

AN EXPERIMENTAL STUDY OF THE EFFECT OF THE
TIME ELEMENT IN THE ADMINISTRATION OF
SPEED TESTS IN TYPEWRITING

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SPEED TESTS IN TYPEWRITING

By

WILDA TALBOT

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APPROVED:

C. K. Reiff.
Chairman, Thesis Committee

M. Fred Tidwell
Member, Thesis Committee

C. K. Reiff.
Head of the Department

D. C. McIntosh
Dean of the Graduate School

To

George

Who Made My Education Possible

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CHAPTER I

IMPORTANCE AND SCOPE OF THE STUDY

Nature of the Study. This study is concerned with an experimental problem in the field of commercial education involving a time factor in the administration of speed tests in typewriting.

A control group of twenty students was set up and given a timed writing test, lasting fifteen minutes each week for seventeen weeks.

Another group of twenty students, comparable in every way was set up and given a timed writing test every week beginning with a test five minutes in length and increasing one minute each subsequent week until fifteen minutes maximum time was reached. The fifteen minutes period was reached at the end of the tenth week. This group then continued with the fifteen minute test for seven weeks or until the end of the semester.

The groups were evenly matched on pertinent points, the same instruction was used, except for the one experimental factor cited. The students were freshmen in Amarillo Junior College, Amarillo, Texas enrolled in the second semester typewriting courses.

The experiment was conducted to find which of the two methods is most effective in gaining speed in typewriting.

Necessity for Experimentation. In all activities of life people are continually searching for the best ways of obtaining results in their respective fields. Each year business pays large sums for research to determine more efficient methods and processes. Our government maintains experimental workers in many

branches of its service. The value of research is just as applicable, and perhaps more important, to the teaching field than to business and government, for regardless of how effective teaching may be, it is always possible to improve it.

Commenting on the importance of teachers experimenting with new methods and devices one authority says:

. . . education is now due for a period of assimilation and application of the new psychology--a new era. The teacher should become thoroughly familiar with its theories and principles, so familiar that she can assist in performing the necessary experiments, in fact initiate some of her own. This is the best advice that can possibly be given the commercial teacher today.¹

A similar experiment to the one undertaken in this study was performed at Goldey College, in Wilmington, Delaware. A gradual increase in the period of timed writings with beginning students in typewriting was used. The method used is described as follows:

The first timed-writing came during the second week of instruction. For several days, there were one-minute timed writings, with emphasis on elements of technique. The length of the timing was increased until they had their first three minute timed writings at the end of the third week. After the third week, the length of the timed writings was gradually built up to five minutes.²

This study is cited to show that teachers are seeking to determine the value of increasing efficiency by varying the time element.

¹Raymond H. Wheeler, "Commercial Teaching and the New Psychology of Learning," Factors of Learning and Teaching Technique, Fourth Yearbook, National Commercial Teachers Federation, 1938, p. 11.

²M. Elinor Betts, "An Experiment in Typewriting Speed," Indices of Good Teaching, Fifth Yearbook, National Commercial Teachers Federation, 1940, p. 256.

One element in the philosophy underlying this type of experiment is that some students need to be prepared for longer periods of writing as their attention tends to lapse if they become over-fatigued and,

. . . they work lazily until a habit of working lazily is fastened upon them. . . . The learner fails to push himself on to a higher plane of writing and continues to work lazily until his interest in the work has been permanently dulled.³

Even though the student may not acquire the habit of working lazily, it is believed that longer periods of practice may not be the most effective learning device in acquiring speed and skill in typewriting. Dr. Book says:

A period of rest not only removes fatigue for the work as a whole and the incipient bad habits of attention and the interfering associations to which the fatigue and the work give rise, proper intervals of rest may allow for a natural neural growth or setting of the habits to be formed that would be more helpful for their development than further practice, even though it be careful and correct.⁴

. . . .

A large part of the typewriting teacher's job is to discover the best way to regulate the intensity of the effort being made by the learner.⁵

. . . .

. . . . The learning period should be broken up into short units, since shorter learning periods are more effective than longer ones.⁶

³William Frederick Book, The Psychology of Skill, (New York: The Gregg Publishing Company, 1925), p. 200.

⁴Ibid., p. 243f.

⁵William R. Odell and Esta Ross Stuart, Principles and Techniques for Directing the Learning of Typewriting, D. C. Heath and Company, p. 21.

⁶Ibid., p. 23.

Experiments to determine the importance of time intervals in learning have been conducted in other fields, particularly in music. Music teachers have reached the conclusion that too long periods of practice are not as effective as shorter periods.

Mr. O'Toole writes:

The length of a practice period should depend on the ability of the student to concentrate. . . . If a long period is attempted there are bound to be lapses of attention in which mistakes will occur or hazy impressions will be formed, thus canceling the effect of the concentrated study which preceded. By dividing the available time into a number of short periods the attention can be kept at a white heat. Moreover, the interval between, the impressions will have had time to deepen, to become a part of the student's mental life.⁷

There should be a distinction made in habituated and non-habituated practice, however.

In the ability to do long-continued work without much fatigue and without diminution in ability to perform the work we should keep in mind the difference between habituated and non-habituated work as fatigue comes more quickly in non-habituated work. Effective learning can not go on unless fatigue is at a minimum.⁸

It is believed that this psychological application is fundamental to this experiment. The students were engaged in learning and acquiring skill and speed in typewriting. At the beginning of the semester the students of Group I began with a period of such short duration that even the student who tired most easily could complete the test without undue fatigue and as he became more habituated to

⁷William J. O'Toole, "Maintaining Concentration in Practice," The Etude, December 1928, p. 920.

⁸William Henry Pyle, The Psychology of Learning (Baltimore: Warwick and York, Inc., 1928), pp. 344-345.

the timed writing practice period he was able to type for longer periods without becoming fatigued.

D. D. Lessenberry,⁹ a noted authority in the field of typewriting, has commented on several occasions of the conflicting classroom practice as to the length of speed tests. He recommended that an experiment be conducted in order that teachers might have some facts to guide them with reference to this important phase of teaching typewriting. He also recommended this experiment as a defensible subject for a master's thesis.

Mr. Lessenberry recently reiterated this need in a letter to the writer.¹⁰

Statement of the Problem. This experiment was conducted to determine whether a fifteen minute weekly typewriting timed writing test, continuing for seventeen weeks was more effective in enabling students to acquire skill and speed in typewriting, or whether a timed writing test starting at five minutes and increasing one minute each subsequent week until fifteen minutes maximum time was reached, then continuing at this time for seven weeks was more effective?

Method of Procedure. The initial step in this study was to make a careful search of recent literature to ascertain whether or not an experiment of similar nature had been reported.

⁹D. D. Lessenberry, Director, Courses in Commercial Education, University of Pittsburgh, Pittsburgh, Pennsylvania.

¹⁰Personal letter to the writer may be found in the Appendix of this thesis.

The purpose of this search was to use such an experiment, if it had been made, as a guide in conducting this experiment and also to have some result against which to check the findings. Failing to find anything similar, the following procedure was used: Forty students were secured from the typewriting classes, numbering 102, in Amarillo Junior College, Amarillo, Texas. These students were divided into two groups. These two groups made comparable scores on the Otis General Intelligence Test and the Minnesota Vocational Test for Clerical Workers. In addition to these tests, the high school averages, the high school English average, and the average for the first term typewriting grade were used as a basis of selection.

As a further index of equivalency a comparison was made of the first typewriting speed test given to each group at the beginning of the semester. The equivalency of the groups from the standpoint of chronological age, sex, and race was established.

The teacher factors including instructional techniques were the same for both groups. Also, the general school factors such as the same room, the same equipment, and the same typewriters were used for both groups. The extra-school factors were also the same for the two groups. The only variable factor in the handling of the two groups, after their equivalency was established was the difference in the time of the timed writings, as previously explained.

Sources of Data. Since the study was primarily of an experimental nature the data were obtained from: (1) official records, which include the student's high school records, particularly in

English and typewriting; (2) the comparison of the scores of the Otis General Intelligence Test; (3) The Minnesota Vocational Test for Clerical Workers, and, (4) the standard typewriting speed tests given to each group for seventeen weeks.

Definition of Terms. The term "timed writing" is used in this experiment almost interchangeably with the term "speed test." A timed period of writing is used in teaching typewriting to determine how many words per minute the students are able to write. It may also determine the accuracy of the writing as a certain number of words are deducted from the total scores for each error made. However, in this report it was used to determine the net number of words per minute the student is able to write.

The term "teaching techniques" is used in this report to include the manner and methods by which the teacher presented work and taught the classes.

"Teacher factors" include the points to be considered in regard to different methods and techniques used by different teachers. In this investigation the teacher factors were identical for both groups as the same teacher was in charge and made a definite and conscious effort to use the same methods with both classes--even going so far as to use the same words when giving instruction.

The term "general school factors" has been interpreted to mean such items as the room, typewriters, tables, and chairs, and in fact, everything pertaining to the physical equipment and environment.

CHAPTER II

CHARACTERISTICS OF PUPILS CONSIDERED IN EQUATING THE GROUPS

Factors Considered in Equating the Groups. The factors pertaining to pupil characteristics considered in equating the groups will be discussed in this chapter.

In conducting the experiment for this study, comparable groups of students, equated as described in Chapter I, were used. The experimental group, designated here-in-after as Group I throughout the discussion and tables, took a speed test in typewriting for a graduated period of time beginning at five minutes and each subsequent week increased one minute in point of time for ten weeks, or until the test covered a period of fifteen minutes, then continued at this time for seven weeks. The other group, a comparable control group, designated here-in-after throughout the discussion and tables as Group II, took the regular fifteen minute test each week from the second week in the semester which marked the beginning of the experimental period. This procedure provided the experimental factor.

An authority on the experimental method says, "... the most difficult problem in controlled group experimentation is to insure the equivalence of parallel groups."¹ Therefore, for each group, the important variable factors were paired with much care and exactness.

¹Carter V. Good, A. S. Barr, and Douglas E. Scates, The Methodology of Educational Research (New York: D. Appleton-Century Company, 1938), p. 502f.

A comprehensive outline of the variable factors to be considered in equating groups as given by Monroe and Engelhart² was used as a frame of reference in this chapter. The Minnesota Vocational Test for Clerical workers was used as an additional index.

The following factors selected from the above mentioned outline are considered pertinent to this study and will be considered in determining the equivalency of the two groups.

- I. Characteristics of pupils
 - A. General intelligence in terms of point scores
 - B. Chronological age
 - C. Previous achievement
 - D. Sex
 - E. Race³

Otis General Intelligence Test.⁴ In determining the general intelligence of the two groups in terms of point scores, the Otis General Intelligence Test was used and considered as a reliable indication of intelligence in that it embodies the experience of the author in testing over 50,000 draftees in the army, more than 600,000 students in every type of school and college, and large numbers of employees in business institutions.

²Walter S. Monroe and Max D. Engelhart, The Techniques of Educational Research, p. 14f. The University of Illinois Bulletin, Vol. XXV, No. 19, Bureau of Educational Research Bulletin, No. 38 (Urbana: University of Illinois, 1928).

³Loc. cit.

⁴Arthur S. Otis, Ph.D., Otis General Intelligence Examination, Direction and Key.

TABLE I

ARITHMETIC MEAN, STANDARD DEVIATION, STANDARD ERROR AND
THE T: DATA DERIVED FROM OTIS GENERAL INTELLIGENCE TEST

GROUP I

Step-Interval Scores	Midpoint	f	x'	fx'		fx' ²
75 - 79	77	0				
70 - 74	72	7	3	21		63
65 - 69	67	3	2	6	28	12
60 - 64	62	1	1	1		1
55 - 59	57	2	0	0		0
50 - 54	52	2	-1	-2		2
45 - 49	47	2	-2	-4		8
40 - 44	42	2	-3	-6		18
35 - 39	37	1	-4	-4	-16	16

N = 20

Arithmetic Mean 60
Standard Deviation 13.85
Standard Error 3.10

GROUP II

Step-Interval Scores	Midpoint	f	x'	fx'		fx' ²
75 - 79	77	1	4	4		16
70 - 74	72	1	3	3		9
65 - 69	67	4	2	8	20	16
60 - 64	62	5	1	5		5
55 - 59	57	1	0	0		00
50 - 54	52	5	-1	-5		5
45 - 49	47	2	-2	-4		8
40 - 44	42	0	-3	0	-13	00
35 - 39	37	1	-4	-4		16

N = 20

Arithmetic Mean 58.75
Standard Deviation 9.52
Standard Error 2.13
T .332

Table I shows the scores of the participants selected for each group, giving the step-intervals scores, the midpoint scores, the frequencies, the sum of the frequencies, and the arithmetic mean, the standard distribution, the standard error and the T.

According to the preceding table it may be observed that although the same number of frequencies do not occur at each step-interval in both groups, the range is relatively short and the variability small, thus indicating an equivalency between the groups. Group I shows a standard deviation of 13.85 with standard error of 3.10 while Group II shows a standard deviation of 9.52 with standard error of 2.13. This difference of 4.33 in the standard deviation in the two groups is not a great deviation considering that only twenty students in each group are used in this study. It is believed that if there were one hundred or more students in each group that the difference in the standard deviation might be even smaller, however, it was not possible to have more students in each group due to the size of the classes in Amarillo Junior College where this experiment was conducted.

The result of the T test is .332. A statistical analysis of the T test was no significant difference between Group I and Group II in general intelligence.

It might be pointed out that tests were given to more pupils than were used in this study, which are not included in the preceding table, as eliminations were made when wide discrepancies were prevalent in factors other than general intelligence, since estab-

lishing equivalency of the groups was necessary before conducting the study.

Chronological Age. The second factor considered in paralleling the groups was chronological age. This data is given in Table II.

TABLE II
CHRONOLOGICAL AGE

Years	Group I	Group II
17	15	7
18	4	9
19	1	4

The greatest variance in the chronological age, as shown in Table II, is in the age bracket of 17 years. In Group I there are fifteen participants, aged 17, while in Group II there are only seven of that age. This variance of the number in the same age bracket is counterbalanced in the 18 year old group by having five more of this age in Group II than in Group I. Since all of the participants, both in the experimental and in the control group, are either 17, 18, or 19 years of age, it is believed that a range of not more than three years in chronological age should not make any appreciable difference in the validity of this experiment. It might be of interest to state that all of the pupils in the class, even those who were eliminated, fall within this age level.

Comparison of Previous Achievement in Terms of Grades. Regarding the previous achievement of the pupils, the high school averages, the high school English averages, and previous semester grades in

typewriting were compared. This information is tabulated in Table III.

TABLE III

A COMPARISON OF HIGH SCHOOL AVERAGES, HIGH
SCHOOL ENGLISH AVERAGES, AND FIRST
SEMESTER GRADES IN TYPEWRITING

Complete High School Averages		
Grade	No. in Group I	No. in Group II
A	2	2
B	7	9
C	11	9
	20	20
High School English Averages		
Grade	No. in Group I	No. in Group II
A	6	5
B	6	8
C	8	7
	20	20
First Semester Typing Averages		
Grade	No. in Group I	No. in Group II
A	2	3
B	7	5
C	9	10
D	2	2
E	0	0
	20	20

Grade Values: A = 93 - 100 points; B = 85 - 92 points; C = 77 - 84 points; D = 69 - 76 points; E = 61 - 68 points.

The grade averages for the data in Table III were found by converting the numerical grades assigned by the teachers of the various subjects into the letter equivalent as per the grade value schedule

of the High School and Junior College. The letter representing the complete high school average grade was determined by averaging all grades made by each pupil in every subject completed in high school. The English averages were determined in the same manner, by using an average of grades made in four years of high school English. The typewriting grade average was determined by using either the first semester college typing grade or the average of two semesters grades made in high school.

The majority of the students used in this study made average or above average grades for high school students. While it might be interesting and valuable to know how the variation in the length of time of the speed tests might affect the typewriting achievement of below average students, this factor is not considered since it is not pertinent in determining the equivalency of the groups. Furthermore, it should be stated that there were no students in either group whose high school average or whose high school English average was below the grade of C. The writer does not mean to infer that none of the students made below C on any course but that the averages were not below C.

In the first part of Table III, which deals with the students' averages on their high school work, it may be observed that the same number of A's occur in each group; there are two more B's in Group II than in Group I, and conversely, two more C's in Group I than in Group II. This part of the academic achievement record indicates that the two groups are evenly matched.

The second part of Table III deals with the average grade for four years of high school English. In this section it can be seen that there is one more student making an A average in Group I than in Group II; two more students making a B average in Group II than in Group I; and one more student making a C average in Group I than in Group II. From this information it would seem that the students comprising each group are as nearly equivalent in ability in English as could be found.

The third part of Table III deals with the average grade in typewriting for two semesters in high school. It shows that there is one more student having an A average in Group II than in Group I; two more students having a B average in Group I than in Group II; one more student having a C average in Group I than in Group II; and the same number, two students in each group, having a D average in typewriting. By using the grades based on typewriting skill which the students acquired before enrolling in this course as an index of equivalency, the data indicate that the groups are closely paralleled in typewriting achievement.

Comparison of First Speed Test. As a further index, and since the typewriting skill of the pupils is a basic factor in this experiment, the results of the first speed test given to both groups at the beginning of the semester in which this experiment was conducted are included in Table IV.

As shown by the statistical calculations in Table IV, the arithmetic mean of Group I is 30.5 and for Group II is 30, a difference in the mean of the number of words per minute for the two groups of

TABLE IV
A COMPARISON OF THE RESULTS OF THE
FIRST TYPEWRITING SPEED TESTS

GROUP I

Step-Interval Scores	Midpoint	f	x'	fx'	fx' ²
45 - 49	47	1	3	3	9
40 - 44	42	1	2	2	4
35 - 39	37	2	1	2	2
30 - 34	32	7	0	0	0
25 - 29	27	6	-1	-6	6
20 - 24	22	2	-2	-4	8
15 - 19	17	1	-3	-3	9

N = 20

Arithmetic Mean 30.5
Standard Deviation 9.95
Standard Error 2.22

GROUP II

Step-Interval Scores	Midpoint	f	x'	fx'	fx' ²
45 - 49	47	1	3	3	9
40 - 44	42	2	2	4	8
35 - 39	37	4	1	4	4
30 - 34	32	2	0	0	0
25 - 29	27	5	-1	-5	5
20 - 24	22	4	-2	-8	16
15 - 19	17	2	-3	-6	18

N = 20

Arithmetic Mean 30
Standard Deviation 14.45
Standard Error 3.89
T .128

only .5 point. The standard deviation for Group I is 9.95 and for Group II 14.45, a difference of 4.50. The standard error of Group I is 2.22 and of Group II 3.89, a difference of 1.67. The T test, with a result of .128 shows that there is no appreciable difference in the typewriting ability of the groups at the beginning of the semester.

Sex and Race Factors. When considering the sex and racial factors, it was found that there were seventeen girls and three boys in each group; while both classes were predominantly Anglo-Saxon. In Group I, one participant was an American-born Jew; and in Group II there was one Spanish-American. On this basis, the groups are seen to be parallel with reference to sex and race.⁷

Minnesota Vocational Test for Clerical Workers. In addition to the factors suggested by Monroe and Engelhart⁴ the Minnesota Vocational Test for Clerical Workers was used to obtain further information to use as a basis in equating the groups. There is an admitted high correlation between the Minnesota Clerical Test and general intelligence tests.⁵ The scores which the two groups made on the number comparison part of the test are shown in Table V, parts I, and II; and the scores made on the name comparison part of the test are shown in Table VI, parts I, and II.

⁴Monroe and Engelhart, op. cit., p. 504f.

⁵Manual of Directions, Minnesota Vocational Test for Clerical Workers, Part VI, p. 4.

TABLE V
MINNESOTA VOCATIONAL TEST. TEST NUMBER 1,
NUMBER COMPARISON

GROUP I

Step-Interval Scores	Midpoint	f	x'	fx'	fx' ²
145 - 149	147	1	6	6	36
140 - 144	142	0	5	0	5
135 - 139	137	1	4	4	16
130 - 134	132	2	3	6	18
125 - 129	127	1	2	2	4
120 - 124	122	3	1	3	3
115 - 119	117	1	0	0	0
110 - 114	112	2	-1	-2	2
105 - 109	107	4	-2	-8	16
100 - 104	102	3	-3	-9	27
95 - 99	97	1	-4	-4	16
90 - 94	92	1	-5	-5	25

N = 20

Arithmetic Mean 115.25
Standard Deviation 14.40
Standard Error 3.21

GROUP II

Step-Interval Scores	Midpoint	f	x'	fx'	fx' ²
145 - 149	147	1	6	6	36
140 - 144	142	1	5	5	25
135 - 139	137	1	4	4	16
130 - 134	132	1	3	3	9
125 - 129	127	1	2	2	4
120 - 124	122	2	1	2	2
115 - 119	117	3	0	0	0
110 - 114	112	1	-1	-1	1
105 - 109	107	2	-2	-4	8
100 - 104	102	3	-3	-9	27
95 - 99	97	3	-4	-12	48
90 - 94	92	1	-5	-5	25

N = 20

Arithmetic Mean 114.75
Standard Deviation 15.65
Standard Error 3.21
T .110

TABLE VI
MINNESOTA VOCATIONAL TEST. TEST NUMBER 2,
NAME COMPARISON

GROUP I

Step-Interval Scores	Midpoint	f	x'	fx'	fx' ²
170 - 174	172	1	8	8	64
165 - 169	167	0	7	0	0
160 - 164	162	0	6	0	0
155 - 159	157	0	5	0	0
150 - 154	152	2	4	8	32
145 - 149	147	1	3	3	9
140 - 144	142	1	2	2	4
135 - 139	137	1	1	1	1
130 - 134	132	0	0	0	0
125 - 129	127	1	-1	-1	1
120 - 124	122	4	-2	-8	16
115 - 119	117	1	-3	-3	9
110 - 114	112	2	-4	-8	32
105 - 109	107	1	-5	-5	25
100 - 104	102	2	-6	-12	72
95 - 99	97	1	-7	-7	49
90 - 94	92	0	-8	-0	0
85 - 89	87	1	-9	-9	81
80 - 84	82	1	-10	-10	100

N = 20

Arithmetic Mean	121.25
Standard Deviation	21.50
Standard Error	4.80

TABLE VI
MINNESOTA VOCATIONAL TEST. TEST NUMBER 2,
TIME COMPARISON

GROUP II

Step-Interval Score	Midpoint	f	x'	fx'	fx' ²
170 - 174	172	0	8	0	0
165 - 169	167	1	7	7	49
160 - 164	162	1	6	6	36
155 - 159	157	1	5	5	25
150 - 154	152	0	4	0	0
145 - 149	147	0	3	0	0
140 - 144	142	0	2	0	0
135 - 139	137	2	1	2	2
130 - 134	132	2	0	0	0
125 - 129	127	2	-1	-2	2
120 - 124	122	3	-2	-6	12
115 - 119	117	3	-3	-9	27
110 - 114	112	0	-4	-0	0
105 - 109	107	0	-5	-0	0
100 - 104	102	3	-6	-18	108
95 - 99	97	1	-7	-7	49
90 - 94	92	0	-8	-0	0
85 - 89	87	1	-9	-9	81
80 - 84	82	0	-10	-0	0

N = 20

Arithmetic Mean 124.58
Standard Deviation 21.15
Standard Error 4.73
T .494

The arithmetic mean for the number comparison of Group I is 115.25 and for Group II is 114.75, a difference of only .50. The standard deviation for Group I is 14.40 and for Group II 15.65, a difference of 1.25. The standard errors for the two groups are exactly the same, 3.21. The T result of the test is .110, which when analyzed statistically shows that the difference between the two groups is not significant.

The scores of the two groups for the name comparison division of the test proved by the T show that the groups are practically equal in this part of the Minnesota Vocational Test also. Group I has an arithmetic mean of 121.25, Group II has a mean of 124.58, a difference of 3.33. The standard deviation shows a difference of only .35. Group I has a standard deviation of 21.50 and Group II has a standard deviation of 21.15. The standard error of Group I is 4.80 and of Group II 4.73, a difference of only .07. The T is .494.

It is not the purpose of this study to determine whether or not this test will indicate the probable success of typing students, but it is utilized as a basic criterion for equating the groups. Accepting these tests as an instrument in the selection of comparable groups, the results of the test indicate a very high correlation between the groups.

Commenting on paralleling groups, Garrett says, that:

If groups are . . . made up of individuals of nearly the same ability, most of the scores will fall near the same point on the scale, the range will be

relatively short and the variability will be small.⁶

It is believed that this rule would apply to Groups I and II indicating that the groups are equivalent.⁷

Summary of Chapter. In summarizing the characteristics of pupils considered in equating the experimental group and the control group before entering upon the experiment, the following factors of significance were brought out:

1. Pertinent points in Monroe and Engelhart's outline of variable factors in pupil characteristics were considered.
2. The Minnesota Vocational Test for Clerical Workers and the Otis General Intelligence Tests were given. A comparison of the scores shows the groups to be equal.
3. All of the pupils were within three years of the same age. In fact all of the pupils in the two classes are 17, 18, and 19 years of age.
4. The complete high school averages of the two groups indicate that the groups were evenly paired, whereas, the high school English averages show the same equivalence. The typewriting grades based on previously acquired skill in this field shows a close parallel. As a further measure of typewriting ability a comparison was made between the two groups using the results of the first

⁶Henry E. Garrett, Statistics in Psychology and Education (New York: Longmans, Green and Company, 1941), p. 33.

⁷See Appendix.

typewriting speed test given at the beginning of the semester. From the statistical analysis of the results of the test, there was no significant difference in the typewriting ability of the two groups at the beginning of the experiment.

5. The number of boys and girls was the same in both groups. The number of Anglo-Saxons was also the same in both groups.

6. The results of the Minnesota Vocational Tests for Clerical Workers, on both the Number Comparison and the Name Comparison shows the groups were well matched.

Although it is recognized that it would be impossible to absolutely match two groups on every item it is believed that the two groups used in this study were well paralleled.

The educative factors affecting pupil achievement will be discussed in Chapter III, wherein the suggested outline of variable factors by Monroe and Engelhart will again be used. The classroom procedure for the timed writing and the results of the tests will also be discussed.

CHAPTER III

A DISCUSSION OF THE EDUCATIVE FACTORS AFFECTING PUPIL
ACHIEVEMENT, AND A COMPARISON OF RESULTS OF THE
TIMED-WRITINGS

Educative Factors Affecting Pupil Achievement. It has been shown in Chapter II how the experimental and control groups were equated in regard to pupil characteristics. This chapter contains a discussion of the educative factors affecting pupil achievement. It also gives a resume of the methods in classroom procedure; the methods in giving and scoring the tests; and a comparison of the results of the timed-writings.

The Educative factors affecting pupil achievement which will be discussed may be divided into three classifications, which are as follows:

- A. Teacher factors
- B. General School factors
- C. Extra-School factors¹

Teacher Factors. In regard to teacher factors it should be pointed out that since the same teacher taught both groups that the teacher influence and the instructional techniques were as nearly the same for the experimental and control groups as was humanly possible. From the beginning throughout the entire experiment the instructor was enthusiastic, impartial, and had no preconceived opinion as to the outcome of the experiment. At all times she was in a good state of health. The personal factor, as far as the

¹Walter S. Monroe and Max D. Engelhart, The Techniques of Educational Research, p. 14f. The University of Illinois Bulletin, Vol. XXV, No. 19, Bureau of Educational Research Bulletin, No. 38 (Urbana: University of Illinois, 1928).

influence of the teacher was concerned, was as nearly equivalent for both groups as could be expected in a normal teaching situation.

General School Factors. As concerns the general school factors it should be stated that both groups used the same room, the same equipment, including typewriters, tables, chairs, and charts. The equipment included twenty-seven typewriters all of which were in good working order, however, not all of the machines were of the same trade name, but all were of standard size and make. There were eleven Royals, ten Underwoods, four L. C. Smiths, and two Remingtons.

At the beginning of the semester each student was asked to select the typewriter which he liked best. After a choice was made the student was assigned the machine throughout the course. This procedure was followed in both groups; therefore, there was no lost motion in locating a typewriter when the students reported to class. The subject matter and the text materials were the same for both groups.²

²D. D. Lessenberry, College Typing, Third Edition, South-Western Publishing Co., Dallas, Texas.

Adaline Hakes, Typewriting Speed Studies, Third Edition, Gregg Publishing Co., Chicago, Illinois.

Fred Tidwell, Unpublished materials, Oklahoma A. and M. College, Stillwater, Oklahoma

Speed Tests, published by the Typewriter Exchange.

Group I met from 8:30 to 9:30 A.M. on Monday, Wednesday, and Friday of each week. Group II met from 9:30 to 10:30 A.M. on the same days in the same room. This room was located on the west side of the building which was a favorable factor from the standpoint of having adequate natural light. Except for a few cloudy days it was not necessary to use the electric lights.

The personnel of each class remained the same for the entire semester; there being twenty-seven pupils in each group. Although only twenty pupils from each group were included in the study, every one received the same instruction and recognition. This procedure made it possible to eliminate distractions on the part of the non-participants, and furthermore the students did not know that the results of the tests were being used for this study.

Extra-School Factors. Pertaining to the Extra-School factors it may be said that the Amarillo Junior College is located adjacent to the residential section of the city. It is approximately two miles to the down town business district; consequently there were no unusual distractions or noises which would tend to interfere with normal classroom learning. Therefore, the exterior environment surrounding the participants in no way interfered with or hindered their accomplishments. A careful watch was maintained for factors within the groups which would affect the results of the experiment. At no time was it necessary to delete the record of any participant because of absences or over-participation in extra-curricular activities. None of the students worked outside of school either on part or full time jobs. There was only one

absence from a test in either group throughout the semester. This factor is mentioned because it provides an index, though not an objective one, to the attitude and interest of the participants toward their work.

Classroom Procedure Methods. The teacher divided the class periods into three principal parts: (1) the students were given what might be called a 'warming up exercise.' This lasted from ten to fifteen minutes and consisted of writing numbers, the alphabet, or some similar material followed by an exercise from the textbook. This latter exercise was for accuracy. (2) This period sometimes included a brief lecture on form, accuracy, and other important techniques in acquiring typing skill. Also, this part of the class period was sometimes used as a time for clearance of questions which the students wished to ask. Every member of the groups selected the typing course because of an interest in the subject; and because of this interest these informal discussion periods were engaged in with considerable enthusiasm by the majority of the participants in each group. (3) On the days the timed-writings were given, they were given following the discussion period.

The personnel of each group included only first year in college, second semester, students in typewriting. The chief aim of the course was to aid the students in acquiring more speed and accuracy in using the typewriter. Consequently, the learning exercises, the motivation procedures, directive suggestions, and diagnostic procedures were the same for each group.

It was important that the experiment be carried out in a natural and normal teaching atmosphere. Both groups were given the same instruction and the same procedures and terms were used. All unusual conditions such as an appeal to do well on the test, or timed writing were avoided. Furthermore, neither group knew what the other group had done except as the test results appeared on the bulletin board. This procedure was decided upon so that unusual rivalry between the groups might not arise, thus making the conditions surrounding the experiment unnatural.

A uniform procedure for each group was followed in correcting errors. After the timed-writing test each participant was asked to proofread his test and mark all errors. This was the first step in making the corrections. To correct an error the student was asked to isolate the word containing an error and practice it until a proper concept of the word had been set up and then to begin with the third word preceding the word containing the error and write again the words through the third word following the word in which the error was made. This exercise caused the pupil to rewrite seven words in context for each error. After all errors had been corrected in this manner, the sentence in which the error occurred was rewritten. The last requirement in the correction of an error was to rewrite the whole paragraph in which the error was made.

Methods of Giving and Scoring Tests. The instructions for the speed test were the same for each group and were used uniformly throughout the semester. At the beginning of each test the group

was told to, "Set your machine for a ____ minute posting test." Allowing sufficient time for the paper to be inserted and the machines to be set, the following questions were asked: "Are your line gauges set for double spacing?" "Are your margins set for a seventy space line at five and seventy-six?" "Is your paper marked one inch from the bottom?"

After the above conditions were complied with, the following instructions were given: "If you should make an error, omit the word in which the error occurs and continue. Finish the word that you are on when the bell begins to ring. Remove your paper from the machine, using the paper release device. This done, begin checking."

The number of errors and the net words per minute for each student were typed in chart form and posted in a conspicuous place on the bulletin board. Each chart was displayed for a week before being replaced by another one. This technique served a double purpose: it showed each participant his standing and progress in relation to the other members of his group; and it served as an incentive to do better. In this way each person endeavored to improve his record and was on the alert for ideas which would enable him to surpass last week's attainment.

The same procedure was followed for Groups I and II except that Group I began the second week of the semester with a five minute test with one minute added to the length of the test each week until a maximum of fifteen minutes was reached. Having reached this maximum time the length of the test remained at fifteen minutes for

TABLE VII

A COMPARISON OF THE RESULTS OF THE SEVENTEENTH
TYPEWRITING SPEED TEST

GROUP I

Step-Interval Scores	Midpoint	f	x'	fx'		fx' ²
65 - 69	67	1	4	4		16
60 - 64	62	1	3	3		9
55 - 59	57	0	2	0	11	0
50 - 54	52	4	1	4		4
45 - 49	47	8	0	0		0
40 - 44	42	3	-1	-3		3
35 - 39	37	1	-2	-2	-11	4
30 - 34	32	2	-3	-6		18

N = 20

Arithmetic Mean 47.00
 Standard Deviation 5.2
 Standard Error 1.16

GROUP II

Step-Interval Scores	Midpoint	f	x'	fx'		fx' ²
65 - 69	67					
60 - 64	62					
55 - 59	59					
50 - 54	52	5	2	10	14	20
45 - 49	47	4	1	4		4
40 - 44	42	5	0	0		0
35 - 39	37	4	-1	-4	-8	4
30 - 34	32	2	-2	-4		8

N = 20

Arithmetic Mean 43.50
 Standard Deviation 6.5
 Standard Error .42
 T 2.52

the remainder of the semester. Group II began with and did not vary from the fifteen minute weekly test throughout the semester.

Comparison of Last Speed Test. Table VII shows the results of the seventeenth speed test or timed-writing test for Group I, the experimental group. In order to observe the results more readily the number of words per minute for each participant was tabulated, then a table of scores ranging low enough to include the students making the highest and the lowest scores was arranged.³ Step-intervals of five were used in setting up the table. Then the midpoint of each interval and the number of frequencies for each interval was used to find the arithmetic mean for the entire group. The arithmetic mean for Group I is 47.00 words per minute. The mean for this group on the first timed test was 30.5 words per minute. This shows a net gain of 16.50 words per minute for the group during the semester.

The same procedure was used in finding the arithmetic mean for Group II as shown in the second part of Table VII. On the seventeenth timed test Group II, the control group, attained an arithmetic mean of 43.50 words per minute. The mean for this group on the first test of the semester was 30.0 words per minute. The net gain in words per minute for Group II was 13.50 words.

The average number of words per minute for Group I for the seventeenth week of the experimental period was 47.00 words per minute. Group II on the seventeenth test averaged 43.50 words

³ See Appendix.

per minute. Group I excelled Group II by 3.50 words per minute on the seventeenth test. Group I showed a net gain of 16.50 words per minute during the semester while the net gain of Group II was 13.50 words per minute. This difference of 3.00 words per minute in favor of Group I would indicate that the gradual increase in point of time is a more desirable technique in teaching type-writing to students of the first semester junior college level than the traditional procedure of maintaining a fixed time without variation for a timed test.

Table VII also shows the standard deviation of Group I as 5.2 and the standard error as 1.16. Group II had a standard deviation of 6.5 and a standard error of .42. The T of the seventeenth test is 2.52 which is significant at the 5 per cent level.

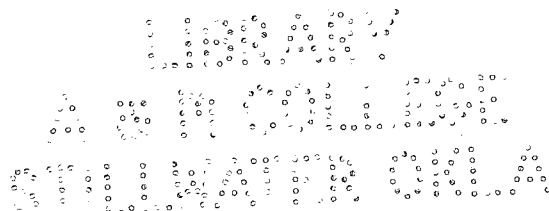
Summary of Chapter. In summarizing the data herein presented it has been shown that:

1. Since the same teacher taught both groups and used the same instructional techniques this enabled both groups to have equivalent learning opportunity.
2. Regarding general school factors, such as, the room, equipment, and text materials, it has been shown that exactly the same facilities were used.
3. The extra-school factors affected each group equally.
4. The classroom procedure was the same for each group.
5. In giving the tests exactly the same procedure was followed except Group II took a fifteen minute weekly test from the beginning of the semester and Group I began with a five minute test

which was increased one minute weekly until it reached the
 teen minute maximum time. This was the experimental factor to
 determine which method for timed-writing was productive of the
 best results under these same conditions.

6. The average words per minute for Group I was increased
 from 30.5 at the beginning of the semester to 47.00 at the close
 of the semester, a gain of 16.50 words per minute during the
 semester. The average words per minute for Group II was increased
 from 30.0 at the beginning of the semester to 43.50 at the close
 of the semester, a gain of 13.50. Group I, the experimental group,
 excelled Group II by 3.00 words per minute, in point of gain during
 the entire semester. On the last test, however, the score showed
 Group I to be 3.50 words a minute faster than Group II. On the
 first test Group I was only .5 words a minute faster than Group II.

The T scale test, which is a statistical device to measure
 the validity of the small sample, was applied to determine just
 how accurate the test was. The T, 2.52, was found to be signifi-
 cant in this case at the 5 per cent level.



CHAPTER IV

SUMMARY AND CONCLUSIONS

Summary. In summarizing the study it should be noted that in typewriting the element of fatigue should not be ignored when administering timed tests.

Psychologists have advocated using shorter intervals for performing non-habituated work to avoid undue fatigue. When fatigue does set in, the pupil's attention lapses and interfering associations arise. The student may acquire bad habits of work among which are habits of working lazily, or if not lazily, he at least may not be working carefully and correctly. It is generally recognized by psychologists and teachers that practice periods should depend on the ability of the student to concentrate. Since the ability of the students to concentrate will necessarily vary with the individual student, it is believed to be a psychologically sound method to begin the timed writing test at a short period of time and increase the timing gradually.

Equating the two groups before starting the experiment was considered to be of the utmost importance. The groups were matched on the basis of general intelligence in terms of point scores, chronological age, previous achievement, which included the complete average of the high school work, the high school English average, and previous achievement in typewriting. The groups were also matched as to sex and race. In addition to these factors the Minnesota Vocational Test for Clerical Workers was given to each student to obtain a further criterion for equating the groups. In all of these measurements the two groups showed a close equivalency.

The same teacher taught both classes in typewriting and consciously handled both classes in the same manner using the same techniques and procedures. The general school factors, as well as, the extra-school factors were the same for both groups. Equal opportunity was available for both groups to do well on their tests.

Exactly the same procedure was followed in giving the tests except the control group took a fifteen minute weekly test from the beginning of the semester, whereas the experimental group increased the length of the test one minute weekly from five minutes to fifteen minutes. This was the experimental factor.

Findings and Conclusions. The average words per minute for the experimental group was increased from 30.5 to 47.00 or 16.50 words increase during the semester. The average words per minute for the control group was increased from 30.0 to 43.50 or 13.50 words increase during the semester. The experimental group showed 3.50 words per minute increase over the control group which indicates that (the gradual increase in the time of the speed test is an efficient method.) However, the data are too limited, both from the standpoint of the number of students involved, and from the time limit of the study, to make the conclusions of decided value except as an indication of trends in a similar situation. It should be kept in mind that the graduated method was more effective in this controlled situation of selected students. This study should not be interpreted as predicting what would be the result in an ordinary class of students of varying intellect and ability as normally found in schools.

Suggestions for Further Study. An experiment with this method of timing the typewriting students speed tests should be made over a longer period of time in order to more thoroughly test the method. Also, it is recommended that a larger sampling of students be used in conducting this experiment. Further a comparison of results of such studies in different sections of the country would be of value.

It would be valuable to follow the students who participated in an experiment of this kind through another semester or two to determine whether or not their progress would continue in the same proportion and the same results as were found in this study.

It might be interesting and valuable to know how the variation in the length of time of the speed tests might affect the typewriting achievement of below average students in comparison with this group, all of whom averaged a grade of C or better.

It is suggested that further tests along this line and further refinement of interpretation of the data would be useful and enlightening in determining the most desirable timing of the tests as a guide to future activities of teachers in this field under the normal classroom situation.

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APPENDIX

TABLE VIII

PRIMARY DATA SHOWING NUMBER OF WORDS PER MINUTE
MADE ON EACH SPEED TEST DURING SEMESTER

GROUP I

27	30	25	27	30	32	36	38	37	32	33	38	39	32	34	32	33
38	40	41	47	35	49	52	48	46	51	46	54	51	48	48	49	49
23	26	34	33	30	28	32	37	33	33	28	37	37	37	39	42	40
47	51	53	55	45	53	50	57	61	63	55	57	64	62	49	61	63
32	31	37	44	39	52	36	46	48	53	58	52	54	54	47	53	51
30	30	38	41	41	45	39	44	43	47	54	49	49	50	43	49	46
29	33	37	34	31	37	37	38	38	40	42	34	35	34	40	40	46
28	32	28	33	32	33	35	38	41	41	44	37	36	40	37	36	47
42	27	35	41	37	42	41	35	44	45	44	46	49	48	51	52	48
34	36	37	55	55	56	57	55	60	58	61	63	63	34	44	60	67
32	35	37	44	39	37	43	38	44	42	45	56	53	44	49	45	51
25	30	35	38	30	37	37	40	37	41	45	42	44	49	37	46	48
37	49	42	49	44	47	51	44	58	39	41	47	44	50	42	44	49
29	35	28	40	34	45	42	41	35	42	43	47	46	44	44	42	51
26	31	38	36	28	34	40	35	33	37	18	40	34	39	34	40	30
33	27	34	37	39	42	38	39	41	34	37	44	49	45	44	45	44
28	31	31	27	35	38	34	32	37	35	34	42	40	36	20	38	41
16	22	27	32	34	39	34	33	27	21	39	43	36	44	26	39	45
22	25	26	33	30	36	35	36	34	39	36	41	45	40	35	37	39
34	38	36	40	46	45	43	50	45	39	40	39	44	36	42	49	52

TABLE VIII

PRIMARY DATA SHOWING NUMBER OF WORDS PER MINUTE
MADE ON EACH SPEED TEST DURING SEMESTER

GROUP II

37	34	35	36	40	41	35	35	36	30	33	25	36	45	28	34	36
36	34	30	38	44	46	42	45	46	48	49	50	45	46	48	47	51
26	27	20	33	24	32	28	31	37	34	36	32	24	35	33	34	32
22	25	25	28	31	37	39	35	34	38	41	37	34	29	41	39	46
42	44	43	48	51	45	43	43	50	51	46	47	45	49	32	50	50
47	41	43	43	45	52	47	43	49	43	50	52	41	49	42	51	41
28	29	33	34	31	36	41	40	38	39	47	38	43	37	31	42	38
21	26	33	32	32	31	37	40	30	36	36	38	33	34	39	34	36
44	54	47	52	56	46	55	53	45	52	52	53	53	62	60	53	53
32	36	32	32	41	44	45	46	47	45	46	39	44	45	46	46	46
28	34	37	41	44	35	47	43	44	38	45	50	49	43	23	48	49
18	21	22	19	23	30	25	29	34	28	31	30	28	31	33	35	36
35	37	38	31	34	41	40	41	37	36	41	44	47	44	45	47	44
31	32	34	35	39	40	40	41	45	42	48	49	54	56	41	49	50
28	31	25	29	30	35	43	50	32	46	44	33	43	36	40	50	45
37	34	35	41	39	40	49	47	51	41	46	48	56	49	50	56	53
20	28	31	33	33	28	36	36	40	37	32	34	43	37	44	43	43
27	31	34	35	33	31	38	38	41	36	33	39	42	40	25	48	44
24	30	30	31	32	37	32	29	32	39	37	32	35	37	22	35	34
18	25	20	33	31	37	35	36	39	41	38	41	37	41	37	37	43

UNIVERSITY OF PITTSBURGH

University Extension Division
Summer Sessions
Late Afternoon, Evening, and Saturday Classes

Office of the Director

June 18, 1942

Mrs. Wilda Talbot
2705 Harrison Street
Amarillo, Texas

Dear Mrs. Talbot

I am covered with shame and confusion that your letter of May 15 has been unanswered for so long a time. I have been out of the office much of the time since commencement, which we held this year some weeks ago. I make this explanation so that you will know that I do not usually neglect my correspondence as I have neglected your letter.

For the life of me I cannot find where I said anything about the need for the study you have undertaken, yet I distinctly recall having made such a statement on several occasions, although the statement was oral rather than written. As a matter of fact, you do not need any authority for the need of the study because the problem has its beginnings in conflicting classroom practice. I think it would be a defensible study for a master's degree and I am sure you need no further authority for setting up the problem.

I hope that you will forgive me for the delay in writing you. When your study is completed, I shall be interested to know something of your findings. Perhaps you will publish a summary of your studies. Your problem is interesting, and we do need some facts to guide our thinking in terms of this classroom practice.

Please accept my apologies--and at the same time accept my best wishes for success in your work.

Sincerely yours

D. D. Lessenberry

rh

This test is to be given during the week beginning October 7 or 14, 1940

STUDENT'S TYPEWRITING TEST

TYPEWRITER EDUCATIONAL RESEARCH BUREAU
100 EAST FORTY-SECOND STREET . NEW YORK

The Bureau distributes students' typewriting tests free to schools for use in their typewriting classes. The entire cost of maintaining this service has been subscribed equally by:

ROYAL TYPEWRITER COMPANY UNDERWOOD ELLIOTT FISHER COMPANY
L. C. SMITH & CORONA TYPEWRITERS, INC. REMINGTON RAND, INC.

Volume VII

October 1940

Number 1

COPYING TEST WITH ERASURES AND CORRECTIONS

Read instructions in Manual of Directions before giving this test

Do you know how to work? It does not matter what tasks you have to do, there is a right way to do each one. There are many wrong ways. The right way is always best in the long run. It will pay you to find that way when you have something important to do. It is best to do even the less important things in the right way.

There are at least two good reasons for this. Tasks done in the wrong way may have to be re-done. Time wasted in doing things over cannot be used for other things in the line of duty or pleasure. The other reason for doing all things as they should be done, even if no one will care if we don't, is that we thus form the habit of doing things right. It is this habit that makes it unnecessary to give attention to the way we do the simple tasks that make up the round of our daily work.

Now it should not be thought that the right way always takes less time. It may take more time than would several other ways. So we must not expect to shorten the task whenever we do something the right way. Usually it is better to do fewer things as they should be done than to do more things in a haphazard way.

However, there are times when perfection in doing things is not required. Suppose you are a typist in an office. Your employer hands you pencil copy for an advertisement and asks you to type it for him to edit and revise. Knowing that this piece of writing is not in its final form, and that it is going to be worked over some more before it is used, it would be a waste of time to type it with great care. But when it comes back to you for final typing, it is important to do it exactly right.

Of course, one must know the wishes of his employer when handling such a task. His wishes must be respected. An alert typist finds out what his employer's wishes are before going ahead with a typing job, and suggests time-saving ways of doing his work.

EXAMINATION

Designed especially for business institutions

By ARTHUR S. OTIS, PH.D.

Formerly Development Specialist with Advisory Board, General Staff, United States War Department

Name Time of finishing Acc.
 Permanent address Time of beginning Sp.
 Date 19 Time of exam Tot.

DIRECTIONS. Read this page carefully and do as you are directed.

First, write your name and address and the date on the dotted lines above.

This examination contains a list of 75 questions. You are not expected to be able to answer all of them correctly, but you should answer as many as you can. Take all the time you need. You will be scored on both accuracy and speed, but much greater weight will be given to accuracy than to speed. You will gain more by being sure you are right than by trying to finish quickly. You may answer the questions in any order.

In answering the questions do not write any words. If the answer is a word, it will be one of the five words given after the question. Only one answer is correct. First read the question, then look at the five words following it, pick out the right answer and draw a line under it for reference. Then put the number of that word in the parentheses () at the end of the line, as shown in the samples below. You will be scored only according to the numbers in the parentheses; so be sure these are right. For example, look at the first sample question and the five words following it. It says: "A pear is a kind of (?)" It is not a tree nor flower nor vegetable nor animal, but a fruit. So the word "fruit" is underlined; and as it is No. 4, a figure 4 is placed in the parentheses at the end of the line. This is the way you are to answer the questions. Now look at the second sample. The opposite of tall is short, so the word "short" is underlined; as it is No. 3, a figure 3 is placed in the parentheses at the end of the line. If the answer is a number or a letter, as in the third and fourth samples, you may write that number or letter in the parentheses at the end of the line without underlining anything. Make your letters like printed capitals. If you think you understand these directions, go ahead and answer questions numbered 5, 6, 7, and 8 below the samples. After you have done this, show your paper to the examiner before you do anything else. If you do not fully understand the directions, ask the examiner then. Do not open or turn over the examination paper. No questions will be answered after you turn the page.

SAMPLES:

1. A pear is a kind of (?) 1 tree, 2 flower, 3 vegetable, 4 fruit, 5 animal (4)
2. The opposite of tall is (?) 1 down, 2 thin, 3 short, 4 flat, 5 young (3)
3. What number should come next after 12 in this series? 2, 4, 6, 8, 10, 12 (14)
4. What is the seventh letter of the alphabet? (Make it like a printed capital.) (G)

BEGIN HERE:

5. The opposite of west is (?) 1 north, 2 equator, 3 east, 4 south, 5 pole (3)
6. A boy's father's father is his (?) 1 cousin, 2 grandfather, 3 uncle, 4 son, 5 nephew (2)
7. What number should come next after 9 in this series? 1, 3, 5, 7, 9 (11)
8. Write the letter that comes just before T in the alphabet (S)

Show your paper to the examiner before turning the page.

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CONTINUE HERE :

1. A pansy is a kind of (?).....1 animal, 2 flower, 3 fruit, 4 tree, 5 dish (2)
2. The opposite of early is (?).....1 after, 2 now, 3 late, 4 soon, 5 when..... (3)
3. The opposite of brave is (?).....1 fear, 2 weak, 3 pain, 4 stingy, 5 cowardly . (5)
4. A boy's father's brother is his (?)...1 cousin, 2 uncle, 3 grandfather, 4 son, 5 nephew (2)
5. What number should come next after 12 in the following series? 3, 6, 9, 12..... (14)✓
6. What number should come next after 8 in the following series? 24, 20, 16, 12, 8 (12)✓
7. If these words — build, birds, nests — were arranged to make a sentence, the first word of the sentence would be (?).....1 build, 2 birds, 3 nests (2)
8. If the words — months, warmest, are, summer, the, the — were arranged to make a sentence, the second word of the sentence would be (?)
1 months, 2 warmest, 3 are, 4 summer, 5 the (4)
9. If the words — pens, for, used, are, writing, ink, and — were arranged to make a sentence, the fourth word of the sentence would be (?)
1 pens, 2 for, 3 used, 4 are, 5 writing, 6 ink, 7 and (2)✓
10. If the words — and, keep, feathers, warm, fur, animals — were arranged to make a sentence, the last word of the sentence would be (?)
1 and, 2 keep, 3 feathers, 4 warm, 5 fur, 6 animals (4)
11. At 7 cents each, how many pencils can be bought for 56 cents? (8)
12. If a boy spent 17 cents and then earned 35 cents, how many more cents did he have than at first? (38)✓
13. How many miles can a train go in 6 hours at the rate of 40 miles an hour? (240)
14. Foot is to man as hoof is to (?)...1 leg, 2 dog, 3 horse, 4 boy, 5 shoe (3)
15. Pitcher is to milk as (?) is to flowers...1 stem, 2 leaves, 3 water, 4 vase, 5 roots.... (4)
16. Boy is to man as (?) is to sheep...1 wool, 2 lamb, 3 goat, 4 shepherd, 5 dog ... (2)
17. Clock is to time as thermometer is to (?)
1 glass, 2 warm, 3 bulb, 4 mercury, 5 temperature (5)
18. It is safest to judge a man's character by his (?)
1 voice, 2 clothes, 3 deeds, 4 wealth, 5 profile (3)
19. Gold is more costly than silver because it is (?)
1 heavier, 2 scarcer, 3 yellow, 4 more malleable, 5 prettier (1)✓
20. What number is wrong in this series? 1, 2, 4, 7, 11, 16, 23..... (2)✓
21. Which of the ten statements below explains this proverb? "Don't cry over spilt milk." (3)
1. Don't believe everything you hear.
2. Unhappy experiences teach us to be careful.
3. It is foolish to worry about things we can't help.
4. It is better to be content with little than to gamble for more.
5. Appearances are often deceptive.
6. Desperate people cling to absurd hopes.
7. It pays to attend to troubles before they get worse.
8. One cannot have the same luck forever.
9. A single sign is not convincing.
10. It pays to do only one thing at a time.
22. Which statement above explains this proverb? "All is not gold that glitters."..... (1)✓
23. Which statement explains this proverb? "A stitch in time saves nine."..... (10)✓
24. Which statement explains this proverb? "A burned child dreads the fire."..... (2)
25. Which statement explains this proverb? "A bird in hand is worth two in the bush." (4)
26. Which statement explains this proverb? "It is a long road that has no turn."..... (9)
27. Which statement explains this proverb? "One swallow does not make a summer."... (5)✓
28. Which statement explains this proverb? "A drowning man will grasp at straws."... (6)
29. One number is wrong in this series: 1, 2, 4, 8, 16, 36, 64. What should it be?..... (1)✓

30. One number is wrong in this series: 1, 5, 2, 6, 3, 7, 4, 8, 6, 9. What should it be?... (6) ✓
31. Among the five things mentioned after this question, which is most like these three?
rose, daisy, violet..... 1 tree, 2 seed, 3 peach, 4 bush, 5 pansy..... (4) ✓
32. Which is most like these three? pan, bowl, basket
1 fork, 2 pail, 3 eat, 4 food, 5 spoon (2)
33. Which is most like these three? ax, knife, shears
1 razor, 2 hammer, 3 hoe, 4 rake, 5 fork (1)
34. Which is most like these three? tugboat, tractor, horse
1 locomotive, 2 canoe, 3 caboose, 4 side car, 5 track (4) ✓
35. Which is the opposite of pride?... 1 sorrow, 2 humility, 3 misery, 4 conceit, 5 envy () ✓
36. Which is the opposite of hope?... 1 faith, 2 glory, 3 sorrow, 4 despair, 5 hate.. (3) ✓
37. Which is the opposite of honor?... 1 insult, 2 disgrace, 3 cowardice, 4 fear, 5 defeat (5) ✓
38. Which is the opposite of if?... 1 however, 2 unless, 3 also, 4 therefore, 5 and (2)
39. Congress is to United States as (?) is to city
1 mayor, 2 council, 3 city attorney, 4 president, 5 citizens (2)
40. Beautiful is to appearance as sweet is to (?)... 1 taste, 2 beauty, 3 sour, 4 ugly, 5 nice (1)
41. Physics is to motion as (?) is to blood
1 temperature, 2 body, 3 veins, 4 physiology, 5 geography (2) ✓
42. Sorrow is to misfortune as joy is to (?)
1 grief, 2 happiness, 3 hatred, 4 success, 5 pride (4)
43. Violence is to anger as (?) is to love. 1 caressing, 2 hate, 3 temper, 4 hope, 5 pleasure (5) ✓
44. A mother is always (?) than her daughter
1 wiser, 2 homelier, 3 kinder, 4 older, 5 taller (4)
45. Which is most like love, fear, and sorrow?
1 habit, 2 anger, 3 memory, 4 life, 5 thought (3) ✓
46. Which is most like loyalty, bravery, and generosity?
1 sympathy, 2 wealth, 3 wisdom, 4 strength, 5 health (3) ✓
47. Think how the first three drawings below are alike and tell by number which one of the five others is most like the first three (5) ✓
48. Do the same with these drawings (4) ✓
49. If I have a large box with 2 small boxes in it and 3 very small boxes in each of the 2 small boxes, how many boxes are there in all?..... (9)
50. If I have a large box with 3 small boxes in it and 5 very small boxes in each of the 3 small boxes, how many boxes are there in all?..... (19)
51. Safety is to accident as (?) is to disease
1 doctor, 2 hospital, 3 bandage, 4 sanitation, 5 pain (4)
52. Revolution is to evolution as explosion is to (?)
1 plants, 2 world, 3 volcano, 4 crumbling, 5 war (3) ✓
53. If a strip of cloth 48 inches long will shrink to 44 inches when washed, how many inches long will a 36-inch strip of the same cloth be after shrinking?..... (32) ✓
54. A hotel serves a mixture of 3 parts cream and 2 parts milk. How many pints of cream will it take to make 15 pints of the mixture? () ✓
55. If a wire 30 inches long is to be cut so that one piece is $\frac{2}{3}$ as long as the other piece, how many inches long must the longer piece be?..... (1) ✓

56. If a boy is now one and one half times as old as his sister and in five years will be one and one third times as old, how old is he now?..... (16) ✓



57. If the hands of the clock were reversed from their position when it is 10:08 (8 minutes past 10), each hand being put in the position of the other, the time by the clock would then be approximately (?). Tell in figures. Do not mark in drawing..... (1:50)

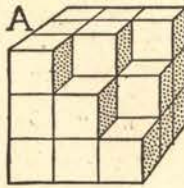
58. Count each 4 in this series that is followed by an 8 next to it if that 8 does not have a 6 next after it. Tell how many 4's you count..... (6) ✓

4 8 6 2 4 6 8 3 4 8 8 6 3 8 6 4 6 4 8 7 4 8 4 8 6 2 4 6 8 6 4 2 4 8 7 4

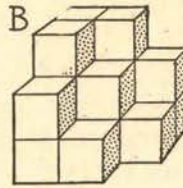
59. What is the third number that is skipped in this series?..... (50)

123456789101112131415161718192021222324252627282930313234353637383940414243
454647484951525354565860

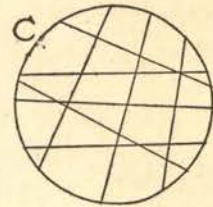
60. How many cubes are there in the pile pictured at A?..



61. How many cubes are there in the pile pictured at B?..



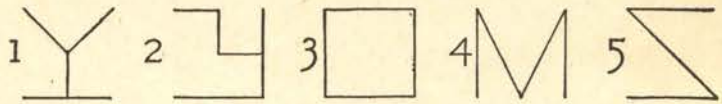
62. Count all the spaces, large and small, between the lines in the circle at C without making any marks in it, and tell how many there are.....



63. What is the least number of links it would be necessary to cut open and join together again to make one straight chain of these five pieces?..... (3)



64. Which of these five forms would take the most wire to make?..... (3)



65. Which of the same five forms would take the least wire?..... (5) ✓

66. Write the letter which follows the letter which comes next after E in the alphabet. (Make it like a printed capital.)..... (G)

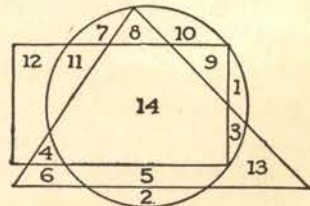
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

67. If all the even-numbered letters in the alphabet were crossed out, the sixth letter left, not crossed out, would be what letter? Do not mark the alphabet..... (F) ✓

68. Write the letter which is the third letter to the right of the letter which is midway between L and P..... (Q)

69. Suppose that the first and second letters of the alphabet were interchanged, also the third and fourth, the fifth and sixth, etc. Write the letter which would then be the sixteenth letter of the series..... (O)

70. What number is in the space which is in the rectangle and in the triangle but not in the circle?..... (4)



71. What number is in the same geometrical figure or figures as the number 6?..... (13)

72. What letter in the word "Washington" is the same number in the word (counting from the beginning) as it is in the alphabet?..... (G)

73. What is the first letter in the word "Evelyn" that is just as far from the end of the alphabet as it is from the end of the word?..... (Y) ✓

74. Find the two letters in the word "water" which have just as many letters between them in the word as in the alphabet. Write the one of these letters that comes first in the alphabet..... (S) ✓

75. Find the letter which in this question appears a second time nearest the beginning.... (E)

OTIS GENERAL INTELLIGENCE EXAMINATION

Designed especially for business institutions

By ARTHUR S. OTIS, Ph.D.

Formerly Development Specialist with Advisory Board, General Staff, United States War Department

DIRECTIONS AND KEY

Purpose of the examination. The Otis General Intelligence Examination is designed expressly for commercial institutions which have need to test the intelligence of applicants for clerical and executive positions. It embodies the experience of the author in the testing of over 50,000 draftees in the United States Army, in the making of the Otis Group Intelligence Scale which has been used to test the intelligence of over 600,000 pupils and students in every type of school and college, and in the testing of large numbers of employees in business institutions.

Its self-administrative character. The examination is an innovation in intelligence testing in that it embodies the principle of "self-administration." The Army Intelligence Scale, for instance, requires all who are to be tested to assemble together and begin the examination at the same time, while a trained examiner devotes from 45 minutes to an hour in reciting at intervals the directions for the different tests. This method would be next to impossible in a commercial institution, for applicants must be interviewed singly and after being interviewed are ready to take the examination without further delay. Applicants therefore appear for examination one at a time at intervals throughout the day. For a trained examiner to devote in this way his whole time to each applicant singly would be decidedly costly. The distinctive feature of the Otis General Intelligence Examination is one which obviates these difficulties. The examination is so constructed that any number of individuals may begin at any time, or singly at any intervals, and no attention on the part of the examiner is required during the taking of the examination. No training whatever is required to administer the examination; this may be done, indeed, by a clerk, who will simply hand the examination folder to the applicant, call his attention to the printed directions on the first page, see that he understands these after reading them, and note the time when the examinee begins the examination and the time of finishing. This completes the administration of the examination. The folder may be scored by a clerk in from 40 seconds to 1 minute. One point is given for each of the 75 questions constituting the examination and from 1 to 25 points for "speed," making a possible Total Score of 100 points.

Its validity. The most important consideration with regard to any so-called intelligence examination is, after all, the degree of correspondence between the scores in the examination and the opinion of competent judges as to the intelligence of an individual. To test the examination in this regard, a special investigation was made in which it was administered to one hundred clerks in the office of a large New York firm, each of whom was also rated by executives of the office, who knew them well. Each clerk was rated in each of three factors which taken together would constitute a rating in "General Value to the Firm." These were Intelligence, Personal Qualities, and Professional Value. No assumption was made, of course, as to whether the examination would measure Personal Qualities or Professional Value, but these were rated as a matter of interest. The problem of prime importance was to determine the extent to which the examination measures Intelligence as judged by those who knew the examinees well. In rating Intelligence, judges were requested to consider Intelligence as a combination of resourcefulness, ingenuity, ease of learning, and ability to understand directions easily and to arrive at a sensible decision in a new and problematical situation. In rating Personal Qualities, the judges were asked to consider neatness, taste, agreeableness of personality, initiative, loyalty, reliability, and coöperation. "Professional Value" was defined to cover training and experience both in and previous to the present occupation.

Each clerk was rated very carefully by from two to four executives who had known him for a year or more, according to a rating scale of the type used so successfully in the Personnel Division of the United States Army. The ratings of the same individual by different judges were found to correspond only fairly, a fact which it was necessary to take into consideration. To obtain exact measurements of the degree of correspondence between scores in the examination and the ratings, this degree of correspondence was found in terms of the coefficient of correlation between the scores of the one hundred clerks in the examination and the combined ratings of the judges as to the Intelligence of each of the individuals. Similarly a coefficient of correlation was found between the scores and a measure called "General Value,"

which was an average of the ratings in Intelligence, Personal Qualities, and Professional Value. Making allowance by the so-called method of correcting for attenuation, for the errors of judgment, as indicated by the lack of uniformity between judgments of the same individual by different judges, these coefficients of correlation are as follows:

Scores with judgments of Intelligence: .73

Scores with judgments of General Value: .57

These coefficients show that it is possible by means of the Otis General Intelligence Examination to ascertain the degree of Intelligence of an applicant with the expenditure of only a few minutes of a clerk's time, with a degree of accuracy equal to an estimate of a competent judge after an acquaintance of several years. They show also that while the examination in no sense aims to measure Personal Qualities or Professional Value, nevertheless the score is of considerable significance as a measure of these factors of General Value, due to the fact that to some extent these are associated with Intelligence.

The Otis General Intelligence Examination shows a correlation of .84 with the Army Intelligence Scale, which was used to classify according to Intelligence over a million and a half draftees in the United States Army.

A word of caution needs to be said at this point. Since the instances are often so striking in which the examination "spots" the man who has recognized intelligence and sagacity (as in a recent case in which, of a large number of employees of a certain firm who were tested, the individual obtaining the highest score was the general manager) and in which the results so accurately forecast the career of an applicant, as later unfolded, employment managers and others are inclined to consider the score in the examination as final and to regard it as almost absolute. Obviously, however, the examination is not infallible, and while it is impossible for a really dull person to make a high score, it occasionally happens that for certain reasons a really bright person fails to do himself justice. This being the case, one may confidently say that any one who makes a high score is surely intelligent, but that, on the other hand, confusion from extreme nervousness or other cause may sometimes prevent an applicant from making the score he should. If an individual makes a low score, who from other considerations gives evidence of having more intelligence than the score would indicate, a second interview or a second examination, making due allowance for previous knowledge, will often be illuminating. Such cases are ex-

ceptional, however, and in general it should be said that the examination should be considered in no sense final or absolute, but as a very valuable adjunct to the regular interview. Its results should be interpreted in the light of the interview and judgment made on the evidence as a whole.

Administration. To administer the examination, place the examination folder before each applicant to be tested and say, "Read this first page carefully and do what it says. Do not open the examination paper." Allow the applicant as much time as he desires in which to read the directions and to answer the last four sample questions. When he has brought the folder back as directed on the first page, note whether the blanks at the top are properly filled and the four samples correctly answered. In samples 5 and 6, the words *east* and *grandfather* should be underlined and the answers in the parentheses should be respectively 3, 2, 11, and S. The letter S should be a capital letter; if it is not, call the applicant's attention to the directions regarding the use of only capital letters in the answers. If any other error occurs, call the applicant's attention to the appropriate direction or otherwise explain. Finally, whether errors have been made or not, ask the applicant if he understands the directions perfectly, and when he thinks he does, record the time by the clock in the space marked "Time of beginning" and say: "Now turn over the page and begin the examination. When you have finished, bring the paper to me immediately so that I may record the time of finishing."* Give no explanation regarding the meaning of any questions. When the applicant has brought the folder back after finishing, record immediately the time in the space marked "Time of finishing."

If desired, the examination folders may be numbered and filed consecutively and the examination number placed on such filing cards as are kept in the employment office.

Scoring. To score the examination, fold open the Manual and compare the answers given in the blank with those printed on the margins of pages 2 and 3 of the Manual. Each correct answer counts one point. No partial credits are given. Place the number of correct answers in the space after "Acc." This is called the Score for Accuracy. The asterisks after certain answers denote that certain additional considerations are to be taken into account, as follows: No. 57, count as correct also 1:50 and 1:52, except that no answer is counted correct if marks have been made in the drawing; No. 62, count

* If desired, a time limit of, say, half an hour may be placed upon the examination and the examinee so informed at this point. This will in no way alter the method of scoring the examination.

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cent of clerks, then 75 is to be considered a very good score for a clerk. A score, therefore, can be understood only in the light of other scores. In interpreting any individual's score in the Otis General Intelligence Examination, therefore, do not do so in terms of any preconceived notion as to what should be a "passing score," nor in relation to a "perfect score," nor think of the score itself as necessarily a "per cent."

The most practical way to interpret the score of any individual is to determine the *percentage of individuals in his class whom he exceeds in intelligence*. Thus let us suppose the individual is applying for the position of clerk. The question to be answered is: What percentage of clerks in general will this individual exceed in intelligence? If he exceeds just 50 per cent, he is of "average" intelligence for a clerk. If he exceeds 75 per cent of clerks in intelligence, that fact is significant of itself, though we might characterize his intelligence

as "good" for a clerk. If he exceeds 95 per cent of clerks in intelligence, we might describe his intelligence as "exceptional" for a clerk; but the percentage of clerks whom he exceeds — the fact, in other words, that only five clerks in one hundred would exceed him in intelligence — is, after all, the most significant aspect of his intelligence.

To enable the examiner to compare the score of any individual with scores of others, the following tables are provided. Table 1 shows the percentage of clerks in general whose scores are exceeded by a given score. Thus, suppose an applicant makes a score of 75 in the examination; by the table it will be seen that he exceeds 98 per cent of clerks in intelligence. He is said, therefore, to have a "Percentile Rank" of 98 among clerks. An applicant who makes a score of 30 in the examination is seen to have a Percentile Rank of 16 among clerks; that is, he exceeds only 16 per cent of clerks in intelligence — a fact which needs no further elucidation.

TABLE 1. SHOWING FOR EACH SCORE THE CORRESPONDING PERCENTILE RANK AMONG CLERKS
(Revised August, 1922)

Score	2	7	11	13	15	17	19	20	22	23	24	25	26	27
Percentile Rank	0.2	0.5	1	1.5	2	3	4	5	6	7	8	9	10	11
Score	28	29	30	31	32	33	34	35	36	37	38	39	40	41
P. R.	13	14	16	17	19	21	23	25	27	29	32	34	37	39
Score	45	46	47	48	49	50	51	52	53	54	55	56	57	58
P. R.	50	53	55	58	61	63	66	68	71	73	75	77	79	81
Score	62	63	64	65	66	67	68	70	71	73	75	77	79	83
P. R.	87	89	90	91	92	93	94	95	96	97	98	98.5	99	99.5

In Table 2 is shown the correspondence between scores and Percentile Ranks among privates in the United States Army. This table is perhaps

of incidental interest only, but it serves to throw some additional light upon the significance of scores.

TABLE 2. SHOWING FOR EACH SCORE THE CORRESPONDING PERCENTILE RANK AMONG PRIVATES OF THE U. S. ARMY

Score	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
Percentile Rank	9	10	11	13	14	16	17	19	21	23	25	27	29	32	34	37	39	42	45	47	50	53	55	58
Score	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67
P. R.	61	63	66	68	71	73	75	77	79	81	83	84	86	87	89	90	91	92	93	94	95	95.5	96	97

Refinement of tables. In order that Percentile Rank tables may be made, based upon still larger numbers of persons, and that special tables may be made for the various types of employees, — i.e., stenographers, salesmen, executives, etc., — the author requests that results of examinations be sent him. As results accumulate, these tables may be

made of increasing value. In consideration of this coöperation the author will send the latest tables that have been compiled.

For this purpose no names are required, but merely a list giving the specific occupation and score of each examinee. Address Dr. Arthur S. Otis, care of World Book Company, Yonkers-on-Hudson, New York.

MINNESOTA VOCATIONAL TEST FOR CLERICAL WORKERS

(Arranged by Dorothy M. Andrew under the direction of Donald G. Paterson and Howard P. Longstaff)

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Name _____ Date _____

TEST 1—Number Comparison

Number Right 134

Number Wrong 1

Score = R—W 133

Percentile Rating _____

TEST 2—Name Comparison

Number Right 136

Number Wrong 0

Score = R—W 136

Percentile Rating _____

Instructions

On the inside pages there are two tests. One of the tests consists of pairs of names and the other of pairs of numbers. If the two names or the two numbers of a pair are *exactly the same* make a check mark (✓) on the line between them; if they are *different*, make no mark on that line. When the examiner says "Stop!" draw a line under the last pair at which you have looked.

Samples done correctly of pairs of Numbers

79542 _____ 79524

5794367 ✓ 5794367

Samples done correctly of pairs of Names

John C. Linder _____ John C. Lender

Investors Syndicate ✓ Investors Syndicate

Now try the samples below.

66273894 _____ 66273984

527384578 ✓ 527384578

New York World ✓ New York World

Cargill Grain Co. _____ Cargil Grain Co.

This is a test for Speed and Accuracy. Work as fast as you can without making mistakes.

Do not turn this page until you are told to begin.

Test 1

✓ Check if the two numbers are the same.

- | | | | | | |
|-----|--------------|--------------|------|--------------|--------------|
| 1. | 307 | 309 | 51. | 5829 | 5820 |
| 2. | 4605 | 4603 | 52. | 192836472829 | 192836472829 |
| 3. | 976 | 996 | 53. | 362 | 362 |
| 4. | 101267 | 101267 | 54. | 2039271827 | 2039276837 |
| 5. | 3065432 | 30965432 | 55. | 73829 | 73829 |
| 6. | 103345700 | 103345700 | 56. | 82739102837 | 82739102837 |
| 7. | 46754 | 466754 | 57. | 48891028 | 48891028 |
| 8. | 3367490 | 3367490 | 58. | 7291728 | 7291928 |
| 9. | 2779 | 2778 | 59. | 172839102839 | 172839102839 |
| 10. | 57394 | 57394 | 60. | 628192 | 628102 |
| 11. | 63801829374 | 63801839474 | 61. | 473829432 | 473829432 |
| 12. | 283577657 | 283577657 | 62. | 478 | 478 |
| 13. | 75689 | 75689 | 63. | 372816253902 | 372816252902 |
| 14. | 2547892026 | 2547893026 | 64. | 64829 | 64830 |
| 15. | 336354 | 336254 | 65. | 4739210249 | 4739210249 |
| 16. | 998745732 | 998745733 | 66. | 748362 | 748363 |
| 17. | 623 | 623 | 67. | 728354792 | 728354772 |
| 18. | 263849102983 | 263849102983 | 68. | 3927 | 3927 |
| 19. | 5870 | 5870 | 69. | 927384625 | 927384625 |
| 20. | 379012 | 379012 | 70. | 4628156 | 4628158 |
| 21. | 8734629 | 8734629 | 71. | 6382 | 6392 |
| 22. | 2549806746 | 2549806746 | 72. | 12937453829 | 12937453829 |
| 23. | 57802564 | 57892564 | 73. | 523 | 533 |
| 24. | 689246 | 688246 | 74. | 7263920 | 7263920 |
| 25. | 1578024683 | 1578024683 | 75. | 74293 | 74293 |
| 26. | 582039485618 | 582039485618 | 76. | 82734291 | 82734271 |
| 27. | 63829172630 | 63829172639 | 77. | 2739102637 | 2739102637 |
| 28. | 592 | 592 | 78. | 62810263849 | 62810263846 |
| 29. | 829374820 | 829374820 | 79. | 638291 | 638291 |
| 30. | 62937456 | 63937456 | 80. | 62831027 | 62831027 |
| 31. | 8293 | 8293 | 81. | 527 | 529 |
| 32. | 6382910293 | 6382910292 | 82. | 172438291026 | 172438291026 |
| 33. | 781928374012 | 781928374912 | 83. | 7253829142 | 725382942 |
| 34. | 68293 | 68393 | 84. | 836287 | 836289 |
| 35. | 18203649271 | 18293649271 | 85. | 62435162839 | 62435162839 |
| 36. | 4820384 | 4820384 | 86. | 6254 | 6256 |
| 37. | 283019283745 | 283019283745 | 87. | 6241526 | 6241526 |
| 38. | 73927102 | 73927102 | 88. | 1426389012 | 1426389102 |
| 39. | 91029354829 | 91029354829 | 89. | 825 | 825 |
| 40. | 38291728 | 38291728 | 90. | 67253917287 | 67253917287 |
| 41. | 6283910293 | 6283910203 | 91. | 6271 | 6271 |
| 42. | 392018273648 | 392018273848 | 92. | 263819253627 | 263819253629 |
| 43. | 820 | 829 | 93. | 82637 | 82937 |
| 44. | 572937273 | 572937373 | 94. | 728392736 | 728392736 |
| 45. | 7392 | 7392 | 95. | 62739 | 62739 |
| 46. | 8172036 | 8172036 | 96. | 728352689 | 728352688 |
| 47. | 68391028364 | 68391028394 | 97. | 463728 | 463728 |
| 48. | 48293 | 48292 | 98. | 73829176 | 73827196 |
| 49. | 739201 | 739201 | 99. | 4825367 | 4825369 |
| 50. | 62839201 | 62839211 | 100. | 56382018 | 56382018 |

✓ Check if the two numbers are the same.

- | | | | |
|------|-----------------------------|------|-----------------------------|
| 101. | 789 ✓ 789 | 151. | 73526 — 73526 |
| 102. | 819263728192 — 819263728172 | 152. | 7283627189 — 7283627189 |
| 103. | 682537289 — 682537298 | 153. | 627 — 637 |
| 104. | 7245 ✓ 7245 | 154. | 728352617283 — 728352617282 |
| 105. | 82936542891 ✓ 82936542891 | 155. | 6281 — 6381 |
| 106. | 4738267 — 4738277 | 156. | 936271826 — 936371826 |
| 107. | 63728 — 63729 | 157. | 82637192037 — 82637192037 |
| 108. | 6283628901 — 6283628991 | 158. | 527182 — 527182 |
| 109. | 918264 ✓ 918264 | 159. | 6273 — 6273 |
| 110. | 263728192037 — 263728192073 | 160. | 726354256 — 72635456 |
| 111. | 52839102738 — 5283910238 | 161. | 725361552637 — 725361555637 |
| 112. | 6283 — 6282 | 162. | 7526378 — 7526377 |
| 113. | 7283529152 ✓ 7283529152 | 163. | 685 — 685 |
| 114. | 208 — 298 | 164. | 82637481028 — 82637481028 |
| 115. | 82637201927 — 8263720127 | 165. | 3427 — 3429 |
| 116. | 15273826 ✓ 15273826 | 166. | 827364933251 — 827364933351 |
| 117. | 72537 — 73537 | 167. | 63728 — 63728 |
| 118. | 726391027384 ✓ 726391027384 | 168. | 6273846273 — 6273846293 |
| 119. | 627389 — 627399 | 169. | 62836 — 6283 |
| 120. | 725382910 ✓ 725382910 | 170. | 2638496 — 2638496 |
| 121. | 46273 ✓ 46273 | 171. | 738291627874 — 738291627874 |
| 122. | 629 — 620 | 172. | 62836454 — 62836455 |
| 123. | 7382517283 ✓ 7382517283 | 173. | 42738267 — 42738269 |
| 124. | 637281 — 639281 | 174. | 573829 — 573829 |
| 125. | 2738261 — 2728261 | 175. | 628364728 — 628364928 |
| 126. | 627152637490 ✓ 627152637490 | 176. | 725 — 735 |
| 127. | 73526189 ✓ 73526189 | 177. | 627385 — 627383 |
| 128. | 5372 — 5392 | 178. | 63354 — 63354 |
| 129. | 63728142 — 63728124 | 179. | 54283902 — 54283602 |
| 130. | 4783946 — 4783046 | 180. | 7283562781 — 7283562781 |
| 131. | 82637281028 ✓ 82637281028 | 181. | 62738 — 63738 |
| 132. | 628 ✓ 628 | 182. | 727355542321 — 72735542321 |
| 133. | 7293728172 — 7293728177 | 183. | 263849332 — 263849332 |
| 134. | 7362 ✓ 7362 | 184. | 162837 — 163837 |
| 135. | 927382615 ✗ 927382615 | 185. | 47382912 — 47382922 |
| 136. | 85345 — 85345 | 186. | 628367299 — 628367399 |
| 137. | 895643278 — 895643277 | 187. | 111 — 111 |
| 138. | 726352 — 726353 | 188. | 11829304829 — 11828304829 |
| 139. | 7263524 — 7263524 | 189. | 4448 — 4448 |
| 140. | 632685 — 632685 | 190. | 333693678 — 333693678 |
| 141. | 273648293048 — 273648293048 | 191. | 3212 — 3212 |
| 142. | 634 — 634 | 192. | 27389223678 — 27389223678 |
| 143. | 7362536478 — 7362536478 | 193. | 473829 — 473829 |
| 144. | 7362 — 7363 | 194. | 7382937 — 7383937 |
| 145. | 7362819273 — 7362819273 | 195. | 3628901223 — 3628901233 |
| 146. | 63728 — 63738 | 196. | 5572867 — 5572867 |
| 147. | 63728192637 — 63728192639 | 197. | 87263543 — 87263543 |
| 148. | 728 — 738 | 198. | 3678902 — 3678892 |
| 149. | 62738291527 — 62738291529 | 199. | 15672839 — 15672839 |
| 150. | 63728192 — 63728192 | 200. | 9927382 — 9927382 |

Test 2

✓ Check if the two names are the same.

1. Hulme Co. — Hulme Co. ✓
2. L. T. Piver — L. T. Piver ✓
3. Foley & Co. — Foley & Co. ✓
4. Floyd Gibbons — Floyd Gibbens
5. Dole Publishing Co. — Dole Publishing Co. ✓
6. Chase Bag Co. — Chase Bag Co. ✓
7. Aladdin Co. — Aladdin & Co.
8. Arthur Bier & Co. — Arthur Bier Co.
9. Mydall Cain — Mydell Cain
10. M. C. D. Borden & Sons — M. C. D. Borden & Sons ✓
11. Midland Nat'l. Bank — Midland Nat'l. Bank ✓
12. Hixon Lt'd. — Hixon Lt'd. ✓
13. R. Weiner — R. Wiener
14. Pacqueres — Pacqueris
15. Ponemah Mills — Ponemah Mills ✓
16. Keeley Institute — Keeley's Institute
17. Jim Pepper — Jim Pepper ✓
18. Pictorial Review — Pictorial Review ✓
19. Colette Cartier — Colete Cartier
20. Mayno Salon — Mayno's Salon
21. Glazo Co. — Glazo Inc.
22. Bonne Lee — Bonne & Lee
23. Vapo Cresolene Co. — Vapo Cresolen Co.
24. Wiebusch & Helger — Weibusch & Helger
25. A. M. Davis — A. M. Davis ✓
26. Foote Lb'r. Co. — Foot Lb'r. Co.
27. Lander's — Lander's ✓
28. Delle Ross — Dell Ross
29. Savage Rug Co. — Savage Rug Co. ✓
30. Landon & Warner — Landen & Warner
31. Dennison's — Dennison's ✓
32. Piggily Wiggily Co. — Piggily Wiggily Co. ✓
33. Hurley Machine Co. — Hurly Machine Co.
34. J. Bauer & Black — J. Baeur & Black
35. Edwin Cigar Co. — Edwin Cigar Co. ✓
36. Vik Oil Co. — Vik Oil Co. ✓
37. John Skinner & Sons — John Skinner & Son
38. Eagle Pencil Co. — Eagle Pencil Co. ✓
39. Hudson Bros. — Hudson Bros. ✓
40. D. M. Ferry & Co. — D. M. Ferry Co.
41. Johnsen A. J. — Johnson A. J.
42. Todd & Son — Todd & Sons
43. Merrill Palmer — Merrill Palmer ✓
44. T. Cook & Son — T. Cook & Son ✓
45. Funk & Wagnall — Funk & Wagnull
46. F. H. Vizetelly — F. H. Vizitelly
47. Higgen & Co. — Higgin & Co.
48. Bert Cooksley — Bert Cooksley ✓
49. W. C. Wadsworth Co. — W. C. Wadworth Co.
50. Alvah Bushnell — Alvah Bushnell ✓
51. Armo Culvert Co. — Armo Culvert & Co.
52. Larous & Bro. — Larus & Bro.
53. Winstar W. B. — Winsten W. B.
54. Bender L. C. — Binder L. C.
55. J. C. Andresen Inc. — J. C. Andresen Inc. ✓
56. Vacuum Oil Company — Vacuum Oil Company ✓
57. Endicott Co. — Endicott Co. ✓
58. Minneapolis Mfg. Co. — Minneapolis Mfg. Co. ✓
59. Beverly A. B. — Beverley A. B.
60. Jensen & Co. — Jensen & Co.
61. Meumann L. R. — Meumann L. R. ✓
62. Stevenson & Co. — Stevenson & Co. ✓
63. Haldoran H. P. — Haldoran H. P. ✓
64. Evers Bros. — Evers Bros. ✓
65. Nevens Sales Co. — Nevens Sale Co.
66. Outdoor Sign Co. — Outdoor Sign Co. ✓
67. Young & Co. — Young & Co. ✓
68. Goodyear Tire Co. — Goodyear Tire Co. ✓
69. Redford Lb'r. Co. — Redferd Lb'r. Co.
70. Canadian National — Canadian Nat'l.
71. Standard Oil Co. — Standard Oil Co. ✓
72. Valiant Mfg. Co. — Valant Mfg. Co.
73. C. Harris — C. Harris ✓
74. J. Williams Company — G. Williams Company
75. Kaufmann A. C. — Kaufman A. C.
76. Frisby N. C. — Frisby N. C. ✓
77. Donald T. C. — Donald T. C. ✓
78. Waldo Inc. — Waldo Co.
79. Andres Mfg. Co. — Andres Mfg. Co. ✓
80. Oriza Ann Legrand — Oriza Anne Legrand
81. A. Stein & Company — A. Stien & Company
82. Robert Courtney — Robert S. Courtney
83. Leonard Music Co. — Leonard Music Co. ✓
84. George Morgan — George Morgen
85. Paulson's Cafe — Paulson's Cafe ✓
86. Robert T. Quamme — Robert T. Quame
87. Traverse Studio — Traverse Studio ✓
88. Upton Grain Co. — Upten Grain Co.
89. E. E. Atkinson — E. E. Atkinson ✓
90. Zeisler Furrier — Ziesler Furrier
91. E. G. Kenyon — E. G. Kenyon ✓
92. Backus, Roy — Backus, Ray
93. Carpenter Steel Co. — Carpenter Steel Co. ✓
94. W. E. Davenport — W. E. Davanport
95. John Kingsley — John G. Kingsley
96. Lane Inc. — Lane Inc. ✓
97. T. G. Lentingworth — T. G. Lentinworth
98. Elizabeth Bennett — Elizabeth Bennett ✓
99. Charibel — Claribel
100. R. C. A. Victor Company — R. C. A. Victer Company

✓ Check if the two names are the same.

- | | | | |
|------|--|------|--|
| 101. | Crane Ltd.—Crane Co. | 151. | H. J. Heinz—H. J. Hienz |
| 102. | Isaac F. Marcossou—Isaac F. Marcosen | 152. | National City Co.—National City Co. |
| 103. | Stromberg Carlson—Stromberg Carlsen | 153. | Dorothy Gray—Dorothy Gray |
| 104. | W. A. Evans—✓W. A. Evans | 154. | Reinhard Brothers—Reinhart Brothers |
| 105. | Mason Tile Co.—Matson Tile Co. | 155. | Oscar Bye—Oscar Bye |
| 106. | Clark Frame Co.—✓Clark Frame Co. | 156. | Ben Coal Co.—Ben Coal Co. |
| 107. | William G. Kellogg—William P. Kellogg | 157. | C. Lundstrom Mfg. Co.—C. Lundstrom Mfg. Co. |
| 108. | Berwind Briquets—✓Berwind Briquets | 158. | J. C. McKesson Drug Co.—J. C. MacKesson Drug Co. |
| 109. | F. W. Bronson—✓F. W. Bronson | 159. | Waite Coal Co.—Wait Coal Co. |
| 110. | Nash Motors—Nash Motor | 160. | Berry Brothers—Berry Brothers |
| 111. | C. E. Locke—C. E. Lock | 161. | J. Coty Co.—J. Coty Co. |
| 112. | Mazer Cressman Co.—Mazer Cressmon Co. | 162. | F. R. Connell—F. R. Connell |
| 113. | Leslie Thrasher—✓Leslie Thrasher | 163. | Dr. Miles Company—Dr. Mills Company |
| 114. | Plough Inc.—Plough Lt'd. | 164. | Northam Warrer—Northam Warren |
| 115. | Walpole—Wallpole | 165. | Indian Refining Co.—Indian Refining Co. |
| 116. | John Hergesheim—John Hergesheimer | 166. | Jack Richard—Jack Richard |
| 117. | Hudson Bay & Co. Ltd.—Hudson Bay Co. Ltd. | 167. | Kirsch Mfg. Co.—Kirsch Mfg. Co. |
| 118. | Lassco Co.—Lassko Co. | 168. | Jack Wachter—Jack Wachter |
| 119. | Albert Mills—Albert Mill | 169. | C. M. Stend—C. M. Stent |
| 120. | Yale Stores—Yale Store | 170. | John Blassingham—John Blassingham |
| 121. | Bob Fairbanks—✓Bob Fairbanks | 171. | W. W. Brock—W. W. Brock |
| 122. | Denton Products—Denten Products | 172. | L. Waterman Company—L. Watermon Company |
| 123. | Wells Dickey Co.—Wells Dickey Inc. | 173. | F. H. Weaver—F. P. Weaver |
| 124. | S. N. Jonas—S. N. Jonus | 174. | Multistamp Co., Inc.—Multistamp Co., Inc. |
| 125. | Warren Co.—✓Warren Co. | 175. | Sani-flush—Sani-flush |
| 126. | Kelly Transfer—✓Kelly Transfer | 176. | Tung Sol Lamp Inc.—Tung Sul Lamp Inc. |
| 127. | S. Karpen & Brothers—✓S. Karpen & Brothers | 177. | F. J. Suderman—F. J. Suderman |
| 128. | A. J. Drexel—✓A. J. Drexel | 178. | Theo. Audel & Co.—Theo. Audel Co. |
| 129. | C. H. Salmon—S. H. Salmon | 179. | Cox Realtors—Cox Realtors |
| 130. | H. Simons Lbr. Co.—✓H. Simons Lbr. Co. | 180. | Kellogg Company—Kellogg Company |
| 131. | Villaume Lbr. Co.—Villauum Lbr. Co. | 181. | Ann Lowe—Anna Lowe |
| 132. | Banett Company—✓Banett Company | 182. | A. Cederstrand & Son—A. Cedarstrand & Son |
| 133. | B. B. Quinn—✓B. B. Quinn | 183. | Marschke Co.—Marsckhe Co. |
| 134. | Beauville Co.—Beauxville Co. | 184. | Collum & Ackerman—Collum & Ackerman |
| 135. | Gordon Mfg. Co.—✓Gordon Mfg. Co. | 185. | Insulite Co.—Insulite Co. |
| 136. | Curtis Mill Co.—Curtis Mill Co. | 186. | General Steel Co.—General Steel Co. |
| 137. | S. Jacobs & Company—S. Jacobs & Company | 187. | Charles Von Buelow—Charles Von Beulow |
| 138. | W. Morton—W. Morten | 188. | A. D. Beaudette—A. D. Beaudette |
| 139. | F. D. Prescott—F. D. Prescott | 189. | Firestone Tire Co.—Firestone Tire Co. |
| 140. | Old Gold—Old Gold | 190. | Foxsworth & Son—Foxsworth & Son |
| 141. | Jones Inc.—Jones Bros. | 191. | A. S. Hinds Co.—A. S. Hinds Co. |
| 142. | Petropalm & Son Inc.—Petropalm & Son Inc. | 192. | Charles Beardslee—Charles Beardslee |
| 143. | Palmers Ltd.—Palmers Ltd. | 193. | Axton Tobacco Co.—Axeton Tobacco Co. |
| 144. | Higgin Mfg. Co.—Higgen Mfg. Co. | 194. | Inso Board Co.—Inso Board Co. |
| 145. | Lehigh Coal Sales—Lehigh Coal Sales | 195. | Stanley Russell—Stanley Russell |
| 146. | Buick Motor Co.—Buick Motors Co. | 196. | Babson Mfg. Co.—Babsen Mfg. Co. |
| 147. | George Carpenter—George Carpentier | 197. | Bodee Institute—Bodee Institute |
| 148. | H. H. Hemenway—H. H. Hememway | 198. | Greer College—Greer College |
| 149. | M. A. Gladding—M. A. Gladding | 199. | Lampland Lbr. Co.—Lamplund Lbr. Co. |
| 150. | F. J. Cheney & Co.—F. J. Cheney & Co. | 200. | Bird & Son Inc.—Bird & Sons Inc. |

by DOROTHY M. ANDREW
 Pennsylvania College for Women
 DONALD G. PATERSON
 University of Minnesota

MINNESOTA VOCATIONAL TEST FOR CLERICAL WORKERS

The Psychological Corporation
 New York City

I. GENERAL NATURE OF THE TEST

The test consists of two parts, a number checking and a name checking test. In each of the tests, there are two hundred items, one hundred of which are the same and one hundred of which are different. The numbers range from three through twelve-place numbers, and the names from seven through sixteen letters. The test is so arranged that the first one hundred items may be compared with the second one hundred items of each test.

II. DIRECTIONS FOR GIVING

Pass out the folders, warning the subjects not to open the folders. As soon as all the tests are passed out, say: **WRITE YOUR NAME ON THE FIRST PAGE.** When all have done this, say: **NOW READ THE INSTRUCTIONS AND WORK THE SAMPLES AS DIRECTED AT THE BOTTOM OF THE FIRST PAGE.** Look over each subject's work to make sure he has completed the samples and understands the directions. If the group be a large one, the examiner may read the correct answers to the samples, ask for questions, thereby dispensing with the examination of each subject's work. Say: **BE READY TO OPEN THE FOLDER, AND WHEN I GIVE THE SIGNAL, START. BEGIN CHECKING THOSE THAT ARE THE SAME; THOSE THAT ARE DIFFERENT YOU LEAVE BLANK. WHEN I GIVE THE SIGNAL, STOP, STOP IMMEDIATELY AND DRAW A LINE UNDER THE LAST ONE YOU ARE LOOKING AT.** Then say: **NOW OPEN YOUR FOLDER AND START.** These directions are read only before Test 1. At the end of exactly eight minutes, say: **STOP, AND DRAW A LINE UNDER THE LAST ONE YOU ARE LOOKING AT.** Then say: **TURN THE PAGE TO TEST 2, AND START.** At the end of exactly seven minutes, say: **STOP, DRAW A LINE UNDER THE LAST ONE YOU WERE LOOKING AT AND TURN BACK TO THE FRONT PAGE.**

TIME LIMITS

Test 1	Number checking	8 minutes
Test 2	Name checking	7 minutes
Total		15 minutes

III. DIRECTIONS FOR SCORING

The score for each part is the number of items correct minus the number wrong. The correct items are those in which the "sames" have been checked and the "differents" left blank. The highest possible score on each test is two hundred.

Paper scoring keys are supplied for the test. If a more permanent stencil is desired, a single strip of cardboard can be prepared and used for scoring all of the columns in Test 1, and another strip for Test 2. In preparing the cardboard stencil for Test 1, a strip of cardboard three and one-fourth inches wide by eleven inches long should be cut. Place the strip between the answer spaces for the two columns, fitting the top and bottom of the cardboard flush with the top and bottom of the test page. From both sides of the cardboard draw lines corresponding to the answer lines. Put check marks on the lines corresponding to each pair of same items. Write in the numbers of the items. At the top of the cardboard write **Test 1, Score equals right minus wrong.** Turn the cardboard strip over and in the same manner prepare the stencil for scoring the third and fourth columns.

The usual scoring formula, R-W, for two alternative response tests has been used in order to correct for guessing, carelessness, or inaccuracy. Copeland (4) has suggested that

"number of items attempted" might be used in certain employment situations where large numbers of applicants are to be disposed of in a minimum time and at minimum cost. The correlation between R-W score and the number attempted for an occupationally heterogeneous group of 175 adult women workers was found to be +.96 for the number checking and +.89 for the name checking test. Thus R-W score and number attempted give substantially the same results for number checking but not for name checking.

TABLE A
 Norms for Employed Clerical Workers*

Centiles	Women		Men	
	Test 1 Numbers	Test 2 Names	Test 1 Numbers	Test 2 Names
100	200	200	198	196
90	178	187	176	166
80	166	178	162	154
70	158	173	151	143
60	151	161	141	134
50	144	152	135	126
40	137	145	129	119
30	129	136	121	112
20	119	125	114	105
10	106	111	104	97
1	65	63	68	62

* Norms based on 284 women clerical workers and 120 men clerical workers. Men shipping and stock clerks have been omitted from the norms since their scores are so much lower than those for other clerical workers.

TABLE B
 Norms for the Adult Gainfully Occupied*

Centiles	Women		Men	
	Test 1 Numbers	Test 2 Names	Test 1 Numbers	Test 2 Names
100	200	196	179	198
90	157	159	121	122
80	140	143	108	107
70	126	131	97	96
60	117	120	90	86
50	109	111	83	78
40	103	102	75	69
30	97	93	67	60
20	87	80	57	48
10	77	65	45	34
1	33	2	7	0

* Norms based on the standard samples of 500 men and 232 women (8).

TABLE C
 Norms for Ninth Grade Students*

Centiles	Girls		Boys	
	Test 1 Numbers	Test 2 Names	Test 1 Numbers	Test 2 Names
100	166	168	144	148
90	136	139	116	114
80	125	128	107	101
70	117	119	99	94
60	110	113	95	88
50	105	105	90	83
40	100	99	85	78
30	95	94	80	73
20	89	87	73	66
10	81	77	63	54
1	61	58	42	30

* Norms based on 328 girls and 353 boys in Kirkwood High School, Kirkwood, Missouri.

In constructing the Minnesota Clerical Test the authors were primarily concerned with the factor of speed although they recognized that accuracy was a factor which could not be entirely eliminated. As a matter of fact, the test is performed usually at a high level of accuracy, 95% or higher accuracy in the number checking and 92% or higher accuracy in the name checking. The R-W scoring formula, therefore, was not introduced in order to take into account two equally important variables but rather merely to penalize those individuals who might attempt to secure a high score by "stepping on the gas" to such an extent that accuracy is sacrificed. Candee and Blum (3) advocate the securing of a time score and an accuracy score separately but they fail to indicate how these two separate indices of performance on the test are to be weighed and interpreted by the examiner in the practical employment situation. In view of the fact that the test is primarily a speed test with accuracy as a negligible factor it would seem wise to continue to use the R-W scoring formula in order to penalize those subjects who happen to be unusually careless or inaccurate.

IV. RELIABILITY

The reliability of the test is sufficiently high to warrant its application in individual diagnosis (2). When odd-even items or comparable forms are compared, the reliability is about +.90. Test-retest reliability is +.85 when the second testing is about ten weeks later. Table I gives the coefficients of reliability.

V. VALIDITY

The validity of the Minnesota Clerical Test has been studied by several methods.

Ratings (2): Personal history ratings, supervisors', and combined ratings were compared with test scores for groups of employed clerical workers. The personal history ratings in every case were computed without knowledge of test scores and were based upon education, clerical experience, commercial training, and age at leaving highest grade. Table II shows that the validity coefficients based on personal history ratings are about +.65, while supervisors' ratings and test scores give coefficients of approximately +.37. This latter relationship is undoubtedly lower because of the tendency of supervisors to rate their employees above the average and to be influenced by length of service, and personal likes and dislikes. Combined ratings, obtained by weighting personal history and supervisors' ratings equally, correlate about +.60 with Clerical Test scores.

A group of 109 vocational high school students were rated by commercial teachers who had worked with these pupils for one and one-half years in commercial courses. The correlation between commercial teachers' ratings and Clerical Test scores is +.58. Commercial teachers' ratings agree more closely with Clerical Test scores than with intelligence test scores, the correlation being +.40 between ratings and intelligence quotients. When intelligence and clerical scores are both used, the validity coefficient is raised to +.66, by multiple correlation technique. The best prediction of ability

TABLE I
Reliability Coefficients for the Minnesota Vocational Test for Clerical Workers

Test	Group Tested	Correlation	Number of Cases
1. Given at a single testing:			
Test 1, numbers (odd vs. even)	Women clerical workers	.86±.01	147
Test 2, names (odd vs. even)	" " "	.93±.01	147
Tests 1+2 and comparable forms	Employed clerical workers	.90±.01	138
2. Given at two different times:			
Test 1 and Test 1, numbers	Univ. business students	.76±.04	48
Test 2 and Test 2, names	" " "	.83±.03	48
Tests 1+2 and Tests 1+2	" " "	.85±.03	48
3. Given at three different times:			
a. First and second time			
Test 1 and Test 1, numbers	Clerical training group	.76±.06	28
Test 2 and Test 2, names	" " "	.77±.05	28
Tests 1+2 and Tests 1+2	" " "	.86±.04	28
b. First and third time			
Test 1 and Test 1, numbers	" " "	.77±.05	28
Test 2 and Test 2, names	" " "	.83±.04	28
Tests 1+2 and Tests 1+2	" " "	.91±.02	28
C. Second and third time			
Test 1 and Test 1, numbers	" " "	.93±.02	28
Test 2 and Test 2, names	" " "	.86±.04	28
Tests 1+2 and Tests 1+2	" " "	.91±.02	28

TABLE II

Coefficients of Correlation Between Ratings and Minnesota Clerical Test Scores

Ratings	Group Tested	Product Moment Correlation	Continuity Coefficient	Number of Cases
Personal history, general clerical	Employed clerical	.65±.03	.63±.07	138
Personal history, filing	" " "	.60±.04	.66±.06	138
Supervisors', general clerical	Company A, clerical		.28±.13	97
Supervisors', filing	" " "		.37±.20	34
Supervisors', general clerical	Company B, clerical		.37±.25	22
Supervisors', filing	" " "		.42±.24	22
Combined, general clerical	Company A, clerical		.54±.10	97
Combined, general clerical	Company B, C, D, clerical		.61±.13	41
Combined, general clerical	File clerks		.63±.10	62
Combined, filing	Company A, clerical		.56±.16	34
Combined, filing	Companies B, C, D, clerical		.64±.15	28
Combined, filing	File clerks		.60±.11	62
Commercial teachers'	H.S. commercial students		.58±.04	

would be obtained, according to these data, by weighting academic ability test scores by 1.00 and Clerical Test scores by 1.42.

Grades in Accounting (2): The prognostic value of the Minnesota Clerical Test was studied with 167 university students by combining it with a test of academic ability, the Minnesota College Aptitude Test. The results indicate that the Clerical Test is more closely related to grades in accounting than is the Academic Ability Test, as shown by coefficients of +.47 and +.49 between grades and number and name checking, respectively, as compared with +.17 between academic ability and grades in accounting. No student with a centile rating below 51 and only one with a rating below the 60 centile on the name checking test received an A or B grade in the course. With one exception, no student with a centile rating lower than 41 on the number checking test received an A or B in accounting.

Speed of Typing (2): The validity of the Minnesota Clerical Test was studied by comparing typing test scores and Clerical Test scores for 119 employed women clerical workers who had received varying amounts of clerical training and education. These workers were also given the Pressey Senior Classification and Verification Tests; both are measures of academic ability. The Clerical Test differentiates the rapid group (65 to 89 words a minute) and the average group (40 to 64 words a minute) from the slow group (15 to 39 words a minute) better than do the academic ability tests, as shown by difference ratios of 3.32 and 3.68 for Clerical Test scores as compared with 1.98 and 2.91 for academic ability test scores.

Differentiation of Employed Clerical Workers from Workers in General (2): A valid test of clerical aptitude should differentiate employed clerical workers from workers in other occupations. A study of occupational ability profiles of successfully employed clerical workers indicates that clerical workers are most markedly differentiated from the gainfully employed population by their superior scores on the Clerical Test. These difference ratios range from 2.85 to 14.23. Scrutiny of the norms for the "general population" and for "employed clerical workers" will indicate the striking differences that exist.

Comparison among Various Classes of Clerical Workers (2): Although some clerical groups such as accountants, bookkeepers, stenographers, and general clerical workers tend to make scores higher than routine clerical workers and shipping and stock clerks, differences between means are not always statistically significant. These results indicate that the Clerical Test used alone or in combination with intelligence tests can do no more than serve as a guide toward or away from clerical occupations as a group.

Comparison between Employed and Unemployed Clerical Workers (2): The results from a study of employed and unemployed women clerical workers indicate that unemployed clerical workers score significantly lower than employed clerical workers on the Clerical Test as shown by difference ratios of 3.32 and 4.49 for number and name checking, respectively.

Differentiation of Employed Clerical Workers from Workers in Other Occupations: Another investigator has reported significant differences in Clerical Test scores between mer office clerks and garage mechanics and between women office clerks and retail saleswomen. Occupational ability profiles indicate that clerical workers score significantly higher than janitors, policemen, ornamental iron workers, manual train

g teachers, draftsmen, and casual laborers on the Clerical Test (5). A study of the aptitudes of three hundred graduate nurses showed that the median for nurses on clerical number checking is lower than the median for the general population while the medians are about the same on clerical name checking (7). Nurses rated as "outstanding" scored significantly higher on the Clerical Test than those rated below average (difference ratios of 2.29 for number checking and 4.45 for name checking).

Prediction of Future Clerical Success by the Minnesota Clerical Test: Sixty-three workers with varying academic and clerical ability test scores were selected out for a five months training course in shorthand, typewriting, bookkeeping, business English, and office practice by Eriksen (6). Students rated by their instructors, who did not know the test scores, as having an excellent or good chance for success were "considerably higher" on academic ability and clerical aptitude test scores than those rated as having only average or a poor chance for success. Students placed in the group having a poor chance for success scored very much lower on clerical and academic aptitude than those in the better rated groups. This study also indicated that over 70 per cent of the students who had sufficient academic ability and interest in clerical work but less than average clerical aptitude, were rated in the group who had only a fair or poor chance of success. Every student who had tested interests in clerical work but who was below the average in academic ability and clerical aptitude was rated as poor or dropped out of the course before its completion. Additional findings indicate that, of the students who attained a speed in dictation of 80 or more words a minute, all but one had a centile rating above 85 on the Clerical Test. All but three students who failed to attain a speed of over 40 words a minute had centile ratings lower than 75 on the Clerical Test. Eriksen concludes that the Minnesota Clerical Test is useful as an instrument in the prognosis of achievement in shorthand, typewriting, and bookkeeping.

Relation of the Minnesota Clerical Test to Other Clerical Tests: The correlation between the Minnesota Clerical Test and the "Scott Company Test for File Clerks" is $+0.71$, while the correlation between the "Hoke Prognostic Test of Stenographic Ability" and the Clerical Test is $+0.55$. Copeland (4) reports a correlation of $+0.55$ between the "O'Rourke Clerical Aptitude Test, Junior Grade" and the Minnesota Clerical Test. Hales (9) reports a correlation of $+0.61$ between the Minnesota Clerical Test and the Thurstone Clerical Test.

VI. RELATION BETWEEN THE MINNESOTA CLERICAL TEST AND AGE, SEX, CLERICAL EXPERIENCE, FORMAL EDUCATION, INTELLIGENCE, AND SPEED OF READING

Age: Among adult workers, age does not seem to have any appreciable effect on Clerical Test scores, as shown by the negative correlation of -0.19 for 120 employed clerical workers (2). Other results (10) indicate the probability that after forty years of age there is a slight decrement in speed in number and name checking. This result may not be due to the effects of age but to selective factors and to the non-comparability of clerical workers above and below this critical age. Since individual differences transcend age differences, it is impossible to judge the abilities of an individual on the basis of age alone.

Sex (2): For workers in the general population, sex differences are significant on the Clerical Test; only about 16 per cent of men workers reach or exceed the median of women on clerical number and name checking tests. For employed clerical workers sex differences on the clerical name checking test are significant in that only 21 per cent of employed men clerical workers reach or exceed the median of women clerical workers. Sex differences tend to disappear, however, on both checking tests when comparisons are restricted to a given level or type of clerical work. This is additional evidence that the abilities measured by the Clerical Test are an important factor in occupational adjustment in clerical work.

Experience and Training (2): The relationship between Clerical Test scores and years of clerical experience for about one hundred clerical employees is negligible, $+0.08$. A low but positive relationship, $+0.30$, was found between Clerical Test scores and years of clerical experience for 155 employed and unemployed women clerical workers between the ages of seventeen and twenty-nine (1). Those with many years of experience do not seem to have any marked advantage in taking the Clerical Test.

A slight negative correlation, -0.13 , was obtained between Clerical Test scores and amount of commercial training for a group of 65 employed clerical workers. Scores on the Clerical Test do not seem to be affected by commercial training. When two groups were tested before and after commercial training, there was no gain in the second testing, as compared with the first testing, beyond the normal practice effect obtained in control groups. The normal practice effect in repeating the test after time intervals from three to six months varies between 7 and 12 per cent. Thus the Minnesota Clerical Test fulfills the requirements of an aptitude test in that training and experience do not seem to exert any large or specific effect on test scores.

Formal Education (1): When formal education or grade of school completed is considered, academic intelligence is also a related factor, since grade of school completed and academic ability are positively related. The relationship between grade of school completed and Clerical Test scores for 120 employed clerical workers is $+0.20$ and for 155 women clerical workers between the ages of seventeen to twenty-nine about $+0.22$. Among clerical groups the better educated do not seem to have any great advantage on the Clerical Test over those with fewer years of schooling.

Intelligence (2): The correlations between academic ability test scores and Clerical Test scores for groups of employed clerical workers, university business students, and high school commercial students are approximately $+0.23$; the correlation between intelligence and number checking being about $+0.12$ and the correlation for name checking about $+0.37$. When heterogeneous groups, made up of men ranging from less than seventh grade ability to better than twelfth grade ability, are considered, the relationship between the Clerical Test and academic ability becomes closer (10). The correlation between academic ability and clerical number checking for these heterogeneous groups is about $+0.47$ and between clerical name checking and intelligence is about $+0.65$. These coefficients, however, are inapplicable to the more homogeneous groups for which the test is designed. Even in the heterogeneous groups, they indicate that the Clerical Test is relatively unique with respect to academic ability, since the coefficients of alienation, indicating lack of relationship, are 0.88 for clerical number checking and intelligence and 0.76 for clerical name checking and intelligence.

Speed of Reading (2): The Minnesota Clerical Test is only slightly related to the "Chapman-Cook Speed of Reading Test." Number checking is unrelated to speed of reading as shown by the coefficient of $+0.09$, while clerical name checking is positively related to speed of reading as shown by the low positive correlation of $+0.45$. When academic ability is held constant statistically, the correlation between speed of reading and clerical name checking drops to $+0.30$.

VII. RESULTS FROM FACTORIAL ANALYSIS (1)

Analysis of the Minnesota Clerical Test indicates that the Clerical Test is measuring a specific ability which is relatively independent of spatial, dexterity, and academic abilities. For heterogeneous groups, the Clerical Test becomes more closely related to academic ability. The Minnesota Clerical Test is measuring an aptitude which is related positively to the abilities to discriminate small differences rapidly, to observe and compare, to adjust to a new situation, and to give attention to a problem.

Although the clerical checking tests are closely related, as shown by the correlation coefficient of $+0.66$, clerical number checking measures more of a numerical factor and the clerical name checking more of a verbal factor. For a homogeneous group of clerical workers, a correlation coefficient of $+0.65$ was found between clerical name checking and a spelling test and a coefficient of $+0.51$ between clerical number checking and a test of verifying arithmetical computations.

VIII. NORMS

Centile norms for employed clerical workers are given in deciles in Table A (2). Because of sex differences, especially in the name checking test, separate norms are given for women and men. Norms are also available for a standard sample of the employed population and are given in Table B (8). The standard sample was carefully selected with respect to age and occupation so as to be representative of the gainfully occupied adult population of the three cities, Minneapolis, St. Paul, and Duluth, as given by the 1930 census.

There are marked differences between the norms for successfully employed clerical workers and for gainfully occupied adults in general. For example, a score of 152 for Test

2, name checking, is equal to the 50th centile on the norms for women clerical workers. Likewise, a score of 111 on the name checking test is equal to the average or 50th centile on the general population norms for women, but only equal to the 10th centile for successfully employed women clerical workers.

Similar comparisons may be made between the employed clerical and general population norms for men. For example, a score of 135 on number checking places a man at the 50th centile for employed men clerical workers but at the 94th centile on the general adult norms. Similarly, a man scoring 83 on the clerical number checking test is rated as average, at the 50th centile for men workers in general, but only at the 5th centile for successfully employed men clerical workers.

Such comparisons indicate that the clerical norms are based upon a selection of workers that is far superior to adult workers in general on the Clerical Test. This suggests the importance of these tested abilities for success in clerical work.

Both sets of norms have their uses in practical situations. In guidance, a counselor is chiefly interested in the abilities of an individual in comparison with the abilities of persons in general. By such a procedure, the counselor may find the aptitudes of the individual which are the most outstanding. As a second consideration, the counselor may be interested in knowing how the tested abilities compare with those of employed workers in a given occupation. The employment manager, however, when considering applicants for a clerical position, is primarily interested in the standing of the applicants when compared to successful employees in similar occupations, and is not so much interested in the rank of the individual when compared to workers in general. In such a

name checking test, the women stenographers and typists exceed the scores made by such clerical groups as men accountants and bookkeepers, general and routine clerical workers, and shipping and stock clerks. That is, norms based upon successful clerical employees selected from seven companies indicate that an applicant for an accounting or bookkeeping position should be expected to score higher on the clerical number test than an applicant for a filing position. Furthermore, a qualified person to fill a position as a filer, clerk, biller, sorter, or office machine operator would not be expected to test as high on the clerical name checking test as a qualified stenographer or typist. But these differences are not striking whereas the differences between clerical workers and workers in general are quite marked.

Some examples will illustrate this point:

The average employed man bookkeeper and accountant scores 144 on clerical number checking which is at the 9th percentile for the general norms. The bookkeeper testing the lowest on the number checking test for his group, scores 10 which is at the 79th percentile for workers in general.

The average employed woman office machine operator scores 149 on the clerical number checking test which is at the 86th percentile for women workers in general. The operator testing the lowest among the employed office machine operators on clerical number checking scores 103 which is at the 41st percentile for the standard sample of women workers.

Similarly, the average employed woman stenographer and typist scores 158 on the clerical name checking test which is at the 91st percentile for the standard sample of women workers. The typist testing the lowest among the employed

TABLE III
TENTATIVE NORMS FOR EMPLOYED CLERICAL WORKERS BY CLASSIFICATION*

	Women Office Machine		Women Stenographers		Men Bank Tellers		Men Acct. Bkks.		Women General Cler.		Men General Cler.		Women Routine Cler.		Men Routine Cler.		Men Ship. Clerk	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
100	187	176	196	200	192	188	178	180	200	196	198	196	182	172	177	166	137	150
90	169	171	180	189	188	175	177	156	171	180	181	172	163	166	166	164	135	144
80	163	153	169	178	164	160	167	148	160	171	163	163	149	157	148	151	128	130
70	158	146	161	170	155	152	155	140	151	161	151	151	141	150	137	137	117	119
60	153	140	154	164	142	145	150	134	145	153	142	137	137	143	130	124	109	117
50	149	134	147	158	137	134	144	127	139	147	134	131	133	134	124	118	104	108
40	144	128	139	152	131	120	138	122	131	141	127	124	129	124	118	111	100	98
30	138	120	136	146	127	111	132	116	124	131	121	115	123	116	111	105	96	87
20	127	113	122	137	120	105	127	110	114	121	116	106	106	101	105	100	80	74
10	111	102	110	118	114	98	107	102	103	111	109	94	90	88	100	92	73	67
1	103	68	70	75	113	93	106	82	65	79	68	63	82	63	92	62	71	38

*Norms based on:

21 women office machine operators 17 men bank tellers

181 women stenographers and typists 29 men accountants and bookkeepers

60 women general clerical workers

General clerical workers include general office clerks, tax and record clerks.

All groups were selected from seven companies, except for the bank tellers who were selected from one company.

44 men general clerical workers

24 women routine clerical workers

30 men routine clerical workers

23 men shipping and stock clerks

Routine clerical workers include file clerks, billers, and sorters.

case, norms for successfully employed workers would be more helpful than norms for the general population.

In the selection of clerical employees, it is not always wise to select those with the highest scores. If the job is of a routine nature, an individual possessing lesser abilities is likely to be a more satisfied employee than a worker possessing more abilities than the job requires. The tested abilities required for certain clerical positions may be suggested but the critical scores for the selection of employees for a given occupation should be determined by the hiring standards for the particular company (11).

Since there are differences in Clerical Test scores made by different types of clerical workers, separate norms for the various classes are reported in Table III. Women office machine operators, women stenographers and typists, and men accountants and bookkeepers score higher on the clerical number checking test than the general and routine clerical workers, and men shipping and stock clerks. On the clerical

women stenographers and typists on the clerical name checking test scores 75 which is at the 17th percentile for the standard sample of women workers. A score of 118 on the name checking test is only equal to the 10th percentile for women stenographers and typists but is at the 60th percentile for women workers in general.

Although routine clerical workers require less of the ability measured by the Clerical Test, it must be remembered that the average routine clerical worker as well as the average shipping and stock clerk scores better than 75th percentile for general population norms.

There is then not only a marked difference between employed clerical workers and workers in general on the Clerical Tests, but there are smaller differences between the different types of clerical workers.

To make adequate use of norms, hiring standards as well as the various levels of abilities required for given positions must be taken into consideration in the selection of employees.

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