

1935

Prognostic testing in typewriting through manual dexterity and intelligence quotients

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PROGNOSTIC TESTING IN TYPEWRITING THROUGH
MANUAL DEXTERITY AND INTELLIGENCE QUOTIENTS

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PROGNOSTIC TESTING IN TYPEWRITING THROUGH
MANUAL DEXTERITY AND INTELLIGENCE QUOTIENTS

BY

FRANCIS MARTIN LOHAN

THESIS SUBMITTED FOR THE DEGREE OF MASTER OF SCIENCE

MASSACHUSETTS STATE COLLEGE

AMHERST, MASS.

1935

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Chapter I

Introduction

Typewriting has been generally adopted by business for all written records, and it aids many of the professions in a similar manner. In the educational system, the growth of typewriting has been very rapid and perpendicular in its trend. Typewriting had its inception in the senior high schools, sent its roots down to the junior high schools, and sent its branches up to the colleges. We have come to accept the advantages of typewriting without greatly appreciating them.

Almost all students entering high school desire to study typewriting. Some have neither the ability nor the application necessary to become successful typists. According to the social philosophy of education, it is advisable to permit all who desire to study typewriting to enroll in the course. Since most commercial teachers and business men prophesy that within a few years our present illegible handwriting will be replaced by typewriting, it is doubtless a fact that the pupils must be prepared for the "new deal" in legibility.

The purpose of this study is an attempt to predict the success or failure of a junior high school student who enrolls in Typewriting; to place typewriting pupils in the proper levels of the typewriting course; to determine the point in the course beyond which a pupil cannot advance as shown by his manual dexterity and intelligence quotient.

If a method of foretelling a pupil's success in typewriting could be formulated, it would be invaluable to both school and pupil. It would eliminate much waste of time for students who did not show the capability of becoming successful typists as measured by a prognostic typewriting test. The school costs could also be enormously decreased by the elimination of inept students who would later on cause a problem of retardation.

This thesis attempts (to find a method of measuring beforehand a pupil's chances in pursuing successfully a course in typewriting. As in all educational measurements, we must assume the pupil to be at all times working at his best during the administration of manual dexterity tests, and speed and accuracy tests in typewriting.

The relation between mental ability and success in typewriting has been a subject of intensive investigation. The relation between finger dexterity and success in typewriting has also been studied extensively, but seldom has the subject of both manual dexterity and intelligence been measured in relation to typewriting ability.

In the following chapters, a brief history of studies made in this field will be given. The investigation of the author and the results of the attempt to predict typewriting success should be an aid in determining the possibility of formulating a valid prognostic typewriting test.

Chapter II

Outline of Other Investigations

Within the past few years, several studies have been made attempting to predict typewriting success. No one, however, has been successful in establishing definite standards for the various types of ability necessary for a pupil to have in order to learn to operate the typewriter with both speed and accuracy.

The following investigations are among those which are considered outstanding. They will be found to form the basis of an interesting comparison. No criticism of these investigations will be offered in the following pages.

Study of the Possibilities of Forecasting Skill in Typewriting, by Miss Clara L. McIntire:

Miss McIntire investigated this subject from both the intelligence and manipulation points of view. After a very intensive study covering a period of three years during which time several varying typewriting groups were tested, Miss McIntire drew the following conclusions:

1. "Pupils with low intelligence quotients stand almost a 50-50 chance with those of high I. Q.'s in the first year of typewriting. Therefore, all pupils who wish to learn typewriting should be allowed to take it.

2. "Similarly, pupils with low prognostic scores have a reasonably good chance of succeeding in beginning typewriting.

3. "Those who have exceptionally low intelligence scores and low prognostic scores should not be encouraged to elect second year typewriting, although if they have the desire to learn and the courage to keep practicing, they will very likely succeed in passing the work.

4. "The exceptionally high correlations found between intelligence and prognostic scores and the net speed and final average results indicate that no pupil who does not show reasonably high scores should be allowed to attempt Typewriting III, for so many factors other than the keyboard manipulation enter into this more advanced work that pupils who do manage to do creditable work in straight copying do not succeed in passing more complicated work.

5. "Exception to the above statement may be made only when poorly endowed pupils have, by virtue of long and assiduous practice, been able to reach the required standard of work and whose plans for the future seem to warrant its continuance.

6. "The reaction time experiment was a definite failure and of no use whatsoever for prognostic purposes."

Learning to Typewrite, by W. F. Book:

Book holds as a premise that general manual ability is one of the requisites for successful operation of a typewriter. He drew his conclusions regarding this necessity of possessing general manual dexterity by test-

ing pupils entered in the International Typewriting Contest. He tested all those who participated in 1923, employing four types of movement for each arm and hand: "(1) the rate per second, the subject can move his forefinger with the hand and arm held rigidly; (2) the rate at which he can move his hand, with the wrist as a hinge; (3) the rate and regularity with which he can move the forearm from the elbow-joint while keeping the wrist rigid; (4) the rate he can move the upper arm using the muscles of the shoulder and upper arm."

Mr. Book obtained evidence which showed that the pupils writing the greatest number of net words per minute during the contest also had the highest records achieved in the motor ability test. The correlation between speed and dexterity scores was almost perfect throughout the group of contestants. It was noted that even with great training those who did not stand high on the general motor ability tests could not attain the speed of those with high ratings on the motor ability tests. Although Mr. Book avers that motor ability is highly essential to success in typewriting, he also believes that a certain amount of mental ability is necessary.

Does Typing Ability Depend on Mentality or Dexterity?,

by Miss Lilah Bradford:

In the study conducted by Miss Bradford, intelligence quotients and fifteen-minute typewriting tests

were correlated. The typewriting tests were ranked and scored according to the number of weeks the students had taken typewriting. The correlation was not high enough to warrant a conclusion that intelligence quotients were reliable indicators of likely success in typewriting. Among those tested, the student with the lowest I.Q. (67) had a typing ability of 93; the student with the highest I.Q. (124) had a typing ability of 87. Miss Bradford concludes with this pertinent statement:

"It would seem unreasonable to make the plea that we cannot produce good typists because our students rate low in mental ability."

Factors Predetermining Success in Typewriting, by the Misses A. A. Vavra and Mable Easterbrook:

For the purpose of predicting typewriting success and preventing retardation, this investigation employed intelligence tests and substitution tests. The substitution test is very similar to recognition of like or code analyzing. From the results of this study, the Misses Vavra and Easterbrook concluded:

"(1) The intelligence quotient furnishes a good indication of ability to acquire typewriting skill.

(2) The substitution test gives a fairly good prognosis of the ability to learn typewriting.

(3) These two factors taken together form an almost perfect prognosis."

Correlation Between General Intelligence and Achievement in Typewriting, by Miss E. M. Barr:

Miss Barr Correlated intelligence quotients and term grades in typewriting, intelligence quotients and Blackstone Typewriting Test scores. Her results showed very conclusively that there was very little relationship between the general intelligence of a pupil and his typewriting ability as measured by marks and the Blackstone Typewriting test scores.

The following correlations were found:

(1) Between I.Q. and marks .237 correlation.

(2) Between I.Q. and Blackstone scores .113 correlation.

(3) Between marks and Blackstone scores .467 correlation.

Commercial Subject Difficulty as Correlated with Intelligence Quotients, by Miss Elizabeth J. Anderson:

Miss Anderson endeavored to discover individual subject difficulty associated with I.Q.'s. She treated all commercial subjects, but the difficulties in typewriting predominated in the cases of pupils whose I.Q.'s were below 94. The Anderson study showed it to be difficult to predict accurately any measure of success in commercial work (typewriting included) when the I.Q.'s of the students fall below 100.

Miss Anderson used school marks as the sole criteria of the pupil's ability. This is ordinarily a very unsatisfactory method of determining one's capability because the teachers' subjective opinions color the marks. A very limited group was tested by Miss Anderson, and this factor might have influenced her results.

Are Some Students Doomed to Failure?, by Mr. L. G. Dake:

The group studied by Mr. Dake was the typewriting division of the St. Louis Schools. He was interested in the solution of the failures in typewriting classes, and whether or not some students who enroll in typewriting are predetermined to fail.

Mr. Dake concluded from his investigation that excessive failures in typewriting are unnecessary. The factors, in the order of their importance, which influence success or failure, are (1) ability of the pupil to concentrate, (2) the motivation provided by the typewriting teacher. These two educational principles lie at the basis of successful instruction in typewriting.

The Rank of the Inferior Student in Typewriting, by Mr. Cecil Puckett:

Mr. Puckett set out to determine the correlation between general intelligence and typewriting grades. His conclusions are:

(1) A student possessing the greater mental capac-

ity can do the better work in typewriting.

(2) Typewriting grades correlate closely with I.Q.'s.

(3) Typewriting grades are fair indication of the ability of the student. These grades run closely to the grades in the other subjects of the curriculum.

Relationship Between Intelligence Quotient and Rate of Attainment in Typewriting, by Miss W. M. Wood:

Terman group intelligence tests were given to all students in the typewriting courses (three years). The scores achieved in the Terman test were correlated with speed tests given to the students in each of the three typewriting courses. The following correlations were found:

(1) .31 was the highest correlation; .102 was the lowest.

(2) The I.Q. of a student does not determine his ability to typewrite.

(3) In advanced typewriting classes, students usually increase the rate of speed and accuracy of their typing in relation to the amount of typewriting instruction previously obtained.

(4) The advancement in school classification (grades 10, 11, or 12) tends to benefit the rate of attainment for pupils beginning typewriting.

A Study of the Possibilities of Predicting Typing Ability, by Mr. John M. Overholtzer:

Terman group intelligence tests were employed to learn the I.Q.'s of a group of students. The mechanical ability of the same group was measured by administering the Macquarrie Mechanical Aptitude Tests.

Mr. Overholtzer found a correlation of .39 between I.Q.'s and typewriting test scores. A correlation of .55 was found between the typewriting test scores and an average score composed of intelligence quotients and prognostic tests scores. This study shows the relation that general intelligence bears toward mechanical ability in learning to operate a typewriter. *did not*

Relation of the I.Q.'s to Success in Learning Typewriting, by Miss M. A. Miller:

The purpose of this study was to determine the relationship between the I.Q.'s of a high school group and their ability to acquire skill in typewriting as measured by standardized tests and semester grades. A correlation of .3318 was found between the I.Q.'s and Blackstone Typewriting Test scores. A correlation of .2634 was found between the I.Q.'s and the semester grades in typewriting. These correlations, it may be noted, are too low to be significant. Miss Miller concludes "that special aptitude tests of special mental functions may prove to be more reliable means of predicting the degree of skill which the individual may acquire in the field of typewriting."

Chapter III

Testing Procedure

The problem which this thesis attempts to solve is whether or not the typewriting ability of any given student, or group of students, can be forecast. As has already been stated a positive answer will benefit the student in saving time, boresome effort doomed to failure, and consequential misplacement in his educational or vocational life; this problem's solution will also benefit the taxpayers by elimination of a major portion of the retardation group and by reductions in the overhead of conducting the class. no J?

Educational and Vocational guidance are intimately connected with the solution of the problem of predicting success in typewriting. The school administrator may advise choice of curriculum^u to fit the individual student, and personnel managers may use information of a prognostic nature to fill positions open in their firms' offices, if the aim of this study is achieved.

With a minimum of mental control a pupil can pass successfully a course in first year typewriting. During the first year's study, he will need primarily a medium degree of manual dexterity. This thesis has for one of its purposes the proper placement of students in different levels of the typewriting course. The first year is mainly given over to familiarization

of the operator with the machine. One can be a good copyist after having successfully passed the first year's course. Intelligence, in other words, does not necessarily determine the making of a good copyist. The second and third years' work prepares for a secretarial career; here, intelligence is a necessary concomitant of finger dexterity in producing a successful operator.

The West Springfield, Massachusetts, Senior High School Typewriting classes are the source of the data in this study. The entire group of students taking typewriting numbered three hundred twenty-five. The data collected and considered were from an individual manual dexterity test given to each student; group intelligence tests; speed and accuracy tests in typewriting; and typewriting grades.

Description of the tests given:

The Whitman Manual Dexterity Test was administered individually. This test has for its purpose the determination of one's native manual dexterity. Whitman believes that manual dexterity does not develop beyond the seventeenth year, just as Binet believed that intelligence ceased development at the sixteenth year. The Whitman test is generally acknowledged to be a valid test of general manual and muscular coordination.

The test is divided into seven parts. Each part is timed. The administrator demonstrates the proper pro-

cedure for each part of the test and starts and stops the subject. Test I examines the preferred hand's ability to place pins, approximately five-eighths^h of an inch long and one-sixteenth of an inch in diameter, in a square block with holes large enough to retain the pins securely. The subject may use only one hand at a time, and must work from a tray (which contains the pins) to the pin-board as rapidly as possible. One minute is allowed to complete this test. The score is determined by the number of pins placed in the board divided by three. The nearest whole number is the score. Test II attempts to determine the ability of the less dexterous hand. The same procedure is followed as in Test I.

Test III is one in which both hands are used. The object is to place three pins in each hole, filling as many holes as possible in two minutes. Both hands work coordinately in preparing the pins to fit readily into the holes of a block which is somewhat larger than that used in Tests I and II. The score is the number of holes containing three pins. Test IV is one in which colored pins placed in a tray are used. Red, Orange, Yellow, Green, and Purple pins must be placed in that order in a large board. One minute is allotted for this test. Either hand may be used, but only one pin may be picked up at a time. The score is the number of pins placed in the board.

Test V uses bolts and nuts. Assembled bolts and

nuts must be disassembled and the parts separated in different compartments of the test-tray. Any method of separating the nut from the bolt may be employed. Thirty seconds is allowed in this test. The score is the number of bolts disassembled multiplied by two.

In Test VI, the previously disassembled nuts and bolts are assembled again; any method may be used in assembling them. Thirty seconds is allotted and the score is twice the number assembled. The last test, Test VII, tries to determine the speed with which the subject can sort the colored pins into the five compartments of the test-tray. They must be placed according to the color sequence: red, yellow, green, purple, and orange. Thirty seconds is allotted, and the score is the number of pins sorted.

A Table of Whitman Dexterity scores and corresponding ages follows:

Dexterity Age		Whitman Scores
Years	Months	
12	0	103
12	2	104
12	5	105
12	7	106
12	10	107
13	0	108
13	2	109
13	5	110
13	7	111
13	10	112
14	0	113
14	2	114
14	5	115
14	7	116
14	10	117
15	0	118
15	3	119
15	6	120
15	9	121

(15)

Dexterity	Age	Whitman Scores
Years	Months	

16	0	122
16	6	123
17	0	124

22
Terman A Group Intelligence tests were used to obtain I.Q.'s of each student. In the second and third year typewriting courses, a certain amount of reading, spelling, and general mentality is required. The Terman Intelligence test is suitable for measuring these requisites. In a thesis, submitted by Mr. William A. Cowing for the Master of Science Degree in Education, in 1931, the validity of substituting I.Q.'s for reading scores was proved. The following is taken from Mr. Cowing's thesis:

Correlations

Terman A I.Q. with Terman B I. Q.	.83	.011
Terman A I.Q. with Monroe Silent Reading Score	.64	.024
Terman A I.Q. with Chapman Silent Reading Score	.50	.046
Chapman Silent Reading with Monroe Silent Reading Score	.54	.047
Terman B I.Q. with Monroe Silent Reading Score	.58	.04
Terman B I.Q. with Chapman Silent Reading Score	.77	.025

A fifteen-minute speed and accuracy test was given to each typewriting class by the teacher in charge. These tests are the basis of some of the

comparisons made in this study. The typewriting grades are given by the teachers over a six-months period. These marks are entirely objective; the speed and accuracy of the individual student determines his mark.

MARKING OF TYPEWRITING PAPERS

Sophomores

Total Errors in Assignment	Speed Tests	
	Accuracy	Speed
0 - 2 - A	0 - - A	Over 40 - A
3 - 4 - B	1 - 2 B	35 - 39 - B
5 - - - B-	3 - 4 B-	30 - 34 - B-
6 - - - C	5 - - C	25 - 29 - C
7 - - - C-	6 - - C-	20 - 24 - C-
8 or more - F	Over 7 F	19-less - F

Juniors and Seniors

Total Errors in Assignment

0 - - - 1 - A
2 - - - - B
3 - - - - B-
4 - - - - C
5 - - - - C-
6 or more - F

Speed Tests

Juniors and Seniors same as Sophomores for Accuracy

Speed Juniors	Speed Seniors
45 or over - A	55 or over - A
40 - - -44 - B	50 - - -54 - B
35 - - -39 - B-	45 - - -49 - B-
30 - - -34 - C	40 - - -44 - C
25 - - -29 - C-	35 - - -39 - C-
24 or less - F	34 or less - F

Chapter IV

Presentation and Interpretation of Data

The following table shows the number of pupils tested in each of the three typewriting classes:

Table I

	Boys	Girls	Total
Typewriting I	57	118	175
Typewriting II	17	50	67
Typewriting III	7	61	68
	<hr/>	<hr/>	<hr/>
Totals	81	229	310

Table II

Frequency Distribution of Whitman
Manual Dexterity Scores

Scale Intervals	No. of Pupils	Deviation	Frequency X Deviation
55-59	1	9	9
60-64	1	8	8
65-69	11	7	77
70-74	20	6	120
75-79	27	5	135
80-84	34	4	136
85-89	31	3	93
90-94	44	2	88
95-99	27	1	27
100-104	78	0	693
105-109	33	-1	-33
110-114	11	-2	-22
115-119	6	-3	-18
120-124	5	-4	-20
125-129	<u>1</u>	-5	<u>-5</u>
	328		-98

Table II (Cont.)

Assumed average.....	102.5
Correction.....	<u>1.81</u>
True Average.....	104.31

This true average for the entire group means that the average manual dexterity of the group is above normal. That is to say, the average chronological age of the group (approximately sixteen years) is less than the manual dexterity age of the group. The average 104.31 would set the average dexterity age for the group at approximately seventeen years. The group as a whole is well-equipped manually to produce successful typists especially as far as speed is concerned.

Table III

Frequency Distribution Of
Typewriting Marks

Scale Intervals	No. of Pupils	Deviation	Frequency X Deviation
50-54	19	5	95
55-59	0	4	0
60-64	26	3	78
65-69	10	2	20
70-74	59	1	<u>59</u>
75-79	72	0	252
80-84	57	-1	- 57
85-89	63	-2	-126
90-94	22	-3	- 66
95-99	<u>1</u>	-4	<u>- 4</u>
	328		-253

Table III (Cont.)

Assumed Average.....	77.5
Correction.....	<u>-.003</u>
True Average.....	77.497

This average in typewriting marks embraces all students in the typewriting courses in the high school. As 70 is the passing mark, the average places the group as a whole in favorable circumstances. Taking into consideration that beginners are grouped with those taking second and third year typewriting, the above average is seen to be relatively high. This table may be compared with the chart of the typewriting marks in order to appreciate the small quota of errors allowed students in the various divisions of the course. Errors in spacing, spelling, syllabification, capitalization, punctuation, erasures, and margins are checked. When a pupil is required to achieve the minimum number of words in speed as given on the chart of typewriting marks, it is difficult for beginners to obtain satisfactory grades.

Students who have obtained outside practice on typewriters are naturally better adapted to fulfill the requirements of the course, provided that their practice tends to strengthen desirable movements rather than undersirable ones. In the latter case, practice must be undone by the teacher in the classroom.

Table IVFrequency Distribution
of Terman I.Q.'s

Scale Intervals	No. of Pupils	Deviation	Frequency X Deviation
65-69	2	7	14
70-74	2	6	12
75-79	5	5	25
80-84	20	4	80
85-89	32	3	96
90-94	40	2	80
95-99	49	1	49
100-104	53	0	356
105-109	37	-1	-37
110-114	39	-2	-78
115-119	19	-3	-57
120-124	10	-4	-40
125-129	16	-5	-80
130-134	1	-6	-6
135-139	<u>2</u>	-7	<u>-14</u>
	327		-312

Assumed average....102.5

Correction......134

True Average 102.634

This average I.Q. of the group compares very closely with the Whitman Dexterity Quotient average of 104.31 which is above the normal of 100. The I.Q. average 102.634 falls within the range of normal intelligence. With such favorable mental and manual endowments, good theoretical typists should result. If they are given the proper instruction, sufficient opportunity for practice, and receive proper motivation with a fair amount of persistence and concentration, they should be successful typists as a group. The typewriting average of 77.497 shows this statement to be true.

Table V

Tabulation of Individual Data

Pupil	A	B	C	D	E	F	G
1	I	17-9	100	114	35	15	75
2	I	15-8	93	127	15	7	75
3	I	16-7	72	98	25	5	75
4	I	16-4	92	107	12	19	60
5	I	19-5	100	100	27	5	85
6	I	16-9	89	88	10	8	50
7	I	17-6	73	110	23	17	65
8	I	16-1	93	97	28	7	80
9	I	14-7	116	128	15	19	60
10	I	16-4	120	103	22	11	65
11	I	16-8	93	128	31	8	85
12	I	16-1	81	128	22	5	75
13	I	15-4	75	117	22	11	70
14	I	15-6	83	120	28	9	75
15	I	18-3	90	117	7	40	85
16	I	18-2	100	110	20	8	80
17	I	15-5	92	115	25	10	65
18	I	16-7	87	96	23	25	75

- A. Typewriting Class
- B. Chronological Age
- C. Whitman Manual Dexterity Quotient
- D. Intelligence Quotient
- E. Speed (Net Words)
- F. Accuracy (Number of Errors)
- G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
19	I	15-0	98	107	32	11	85
20	I	15-7	109	106	19	4	50
21	I	16-11	83	100	29	13	85
22	I	15-6	115	118	14	24	70
23	I	15-5	91	118	19	7	70
24	I	16-10	107	93	24	19	70
25	I	16-6	84	114	24	7	83
26	I	16-8	89	98	15	18	80
27	I	14-10	130	109	27	14	70
28	I	17-10	76	80	13	10	70
29	I	15-8	102	115	26	11	60
30	I	16-8	90	95	20	13	70
31	I	15-5	88	84	20	7	60
32	I	16-0	78	93			60
33	I	17-5	90	129	18	14	75
34	I	18--	10 1	100	25	19	70
35	I	15-4	73	111	5	12	50
36	I	15-7	91	90	16	14	70

- A. Typewriting Class
- B. Chronological Age
- C. Whitman Manual Dexterity Quotient
- D. Intelligence Quotient
- E. Speed (Net Words)
- F. Accuracy (Number of Errors)
- G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
37	I	17-1	98	90	32	8	80
38	I	17-3	83	80	11	27	65
39	I	15-8	112	110			60
40	I	17-8	90	85	6	8	60
41	I	18-3	75	75	14	15	75
42	I	18-10	100	100	23	4	90
43	I	18-11	90	103	1	4	75
44	I	18-11	104	100	14	7	80
45	III	17-7	100	97			85
46	III	17-8	89	110	51	11	90
47	III	18-4	100	123			80
48	I	17-1	100	100	11	18	60
49	II	17-8	95	101	26	13	70
50	I	15-1	101	93	28	9	80
51	I	17-1	88	93	36	14	80
52	II	17-11	95	105	40	4	80
53	II	17-8	100	86	31	12	80
54	II	17-5	89	110	36	12	80

- A. Typewriting Class
- B. Chronological Age
- C. Whitman Manual Dexterity Quotient
- D. Intelligence Quotient
- E. Speed (Net Words)
- F. Accuracy (Number of Errors)
- G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
55	I	17-5	55	81	15	14	70
56	I	15-10	101	88	34	10	60
57	I	17-1	92	73	28	4	80
58	I	15-3	111	110			75
59	II	17-8	100	89	45	12	90
60	I	17-0	105	79	34	6	85
61	II	17-0	77	85	42	9	85
62	I	18-3	86	84	33	11	80
63	I	15-9	79	90	32	13	75
64	I	15-10	116	87	33	4	80
65	I	17-3	65	89	30	9	70
66	I	17-5	69	65	13	3	80
67	I	17-3	92	80	36	11	70
68	I	16-5	83	79	39	15	75
69	I	18-6	96	109	35	6	65
70	I	17-7	100	96			75
71	I	17-8	100	67	43	17	70
72	II	17-4	105	111	44	2	75

A. Typewriting Class
 B. Chronological Age
 C. Whitman Manual Dexterity Quotient
 D. Intelligence Quotient
 E. Speed (Net Words)
 F. Accuracy (Number of Errors)
 G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
73	I	17-4	100	82	42	8	80
74	I	17-3	107	80	30	9	70
75	I	13-3	80	88	32	6	75
76	I	18-10	71	85	28	11	75
77	II	18-3	105	100	38	11	75
78	I	17-7	90	91	35	12	75
79	I	15-9	70	90			70
80	I	18-0	85	73	19	10	50
81	I	17-11	65	76	4	28	50
82	I	16-2	105	87	34	9	80
83	I	15-8	88	90	34	9	80
84	I	15-8	96	96	29	8	80
85	I	17-9	92	81	37	15	70
86	I	18-11	73	70	27	4	70
87	II	18-2	75	100			90
88	I	18-5	84	74			50
89	III	17-10	85	88			80
90	II	19-10	95	88			85

- A. Typewriting Class
- B. Chronological Age
- C. Whitman Manual Dexterity Quotient
- D. Intelligence Quotient
- E. Speed (Net Words)
- F. Accuracy (Number of Errors)
- G. Typewriting Grade

(33)
Table V (Cont.)

Pupil	A	B	C	D	E	F	G
91	II	16-4	80	85	37	19	70
92	I	15-6	97	94	37	11	50
93	I	15-2	91	114	42	8	90
94	I	15-3	109	107			85
95	I	17-2	82	84	23	18	70
96	I	15-3	120	116	33	5	80
97	I	17-0	65	91			70
98	I	18-3	75	98	29	11	50
99	I	16-0	100	95	32	9	70
100	I	17-6	68	100	24	17	85
101	I	15-3	109	118	51	9	85
102	I	16-2	112	128	23	6	50
103	I	17-7	83	84			80
104	I	16-5	104	109	40	13	80
105	I	15-4	91	100	44	9	90
106	I	16-8	89	95	18	16	70
107	I	17-1	93	88	11	35	70
108	I	15-0	102	107	36	10	75

A. Typewriting Class
 B. Chronological Age
 C. Whitman Manual Dexterity Quotient
 D. Intelligence Quotient
 E. Speed (Net Words)
 F. Accuracy (Number of Errors)
 G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
109	I	16-0	78	91			60
110	I	15-10	99	93	35	6	80
111	I	16-7	100	100	18	20	50
112	I	14-5	86	97	37	3	75
113	I	14-7	100	100	34	11	70
114	I	15-8	112	95	34	18	85
115	I	14-10	115	102	25	12	75
116	III	18-11	70	79	10	46	70
117	I	15-0	103	118	29	8	80
118	I	15-5	102	96	29	4	80
119	I	15-9	108	111	29	11	80
120	I	14-11	102	107	44	10	77 ⁸
121	I	15-9	111	121			60
122	I	16-9	106	98	31	17	70
123	I	18-0	80	81	0	68	60
124	II	17-7	76	83	41	7	80
125	III	18-10	99	90	41	19	80
126	I	16-9	100	104	12	39	50

A. Typewriting Class
 B. Chronological Age
 C. Whitman Manual Dexterity Quotient
 D. Intelligence Quotient
 E. Speed (Net Words)
 F. Accuracy (Number of Errors)
 G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
127	III	17-6	104	104	42	4	75
128	III	17-0	105	92	44	7	80
129	III	17-7	105	94	42	8	75
130	III	17-7	100	102	40	10	75
131	III	17-9	100	100	37	14	75
132	III	16-9	101	100	44	7	80
133	III	17-5	104	108	40	11	75
134	III	17-8	100	107	51	2	90
135	III	17-4	84	105	34	16	75
136	III	17-0	104	100	40	4	85
137	III	16-7	81	119	42	5	85
138	III	16-8	76	114	37	4	85
139	III	18-10	98	95	38	13	75
140	III	16-6	105	100	45	2	85
141	III	17-10	102	72	45	6	85
142	III	18-0	82	90	52	7	85
143	III	18-1	71	100	42	13	75
144	III	17-8	84	119	44	17	76

- A. Typewriting Class
- B. Chronological Age
- C. Whitman Manual Dexterity Quotient
- D. Intelligence Quotient
- E. Speed (Net Words)
- F. Accuracy (Number of Errors)
- G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
145	III	17-1	79	101	46	6	75
146	III	16-10	102	108	37	6	70
147	III	17-8	96	111	38	8	85
148	III	17-11	80	109	47	10	75
149	III	17-9	85	100	41	10	85
150	III	18-6	100	72	41	5	75
151	III	17-0	93	120	43	9	95
152	III	18-4	85	92	46	9	85
153	III	17-10	100	112	40	17	80
154	III	17-5	104	96	43	11	85
155	III	18-2	90	102	43	7	75
156	III	17-11	90	88	48	9	75
157	III	18-10	92	95	44	9	75
158	III	19-4	100	110	45	7	80
159	III	17-5	100	90	39	14	75
160	III	17-2	90	103	52	3	90
161	III	17-1	71	115	34	17	75
162	III	17-4	88	111	45	6	85

- A. Typewriting Class
- B. Chronological Age
- C. Whitman Manual Dexterity Quotient
- D. Intelligence Quotient
- E. Speed (Net Words)
- F. Accuracy (Number of Errors)
- G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
163	III	16-3	101	129	51	3	85
164	III	17-2	101	107	39	6	85
165	III	17-4	89	114	44	7	75
166	III	18-3	92	109	36	11	70
167	III	17-3	104	103	57	5	75
168	III	17-4	94	106	40	10	70
169	III	17-2	102	136	41	6	75
170	III	17-10	92	112	38	10	75
171	III	17-0	95	98	34	11	70
172	III-	18-0	92	82	37	4	75
173	III	18-3	103	100	43	7	75
174	III	17-2	89	104	52	2	85
175	III	19-3	68	98	21	11	70
176	III	17-4	88	112	36	9	75
177	III	16-2	107	125	51	4	90
178	III	17-10	100	85	48	4	80
179	III	17-2	95	127	51	5	85
180	III	17-3	74	106	38	5	80

- A. Typewriting Class
- B. Chronological Age
- C. Whitman Manual Dexterity Quotient
- D. Intelligence Quotient
- E. Speed (Net Words)
- F. Accuracy (Number of Errors)
- G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
181	I	17-9	79	83	37	15	85
182	II	15-11	75	114	34	7	85
183	I	15-7	109	106	25	17	80
184	I	15-9	98	104	20	7	75
185	I	15-6	103	118	39	8	80
186	I	17-1	84	89	40	8	90
187	II	17-9	71	93	29	12	50
188	II	17-3	98	93	38	10	85
189	II	17-1	71	96	39	13	90
190	I	15-7	107	120	42	15	70
191	I	14-9	95	137	38	4	70
192	I	16-3	68	102	25	13	65
193	I	16-10	95	97	25	14	85
194	I	15-4	119	123	25	8	70
195	II	16-0	88	101			60
196	I	18-0	80	98			70
197	I	15-8	121	122	62	8	90
198	I	15-3	78	105	18	16	75
199	I	15-6	110	114	48	9	85
200	II	16-7	103	93	48	9	85

A. Typewriting Class
 B. Chronological Age
 C. Whitman Manual Dexterity Quotient
 D. Intelligence Quotient
 E. Speed (Net Words)
 F. Accuracy (Number of Errors)
 G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
201	I	17-5	75	100	40	8	90
202	II	17-1	65	90	35	6	60
203	I	16-4	104	94	23	29	75
204	I	16-11	102	93	21	40	80
205	I	16-7	87	96	23	17	80
206	I	15-10	78	112			50
207	I	16-3	84	99	16	13	50
208	I	16-2	105	100	47	8	85
209	I	16-3	77	89	35	7	85
210	I	14-10	85	112	31	10	50
211	III	17-11	100	88	50	2	75
212	I	16-4	73	94	16	27	70
213	I	17-0	82	89			70
214	I	17-2	101	100	23	26	80
215	I	16-4	109	92			75
216	I	17-0	78	101	41	6	85
217	I	16-0	86	103	7	31	70
218	II	17-1	102	91	20	12	75
219	II	18-1	70	98			65
220	I	17-5	87	78	15	30	70

- A. Typewriting Class
- B. Chronological Age
- C. Whitman Manual Dexterity Quotient
- D. Intelligence Quotient
- E. Speed (Net Words)
- F. Accuracy (Number of Errors)
- G. Typewriting G rade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
221	III	17-4	91	128			85
222	I	16-10	81	95	34	16	75
223	I	15-8	105	116	32	10	80
224	I	17-0	80	90			70
225	III	17-1	77	117	39	3	50
226	I	15-8	109	110	41	8	85
227	II	17-10	105	94	32	16	75
228	II	16-2	79	117	23	22	70
229	II	16-4	94	101	34	8	80
230	I	15-7	112	117	36	16	85
231	II	17-8	104	95	40	10	70
232	II	18-2	95	92	39	8	80
233	II	16-2	75	99	23	30 9	70
234	II	16-1	108	89	14	38	60
235	II	16-3	76	101	48	6	85
236	II	17-1	83	96	29	23	70
237	II	16-6	103	111	46	6	90
238	I	14-0	121	122	47	9	85
239	II	16-6	80	113	46	8	85
240	II	16-9	93	101	53	7	90

A. Typewriting Class
 B. Chronological Age
 C. Whitman Manual Dexterity Quotient
 D. Intelligence Quotient
 E. Speed (Net Words)
 F. Accuracy (Number of Errors)
 G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
241	II	16-7	82	101	29	10	70
242	II	16-0	95	96	40	5	85
243	I	14-3	98	122	40	9	80
244	II	17-11	83	97	35	18	60
245	II	16-7	104	102	45	8	85
246	II	16-9	94	101	40	8	90
247	II	18-11	93	85	32	23	60
248	II	16-1	98	113	41	9	80
249	I	14-8	104	106	24	13	75
250	II	16-2	102	98	31	21	70
251	I	15-0	113	125	46	11	85
252	II	16-7	93	129	31	14	75
253	II	16-8	98	94	33	15	85
254	I	14-11	98	126	31	11	75
255	I	16-2	89	114	47	6	90
256	II	17-8	71	95	23	30	60
257	II	16-5	105	103	42	9	80
258	II	16-8	109	110	24	31	85
259	II	15-11	107	102	27	10	75
260	II	16-2	77	114	29	11	80

A. Typewriting Glass
 B. Chronological Age
 C. Whitman Manual Dexterity Quotient
 D. Intelligence Quotient
 E. Speed (Net Words)
 F. Accuracy (Number of Errors)
 G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
261	II	16-5	104	100	24	14	75
262	I	15-5	113	99	15	30	60
263	II	17-1	103	104	14	11	80
264	I	15-3	97	125	13	21	60
265	I	16-8	102	90	15	14	60
266	II	16-2	86	114			80
267	I	17-9	86	87	16	8	70
268	III	19-1	100	115			85
269	II	17-8	104	92	37	15	85
270	I	15-2	112	123	33	8	85
271	III	17-10	100	97	45	6	85
272	I	16-9	100	108	32	17	75
273	I	16-9	92	85	33	9	75
274	III	17-10	100	99	35	8	80
275	I	16-4	100	100	47	9	85
276	III	14-9	90	105	38	10	75
277	II	17-0	93	120	60	5	95
278	II	16-10	70	104	30	15	70
279	I	16-8	81	104	8	51	70
280	I	16-3	109	105	33	14	78

- A. Typewriting Class
- B. Chronological Age
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- D. Intelligence Quotient
- E. Speed (Net Words)
- F. Accuracy (Number of Errors)
- G. Typewriting Grade

Table V (Cont.)

Pupil	A	B	C	D	E	F	G
281	II	16-8	104	125			70
282	II	18-4	93	100	35	8	75
283	II	17-0	101	107	52	4	85
284	III	19-3	67	85	43	6	85
285	I	15-4	125	105	32	13	75
286	II	16-9	80	124	44	15	75
287	II	16-5	110	100	35	15	75
288	II	16-0	82	100	36	12	70
289	I	15-11	91	100	37	5	85
290	II	16-3	80	100	39	12	75
291	I	15-10	98	110	38	6	85
292	I	16-9	106	89	19	22	85
293	I	17-4	89	114	32	18	75
294	III	19-0	85	83	29	18	75
295	II	16-4	67	131	40	6	70
296	II	16-7	105	95	43	6	80
297	I	15-10	94	110	20	47	75
298	I	15-4	104	127	50	10	90
299	I	16-8	84	89	26	19	70
300	I	16-7	76	101	32	12	65

A. Typewriting Class
 B. Chronological Age
 C. Whitman Manual Dexterity Quotient
 D. Intelligence Quotient
 E. Speed (Net Words)
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 G. Typewriting Grade

The correlations between various paired facts of the information given in Table V are here presented. Whitman Manual Dexterity Quotients for the entire test-group had a correlation of .415 plus or minus .03 with the I.Q.'s of the group. This correlation is relatively high, but yet not highly significant. It is common opinion that general dexterity is not closely related to intelligence and, therefore, there is no great wonder in arriving at such a correlation as .415. Computation of this correlation will be found in Table VI in the Appendix.

The correlation between the Whitman Manual Dexterity Quotients and the Typewriting marks of the entire group was .212 plus or minus .035. Teachers' grades are generally criticized by educators as a genuine rating of a pupil's ability. The personality of the teacher usually determines somewhat her rating of the pupils. On the other hand, the personality of the pupil influences the grading given him by the teacher. The Typewriting marks used in this study were obtained by averaging the grades given over a period of six months. The teachers' subjective opinion was eliminated as much as possible by having marks determined by objective projects to be performed by each pupil. Several projects must be turned in within the range of speed and accuracy required for that particular group, in order to obtain a passing mark. In Table V, it may be noted,

that some pupils appear to have a higher Typewriting grade than their rate of speed and accuracy would justify. This may be explained by the fact that the rate of speed and accuracy given was obtained by administering a fifteen-minute speed-test. Allowing for extremes, it is possible that a single speed-test would not closely resemble the mark which is the average of work, both easy and difficult, over a period of six months. On the other hand, it is fair to assume that this single speed-test should represent the ability of the student at that time. The correlation obtained between the typewriting marks and the Manual Dexterity quotients, although positive, is insignificant.

This seems to disprove the notion that typewriting ability can be predicted so far as Manual Dexterity is concerned. Three hundred and twenty-six students were tested to obtain the data for this correlation. The low correlation is explained by the large number of students obtaining eighty or above in Typewriting when their Dexterity Quotient varied from 55 to 100. The Manual Dexterity Quotient is obtained by dividing the Dexterity Age, taken from the Whitman Table of Norms, by the Chronological Age of the pupil. For instance, a pupil who is chronologically sixteen years old and is thirteen years and ten months old according to the Dexterity Norms would have a Whitman Dexterity Quotient of 86. If this pupil were enrolled in Typewriting I and

should obtain a mark of 85, some explanation may be given as to why the Dexterity Quotient did not foretell accurately his typewriting ability as measured by the typewriting grade. Approximately fifty pupils fell into this class, and threw the correlation to the lowest positive extreme. Data in regard to these students were obtained in an interview with their typewriting teachers. A few of the pupils whose Dexterity scores do not predict successfully the typewriting marks, or in most cases the rate of speed and accuracy, follow.

The numbers of the pupils as given in Table V are as follows: 39, 46, 55, 61, 62, 65, 66, 75, 76, 87, 100, 103, 124, 137, 138, 142, 143, 145, 161, 180, 181, 182, 186, 189, 201, 209, 212, 215, 235, 239, and 284.

Pupil No. 39 is one of the few students whose Dexterity score foretells a successful typewriting course, but who achieved a grade of only 60, ten points below passing. Her Dexterity Quotient of 112 and her I.Q. of 110 would lead one to believe that she is capable of better work. Unfortunately, no records of this student's speed and accuracy were obtained.

The case of Pupil No. 46 may be explained by the fact that she is a Post-Graduate student and has had much experience on the typewriter. Her Dexterity score, 89, does not correlate well with her typewriting mark, 90, or her speed, 51. She is very ambitious and

is typical of most of the Post-Graduate students enrolled in the Typewriting courses in this school.

The cases of Nos. 180, 181, 182, 186, 189, and 201 are similar. In each case, the pupils are all undergraduates whose Dexterity scores are far below normal and whose Typewriting marks are well above the average of the group. This was explained in interviews with their teachers. Seldom were they absent from class; they were very persistent and ambitious; often spending extra time on projects. In each case, hard work was evident, and led to a successful typewriting grade and in most cases, to proper form, traits, and fulfillment of the requirements in speed and accuracy for their class.

The correlation between the Terman I.Q.'s and the typewriting grades was .17 plus or minus .0265. This seems to confirm the results of the studies related in Chapter II. Intelligence appears to be even less reliable than Manual Dexterity as an indicator of typewriting ability.

An interesting comparison was found in a study of the boys and girls taking typewriting. The average typewriting mark for the girls is approximately 80 whereas the boys' average is approximately 75. This is in close agreement with the general belief that girls obtain better grades in all school subjects especially in typewriting and other commercial sub-

jects. It is rare to find a man who can better the standards set by professional women typists. The average speed for boys is 25 words per minute, whereas the girls have an average speed of 35 words per minute. The score for both boys and girls in the Manual Dexterity test varied from 100 to 104 on the average. The correlation between the girls' Whitman Manual Dexterity quotients and typewriting marks was found to be .413 plus or minus .04. This correlation is high enough to show that in general the trend of the typewriting mark can be determined from the Dexterity quotient. The computation of this correlation may be found in Table IX in the Appendix.

The correlation between the boys' Whitman Manual Dexterity scores and the typewriting marks was found to be ^{.37}.974 plus or minus .095. This is almost a perfect correlation and it is readily seen that most of the extreme cases were found in the girls' records, and their variability accounts for the very low correlation of the group's Dexterity quotients and typewriting marks. The correlation between the boys' Whitman Dexterity quotients and typewriting speed was .451 plus or minus .064. The correlation between the girls' Whitman Manual Dexterity quotients and typewriting speed was .504 plus or minus .042. These correlations are signifi-

cant; they show that Dexterity quotients appear to circumscribe the range of speed a typist can achieve. These correlations may be found in their entirety in the Appendix.

Correlation between the typewriting speed and the Manual Dexterity of the group as a whole was found to be ²⁹⁸.955 plus or minus .0034. This seems to indicate that Dexterity is closely associated with typewriting speed. The correlation between the typewriting accuracy and the Whitman Manual Dexterity quotients of the entire group was -.60 (minus). This negative correlation indicates no relationship whatever between Dexterity and accuracy. These correlations are also found in the Appendix.

Chapter V

Although the correlation between the typewriting marks and the Manual Dexterity quotients of the group tested was low, several of the cases which caused the low correlation were girls. A close study of each individual whose Dexterity quotient was low and whose speed and typewriting marks were high, revealed that by sheer persistence, personal interest, and proper motivation on the part of the teacher, that individual could and did become a successful student in typewriting. The chief value of this thesis seems to lie in the fact that students, whose Dexterity score is subnormal may pass the requirements of the course by spending twice the time required by the normal student.

This study also brought out the fact that girls seem to be better adapted to learn typewriting. Their typewriting marks and speed were higher than those of the boys, but this does not necessarily mean that boys are doomed to failure in typewriting. The average typewriting mark of the boys was above the passing mark. In conjunction with other related investigations made upon this same subject, it seems evident that Dexterity positively determined the speed of any typist. It follows that, knowing one's dexterity, we can foretell with a fair degree of accuracy, his typewriting speed.

In order to be a successful secretary in the modern business world, it is essential that a typist have both speed and accuracy. Therefore, in so far as dexterity determines speed, we can foretell that a student should not take a secretarial course if his Dexterity quotient is far below normal.

The results of this study may be summarized as follows:

(1) the success of typewriting students cannot be predicted accurately by means of a manual dexterity test alone as shown by the correlation .212 between Typewriting marks and Dexterity Quotients.

(2) the combination of I.Q.'s and Dexterity Quotients is more reliable in foretelling the success of second and third year Typewriting students than Dexterity Quotients alone.

(3) pupils entering from junior high school may be prejudged in regard to their native dexterity and aptitude for typewriter operation with the administrator's general knowledge of the individual case as the guiding factor.

(4) pupils may be placed in the copyist group (one year of typewriting) if their dexterity quotient is subnormal, indicating small probability that they will be capable of achieving the required speed.

(Correlation .955 ^{Error - should be .37 ± .1} plus or minus .0034 between Dexterity Quotient and Typing Speed)

(5) following the above, pupils may be placed in

the secretarial division of the typewriting course provided they secure a normal or above-normal Dexterity Quotient.

(6) I.Q.'s are poor indicators of success or failure in typewriting; however, used with Dexterity Quotients and the experience of the administrator, they are good prognostic indices of success or failure in second and third year typewriting.

A great responsibility is placed upon the school administrators in using prognostic tests of any type. Educational tests and measurements have been much misused in recent years. Educators are partly to blame for this by placing unwarranted faith of an absolute nature in formal tests. The tests can be used with allowances made for the human element inevitably accompanying the administration of any test. It must be assumed that a pupil is doing his best, that testing conditions are favorable, that emotional distress is at a minimum, etc. The exclusion of pupils from typewriting because of low marks in a manual dexterity test is a difficult problem in administration. Pupil and parental objections must be faced. The success of using such a prognostic test as mentioned in this study depends entirely on the administrator of the test.

APPENDIX

Table VI

		Whitman Manual Dexterity Quotients															Intelligence		
Quotients	Intelligence	125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	f	d	f
		125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	f	d	f
60																	2	4	8
69																	12	3	36
70																	46	2	92
79																	83	1	83
80																	94	0	219
89																	59	-1	-59
90																	27	-2	-54
99																	3	-3	-9
100																			
109																			
110																			
119																			
120																			
129																			
130																			
139																			

$$C_x = \frac{701 - 95}{326} = 1.85$$

$$C_x^2 = 3.4225$$

$$C_y = \frac{219 - 122}{326} = .2975$$

$$C_y^2 = .0885$$

$$\sigma_x = \sqrt{\frac{3406}{326} - 3.4225} = 2.65$$

$$\sigma_y = \sqrt{\frac{601}{326} - .0885} = 1.32$$

$$r = \frac{\frac{453}{326} - .550375}{2.65 \times 1.32} = .415 \pm .03$$

$$P.E. = \pm .6745 \frac{1 - (.415)^2}{\sqrt{326}} = .0308$$

Table VII

Typewriting Marks	Whitman Manual Dexterity Quotients																				f	d	fd	fd ²	Σxy
	125	120	124	115	119	110	114	105	109	108	95	92	90	84	85	80	75	79	70	74	65	69	60	55	51
50																									
54																									
55																									
59																									
60																									
64																									
65																									
69																									
70																									
74																									
75																									
79																									
80																									
84																									
85																									
89																									
90																									
94																									
95																									
99																									

$$C_x = \frac{691 - 99}{326} = 1.81$$

$$C_x^2 = 3.2761$$

$$C_y = \frac{255 - 240}{326} = .046$$

$$C_y^2 = .002116$$

$$C_x C_y = .08326$$

$$\sigma_x = \sqrt{\frac{3355}{326} - 3.2761} = 2.65$$

$$\sigma_y = \sqrt{\frac{1317}{326} - .002116} = 2.009$$

$$r = \frac{\frac{395}{326} - .08326}{2.65 \times 2.009} = .212 \pm .035$$

$$P.E. = \pm .6745 \frac{1 - (.212)^2}{\sqrt{326}} = .035$$

Table VIII

Typewriting										Marks		+ - Eng
54	55	57	60	64	65	66	70	72	73	f	d	
130							2	1		3	3	9
129										3	9	27
120	1	3		3	7	2	7	3	1	29	2	54
119										108		24
110	5		3	2	5	10	13	17	5	60	1	60
109										19		
100	4		5	4	15	30	11	16	10	95	0	123
99												
90	5		10	1	18	17	17	14	1	83	-1	-83
89										83		5
80	1		6	1	13	7	8	6	2	44	-2	-88
79										176		24
70	3				2	3	1	2		11	-3	-33
69										99		36
60										2	-4	-8
59										32		
f 19 0 27 8 59 75 53 62 21 1										325	-212	585
d -5 -4 -3 -2 -1 0 1 2 3 4												103
fd -95 -81 -16 -59 -251 53 124 63 4										244		92
Nfd 475 243 32 59 53 248 189 16										1315		

$$C_x = \frac{244 - 251}{325} = -.0245$$

$$C_x^2 = .0006$$

$$C_y = \frac{123 - 212}{325} = -.276$$

$$C_y^2 = .076$$

$$C_x C_y = .00676$$

$$\sigma_x = \sqrt{\frac{1315}{325} - .0006} = 1.9885 \quad \sigma_y = \sqrt{\frac{585}{325} - .076} = 1.074$$

$$r = \frac{\frac{92}{325} - .00676}{1.9885 \times 1.074} = .17 \pm .0265$$

$$P.E. = \pm .6745 \frac{1 - (.17)^2}{\sqrt{325}} = .0265$$

Table IX

Girls' Whitman Dexterity Quotients	Girls' Typewriting Marks										$\sum x^2$		$\sum xy$	
	55	59	60	64	65	69	70	74	75	79	80	84	85	89
55														
59														
60														
64														
65														
69														
70														
74														
75														
79														
80														
84														
85														
89														
90														
94														
95														
99														
100														
104														
105														
109														
110														
114														
115														
119														
120														
124														
125														
129														

$\sum f$ 1 18 49 38 63 45 4 16 11 245
 $\sum d$ -4 -3 -2 -1 0 1 2 3 4 5
 $\sum fd$ -4 -54 -98 -38 -194 45 8 48 55 156
 $\sum d^2$ 16 162 196 38 45 16 144 275 892

$$C_x = \frac{156 - 194}{245} = -.155 \quad C_x^2 = .024$$

$$C_y = \frac{493 - 66}{245} = 1.74 \quad C_y^2 = 3.03$$

$$C_x C_y = -.2697$$

$$\sigma_x = \sqrt{\frac{892}{245} - .024} = 1.745 \quad \sigma_y = \sqrt{\frac{2291}{245} - 3.03} = 1.32$$

$$r = \frac{\frac{167}{245} + .2697}{1.745 \times 1.32} = .413 \pm .04$$

$$P.E. = \pm .6745 \frac{1 - (.413)^2}{\sqrt{245}} = .04$$

Table X

Boys' Dexterity Quotients	Boys' Typewriting Marks										Σxy
	90	94	95	96	97	98	99	100	104	105	
65											
69		1			3	1	1	1			7
70					1	1	2	2			6
74											6
75		1				1		2			4
79											5
80		1		3	2			1			7
84											4
85		1	2		2		1	1			7
89											3
90				5	2		2				9
94											2
95		2	4	1		1	1				9
99											9
100											9
104	2	3	2	4	3		1				15
105											0
109	1	2	2	1	2						8
110											-1
114								1			8
115											-2
119			1		1		1				-2
120											4
124			1			1					3
125											-3
129											-9
											27
											950
											160
											33
											(127)
											78
											56
											281
											32
											128
											32

$$C_x = \frac{56 - 83}{78} = -.346$$

$$C_x^2 = .1197$$

$$C_y = \frac{181 - 27}{78} = 1.97$$

$$C_y^2 = 3.88$$

$$C_x C_y = -.6816$$

$$\sigma_x = \sqrt{\frac{281}{78} - .1197} = 1.554 \quad \sigma_y = \sqrt{\frac{950}{78} - 3.88} = 1.53$$

$$r = \frac{\frac{127}{78} + .6816}{1.55 \times 1.53} = .974 \pm .095$$

The correlation coefficient is .974 ± .095.

$$P.E. \pm .6745 \frac{1 - (.974)^2}{\sqrt{78}} = .095$$

$$r = .37 \pm .095$$

Table XI

Whitman Man

f	1	0	2	6	11	9	7	13	9	6	4	2	70
d	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	
fd	-7		-10	-24	-33	-18	-7	-99	9	12	12	8	41
fd	49		50	96	99	36	7		9	24	36	32	438

-2180488104
(-16)

$$C_f = \frac{153 - 29}{70} = 1.77 \quad C_f^2 = 3.13$$

$$C_x C_y = -1.466$$

$$\sigma_x = \sqrt{\frac{438}{10} - .686} = 1.692 \quad \sigma_y = \sqrt{\frac{804}{70} - 3.13} = 1.62$$

$$r = \frac{\frac{-16}{70} + 1.466}{1.692 \times 1.62} = .451 \pm .064$$

$$P.E. = \pm .6745 \frac{1 - (.451)^2}{\sqrt{70}} = \pm .064$$

Table XII

Girls' Whitman Dexterity Quotients	Girls' Typewriting Speed															Σxy
	56+	55	54	53	52	51	50	49	48	47	46	45	44	43	42	
55																
59																
60																
64																
65																
69																
70																
74																
76																
79																
80																
84																
85																
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114																
115																
119																
120																
124																
125																
129																
<hr/>																
104	2	2	4	16	11	8	6	6	3	3						
105																
109	2	2	5	1	4	3	1	2	1							
110																
114																
115																
119																
120																
124	1															
125																
129																

$$C_x = \frac{224 - 224}{238} = .021 \quad C_x^2 = .000441$$

$$C_y = \frac{501 - 65}{238} = 1.83 \quad C_y^2 = 3.35$$

$$C_x C_y = .03843$$

$$\sigma_x = \sqrt{\frac{1337}{238} - .000441} = 2.349 \quad \sigma_y = \sqrt{\frac{2328}{238} - 3.35} = 1.33$$

$$r = \frac{\frac{383}{238} - .03843}{2.349 \times 1.33} = .504 \pm .042$$

$$P.E. = \pm .6745 \frac{1 - (.504)^2}{\sqrt{238}} = \pm .042$$

Table XIII

r approx. .298

Table XIV

		Typewriting Accuracy (No. of Errors)																															
		70	65	64	60	57	55	54	50	49	45	44	40	39	35	34	30	29	27	25	24	22	21	15	10	6	0	f	d	fd	fd ²	+Σxy	
Whitman Dexterity Quotients	55																												1	9	9	81	0
	59																												1	8	8	64	32
	60																												1	8	8	64	92
	64																												1	8	8	64	32
	65																												1	8	8	64	92
	69																												1	8	8	64	32
	70																												1	8	8	64	92
	74																												1	8	8	64	32
	76																												1	8	8	64	92
	79																												1	8	8	64	32
	80																												1	8	8	64	92
	84																												1	8	8	64	32
	85																												1	8	8	64	92
	89																												1	8	8	64	32
	90																												1	8	8	64	92
	94																												1	8	8	64	32
	95																												1	8	8	64	92
	99																												1	8	8	64	32
	100																												1	8	8	64	92
	104																												1	8	8	64	32
	105																												1	8	8	64	92
	109																												1	8	8	64	32
	110																												1	8	8	64	92
	114																												1	8	8	64	32
	115																												1	8	8	64	92
	119																												1	8	8	64	32
	120																												1	8	8	64	92
	124																												1	8	8	64	32
125																												1	8	8	64	92	
129																												1	8	8	64	32	

f	1	1	2	2	3	11	8	16	42	85	109	29	309	
d	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1
fd	-12	-9	-16	-14	-18	-55	-32	-48	-84	-85	-373	29	29	
fd ²	144	71	128	98	108	215	728	144	168	85	29	1388		

-98318

87-970

(-883)

-983218 87-970

(-883)

$$C_x = \frac{29 - 373}{309} = -1.11 \quad C_x^2 = 1.23$$

$$C_y = \frac{660 - 98}{309} = 1.81 \quad C_y^2 = 3.27$$

$$C_x C_y = -2.009$$

$$\sigma_x = \sqrt{\frac{1388}{309} - 1.23} = 1.01 \quad \sigma_y = \sqrt{\frac{3218}{309} - 3.27} = 1.41$$

$$r = \frac{\frac{-883}{309} + 2.009}{1.01 \times 1.41} = -0.59$$

Table of Incidence of Typewriting Marks

50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99
70	65	60	55	50	45	40	35	30	25



Table of Incidence of Whitman Manual
Dexterity Quotients

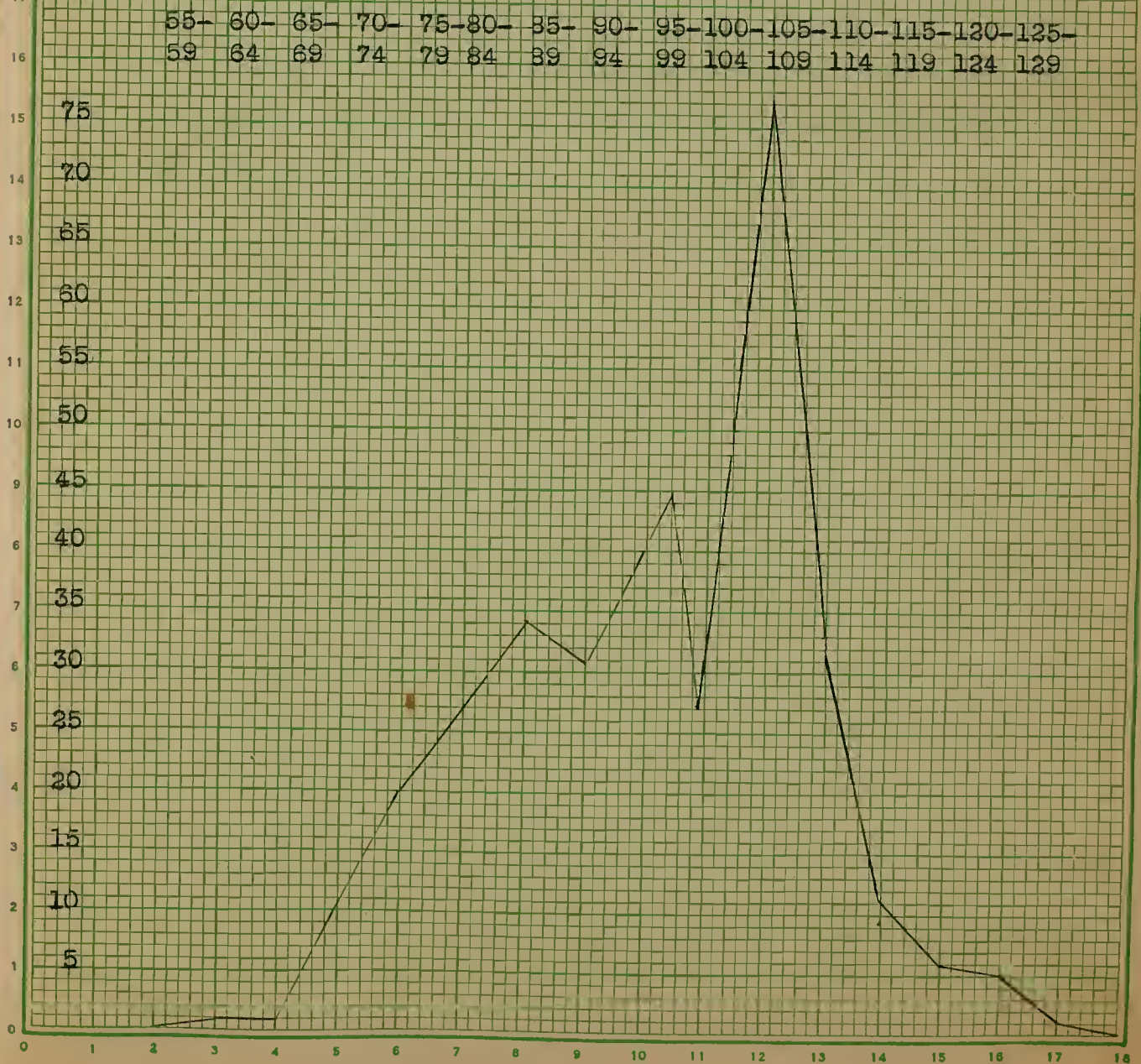
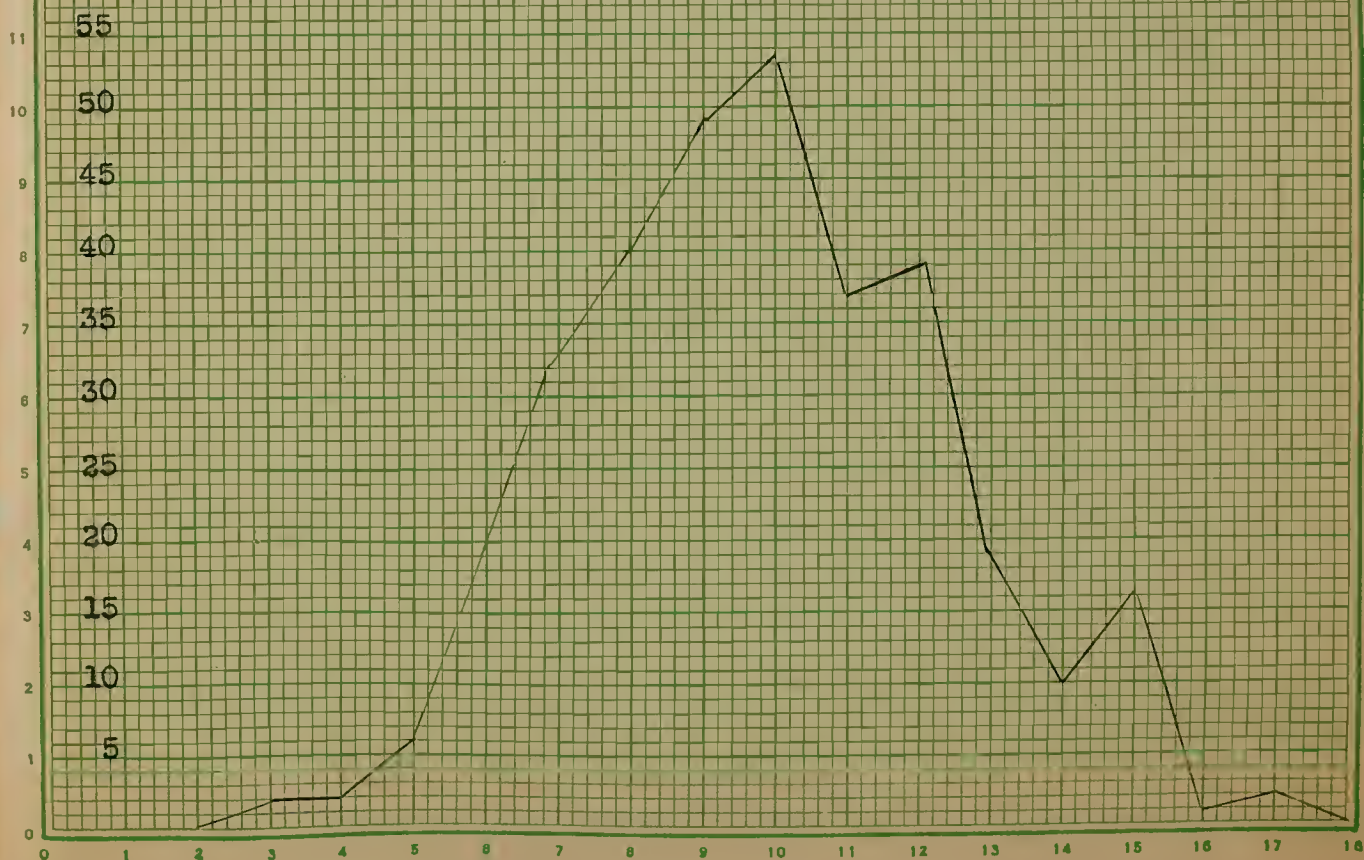


Table of Incidence of Intelligence Quotients

65-70-	75-	80-	85-	90-	100-	105-	110-	115-	120-	125-	130-	135
69 74	79	84	89	94	104	109	114	119	124	129	134	139



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Approved by

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Date April 29, 1935

