements were not as durably made as those used by most typewriter manufacturers.

The students in the Pilot Study had problems reaching speed goals set at five-lesson intervals. However, it was later noted that the same problem existed with Sholes trainees and therefore was not a unique one. Pilot Study trainees had high interest and great expectations for speed attainment promised by previous researchers and Tapping Test predictions. When there seemingly was no miraculous skill development, students began to fall into the humdrum of learning to type. A couple of students fell into the habit of missing class, and one dropped out completely.

There appeared to be little if any difference in the time schedule for learning to type and the speed goals set for each level between Dvorak Pilot Study students and another class of Sholes beginning typists which the researcher was concurrently teaching.

Sample Population Configuration

Twenty Dvorak elements were purchased at a price of $65 per element, which totaled $1,300, to be used by and given to the students who successfully completed Dvorak keyboard training. Eighteen students attempted to learn the Dvorak keyboard with twelve students successfully completing their training. Some students evidently dropped out because of a fear of trying something new and different. Other students feared their acceptance in the world of work would be limited even though they were given the elements after successful completion of the keyboard training and even though they combined their efforts and completed Lessons 26 through 37 with Sholes keyboard students.

Student Number 1 (See Appendix F) dropped because she would have rather learned the Sholes keyboard arrangement and had agreed not to change during the course of training while the option of dropping at any time was open to her. Student Number 2 had conflict of interest problems but felt that he too would rather have selected the Sholes keyboard training than the Dvorak keyboard training. Students Numbered 11 and 12 joined the class under the non-credit, non-pay option which the researcher obtained permission to offer in order to increase enrollment after it was found that the questionnaires and enrollees did not yield a sufficient sample. Student Number 9 dropped out of college temporarily because of personal reasons. The other student who dropped (Student Number 10) obtained a position which she mistakenly felt--the machine provided for her use on the job was an IBM Selectric II--required that some typewriting on the Sholes keyboard be learned and performed. Not being sure whether the advantages of the Dvorak keyboard outweighed those

of learning the Sholes keyboard, she dropped out and chose to wait to enroll in a Sholes keyboard training class the next time it was being offered.

The Sholes keyboard or control group trainees showed a lower attrition rate. Students Numbered 4, 6, and 11 (Appendix F) of the dropouts in the program were enrolled in the free course, non-credit option and did not attend regularly enough to complete the course in the allotted time. The remaining four students, Numbers 11, 13, 14, and 16, received Incompletes for their grades.

The size of the sample in this study is comparable to the Navy Department study[4] conducted by Dr. August Dvorak in 1944, which had a sample size of 14 Sholes keyboard typists who chose to be retrained on the Dvorak keyboard to compare speed and production achievements and improvements. The researcher had a number of Sholes typists who offered to be retrained on the Dvorak keyboard.

Twelve students were trained in the experiment who were not included in the study data. These students had had some previous knowledge of typewriting and were, therefore, not really true beginners. Because of their experience, they could not be included in this study.

The classroom held 19 IBM Selectric typewriters. There were three classroom settings in which the experiment was conducted. One

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[4]Training Section, Department Services, Division of Shore Establishments and Civilian Personnel, Navy Department, Washington, D. C., "A Practical Experiment in Simplified Keyboard Retraining," A Report of the Retraining of Fourteen Standard Keybaord Typists on the Simplified Keyboard, July, 1944 and "A Comparison of Typist Improvement from Training on the Standard Keyboard and Retraining on the Simplified Keyboard," A Supplement to the Aforementioned Experiment, 18 October 1944.

setting was used initially to conduct the Pilot Study. The following quarter had seven students enrolled as a class for this study. At this point, permission was granted by the Academic Dean and the Business Education and Secretarial Department Head of Oakwood College to publicize a special notice in the school newspaper for students who had never had typewriting to join an evening class with fees waived. Those students would have the option of one year to sign up and pay for the course and receive credit. This option resulted in a full classroom and the third class. Only five of the nineteen had initially enrolled for credit and were, therefore, the most conscientious in attendance and satisfactory completion. This session included nine students who dropped out of the class because of heavy academic loads or other problems. Three never finished the course although they remained enrolled for the entire quarter.

Three Dvorak students and one Sholes student matriculated successfully in the second quarter typewriting class. This couse was taught by the researcher as a part of her regular teaching load and data was gathered because of the researcher's interest in following up on previous quarter experimentees. The Dvorak students at this point seemed to develop higher speed and accuracy than the Sholes student. These data are just a point of interest which opens the possibility of more conclusive results for Dvorak trainees with a longer experimental period for future studies.

CHAPTER IV

DATA RESULTS

The primary problem of this experiment was to compare the effects of the Dvorak and Sholes keyboard arrangements on skill development in beginning college typewriting. Data were gathered from the Dvorak experimental, Dvorak pilot-study, and Sholes control groups in an effort to pinpoint achievement in the following areas of comparison:

Tabulations
Rough Drafts
Vertically and Horizontally Centered Announcements
Enumerations
Average Production Rate (All Measures)
Straight-Copy 3-Minute Timed Writings
Straight-Copy 3-Minute Statistical Timed Writings
Straight-Copy 3-Minute Timed Averages
Straight-Copy 1-Minute Timed Averages

Tapping Test

The Tapping Test was also used to determine its prediction possibilities for typing skill attainment. Table IV.1 lists the students of the Sholes control, Dvorak pilot-study, and Dvorak experimental groups by number with their respective Tapping Test scores. Students were assigned numbers relative to the Tapping Test scores each received. These numbers were assigned numerically starting with one for the student who received the highest Tapping Test score. These numbers were used throughout the study to identify particular students and to maintain anonymity.

Identification of Groups for the Study

The Dvorak pilot-study group was different from the Dvorak experimental group in that students in the pilot study did not have the chance

TABLE IV.1
TAPPING TEST SCORES OF SHOLES CONTROL GROUP, DVORAK PILOT-STUDY GROUP AND DVORAK EXPERIMENTAL GROUP

Student Number	Tapping Test Score
SHOLES CONTROL	
1	55
2	50
3	48
5*	39
7*	37
8	37
9	36
12	33
15*	26
17	12
DVORAK PILOT-STUDY	
1	69
2	66
3	55
4	41
5	39
6	31
DVORAK EXPERIMENTAL	
3*	56
4	55
5	44
6*	43
7*	41
8*	40

* Members of the Evening Class

to choose the method or keyboard arrangement for their training. Dvorak experimental and Sholes control trainees did have this choice. The Dvorak experimental and the Sholes control groups were given identical instruction, while the Dvorak pilot-study group was instructed differently. With these differences in mind, the Dvorak experimental and the Dvorak pilot-study groups were compared for differences on all nine measures using t tests in the cases of no significant correlation coefficients with the Tapping Test scores or analysis of covariance in the case where Tapping Test scores revealed significant correlations.

No significant differences were found at the .05 level between the terminal achievements of Dvorak experimental and Dvorak pilot-study groups with respect to the nine variables. Therefore, the Dvorak experimental and the Dvorak pilot-study groups were pooled to increase the size of the sample. (See Table IV.2 for details.) This pooling doubled the size of the Dvorak sample resulting in a Dvorak sample size of 12 to compare with the Sholes control group's sample size of 10. In the analyses of all data, the Dvorak pilot-study and Dvorak experimental groups' net terminal speed averages of the last three lessons on Straight-Copy 1-Minute and Straight-Copy 3-Minute Timed Writings can be found in Tables IV.3, IV.4, and IV.5. The speed drills from Lessons 25, 30, and 37 for both 1-Minute and 3-Minute Straight-Copy Timed Writings were averaged to determine the terminal speed scores of the Sholes and Dvorak groups. Two scores are shown for each student, one for one minute and the second for three minutes. A score shown as 28N-26/3 means a net speed for one minute of 28 words (with two words deducted for each error

TABLE IV.2
MEAN DIFFERENCES BETWEEN THE DVORAK EXPERIMENTAL AND THE DVORAK PILOT-STUDY GROUPS

	Dvorak Experimental N = 6		Dvorak Pilot - Study N = 6		t-value*
	Mean	S.D.	Mean	S.D.	
Tabulations	4.4350	0.2858	3.8667	1.7536	0.7835
Rough Drafts	11.9783	1.3026	12.6650	2.3860	-0.6203
Vertically and Horizontally Centered Announcement	6.8283	1.9293	7.4567	1.7991	-0.5835
Enumerations	5.5767	0.7932	5.9933	0.6321	-1.0061
Average Production Rate	7.2033	0.7792	7.4983	0.9000	-0.6029
S/C 3-Minute Timed Writing	23.3333	7.1181	28.1667	5.6716	-1.5774
S/C 3-Minute Statistical Timed Writing	15.6667	3.3862	17.3333	2.8048	-0.9283
S/C 3-Minute Timed Averages	23.5000	7.2870	27.5000	4.7223	-1.1284
S/C 1-Minute Timed Averages	33.8333	9.4534	37.6667	5.6804	-0.8514

* Significant t value at .05 level is 2.228

TABLE IV.3
SHOLES CONTROL GROUPS' NET TERMINAL SPEED AVERAGES OF LAST THREE LESSONS ON S/C 1-MINUTE & 3-MINUTE TIMED WRITINGS

Student No.	Lesson 25 1' - 3'	Lesson 30 1' - 3'	Lesson 37 1' - 3'	3 - Lesson Averages 1' - 3'
1	28N-26/3	30N-26/0	35N-28/0	31N-27/1
2	28N-23/2	30N-22/0	35N-26/2	31N-24/1
3	24N-18/2	29N-26/0	30N-27/0	28N-24/1
5	39N-33/2	30N-33/2	46N-33/2	41N-33/2
7	27N-19/1	20N-18/3	28N-19/2	25N-19/2
8	26N-22/2	30N-25/0	29N-28/0	28N-25/1
9	29N-30/3	33N-28/2	35N-26/2	32N-28/2
12	30N-34/0	32N-27/3	42N-36/0	35N-32/1
15	32N-19/1	30N-22/2	38N-21/1	33N-21/1
17	33N-22/3	29N-18/3	31N-20/3	31N-20/3

/ stands for with and the number after the slash indicates the number of errors made--error limitation was 3
N net words per minute with 2 words deducted for each error
' minute or minutes

TABLE IV.4
DVORAK PILOT-STUDY STUDENTS' NET TERMINAL SPEED AVERAGES OF LAST THREE LESSONS ON S/C 1-MINUTE AND 3-MINUTE TIMED WRITINGS

Student No.	Lesson 25 1' - 3'	Lesson 30 1' - 3'	Lesson 37 1' - 3'	3 - Lesson Averages 1' - 3'
1	42N-30/1	45N-28/3	40N-31/2	42N-30/2
2	45N-28/2	49N-33/0	44N-37/2	46N-33/1
3	29N-27/2	40N-28/2	44N-30/2	38N-28/2
4	33N-26/1	32N-31/2	40N-32/3	35N-30/2
5	23N-17/2	31N-20/3	35N-24/3	30N-20/3
6	32N-23/3	35N-26/2	37N-24/3	35N-24/3

/ stands for with and the number after the slash indicates the number of errors made--error limitation 3
N net words per minute with 2 words deducted for each error
' minute or minutes

TABLE IV.5
DVORAK EXPERIMENTAL GROUPS' NET TERMINAL SPEED AVERAGES OF LAST THREE LESSONS ON S/C 1-MINUTE AND 3-MINUTE TIMED WRITINGS

Student No.	Lesson 25 1' - 3'	Lesson 30 1' - 3'	Lesson 37 1' - 3'	3 - Lesson Averages 1' - 3'
3	31N-25/2	29N-21/2	31N-30/3	30N-25/2
4	48N-28/3	50N-37/3	55N-40/3	51N-35/3
5	38N-31/2	40N-30/2	47N-23/3	38N-28/2
6	28N-15/3	25N-16/1	30N-20/3	28N-17/2
7	31N-12/2	30N-18/2	32N-20/2	31N-16/2
8	19N-20/3	25N-21/2	30N-20/2	25N-20/2

/ stands for with and the number after the slash indicates the number of errors made--error limitation 3
N net words per minute with 2 words deducted for each error
' minute or minutes

from the gross words) and a three-minute net speed of 26 with three errors.

Nine Lessons (5, 10, 16, 17, 18, 20, 25, 30, and 37) of Lessenberry's College Typewriting, 7th Edition, or the paraphrased and synchronized Dvorak text prepared by the researcher were used in the study for data collection. These lessons were specifically chosen because of their review nature. Lessons 11-15 were intentionally skipped because they had no new keyboard learnings. Speed, accuracy, and control drills were given daily and were coordinated with keyboard instruction, learning, and mastery.

Correlation Analyses

Tables IV.6, IV.7 and IV.8 present scores on the first seven variables by student number: Tabulations, Rough Drafts, Vertically and Horizontally Centered Announcements, and Enumerations, each by gross production rate a minute (GPRAM) and net production rate a minute (NPRAM). Gross production rate a minute is the total possible rate one could get if he/she typed the assignment completely in the time allotted without taking off for errors. Net production rate a minute is the gross (total) words less two words off for each error all divided by the length (in minutes) of the writing. All students who initially began the experiment are listed, but only those students whose numbers do not have asterisks behind them completed the experiment and were eligible to be used in the study for comparison, analysis, and statistical inference purposes.

The net production timed writing results were presented as two numbers separated by a slash. The first number represents the gross

TABLE IV.6

SHOLES STUDENTS' TERMINAL PRODUCTION RATES, STRAIGHT-COPY AND STATISTICAL SPEED DRILLS

Student Number	Tabulations		Rough Drafts		Vertically and Horizontally Centered Announcements		Enumerations		Average Production Speed - All Measures	Straight-Copy 3' Timed Writings	Statistical 3' Timed Writings
	GPRAM	NPRAM	GPRAM	NPRAM	GPRAM	NPRAM	GPRAM	NPRAM			
1	5.47	3.28	16.96	13.57	9.53	7.86	7.07	4.24	7.24	20/7	13/3
2	5.47	4.38	16.96	13.52	9.53	7.93	7.07	5.66	7.87	22/7	16/4
3	5.47	3.83	16.96	9.26	9.53	7.46	7.07	4.95	6.38	18/7	15/6
4*	5.47	3.94	16.96		9.53		7.07				
5	5.47	4.59	16.96	14.98	9.53	8.20	7.07	5.84	8.40	28/7	21/6
6*	5.47	4.21	16.96	14.27	9.53	7.24	7.07	5.44	7.79		
7	5.47	4.07	16.96	11.08	9.53	7.78	7.07	5.02	7.00	19/7	17/1
8*	5.47	4.10	16.96		9.53		7.07				
9	5.47	3.17	16.96	10.90	9.53	8.26	7.07	4.10	6.61	16/6	12/5
10*	5.47	4.07	16.96		9.53		7.07				
11*	5.47	4.59	16.96	11.70	9.53		7.07				
12	5.47	4.10	16.96	11.67	9.53	7.62	7.07	5.30	7.17	17/4	14/7
13*	5.47		16.96		9.53		7.07				
14	5.47	3.99	16.96	9.86	9.53	5.72	7.07	5.16	6.18	19/1	12/1
15	5.47	4.21	16.96	11.65	9.53	6.92	7.07	4.15	6.73	21/5	17/7
16*	5.47	3.28	16.96	11.40	9.53	6.35	7.07	4.24	6.37		
17	5.47	3.28	16.96	11.40	9.53	6.35	7.07	4.24	6.37	21/7	19/6

* - These students dropped out before the completion of the quarter.

' - Minute or Minutes.

GPRAM - Gross Production Rate A Minute.

NPRAM - Net Production Rate A Minute (See Definitions for calculation formula).

TABLE IV.7

DVORAK PILOT-STUDY STUDENTS' TERMINAL PRODUCTION RATES, STRAIGHT-COPY AND STATISTICAL SPEEDS

Student Number	Tabulations		Rough Drafts		Vertically and Horizontally Centered Announcements		Enumerations		Average Production Speed	Straight-Copy 3' Timed Writing	Statistical 3' Timed Writing
	GPRAM	NPRAM	GPRAM	NPRAM	GPRAM	NPRAM	GPRAM	NPRAM			
1	5.47	5.20	16.96	9.35	9.53	8.27	7.07	5.51	7.08	34/7	17/7
2	5.47	5.20	16.96	15.26	9.53	9.07	7.07	6.53	9.02	36/3	22/5
3	5.47	1.07	16.96	12.96	9.53	8.40	7.07	4.93	6.84	25/4	18/3
4	5.47	2.40	16.96	15.23	9.53	8.67	7.07	6.36	8.17	24/5	18/3
5	5.47	5.20	16.96	10.65	9.53	5.00	7.07	6.27	6.78	22/7	14/7
6	5.47	4.13	16.96	12.54	9.53	5.33	7.07	6.36	7.10	28/0	15/3

' Minute or Minutes.
GPRAM - Gross Production Rate a Minute.
NPRAM - Net Production Rate a Minute (See Definitions for calculation formula).

TABLE IV.8
DVORAK STUDENTS' TERMINAL PRODUCTION RATES, STRAIGHT-COPY AND STATISTICAL SPEEDS

Student Number	Tabulations		Rough Drafts		Vertically and Horizontally Centered Announcements		Enumerations		Average Production Speed All Measures	Straight Copy 3' Timed Writings	Statistical 3' Timed Writings
	GPRAM	NPRAM	GPRAM	NPRAM	GPRAM	NPRAM	GPRAM	NPRAM			
1*											
2*	5.47	2.97									
3	5.47	4.38	16.96	12.89	9.53	7.81	7.07	6.73	7.95	27/1	16/0
4	5.47	4.92	16.96	11.81	9.53	8.20	7.07	5.51	7.61	29/4	16/7
5	5.47	4.56	16.96	13.81	9.53	8.20	7.07	5.51	8.02	30/5	18/5
6	5.47	4.08	16.96	9.95	9.53	5.13	7.07	5.73	6.22	11/0	9/1
7	5.47	4.40	16.96	11.76	9.53	3.70	7.07	5.73	6.40	20/4	17/7
8	5.47	4.27	16.96	11.65	9.53	7.93	7.07	4.24	7.02	23/7	18/7
9*											
10*	5.47	2.84									
11*											
12*											

* - These students dropped out before the completion of the quarter.
' - Minute or Minutes.
GPRAM - Gross Production Rate A Minute.
NPRAM - Net Production Rate A Minute (See Definitions for calculation formula).

speed obtained, and the number following the slash represents the number of errors noted.

Table IV.9 presents correlation coefficients when each of the nine variables was correlated with the Tapping Test scores of students in both of the groups. This table also presents the correlation coefficients for the combined Dvorak and Sholes groups. The correlations of the combined sample in conjunction with those for individual groups indicated whether or not the analysis of covariance for significant difference between the two groups should be used for each production measure. Vertically and Horizontally Centered Announcements, Straight-Copy 3-Minute Timed Writings, Straight-Copy 3-Minute Timed Averages, and Straight-Copy 1-Minute Timed Averages were correlated with the Tapping Test scores of the Dvorak group and were found significant at the .05 level. Only one correlation was found to be significant at the .05 level for the Sholes control group, Vertically and Horizontally Centered Announcements.

When the Dvorak and Sholes groups were combined for comparison of the nine variables, one more variable, Average Production Rate--All Measures, was found to be significant in addition to those variables found significant for the Dvorak group. The other four correlating variables were the same.

Uncorrelated Variables

The simple t test for differences was used for comparing the two methods on the four variables which did not correlate with the Tapping Test scores. These variables included Tabulations, Rough Drafts, Enumerations, and Straight-Copy 3-Minute Statistical Timed Writings for both training methods, Dvorak and Sholes. Table IV.10 lists the means and the

TABLE IV.9
CORRELATION COEFFICIENTS OF TAPPING TEST SCORES WITH PRODUCTION MEASURES, 1-MINUTE AND 3-MINUTE STRAIGHT-COPY TIMED WRITINGS AND AVERAGES

	TAPPING TEST CORRELATED WITH		
	DVORAK	SHOLES	COMBINED
Tabulations	.1626	.1339	.1866
Rough Drafts	.0088	.2404	.1762
Vertically and Horizontally Centered Announcements	.6119*	.5983*	.4693*
Enumerations	.0344	.3301	.3692
Avg. Production Rate	.4129	.4255	.4662*
S/C 3-Minute Timed Writing	.6010*	-.0249	.5138*
S/C 3-Minute Statistical Timed Writing	.4185	-.1407	.1109
S/C 3-Minute Timed Averages	.6215*	.3111	.4508*
S/C 1-Minute Timed Averages	.6180*	-.1097	.4497*

* significant at $p < .05$

TABLE IV.10
MEAN DIFFERENCES BETWEEN THE DVORAK AND SHOLES METHODS FOR TABULATIONS, ROUGH DRAFTS, ENUMERATIONS, AND S/C 3-MINUTE STATISTICAL TIMED WRITINGS

	DVORAK N=12		SHOLES N=10		
	MEAN	S.D.	MEAN	S.D.	t-value
Tabulations	4.15	1.23	3.89	0.49	0.6241
Rough Drafts	12.32	1.88	11.79	1.75	0.6835
Enumerations	5.78	0.72	4.87	0.42	2.6841*
S/C 3-Minute Statistical Timed Writings	16.50	3.09	15.60	2.99	0.6891

* significant at $p < .05$

standard deviations of the Dvorak and Sholes methods for the uncorrelated variables and their resultant t-values and reports a difference found significant at the .05 level for Enumerations favoring the Dvorak method with Dvorak and Sholes means of 5.78 and 4.87 respectively reported.

Correlated Variables

When the Tapping Test score had a significant correlation with any of the nine variables, the scores of the subjects were adjusted for the initial high or low scores for comparison purposes of the two methods, and analysis of covariance was used as a statistical test. The details of the analyses follow closely the design used by Snedecor.[1]

Means and adjusted means for correlated variables are listed in Table IV.11. This table also summarizes the F values with the result that Straight-Copy 1-Minute Timed Averages were significant at the .05 level with Dvorak and Sholes means of 35.75 and 31.50 respectively reported.

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[1]George W. Snedecor, Statistical Methods (Ames: The Iowa State University Press, 1966), 394-412.

TABLE IV.11
MEANS AND ADJUSTED MEANS FOR MEASURES WHICH CORRELATED WITH TAPPING TEST SCORES

Achievement Measure	Means		Adjusted Means		Covariance Analysis (F-Value)
	DV N=12	SH N=10	DV N=12	SH N=10	
Vertically and Horizontally Centered Announcements	7.14	4.87	6.79	5.63	1.46
Average Production Speed	7.35	7.00	7.22	7.16	.00
S/C 3-Minute Timing	25.75	20.10	24.88	21.15	3.78
S/C 3-Minute Timed Averages	25.50	25.30	24.35	26.68	1.29
S/C 1-Minute Timed Averages	35.75	31.50	34.79	32.67	4.66*

* significant at $p < .05$

CHAPTER V

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The primary problem of this study was to compare the effects of the Dvorak and Sholes keyboard arrangements on skill development in beginning college typewriting. Secondary problems of this study were (1) to determine the NWPM (New Words Per Minute) 1-minute straight-copy speed differences, if any, between the Dvorak and Sholes trainees, (2) to determine the NWPM 3-minute straight-copy speed differences, if any, between the Dvorak and Sholes trainees, (3) to determine the production-rate performance differences, if any, between the Dvorak and Sholes trainees, and (4) to determine the effectiveness of the Tapping Test scores for predicting typing skill attainment for either or both of the Dvorak and Sholes trainees.

The participants in this study included 22 true beginners (persons who never previously had any formal or informal typing training) enrolled in college typewriting. Prior to any formal typewriting instruction, all participants took the Tapping Test, which purported to predict their future typewriting success. The Tapping Test scores were also used to equate the groups. Enrollees orally were given the advantages and disadvantages of each keyboard arrangement. This information was also given to them in printed handout form. They were given one day to decide their keyboard arrangement training choice. The next day six students chose the Dvorak arrangement and ten chose the Sholes arrangement for their training. Six others who were used in the study were pilot-study

Dvorak trainees whose results did not vary significantly from the experimental Dvorak group's results and were therefore included in the experimental group for more comparable grouping and sample size. The Dvorak experimental group's sample size was doubled by combining the two groups.

The experiment was conducted over a ten-week quarter. The class met for 50 minutes for five days per week or a total of 41 2/3 hours in the quarter. The training involved keyboard (letters, numbers, and special characters) introduction and mastery, rough drafts, vertical and horizontal centering, elementary columnar typing, speed building, technique practice, and production typing. Speed standards at this point had been normally set at 50 wpm, 45 wpm, and 40 wpm for 1-minute; 40 wpm, 35 wpm, and 30 wpm for 3-minute straight-copy timed writings; and 10 wpm, 6 wpm, and 4 wpm for timed production rates for the earned grades of A, B, or C respectively.

Each trainee received simultaneous synchronized taped instruction for keyboard instruction and mastery and skill-development drills as well as daily untaped technique practice. Daily drills were evaluated and speed drill logs were maintained for each trainee. Weekly inventories were taken to measure students' learning and skill development. Timed drills were administered daily after keyboard mastery. A timed production test was given for measuring production rates.

Three null hypotheses regarding keyboard differences were tested: (1) There are no significant differences in net speed scores on 1-minute timed writings when students used Dvorak (Simplified) and Sholes (Conventional) typewriting keyboards, (2) There are no significant differences in speed scores on 3-minute timed writings when students used Dvorak

(Simplified) and Sholes (Conventional) typewriting keyboards, and (3) There are no significant differences in the production rates on production tests which included rough drafts, tabulations, vertical and horizontal centering when students used Dvorak (Simplified) and Sholes (Conventional) typewriting keyboards. These hypotheses were used in testing data collected in the following areas: Tabulations, Rough Drafts, Vertically and Horizontally Centered Announcements, Enumerations, Average Production Rate--All Measures, Straight-Copy 3-Minute Timed Writings, Straight-Copy 3-Minute Statistical Timed Writings, Straight-Copy 3-Minute Timed Averages, and Straight-Copy 1-Minute Timed Averages.

For statistical tests, the Tapping Test scores, the net terminal speed averages and 1- and 3-minute timed writings, and the relationship tests of the nine variables with Tapping Test scores were used. The simple t test for differences was used for the variables which did not correlate with the Tapping Test scores to determine whether there were differences in the achievements of trainees using one keyboarding method over the other. Analysis of Covariance procedures were used on the variables which did correlate with the Tapping Test scores to determine differences, if any, in keyboarding methods.

Findings

As a result of these various and several tests, the following findings were noted:

1. The null hypothesis for 1-minute net speed scores was rejected, indicating a significant difference, favoring Dvorak, in the net speed scores of the students using Dvorak and Sholes typewriter

keyboards on Straight-Copy 1-Minute Timed Writings. (See Table IV.11.)

2. The null hypothesis for 3-Minute Straight-Copy Timed Writings was not rejected. There was no significant difference in the net speed of students using Dvorak or Sholes typewriter keyboards on 3-Minute Straight-Copy Timed Writings. (See Table IV.11.)

3. In two of the seven production categories, Enumerations and Straight-Copy 3-Minute Timed Writing, a significant difference was found favoring Dvorak. The null hypothesis was not rejected for the production rates of Rough Drafts, Tabulations, Vertically and Horizontally Centered Announcements, and Straight-Copy 3-Minute Statistical Timed Writings.

4. The correlation between 3-Minute Speed Averages and Tapping Test scores for Dvorak students was .6215, which was found to be significant at the .05 level. The correlation of .6180 between 1-Minute Speed Averages and Tapping Test scores was also significant for Dvorak students. The correlation was not significant for Sholes students.

Conclusions

On the basis of the preceding findings, the following conclusions were drawn:

1. Students using the Dvorak keyboard will do better on 1-Minute Timed Writings after basic instruction than will students using the Sholes keyboard.

2. Students using Dvorak and Sholes keyboards do equally well on 3-Minute Timed Writings after basic instruction.

4. The Tapping Test scores will predict typewriting skill development for Dvorak keyboard trainees but will not for Sholes keyboard trainees.

Recommendations from the Study

The following recommendations are made based on the difficulties encountered and cost encumbrances noted by the researcher:

1. Manufacturers of typewriting equipment who already manufacture Dvorak keyboards should make this fact a part of their advertised product line.

2. A period of a year to five years should be utilized for study to determine whether differences widen or narrow between the Dvorak and Sholes operators.

3. A larger keyboard-operator population should be used to substantiate further the results of Dvorak keyboard training.

Recommendations for Future Research

The following recommendations are made for future study:

1. Future studies should address true beginners utilizing the same training procedures--multi-channeled audio synchronized taped instruction simultaneously taught--to substantiate the research findings.

2. Studies should be undertaken which involve the AMS Dvorak keyboard arrangement which has the top-row keys the same as QWERTY. The AMS element was not available for this research.

3. With the introduction of the interchangeable keyboards via a switch by the Olivetti Corporation, studies should now be undertaken

to determine whether the switch has an advantage over removing and replacing the element as with the IBM and Remington typewriters.

4. Follow-up studies of former Dvorak trainees should be undertaken to see what difficulties, if any, they have encountered, whether or not they are still Dvorak proteges, if Dvorak advantages and/or disadvantages are holding true, and whether new advantages and/or disadvantages have become evident.

BIBLIOGRAPHY

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Books

Dvorak, August, Nellie L. Merrick, Gertrude Catherine Ford, and William L. Dealey. Scientific Typewriting. Standard Keyboard Edition. New York, Cincinnati, Chicago, Boston, Atlanta, Dallas and San Francisco: American Book Company, 1949.

_____. Typewriting Behavior. New York: American Book Company, 1936.

Gilbreth, Frank B. and Lillian M. Gilbreth. Scientific Management Course. Easton, Pennsylvania: Hive Publications, 1912.

Hoke, R. E. The Improvement of Speed and Accuracy in Typewriting. Baltimore: John Hopkins Press, 1922.

Lessenberry, D. D., S. J. Wanous, C. H. Duncan and S. E. Warner. College Typewriting Complete Course. Ninth Edition. Cincinnati: South-Western Publishing Co., 1975.

_____. College Typewriting Manual for Placement and Achievement Tests. Cincinnati: South-Western Publishing Co., 1975.

McWhirter, Norris and Ross McWhirter. Guinness Book of World Records. Fifteenth Edition. New York: Sterling Publishing Company, Inc., 1977.

Snedecor, George W. Statistical Methods. Ames: The Iowa State University Press, 1966.

Wanous, S. J. Personal and Professional Typing Manual. Cincinnati: South-Western Publishing Co., 1962.

Periodicals

Boyd, Waldo. "Q W E R T Y U I O P ? * ! ?." Writer's Digest. 51 (February, 1971).

Davis, D. W. "An Evaluation of the 'Simplified' Typewriter Keyboard." Journal of Business Education. (May, June, September and October, 1935).

Periodicals, Cont'd.

Davis, Philip. Quick Strokes. Volume III, Number 4, Whole Number 9 (Winter, 1976).

Dvorak, August. "There is a Better Typewriter Keyboard." The National Business Education Quarterly. (December, 1943).

Dvorak, August and G. C. Fird. "Typewriting Demons." Journal of Business Education. (May, 1932).

Flanagan, John C. and Grace Fivars. "The Tapping Test--A New Tool to Predict Aptitude for Typewriting." The Delta Pi Epsilon Journal. (1964).

Frantz, Doug. "Could You Learn to Love This Keyboard?" Cosmopolitan. 180 (February, 1976).

Langford, Thomas E. "Effect of Three Practice Strategies Upon Chaining, Speed, and Accuracy in Typewriting." The Balance Sheet. (November, 1971).

Lekberg, Charles. "The Tyranny of QWERTY." Saturday Review. (September 30, 1972).

Robinson, Jerry W. "An Idea Whose Time Has Come Again?" Century 21 Reporter. (Spring, 1975).

"The Weak Spot in an EDP System." Data Processing Digest. 17 (February, 1976).

Newspapers

Culkin, John. "QWERTY and Beyond." The New York Times. March 15, 1978.

McCauley, Robert. "Typist, 12, Amazes Experts as She Uses New Keyboard." Toronto Daily Star. Friday, April 2, 1971.

Wales, Arthur P. "Ignored Typewriter Plan Gains Interest." The Knoxville News. Sunday, March 30, 1975, B-5.

Publications of Learned Organizations and Societies

Dvorak, August. "A Comparison of Typist Improvement from Training on the Standard Keyboard and Retraining on the Simplified Keyboard." Training Section, Department Services, Division of Shore Establishments and Civilian Personnel, Navy Department, Washington, D. C. (A Supplement to the Aftmentioned Experiment, 18 October 1944).

Publications of Learned Organizations and Societies, Cont'd.

Dvorak, August. "A Practical Experiment in Simplified Keyboard Retraining." (A Report of the Retraining of Fourteen Standard Keyboard Typists on the Simplified Keyboard, Navy Department, Washington, D. C., July, 1944).

Stivers, C. L. "Experience in Retraining on the Dvorak Keyboard." American Management Association. (April, 1941).

Series

Long, N. C. "An Experiment with the Relative Efficiency of Various Methods of Teaching the Typewriter Keyboard." Monographs in Education. First Series No. II. Research Studies in Commercial Education. Volume IV. (University of Iowa, 1929).

Unpublished Materials

Lessley, Brad. "Keyboard Retraining: QWERTY to Dvorak." (Unpublished Doctoral Dissertation, Oregon State University, Corvallis, 1978).

Riemer, Edwin. "A Revised Keyboard for the Typewriter." (Unpublished Master's Thesis, New York University, 1929).

APPENDIXES

APPENDIX A

STUDENT ORIENTATION MATERIALS

STUDENT QUESTIONNAIRE

Name_____ Sex: Male____ Female_____

Classification_____ Residence Hall_____

- -

1. Read carefully all four of the statements below; then check the one statement that applies to you.

   _____ I have been formally taught typewriting.

   _____ I taught myself to type without looking at the keys.

   _____ I taught myself to type "hunt and peck" with a few fingers, looking at the keys.

   _____ I do not know how to type and have had no formal typewriting training.

2. Do you have a typewriter at home? Yes_____ No_____

3. Read carefully and select one statement that applies to you.

   _____ I would like to learn to type.

   _____ I already know how to type.

   _____ I don't care much one way or the other about learning to type.

   _____ I am not opposed to learning to type.

4. How could typewriting be of benefit to you? Check as many as apply.

   _____ Personally.

   _____ Professionally.

   _____ Academically.

CLASSROOM EXPLANATION

I am, Esther Gill, your instructor for this course in beginning typewriting. You and I will be involved in an experimental project this quarter involving two keyboard arrangements (the experimental DVORAK and the conventional SHOLES). Each of you must be a true beginner having had no previous formal typewriting training in order to be included in this study.

I would like for you to participate in my research project as well as learn to type. If you are presently at least 18 years of age, you may indicate your choice to participate in the research project by signing an "Informed Consent" Form which I will provide for you. If you are under 18 years of age, you must receive permission from your legal parent or guardian to participate in this research project. I will provide you with this form also. One of the two forms must be signed and returned to me within seven days before you can formally participate in this research project. (Hand out "Informed Consent" Forms and collect signed forms.)

(Hand out DVORAK and SHOLES Advantages and Disadvantages sheets.) Read with me the advantages and disadvantages of the two keyboard arrangements before you decide which arrangement you would prefer for your training.

Are there any questions? (Pause and answer any questions.)

(Hand out Keyboard Arrangement Preference Forms.)

(Collect Keyboard Arrangement Preference Forms.)

Thank you for your interest and help.

ORIENTATION LETTER TO PARENTS

(To be given to each volunteer at the oral presentation who is under 18 years of age. This statement must be taken home for the parents to read and sign.)

(Current Date)

Dear Parent or Guardian:

I am a graduate student in Business Education at The University of Tennessee and an assistant professor at Oakwood College and am conducting a research project in typewriting this quarter. I have asked all students enrolled in beginning college typing who have had no formal typing instruction to participate in this project.

My interests focus on the effect of two keyboard arrangements on typewriting skill acquisition. The findings will be used to improve instruction in typewriting skill acquisition.

Participants will volunteer to use the experimental DVORAK keyboard arrangement or the conventional SHOLES keyboard arrangement. The participants who volunteer and complete the quarter using the experimental DVORAK keyboard will receive a DVORAK element valued at $65 which is interchangeable on the IBM Selectric or the Remington electric typewriters. Individual skill achievement identities will be kept strictly confidential.

No one is obligated in any way to participate in this research project. Participation is solely on a volunteer basis and the student may withdraw at any time during the project.

If you have any questions about the project, you may reach me by phone at (205) 837-1630, Extension 272. If I am not available, please leave a message and I will get in touch with you as soon as possible.

If you are willing for your (son or daughter) to participate, please sign the attached consent form and have you (son or daughter) return it to me within seven days.

Thank you for your interest and help.

Sincerely yours,

Enclosure

Esther Naomi Gill

INFORMED CONSENT FORM[a]

Project: A Comparison of Two Typewriter Keyboards--DVORAK and SHOLES

Researcher: Esther Naomi Gill, Graduate Student
Vocational-Technical Education
The University of Tennessee, Knoxville

I have been informed of the following objectives and procedures of this research project:

(1) To determine the effects of the DVORAK keyboard arrangement upon skill development in beginning typewriting taught at the college level.

(2) To compare terminal gross words per minute on straight-copy timed writings of college beginning typists using SHOLES keyboards with college beginning typists using DVORAK keyboards.

(3) To compare terminal accuracy attained on 3-minute timed writings of beginning college typists using SHOLES keyboards with beginning college typists using DVORAK keyboards.

(4) To examine the typewriting skill predictive reliance (dependability) of the Tapping Test by its use in pretesting beginning college typing students as compared with their terminal skill acquisition.

(5) To measure and compare skill acquisition in production typing of rough drafts, tabulations, vertically and horizontally centered announcements, and enumerations of beginning college typists using SHOLES keyboards with beginning college typists using DVORAK keyboards.

I understand that my (son's or daughter's) achievements will be reported on as totally anonymous. I understand that my (son's or daughter's) participation in this project is solely on a volunteer basis, and (he or she) is under no obligation to participate. (He or She) may withdraw (his or her) participation at any time. Participation in the project will not prejudice my (son's or daughter's) grade in any way or the credit (he or she) will receive for having taken beginning college typewriting.

My (son or daughter)_____has my permission to participate in this study.

Signature of Parent or Guardian:_____

Date: _____

---

[a]For those participants under 18 years of age.

INFORMED CONSENT FORM[b]

Project: A Comparison of Two Typewriter Keyboards--DVORAK and SHOLES

Researcher: Esther Naomi Gill, Graduate Student
Vocational-Technical Education
The University of Tennessee, Knoxville

I hereby certify that I am 18 years of age or older, and have been informed of the following objectives and procedures of this research project:

(1) To determine the effects of the DVORAK keyboard arrangement upon skill development in beginning typewriting taught at the college level.

(2) To compare terminal gross words per minute on straight-copy timed writings of college beginning typists using SHOLES keyboards with college beginning typists using DVORAK keyboards.

(3) To compare terminal accuracy attained on 3-minute timed writings of beginning college typists using SHOLES keyboards with college beginning typists using DVORAK keyboards.

(4) To examine the typewriting skill predictive reliance (dependability) of the Tapping Test by its use in pretesting beginning college typing students as compared with their terminal skill acquisition.

(5) To measure and compare skill acquisition in production typing of rough drafts, tabulations, vertically and horizontally centered announcements, and enumerations of beginning college typists using SHOLES keyboards with beginning college typists using DVORAK keyboards.

I understand that my accuracy, speed, and production typewriting achievements in this class will be reported as totally anonymous in this research project. I understand that my participation is solely on a volunteer basis and that I am under no obligation to participate. There is no penalty for not participating. I may withdraw my participation at any time. I cannot switch from the DVORAK (experimental) keyboard to the SHOLES (conventional) keyboard or vice versa during the quarter in which the project is being conducted. If I am part of the group completing the quarter on the DVORAK typewriter, I understand that I will receive the DVORAK element valued at $65.

Signed: _____

Date: _____

---

[b]For those participants 18 years of age or older.

DVORAK KEYBOARD ARRANGEMENT ADVANTAGES AND DISADVANTAGES

Advantages:

1. Reduces Fatigue--Average typist speeds his/her fingers over the keyboard only 1 mile in an 8-hour day.

2. Cuts training time in half--typists can learn from scratch on the DSK to type 50 to 100 words per minute in six months to a year.

3. Scientifically arranged ("human-engineered" to fit the writing machine to the to the natural capabilities of human fingers).

4. Seventy percent of all typing can be done without moving the hands from the "home row"--where fingers rest when not typing.

5. Speed alone is not the chief virtue of the DSK. Accuracy is also important, and the importance of fast, accurate typing cannot be overlooked.

6. The lefthand stroking load is decreased to 45 percent and the right hand assumes 54 percent of the load thus more closely approaching hand efficiencies.

7. Over 3,000 commonly used English words can be typed on the "home row."

Disadvantages:

1. Schools do not teach DSK because graduates into the business world find standard (SHOLES) keyboard typewriters only.

2. It is impossible to learn and use both keyboards interchangeably.

3. Manufacturers sell but do not advertise the fact that they make DSK's at these rates: Smith-Corona - $15, Royal - $20, IBM - $40, and Remington at no additional charge.

4. Only two manufacturers produce an interchangeable DSK element which fits the IBM Selectric and Remington typewriters thus making them usable by both DSK and and standard keyboard typists.

SHOLES KEYBOARD ARRANGEMENT ADVANTAGES AND DISADVANTAGES

Advantages:

1. Typists can achieve 100 words per minute on standard electric machines, so why try to go faster.

2. Most manufacturers, Government offices, industries and schools make, use, and/or teach this keyboard.

Disadvantages:

1. Unscientific arrangement designed to be awkward in order to slow typing and thus prevent key jamming on old gravity returning keys.

2. Sholes keyboard is lefthanded while most people are right-handed and have more agility and strength in their right hands. The left hand performs 56 percent of all stroking while the right hand performs only 44 percent.

3. It overworks certain fingers and underworks others out of all proportion to their abilities.

4. Fingers have to jump around too much on the standard keyboard, resulting in must wasted motion and fatigue. In a typical 8-hour day, the average typist speeds his/her fingers over the keyboard a total of 20 miles.

5. One hundred fifty commonly used English words can be typed on the "home row." Only 32 percent of all typing can be done without moving the hands from the "home row."

6. It takes between two and three full years--often more--to acquire a relative degree of skill mastery.

7. Over 3,000 entire words are typed by the left hand alone, with another 300 being typed only by the right hand.

KEYBOARD ARRANGEMENT PREFERENCE FORM

I prefer to be trained to type utilizing the (circle one DVORAK or SHOLES in the space provided):

DVORAK (EXPERIMENTAL) KEYBOARD ARRANGEMENT

OR

SHOLES (TRADITIONAL) KEYBOARD ARRANGEMENT

SIGNATURE:_____ DATE:_____

APPENDIX B

SAMPLE DVORAK AND SHOLES LESSONS

SAMPLE DVORAK LESSON

LESSON 2 | 2A • GET READY TO TYPE

(for each lesson in this section)

1 Clear the desk of unneeded books and papers; then place this book at the right of the typewriter with the top elevated slightly for easier, more accurate reading.

2 Have the front of the typewriter frame even with the edge of the desk or table.

3 Adjust the paper guide and paper-bail rolls as directed on pages vi and 1.

4 Have a full-size sheet of paper on the desk at the left of the typewriter, turned so the long side of the paper is close to you.

5 Insert the paper. (Review the steps on page 1.)

6 Set the line-space regulator on "1" for single spacing.

7 Set the left margin stop 25 spaces to the left of the center of the paper so that your work will be centered horizontally. Move the right margin stop to the end of the scale (see page 2); you will be taught its use later.

Note the numbers on the margin scale 11 at which the stops are set and use the same settings for the remaining lessons of this section.

8 Take correct position at the typewriter—body erect; feet on the floor; fingers curved; wrists low; elbows near the body.

9 Review the typing techniques: quick, sharp stroking; quick, smooth carriage return;. down-and-in space-bar motion.

10 Begin to type at a slow, even pace. Increase your rate of stroking gradually. Type steadily—keep the carriage moving without pauses. Striking and releasing a key should be thought of as one motion with the release motion started almost at the same instant as the downward motion of the finger.

2B • KNOW YOUR TYPEWRITER

TYPEWRITER SPACING

If your typewriter has elite type, you can type 12 spaces to a horizontal inch; if it has pica type, 10 spaces. Note the difference between elite and pica type in the illustration at the right.

```
Elite type has 12 type spaces to an inch.
|1|2|3|4|
Pica type has 10 type spaces to an inch.
```

PAPER SIZE

Paper used for typing is usually 8½ inches wide. Thus, there are 102 elite spaces or 85 pica spaces in a full line 8½ inches long. The center of the paper, therefore, is 51 for elite type or 42 for pica type.

Tryout Practice. Type the words **she has a sled** and compare the type with that shown above to determine whether your typewriter has elite or pica type. You will need this information later when setting stops for exact margins.

• Operate the carriage return lever or key three times to provide extra space between drills; then type the following Preparatory Practice.

2C • PREPARATORY PRACTICE

PROCEDURE Type the copy as shown. Double-space after the second typing of the line. Begin the new line immediately. *To double-space when the line-space regulator is set for single spacing*, operate the carriage return lever or key twice as you return the carriage after the second typing of the line.

Curve the fingers

```
uu hh ee tt oo nn aa ss dd dh ll ls dl dl ls dh dl
uu hh ee tt oo nn aa ss dd dh ll ls dl dl ls dh dl
```

• Double-space (to leave 1 blank line space)

Space quickly with right thumb

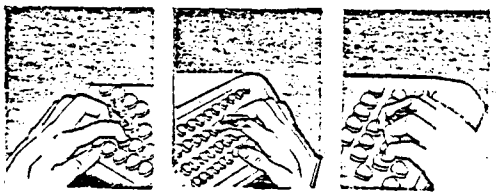
```
de she led led eel sell she shall shall dull shade
de she led led eel sell she shall shall dull shade

de shale sale leads she sells loads dee had a sled
de shale sale leads she sells loads dee had a sled
```

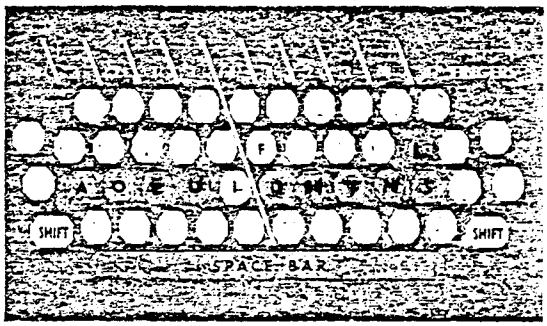
Return carriage without spacing after final stroke in line

2D • NEW KEYS: i, f, and . (period)

PROCEDURE Use the four-step procedure for learning the new keys, page 3.



I F (Period)



1. REACH TECHNIQUE FOR I

Relax the curvature of *left first finger* and move the finger to the right to type i without moving the other fingers from typing position. Watch your finger type iu a few times.

Tryout Practice. Type the following drill twice on one line.

iu is iu is in it did did

2. REACH TECHNIQUE FOR F

Straighten the *right first finger* slightly and move it up to type f without arching the wrist or moving the other fingers from their typing position. Watch your finger type fh a few times.

Tryout Practice. Type the following drill twice on one line.

hf fee if fad hf fee fled

3. REACH TECHNIQUE FOR . (Period)

As you move the *left second finger* up to type ., lift the *left first finger* slightly to free the controlling finger. Watch your finger type .e a few times; then type the following Tryout Practice.

Tryout Practice. Type the drill twice on the same line; then return the carriage.

ee .e .e ee .e .e e.e e.e

2E • STROKING TECHNIQUE PRACTICE

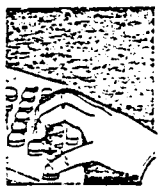
PROCEDURE Operate the carriage return lever or key three times to have two blank line spaces before typing the following drill. Then type the drill lines as shown.

TECHNIQUE CONDITIONER: **Quiet Hands and Arms** When striking a key, use finger action with as little arm motion as possible. Hold the hands and arms quiet, almost motionless.

1	Reach to	if if is did did aid laid is his did did laid laid	Return carriage quickly without spacing after final stroke in line
2	i and f; do not move	if if is did did aid laid is his did did laid laid	
	• Double-space (to leave 1 blank line space)		
3	hand forward	hf fee hf fade fade flat fled flat fee flash flash	
4		hf fee hf fade fade flat fled flat fee flash flash	
5	Curve the	it is a noise this is a hit he said this is a hint	Feet on floor
6	fingers	it is a noise this is a hit he said this is a hint	
7		she said this is the suede she needs as it is less	Use finger action when striking key
8	Hold elbow in position	she said this is the suede she needs as it is less	
9	as you reach	ee .e it .e fit .e this .e list .e fist .e lift .e	
10	to .	ee .e it .e fit .e this .e list .e fist .e lift .e	

2F • SHIFTING FOR CAPITALS: Left Shift Key

To type a capital letter controlled by a finger of the right hand, as H, depress left shift key 28 with the *left fourth (little) finger* without moving the other fingers from typing position. Hold shift key down until the key for the capital has been *struck and released*; then release shift key and return the finger to typing position quickly.



Tryout Practice. Study the illustration; then watch your left hand to see that it does not move out of position as you type **Hal** three times: **Hal Hal Hal** Now type the following sentence.

Hal Hall said Ned filed the list.

2G • CONTINUITY PRACTICE

PROCEDURE Operate the carriage return lever or key three times to have two blank line spaces before typing the drill given below. Type the lines as shown.

TECHNIQUE CONDITIONER: Curved Fingers Keep each finger curved and in its home-key position except when it makes a reach-stroke; then extend the controlling finger (relaxing the curvature only as much as you must to reach to the center of the key). Do not move the hand up or down.

SPACING RULE Space twice after a period at the end of a sentence, except when the period comes at the end of the line of writing; then do not space, but return the carriage immediately and begin the new line without a pause.

• All keyboard characters taught are used in this practice.

1	Space twice after .	Hal did this list. Flo has the last list Hal did.	Return without spacing after . at line end
2		Hal did this list. Flo has the last list Hal did.	
3		Lee said that Ted is still at the lane Tess is ill	
4		Lee said that Ted is still at the lane Tess is ill	
5	Shift firmly with the little finger	She said that Ted had failed the last test he had.	
6		She said that Ted had failed the last test he had.	Use finger action—keep hands and arms quiet
7		Neda said that this is the last list Hal Hale did.	
8		Neda said that this is the last list Hal Hale did.	

2H • SELF-IMPROVEMENT PRACTICE *(each line twice, as shown)*

• All letters taught are used in this practice.

1	Curve your fingers	Seth edits this file list. He had it at the tide.
2		Seth edits this file list. He had it at the tide.
3	Space twice after .	Dinah Hall is still at the lane. He has the file.
4		Dinah Hall is still at the lane. He has the file.
5	Space quickly with the right thumb	Sid said that this is the last list that Nina did.
6		Sid said that this is the last list that Nina did.

SAMPLE SHOLES LESSON

LESSON 2 | 2A • GET READY TO TYPE

(for each lesson in this section)

1 Clear the desk of unneeded books and papers; then place this book at the right of the typewriter with the top elevated slightly for easier, more accurate reading.

2 Have the front of the typewriter frame even with the edge of the desk or table.

3 Adjust the paper guide and paper-bail rolls as directed on pages vi and 1.

4 Have a full-size sheet of paper on the desk at the left of the typewriter, turned so the long side of the paper is close to you.

5 Insert the paper. (Review the steps on page 1.)

6 Set the line-space regulator on "1" for single spacing.

7 Set the left margin stop 25 spaces to the left of the center of the paper so that your work will be centered horizontally. Move the right margin stop to the end of the scale (see page 2); you will be taught its use later.

Note the numbers on the margin scale 11 at which the stops are set and use the same settings for the remaining lessons of this section.

8 Take correct position at the typewriter—body erect; feet on the floor; fingers curved; wrists low; elbows near the body.

9 Review the typing techniques: quick, sharp stroking; quick, smooth carriage return; down-and-in space-bar motion.

10 Begin to type at a slow, even pace. Increase your rate of stroking gradually. Type steadily—keep the carriage moving without pauses. Striking and releasing a key should be thought of as one motion with the release motion started almost at the same instant as the downward motion of the finger.

2B • KNOW YOUR TYPEWRITER

TYPEWRITER SPACING

If your typewriter has elite type, you can type 12 spaces to a horizontal inch; if it has pica type, 10 spaces. Note the difference between elite and pica type in the illustration at the right.

Elite type has 12 type spaces to an inch.



Pica type has 10 type spaces to an inch.

PAPER SIZE

Paper used for typing is usually 8½ inches wide. Thus, there are 102 elite spaces or 85 pica spaces in a full line 8½ inches long. The center of the paper, therefore, is 51 for elite type or 42 for pica type.

Tryout Practice. Type the words **she has a sled** and compare the type with that shown above to determine whether your typewriter has elite or pica type. You will need this information later when setting stops for exact margins.

• Operate the carriage return lever or key three times to provide extra space between drills; then type the following Preparatory Practice.

2C • PREPARATORY PRACTICE

PROCEDURE Type the copy as shown. Double-space after the second typing of the line. Begin the new line immediately. *To double-space when the line-space regulator is set for single spacing*, operate the carriage return lever or key twice as you return the carriage after the second typing of the line.

Curve the fingers

```
ff jj dd kk ss ll aa ;; hh hj ee ed he he ed hj he
ff jj dd kk ss ll aa ;; hh hj ee ed he he ed hj he
```

• Double-space (to leave 1 blank line space)

Space quickly with right thumb

```
he she she led elf self she shelf shelf lake shake
he she she led elf self she shelf shelf lake shake
```

Return carriage without spacing after final stroke in line

Space once after ;

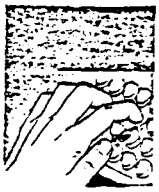
```
he fled; she leads; she sells jade; he has a sled;
he fled; she leads; she sells jade; he has a sled;
```

2D • NEW KEYS: i, t, and . (period)

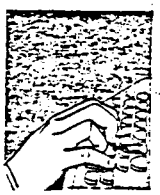
PROCEDURE Use the four-step procedure for learning the new keys, page 3.



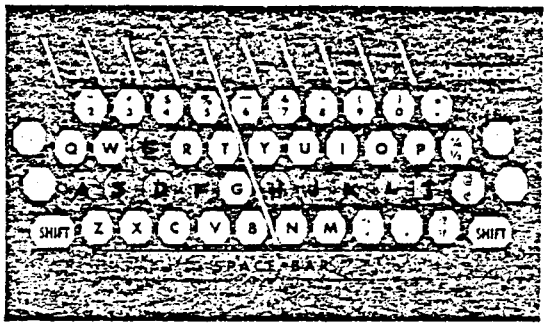
I



T



(Period)



1. REACH TECHNIQUE FOR i

As you move the *right second finger* up to type i, lift the *right first finger* to give freedom of movement to the controlling finger. Type ik a few times: then type the following Tryout Practice.

Tryout Practice. Type the following drill twice on one line.

```
ik if ik is if is did did
```

2. REACH TECHNIQUE FOR t

Relax the curvature in the *left first finger* and move the finger up to t without arching the wrist or moving the hand forward. Type tf a few times: then type the following Tryout Practice.

Tryout Practice. Type the following drill twice on one line.

```
tf the tf the tf the that
```

3. REACH TECHNIQUE FOR . (Period)

As you reach the *right third finger* down to type . (period), extend the finger without moving the hand downward. Type .l a few times; then type the following Tryout Practice.

Tryout Practice. Type the following drill twice on one line.

```
ll .l .l ll .l .l l.l l.l
```

2E • STROKING TECHNIQUE PRACTICE

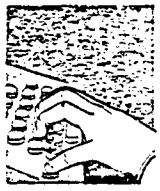
PROCEDURE Operate the carriage return lever or key three times to have two blank line spaces before typing the following drill. Then type the drill lines as shown.

TECHNIQUE CONDITIONER: **Quiet Hands and Arms** When striking a key, use finger action with as little arm motion as possible. Hold the hands and arms quiet, almost motionless.

1	Reach to	if if is did did aid laid is his did did laid laid	Return carriage quickly without spacing after final stroke in line
2	i and t; do not move	if if is did did aid laid is his did did laid laid	
	• Double-space (to leave 1 blank line space)		
3	hand forward	tf the tf that that flat that flat the these these	
4		tf the tf that that flat that flat the these these	
5	Curve the	it is a fit; this is a hit; he said this is a hit;	Feet on floor
6	fingers	it is a fit; this is a hit; he said this is a hit;	
7		she said this is the jade she likes as it is less;	Use finger action when striking key
8	Hold elbow in position	she said this is the jade she likes as it is less;	
9	as you reach	ll .l it .l fit .l this .l list .l fist .l lift .l	
10	to .	ll .l it .l fit .l this .l list .l fist .l lift .l	

2F • SHIFTING FOR CAPITALS: Left Shift Key

To type a capital letter controlled by a finger of the right hand, as H, depress left shift key 28 with the *left fourth (little) finger* without moving the other fingers from typing position. Hold shift key down until the key for the capital has been *struck and released*; then release shift key and return the finger to typing position quickly.



Tryout Practice. Study the illustration; then watch your left hand to see that it does not move out of position as you type **Hal** three times: **Hal Hal Hal** Now type the following sentence.

Hal Hall said Kit filed the list.

2G • CONTINUITY PRACTICE

PROCEDURE Operate the carriage return lever or key three times to have two blank line spaces before typing the drill given below. Type the lines as shown.

TECHNIQUE CONDITIONER: Curved Fingers Keep each finger curved and in its home-key position except when it makes a reach-stroke; then extend the controlling finger (relaxing the curvature only as much as you must to reach to the center of the key). Do not move the hand up or down.

SPACING RULE Space twice after a period at the end of a sentence, except when the period comes at the end of the line of writing; then do not space, but return the carriage immediately and begin the new line without a pause.

• All keyboard characters taught are used in this practice.

1	Space twice after .	Hal did this list. Kit has the last list Hal did.	Return without spacing after . at line end
2		Hal did this list. Kit has the last list Hal did.	
3	Space once after ;	Lee said that Jed is still at the lake; he is ill.	
4		Lee said that Jed is still at the lake; he is ill.	
5	Shift firmly with the little finger	I said that I had failed the last test that I had.	
6		I said that I had failed the last test that I had.	Use finger action—keep hands and arms quiet
7		Jake said that this is the last list Hal Hale did.	
8		Jake said that this is the last list Hal Hale did.	

2H • SELF-IMPROVEMENT PRACTICE *(each line twice, as shown)*

• All letters taught are used in this practice.

1	Curve your fingers	Jeff likes this file desk. He had it at the lake.	Reach—don't lean—to j and f
2		Jeff likes this file desk. He had it at the lake.	
3	Space twice after .	Keith Hall is still at the lake. He has the file.	
4		Keith Hall is still at the lake. He has the file.	
5	Space quickly with the right thumb	Kit said that this is the last list that Jeff did.	
6		Kit said that this is the last list that Jeff did.	

APPENDIX C

SAMPLE TESTS

TYPEWRITING QUIZ - Machine Parts NAME_____

MATCHING: Match the letter of the correct part with its correct definition:

1. The n holds the paper firmly against the cylinder.
2. The v indicates that a line is nearly completed.
3. The j regulates the space between lines.
4. The k is used to regulate the length of lines.
5. The r is used before beginning another line of typing.
6. The o guides the left edge of the paper into the machine.
7. The t is used to write in solid capital letters.
8. The a is used to bring the carriage back one space at a time or continuously if depressed.
9. The u moves the carriage ahead one space at a time or continuously if depressed.
10. The d has paper rolled around it while in the machine, also a key cushion.
11. The s is used to make capital letters.
12. The f is used for measuring the length of typewritten lines for setting margins.
13. The l permits writing outside the margins without changing or readjusting margins.
14. The h is the beginning position in which hands are placed for typing.
15. The p is used to insert paper into and to remove the paper from the machine.
16. The b is used for straightening paper and aligning typewriting as well as for holding odd sizes of paper in the typewriter.
17. The m enables you to determine your bottom margin.
18. The i is used for superior and subscript typing, and in aligning.
19. The q lets one know at what point he or she is typing.

a Backspace
b Card & Envelope Holder
c Carriage
d Cylinder
e Cylinder Knobs
f Front Scale
g Keyboard
h Home-Row Keys
i Line Finder
j Line-Space Regulator
k Margin Sets or Stops
l Margin Release
m Paper-End Indicator
n Paper Bail & Clamps
o Paper-Edge Guide
p Paper Release
q Printing-Point Indicator
r Return Key
s Shift Keys
t Shift Lock
u Space Bar
v Warning Bell

TYPING QUIZ - Punctuation Spacing & Margin Setting

TRUE OR FALSE: For each of the following circle the T if the statement is True and F if it is False:

T F 1. The average sheet of typing paper is 8 1/2 inches by 11 inches.

T F 2. The center of a PICA machine is 50 or 51.

T F 3. Since typing is a skill, anybody can learn to type well.

T F 4. More people take typing than any other course except English.

T F 5. Two causes of typing mistakes are poor posture and excessive pushing for speed.

COMPLETION: For each of the following questions, fill in the correct answer in the blanks provided:

6. The center of an ELITE machine is 50 or 51.

7. You may type 10 strokes per inch on a PICA machine and 12 strokes per inch on an ELITE machine.

8. The front scale of an ELITE machine is from 0 to 102 and for PICA, from 0 to 85.

9. PICA type is (large, small) type; while ELITE type is (large, small).

10. What are the margin sets (left and right) for a 4-inch line of a PICA machine?

Left 22 Right 62

11. What are the margin sets (left and right) for a 5-inch ELITE line?

Left 20 or 21 Right 80 or 81

12. What are the margin sets (left and right) for a 3½-inch line for both PICA and ELITE machines?

PICA Left 25 PICA Right 60

ELITE Left 29 or 30 ELITE Right 71 or 72

13. Figure out the following margin sets for an ELITE machine for a 70-stroke line:

Left 15 or 16 RIGHT 85 or 86

14. Figure out the following margin sets for a PICA machine: 60-stroke line.

Left 12 Right 72

15. Figure out the margin sets for a 65-stroke line for PICA and ELITE.

PICA Left 20 PICA Right 75

ELITE Left 18 or 19 ELITE Right 83 or 84

ELEMENTARY TYPEWRITING

QUIZ - Numbers and Special-Characters' Spacing

NAME_____

- -

MULTIPLE CHOICE QUESTIONS: Circle the letter of the correct answer for each of the following questions:

1. After a semicolon, except at the end of a line (a) space once, (b) space twice, (c) do not space.
2. Between the figure and the symbol # (a) space once, (b) space twice, (c) do not space.
3. After a question mark at the end of a sentence, except at the end of a line (a) space once, (b) space twice, (c) do not space.
4. After a comma, except at the end of a line (a) space once, (b) space twice, (c) do not space.
5. After a hyphen or dash, except at the end of a line (a) space once, (b) space twice, (c) do not space.
6. After an exclamation point, except at the end of a line (a) space once, (b) space twice, (c) do not space
7. Before and after a plus sign (a) space once, (b) space twice, (c) do not space.
8. Before and after an apostrophe (a) space once, (b) space twice, (c) do not space.
9. Before and after a slash (a) space once, (b) space twice, (c) do not space.
10. Between a figure and ½ (one half) or ¼ (one fourth) (a) space once, (b) space twice, (c) do not space.
11. Between a whole number and the fraction 1/8 or 5/6 (a) space once, (b) space twice, (c) do not space.
12. Before and after an asterisk (a) space once, (b) space twice, (c) do not space.
13. Between the figure and the symbol % (a) space once, (b) space twice, (c) do not space.
14. Before and after the quotation marks (a) space once, (b) space twice, (c) do not space.
15. Between the quotation marks and the direct quote (a) space once, (b) space twice, (c) do not space.
16. After the colon, except at the end of a line or salutation (a) space once, (b) space twice, (c) do not space.
17. Between the figure and the symbol ¢ (a) space once, (b) space twice, (c) do not space.
18. Before and after the equals sign (=) (a) space once, (b) space twice, (c) do not space.
19. Between the number and the symbol @ (a) space once, (b) space twice, (c) do not space.
20. Between the parentheses and the enclosed words or word (a) space once, (b) space twice, (c) do not space.
21. Between the dollar sign and the figure (a) space once, (b) space twice, (c) do not space.
22. The # sign (precedes, follows) the figure when it represents number and (precedes, follows) the figure when it represents pounds.

PRODUCTION TEST 1 - Tab Mechanism and Carriage Return (Type twice as shown - 10 minutes)

Procedure for Setting Tab Stops:

1. Clear all tab stops.
2. From Column 2, set a tab stop 5 spaces from end of first column.
3. From Column 3, set a tab stop 5 spaces from end of second column.
4. Set stops for remaining columns in similar manner.

60-stroke line, 8 columns (5 spaces between)

but	old	the	cut	got	rot	tub	map
but	old	the	cut	got	rot	tub	map
big	top	aid	fit	ham	pen	for	due
big	top	aid	fit	ham	pen	for	due
all	see	too	add	you	saw	him	lop
all	see	too	add	you	saw	him	lop
555	551	755	155	757	175	157	751
555	551	755	155	757	175	157	751
999	991	933	391	939	193	139	937
999	991	933	391	939	193	139	937
159	957	195	395	591	937	175	593
159	957	195	395	591	937	175	593
sum	775	hot	595	buy	715	cot	539
sum	775	hot	595	buy	715	cot	539
old	993	use	379	ton	795	rob	591
old	993	use	379	ton	795	rob	591
too	995	see	337	you	793	top	951
too	995	see	337	you	793	top	951

PRODUCTION TEST 2 - Memorandum on the Block Style

Procedure: Insert the half sheet to the first line space at the top of the page; then space forward 9 times and type the current date on Line 10 (for a 1½-inch top margin).

1. Type the memorandum with 4 blank line spaces between the date and subject.

2. Type the memorandum a second time as a 3-minute writing, beginning with the date.

Materials Needed: 2 half sheets of paper, 50-space line, single spacing, 1½-inch top margin, and current date.

Current Date (Operate carriage return 5 times) 3

Use single spacing with the block style and begin 13
all lines at the left margin. In this lesson you 23
are to type the problem with a 50-space line, but 33
other line lengths may be used for later problems. 43

At a later time, you will be taught how to divide 53
words at the end of lines; then you can type copy 63
with a line length that is not the same as in the 73
book. A line that is three to five spaces longer 83
or shorter than other lines should look all right. 93

....1....2....3....4....5....6....7....8....9...10

PRODUCTION TEST 3 - Rough Draft

Type the following paragraphs from typewritten, handwritten, and copy correct script. (60-space line, DS, 5 paragraph indention.) (5 minutes)

The purpose of business letters are many and varied. 2

Letters are used to seek or inform, to direct or explain, to 4

gain or retain goodwill--to name only a few functions. Their 7

value is great; the cost is vital, too. 8

The biggest factor in letter cost is labor. Reduce the 10

cost of this human factor — increase the production of the one 12

who dictates and the one who makes notes and types — and you 15

reduce a major cost of writing letters. 16

It An ~~excellent method~~ easy way to cut cost is to write ~~sounder~~ shorter letters. 18

many are loaded with dry, usless phrases. Study one 21

example: ~~Please~~ Kindly be advised that ~~that~~ the copy was put in to the 23

~~mails~~ mail today. ~~Now~~ how about: we send the letter to day? 25

/ 1 / 2 /....1....2

PRODUCTION TEST 4

Directions: Type one copy (corrected) of each of the following sentences utilizing a 60-stroke line and double spacing, and a top margin of 28 lines. (5 Minutes)

here is book let giving you somefacts about c a r insurance.

Use quick light, sure strokes to build usable typing skill.

The handwriting on wall is often unheeded by mostof us.

It is easier to deside ona risk then is it to live withit.

with out question, theworst boss can we has bad habit.

PRODUCTION TEST 5 - Horizontally Centered Announcement

DS; begin on Line 10; center each line horizontally; and correct copy. (10 minutes)

ALMOND SON'S
IS TS
Present
Proud to ~~Announce~~
Felix de Vega Couture Collections
Exciting, Beautiful Fash~~iongs~~ ions
Wednesday 27 October , Exotic
Sunset Boulevard at Hampton court

PRODUCTION TEST 6 - Vertically and Horizontally Centered Announcement

Center the following announcement both vertically and horizontally on a half-sheet of paper. Use the exact center and double space. (15 minutes)

The Next Meeting of

THE OAKWOOD COLLEGE BUSINESS CLUB

Will Be Held

NOVEMBER SEVENTH :: FIVE-THIRTY :: ROOM NINE

Members Only

ELEMENTARY TYPEWRITING

QUIZ - Word Division NAME_____

- -

COMPLETION: Rewrite each word indicating all correct points at which each word may be divided for typewriting.

1. shouldn't_____
2. explain_____
3. unity_____
4. gratefully_____
5. radiator_____
6. visible_____
7. appear_____
8. elite_____
9. Trunk_____
10. dressing_____
11. salesman_____
12. difficult_____
13. planning_____
14. department_____
15. higher_____

PRODUCTION TEST 7 - Word Division Table Typewriting

Half sheet of paper inserted short edge at left; DS; 70-space line; 10 spaces between columns; center the problem vertically.

Type the hyphen to show preferred word divisions in typewritten work as in Line 1. If necessary, refer to Lesson 36, Problem 1, Page 65 or to a dictionary.

WORD DIVISION

steady	will-ing	blan-ket	quickly
input	enumerate	luggage	preferred
afraid	rustproof	cutting-	safety
billed	newsroom	messenger	dictation
alerted	rectify	skillful	changeable

KEY

7	10	11	10	11	10	11

Achievement Test 1 (Lessons 1-37)
COLLEGE TYPEWRITING, Ninth Edition
by Lessenberry • Wanous • Duncan • Warner

Prepared by
George P. Grill
University of N.C. at Greensboro

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Palo Alto, Calif. / Brighton, England

Name_____ Date_____

1A 3' Straight Copy *gwam*_____ Errors_____ Grade_____

1B 3' Statistical Copy *gwam*_____ Errors_____ Grade_____

1C Problem Typing 30' timing on problems

Quantity_____ Quality_____ Grade_____

1A 3' Straight-Copy Timed Writing Type line for line; determine GWAM

70-space line; 5-space ¶ indention; DS

All letters are used.

	3' GWAM	Total Words
It is now clear that office procedures are in a state of change, a	4	13
change that has been of concern to business and office education teachers	9	28
because they are liable, as well as accountable, for the requisite educa-	14	43
¶ 1 — 1.5 SI, 5.6 AWL, 80% HFW: tion and training of office personnel in our schools. As the office is	19	57
being recognized as one of the vital parts of business, new skills will	24	72
be needed to perform on the job. These new skills will affect all sorts	29	86
of office jobs. A new image of the office is expected to emerge with	33	100
changes in technology and office functions.	36	109
To meet the needs of the office of today and the future, the new	41	122
¶ 2 — 1.5 SI, 5.6 AWL, 80% HFW: employee must be able to read, write, speak, and listen. Having learned	45	136
these skills, he or she will also need others—in the areas of grammar,	50	151
application typing, shorthand and transcription, and simulated work situ-	55	165
ations. All of these must be related to what is taking place in the real	60	180
world-of-work office. The concept of word processing has now made new	65	194
demands in the field of providing workers for the new office life style.	70	209

3' GWAM | 1 | 2 | 3 | 4 | 5 |

1B 3' Statistical-Copy Timed Writing Type line for line; determine GWAM

70-space line; 5-space ¶ indention; DS

All figures and some symbols are used in each ¶.

	3' GWAM	Total Words
On March 21, 1975, May prepared her 1974 individual income tax	4 | 39	13
¶ 1 — 1.5 SI, 5.6 AWL, 80% HFW: return. With her wages of $16,700, plus interest of $350 and dividends	9 | 44	27
of $115.75 (the first $100 is not added), less moving expenses of $244.27,	14 | 49	42
an adjusted gross income of $16,921.48 was found.	17 | 52	52
To determine May's tax for 1974, subtract her itemized deductions of	22 | 57	66
¶ 2 — 1.5 SI, 5.6 AWL, 80% HFW: $2,398 from $16,921.48—a difference of $14,523.48. Finally, subtract	27 | 62	80
$750, as May has identified one exemption. By using a tax-rate schedule	31 | 67	94
on $13,773.48, the 1974 tax for May would be $3,144.31.	35 | 70	105

3' GWAM | 1 | 2 | 3 | 4 | 5 |

T10A— 3 4 5 6 7 8 9 10 3 3 7 [1-1] Printed in U.S.A.

1C Problem Typing (30) Type each problem as directed.

Problem 1: Centered Announcement

Half sheet inserted with short edge at left; 50-space line; SS the ¶s

Type the announcement shown at the right. Center the announcement vertically. (You will type the problem line for line as shown.) Remember to count the correct number of line spaces in determining the top margin.

Words

LOCAL POLLUTION PROBLEMS 5
TS

The members of the Basic Business Education class will present a film on local pollution problems at the weekly assembly program on Friday morning. The film is entitled 39

AMERICA THE BEAUTIFUL 43

During the past semester, the film was produced and edited by three members of the Basic Business class. The film is accompanied by a commentary on local problems, some of which are land, water, air, and noise pollution. 88

Problem 2: Vertical and Horizontal Centering

Half sheet with long edge at the left; reading position; SS groups of lines

Insert a half sheet of paper with the long edge at the left; determine the horizontal center point for your typewriter. Center the entire announcement vertically and each line horizontally. Follow the spacing indicated for the parts of the announcement.

WORKSHOPS IN CREATIVE HANDICRAFTS 7
TS

DECOUPAGE: FUN AND EASY 12
Tanya Macht, Instructor 17
Pictures, Lamps, and Handbags 23
January 21, 7 to 9 p.m. 28
DS

NEEDLEWORK: FUN AND FASHION 33
Sylvia Hurwitz, Instructor 39
Needlepoint, Crewel, and Bargello 45
February 2, 7 to 9 p.m. 50

Problem 3: Two-Column Table

Half sheet with short edge at the left; DS; center the table vertically and horizontally; 20 spaces between columns

SPRING CLASS SCHEDULE FOR PEDRO VALDEZ 8

First period	Shorthand I	13
Second period	Typewriting II	19
Third period	Basic Business	24
Fourth period	English III	29
Fifth period	Modern History II	36
Sixth period	Geometry II	41

Problem 4: Enumeration from Script

Half sheet with short edge at the left; 50-space line; SS items but DS between them; center the heading in correct style on Line 10

Things to do before Friday 5
1. Pick up clothes at dry cleaner. 12
2. Type up a list of telephone numbers 20
of vacation hotels. 24
3. Let Steve know what time the 31
plane leaves. 33
4. Ask Dadley how long to allow for 41
drive to airport. 45
5. Leave ext. key with plant sitter. 53

APPENDIX D

DVORAK AND SHOLES CLASS SCHEDULES, SPEED STANDARDS, AND GRADING FORMULAS

O A K W O O D C O L L E G E

FALL QUARTER, 1978

SC 111 - EXPERIMENTAL TYPEWRITING (D V O R A K)

C L A S S S C H E D U L E

Esther N. Gill, Instructor M-F - 2 P.M. - 3:50 P.M. - 2 Hours' Credit
Office: Moran Hall, Room 209 Office Phone: 837-1630, X272
TEXTBOOKS: Gill, Esther, Dvorak Typewriting Keyboard Arrangement, 1st Edition, 1978 and Lessenberry, Wanous, Duncan and Warner, College Typewriting - Complete Course, 9th Edition, South-Western Publishing Co., Cincinnati: 1975.

Date		Assignments
Sept. 18	- Orientation, Explanation, and TAPPING TEST Administration and Keyboard Choice Training Decision	
19	- Prediction of Typing Achievement via TAPPING TEST Results LESSON 1 - New Keys: d and l also finger position, key stroking, carriage returning, and spacing	1F
20	- LESSON 2 - New Keys: i, f, . (Period) and Left Shift Key, Paper Size, Typewriting Spacing, and Size of Type	2H
21	- LESSON 3 - New Keys: j, r, and k	3E and 3F
22	- LESSON 4 - New Keys: y, , (Comma), and c also Right Shift Key	4F
25	- LESSON 5 - SPEED DRILLS (1-Minute) also Machine Parts Quiz	5E
26	- LESSON 6 - New Keys: p, g, and w	6F
27	- LESSON 7 - New Keys: q, m, and x also back-spacing	7F
28	- LESSON 8 - New Keys: b, z, and ; (Semicolon) also Tab Mechanism Control	8D and 8F
29	- LESSON 9 - New Keys: v and ? (Question Mark) also Punctuation Spacing Rules	9D and 9F
Oct. 2	- LESSON 10 - SPEED DRILLS (1-Minute) also Keyboard Quiz	
3	- LESSON 16 - New Keys: 1, 2, and 7 also 1-Minute and 3-Minute SPEED DRILLS	16D
4	- LESSON 17 - New Keys: 9, 5, and : (Colon) also 1-Minute and 3-Minute SPEED DRILLS	17D
5	- LESSON 17 - 1-Minute and 3-Minute SPEED DRILLS and Production Test 1	
6	- LESSON 18 - New Keys: 6, 2, and / (Diagonal) also 1-Minute & 3-Minute SPEED DRILLS	18D
9	- LESSON 18 - 1-Minute and 3-Minute SPEED DRILLS and Catch-Up Day	

SC 111 - Experimental Typewriting (DVORAK) - Class Schedule--Page 2

Date		Assignments
Oct. 10	- LESSON 19 - New Keys: 8, 4, and 0	19D
11	- LESSON 19 - 1-Minute and 3-Minute SPEED DRILLS	
12	- LESSON 20 - New Keys: - (Hyphen)	20E/Self-Imp
13	- LESSON 20 - 1-Minute and 3-Minute SPEED DRILLS	
16	- LESSON 21 - New Keys: $, ' (Apostrophe), and " (Quotation Mark)	21D
17	- LESSON 22 - New Keys: # (Pound or Number), & (Ampersand), and) (Right Parenthesis)	22E
18	- LESSON 23 - New Keys: % (Percent), _ (Underline), and ((Left Parenthesis)	23E
19	- LESSON 24 - New Keys: * (Asterisk), ½-¼, and ¢-@ (Cent or Cents and At or Each)	24C
20	- LESSON 24 - Numbers and Special-Characters' Spacing Quiz	
23	- LESSON 25 - Typing Stroking Technique Review B R I N G LESSENBERRY, College Type-writing (9th Edition) T E X T T O C L A S S N E X T S E S S I O N	25D
24	- LESSON 25 - 1-Minute and 3-Minute SPEED DRILLS also Production Test 2	
25	- LESSON 25 - Proofreader Revision Marks	25E
26	- LESSON 26 - Proofreader Revision Marks	26D
27	- LESSON 28 - Proofreader Revision Marks	28D
30	- LESSON 29 - Production Tests 3 and 4	
31	- LESSON 30 - 1-Minute and 3-Minute SPEED DRILLS	
Nov. 1	- LESSON 31 - Horizontal Centering	31D/1 and 2
2	- LESSON 31 - Production Test 5 also 1-Minute and 3-Minute SPEED DRILLS	
3	- LESSON 32 - Vertical Centering	32E/1 and 2
6	- LESSON 32 - Production Test 6 also 1-Minute and 3-Minute SPEED DRILLS	
7	- LESSON 33 - Homemade Special Characters	33C
8	- LESSON 33 - Homemade Special Characters	33D
9	- LESSON 34 - Centering Data on Special-Size Paper	34F/1 and 2
10	- LESSON 35 - Setting the Right Margin Stop	35E
13	- LESSON 36 - Word Division Rules and Practice	36C/1 and 2
14	- LESSON 36 - Production Test 7 also 1-Minute and 3-Minute SPEED DRILLS	
15	- LESSON 37 - Dividing Words and Sentence Parts also Bell Cue	37B and 37D
16	- LESSON 37 - Catch-Up Day also 1-Minute and 3-Minute SPEED DRILLS	
21	- LESSONS 1-37 QUARTER FINAL (Speed Drills and Production)	

SC 111 - Experimental Typewriting (DVORAK) - Class Schedule--Page 3

S P E E D S T A N D A R D S

3 Minutes with 3-Error Cutoff		1 Minute 2 off for each Error	
40	A	50	A
35 - 39	B	45 - 49	B
30 - 34	C	40 - 44	C
25 - 29	D	35 - 39	D

G R A D I N G S C A L E

(See OAKWOOD COLLEGE BULLETIN, Page 55)

G R A D I N G F O R M U L A

50 Percent . . . . . Daily Assignments

25 Percent . . . . . Speed Requirements

25 Percent . . . . . Production Achievements

---

100 Percent

O A K W O O D C O L L E G E

FALL QUARTER, 1978

SC 111 - EXPERIMENTAL TYPEWRITING (S H O L E S)

C L A S S S C H E D U L E

Esther N. Gill, Instructor M-F - 2 P.M. - 3:50 P.M. - 2 Hours' Credit
Office: Moran Hall, Room 209 Office Phone: 837-1630, X272
TEXTBOOKS: Gill, Esther, Sholes Typewriting Keyboard Arrangement, 1st Edition, 1978 and Lessenberry, Wanous, Duncan, and Warner, College Typewriting, Complete Course, 9th Edition, South-Western Publishing Co., Cincinnati: 1975.

Date		Assignments
Sept. 18	Orientation, Explanation, and TAPPING TEST Administration and Keyboard Choice Training Decision	
19	Prediction of Typing Achievement via TAPPING TEST Results LESSON 1 - New Keys: h and e also finger positioning, key stroking, carriage returning, and spacing	1F
20	LESSON 2 - New Keys: i, t, and . (Period) also Left Shift Key, Paper Size, Typewriting Spacing and Size of Type	2H
21	LESSON 3 - New Keys: o, r, and n	3E and 3F
22	LESSON 4 - New Keys: w, u, and c also Right Shift Key	4F
25	LESSON 5 - SPEED DRILLS (1-Minute) also Machine Parts Quiz	5E
26	LESSON 6 - New Keys: p, g, and m	6F
27	LESSON 7 - New Keys: q, y, and x also Backspacing	7F
28	LESSON 8 - New Keys: b, z, and , (Comma) also Tab Mechanism Control	8D and 8F
29	LESSON 9 - New Keys: v and ? (Question Mark) also Punctuation Spacing Rules	9D and 9F
Oct. 2	LESSON 10 - SPEED DRILLS (1-Minute) also Keyboard Quiz	
3	LESSON 16 - New Keys: 1, 3, and 7 also 1-Minute and 3-Minute SPEED DRILLS	16D
4	LESSON 17 - New Keys: 9, 5, and : (Colon) also 1-Minute and 3-Minute SPEED DRILLS	17D
5	LESSON 17 - 1-Minute and 3-Minute SPEED DRILLS and Production Test 1	
6	LESSON 18 - New Keys: 6, 2, and / (Diagonal) also 1- and 3-Minute SPEED DRILLS	18D

SC 111 - Experimental Typewriting (SHOLES) - Class Schedule--Page 2

Date		Assignments
Oct. 9	LESSON 18 - 1-Minute and 3-Minute SPEED DRILLS and Catch-Up Day	
10	LESSON 19 - New Keys: 8, 4, 0	19D
11	LESSON 19 - 1-Minute and 3-Minute SPEED DRILLS	
12	LESSON 20 - New Keys: - (Hyphen)	20E/Self-Imp
13	LESSON 20 - 1-Minute and 3-Minute SPEED DRILLS	
16	LESSON 21 - New Keys: $, ' (Apostrophe), and " (Quotation)	21C
17	LESSON 22 - New Keys: # (Pound or Number), & (Ampersand), and) (Right Parenthesis)	22E
18	LESSON 23 - New Keys: % (Percent), _ (Underline), and ((Left Parenthesis)	23E
19	LESSON 24 - New Keys: * (Asterisk), ½-¼, and ¢-@ (Cent or Cents and At or Each)	24C
20	LESSON 24 - Numbers and Special-Characters' Spacing Quiz	
23	LESSON 25 - Typing Stroking Technique Review B R I N G LESSENBERRY, College Typewriting T E X T T O C L A S S N E X T S E S S I O N	25D
24	LESSON 25 - 1-Minute and 3-Minute SPEED DRILLS also Production Test 2	
25	LESSON 25 - Proofreader Revision Marks	25E
26	LESSON 26 - Proofreader Revision Marks	26D
27	LESSON 28 - Proofreader Revision Marks	28D
30	LESSON 29 - Production Tests 3 and 4	
31	LESSON 30 - 1-Minute and 3-Minute SPEED DRILLS	
Nov. 1	LESSON 31 - Horizontal Centering	31D/1 and 2
2	LESSON 31 - Production Test 5 also 1-Minute and 3-Minute SPEED DRILLS	
3	LESSON 32 - Vertical Centering	32E/1 and 2
6	LESSON 32 - Production Test 6 also 1-Minute and 3-Minute SPEED DRILLS	
7	LESSON 33 - Homemade Special Characters	33C
8	LESSON 33 - Homemade Special Characters	33D
9	LESSON 34 - Centering Data on Special-Size Paper	34F/1 & 2
10	LESSON 35 - Setting the Right Margin Stop	35E
13	LESSON 36 - Word Division Rules and Practice	36C/1 and 2
14	LESSON 36 - Production Test 7 also 1-Minute and 3-Minute SPEED DRILLS	
15	LESSON 37 - Dividing Words and Sentence Parts also Bell Cue	37B and 37D
16	LESSON 37 - Catch-Up Day also 1-Minute and 3-Minute SPEED DRILLS	
21	LESSONS 1-37 Quarter Final (SPEED DRILLS and PRODUCTION)	

SC 111 - Experimental Typewriting (SHOLES) - Class Schedule--Page 3

S P E E D S T A N D A R D S

3 Minutes with 3-Error Cutoff		1 Minute 2 off for each Error	
40	A	50	A
35 - 39	B	45 - 49	B
30 - 34	C	40 - 44	C
25 - 29	D	35 - 39	D

G R A D I N G S C A L E

(See OAKWOOD COLLEGE BULLETIN, Page 55)

G R A D I N G F O R M U L A

50 Percent	Daily Assignments
25 Percent	Speed Requirements
25 Percent	Production Achievements
100 Percent	

APPENDIX E

UNIVERSAL AND SIMPLIFIED TYPEWRITING DEMONS RESPECTIVELY

UNIVERSAL AND SIMPLIFIED TYPEWRITING DEMONS RESPECTIVELY

1 the	21 this	41 he	61 well	81 look
2 to	22 are	42 like	62 only	82 find
3 of	23 was	43 has	63 then	83 our
4 and	24 their	44 turn	64 one	84 by
5 is	25 do	45 as	65 not	85 doubt
6 which	26 good	46 those	66 done	86 because
7 it	27 time	47 think	67 these	87 many
8 that	28 write	48 more	68 about	88 year
9 when	29 there	49 can	69 word	89 two
10 for	30 never	50 some	70 ever	90 so
11 with	31 they	51 great	71 say	91 told
12 have	32 my	52 must	72 began	92 heart
13 be	33 we	53 should	73 begin	93 eight
14 would	34 your	54 could	74 people	94 same
15 will	35 what	55 effort	75 away	95 while
16 work	36 very	56 than	76 other	96 also
17 you	37 been	57 take	77 day	97 most
18 but	38 his	58 if	78 over	98 said
19 thank	39 thing	59 every	79 up	99 had
20 in	40 them	60 give	80 from	100 I

1 new	21 however	41 desire	61 rate	81 women
2 beautiful	22 most	42 enclose	62 rule	82 action
3 during	23 November	43 enjoy	63 south	83 anyway
4 everything	24 obtain	44 family	64 subject	84 always
5 help	25 suggest	45 marriage	65 service	85 article
6 oblige	26 their	46 husband	66 song	86 against
7 certain	27 tonight	47 half	67 though	87 anything
8 company	28 various	48 hold	68 therefore	88 along
9 length	29 vacation	49 itself	69 watch	89 become
10 October	30 work	50 impossible	70 name	90 blue
11 possible	31 office	51 January	71 high	91 begin
12 result	32 principle	52 kind	72 where	92 black
13 serve	33 accept	53 leave	73 home	93 charge
14 stamp	34 addition	54 loss	74 baby	94 children
15 never	35 arrangement	55 March	75 whose	95 character
16 importance	36 behind	56 opinion	76 just	96 conference
17 awful	37 build	57 probably	77 life	97 consider
18 committee	38 change	58 pleasure	78 public	98 copy
19 close	39 condition	59 particular	79 table	99 class
20 difference	40 card	60 request	80 under	100 cause

APPENDIX F

STUDENTS' TAPPING TEST SCORES COMPARED WITH ACTUAL RESULTS AND TERMINAL AVERAGES ATTAINED ON STRAIGHT-COPY AND STATISTICAL SPEED DRILLS TAKEN AT VARIOUS LEVELS OF TRAINING

DVORAK PILOT-STUDY STUDENTS' TAPPING TEST SCORES COMPARED WITH ACTUAL RESULTS AND TERMINAL SPEED AVERAGES ATTAINED ON STRAIGHT-COPY AND STATISTICAL SPEED DRILLS TAKEN AT VARIOUS LEVELS OF TRAINING

Student Number	Tapping Test Scores	Lesson 5 - 1'	Lesson 10 - 1'	Lesson 10 - 3'	Lesson 16 - 1'	Lesson 16 - 3'	Lesson 17 - 1'	Lesson 17 - 3'	Lesson 18 - 1'	Lesson 18 - 3'	Lesson 20 - 1'	Lesson 20 - 3'	Lesson 25 - 1'	Lesson 25 - 3'	Lesson 30 - 1'	Lesson 30 - 3'	Lesson 37 - 1'	Lesson 37 - 3'	1' Terminal Avg. Last 3 Lessons	3' Terminal Avg. Last 3 Lessons
"A" Stds. f/1'		20	25		30		30		30		35		40		45		50		50	
"A" Stds. f/3'		0	15		20		20		20		25		30		35		40		40	
1	69	22N	27N-24/2	30N-27/2	37N-30/1		38N-31/2		38N-30/1		42N-30/1		45N-28/3		40N-31/2		42N-30/2			
2	66	15N	21N-15/3	31N-22/3	32N-30/3		32N-29/2		41N-34/2		45N-28/2		49N-33/0		44N-37/2		46N-33/1			
3	55	14N	14N-10/3	31N-12/3	36N-25/2		32N-09/3		23N-27/3		29N-27/2		40N-28/2		44N-30/2		38N-28/2			
4	41	14N	19N-18/3	22N-19/2	19N-19/3		22N-12/3		33N-26/2		33N-26/1		32N-31/2		40N-32/3		35N-30/2			
5	39	06N	11N-06/3	12N-12/3	14N-06/3		18N-12/3		17N-12/3		23N-17/2		31N-20/3		35N-24/3		30N-20/3			
6	31	16N	17N-04/3	22N-10/3	32N-18/2		36N-20/3		35N-24/3		32N-23/3		35N-26/2		37N-24/3		35N-24/3			

N Net words per minute with 2 words deducted for each error.
' Minute or minutes.
Stds. Standards.

DVORAK STUDENTS' TAPPING TEST SCORES COMPARED WITH ACTUAL RESULTS AND TERMINAL SPEED AVERAGES ATTAINED ON STRAIGHT-COPY AND STATISTICAL SPEED DRILLS TAKEN AT VARIOUS LEVELS OF TRAINING

Student Numbers	Tapping Test Scores	Lesson 5 - 1'	Lesson 10 - 1'	Lesson 10 - 3'	Lesson 16 - 1'	Lesson 16 - 3'	Lesson 17 - 1'	Lesson 17 - 3'	Lesson 18 - 1'	Lesson 18 - 3'	Lesson 20 - 1'	Lesson 20 - 3'	Lesson 25 - 1'	Lesson 25 - 3'	Lesson 30 - 1'	Lesson 30 - 3'	Lesson 37 - 1'	Lesson 37 - 3'	1' Terminal Avg. Last 3 Lessons	3' Terminal Avg. Last 3 Lessons
"A" Stds. f/1'		20	25		30		30		30		35		40		45		50		50	
"A" Stds. f/3'		0	15		20		20		20		25		30		35		40		40	
1*	83	15N																		
2*	73	18N	21N-08/3		16N-15/3		23N-15/3													
3	56	11N	24N-18/3		19N-18/2		23N-21/1		26N-18/2		30N-22/1		31N-25/2		29N-21/2		31N-30/3		30N-25/2	
4	55	16N	20N-18/2		32N-22/3		43N-14/3		46N-15/3		44N-22/3		48N-28/3		50N-37/3		55N-40/3		51N-35/3	
5	44	27N	17N-10/2		33N-21/3		34N-16/3		35N-25/3		45N-21/2		38N-31/2		40N-30/2		47N-23/3		38N-28/2	
6	43	09N	15N-09/3		18N-13/2		18N-09/2		21N-15/2		25N-16/2		28N-15/3		25N-16/1		30N-20/3		28N-17/2	
7	41	09N	14N-11/1		15N-13/0		10N-14/0		20N-16/2		20N-16/0		31N-12/2		30N-18/2		32N-20/2		31N-16/2	
8	40	13N	15N-15/2		20N-25/2		16N-16/3		19N-11/3		22N-17/2		19N-20/3		25N-21/2		30N-20/2		25N-20/2	
9*	40	04N																		
10*	33	13N	15N-06/3																	
11*	26	08N																		
12*	25	05N																		

Stds. Standards.
* These students dropped out before the completion of the quarter.
N Net words per minute with 2 words deducted for each error.
' Minute or Minutes.

SHOLES STUDENTS' TAPPING TEST SCORES COMPARED WITH ACTUAL RESULTS AND TERMINAL AVERAGES ATTAINED ON STRAIGHT-COPY AND STATISTICAL SPEED DRILLS TAKEN AT VARIOUS LEVELS OF TRAINING

Student Number	Tapping Test Scores	Lesson 5 - 1'	Lesson 10 - 1'	Lesson 10 - 3'	Lesson 16 - 1'	Lesson 16 - 3'	Lesson 17 - 1'	Lesson 17 - 3'	Lesson 18 - 1'	Lesson 18 - 3'	Lesson 20 - 1'	Lesson 20 - 3'	Lesson 25 - 1'	Lesson 25 - 3'	Lesson 30 - 1'	Lesson 30 - 3'	Lesson 37 - 1'	Lesson 37 - 3'	1' Terminal Avg Last 3 Lessons	3' Terminal Avg Last 3 Lessons
"A" Stds. f/1'		20	25		30		30		30		35		40		45		50		50	
"A" Stds. f/3'		0	15		20		20		20		25		30		35		40		40	
1	55	16N	20N-13/3		18N-13/3		18N-09/3		22N-10/3		20N-12/3		28N-26/3		30N-26/0		35N-28/0		31N-27/1	
2	50	19N	25N-13/3		21N-15/1		13N-13/3		21N-17/3		22N-16/0		28N-23/2		30N-22/0		35N-26/2		31N-24/1	
3	48	14N	15N-10/2		17N-11/1		21N-15/2		24N-15/1		28N-20/2		24N-18/2		29N-26/0		30N-27/0		28N-24/1	
4*	47	08N	21N-15/3		15N-16/2		20N-18/3		25N-17/2		21N-20/3		24N-17/2							
5	39	16N	30N-17/1		25N-13/3		32N-28/2		31N-28/2		32N-29/2		39N-33/2		39N-33/2		46N-33/2		41N-33/2	
6*	39	16N	18N-05/3		18N-12/2		20N-13/3		17N-15/1		30N-10/3									
7	37	09N	16N-10/3		21N-08/3		20N-09/3		22N-15/3		28N-13/3		27N-19/1		20N-18/3		28N-19/2		25N-19/2	
8	37	23N	25N-19/2		22N-19/3		23N-25/1		27N-22/2		24N-25/1		26N-22/2		30N-25/0		29N-28/0		28N-25/1	
9	36	16N	16N-06/3		18N-08/0		20N-11/1		21N-14/3		20N-12/3		29N-30/3		33N-28/2		35N-26/2		32N-28/2	
10*	34	13N	13N-08/3		15N-09/0		14N-09/3													
11*	34	08N	09N-12/2		16N-13/1		18N-13/1		17N-14/1		20N-12/0									
12	33	11N	14N-05/3		08N-07/0		18N-11/2		23N-15/3		26N-16/3		30N-34/0		32N-27/3		42N-36/0		35N-32/1	
13*	32	11N	25N-15/3		24N-16/3		18N-12/2		23N-14/3		18N-15/1									
14*	31	12N	15N-12/3		16N-13/3		18N-15/3		20N-16/2		21N-17/0									
15	26	12N	14N-10/3		20N-11/3		23N-13/3		25N-19/1		26N-17/3		32N-19/1		30N-22/2		38N-21/1		33N-21/1	
16*	22	14N	15N-05/3																	
17	12	09N	20N-10/3		22N-07/3		25N-10/2		22N-14/3		21N-17/3		33N-22/3		29N-18/3		31N-20/3		31N-20/3	

* These students dropped out before the completion of the quarter.
N Net words per minute with 2 words deducted for each error.
' Minute or Minutes.

VITA

Esther Naomi Gill was born in Penn Yan, New York on January 31, 1932. She attended elementary school in that town and was graduated from Penn Yan Academy in June, 1949. The following September she entered the Rochester Business Institute, and 15 months later she received a Medical Secretarial Certificate. She entered Oakwood College as a junior in the fall of 1951, and in June, 1953 received her Bachelor of Science degree in Secondary Education with a minor in Secretarial Science. In the fall of 1953, she accepted a teaching position at the Pine Forge Institute in Pine Forge, Pennsylvania. She later pursued and earned her Master's degree in Business Education from Temple University, Philadelphia, Pennsylvania in 1963.

In the fall of 1963 she returned to her Alma Mater (Oakwood College, Huntsville, Alabama) as an instructor in the Secretarial Science Department. She entered the Graduate School at The University of Tennessee, Knoxville in 1976. She received the Doctor of Education degree with a major in Vocational Education with emphasis on Business Education and minors in Computer Science and Accounting in August, 1981.

The author is a member of the Omicron Tau Theta, Delta Phi Epsilon, National Business Education Association, Seventh-day Adventist Business Education Association, The Southern Business Education Association and various other church and civic organizations.

Miss Gill is employed at the Oakwood College as an Assistant Professor of Business Administration and Business Education.