

THE RELATIONSHIP BETWEEN STROKE INTENSITY OF  
WORDS AND TYPEWRITABILITY

by

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CHAPTER I  
THE PROBLEM

The Need for the Study

It is a common practice for teachers of typewriting to endeavor to increase and measure the typewriting speed and accuracy of students through the administration of timed writings. These timed writings are also used as a measuring device by employment agencies and business organizations in obtaining and promoting employees.

Studies have established the fact that manual dexterity, reading ability and intelligence<sup>1</sup> influence the ability of the student to attain the speed and accuracy necessary to operate the machine at maximum efficiency. However, in order to build this skill, what role does the typewritability of the copy play?

Clifford B. Shipley<sup>2</sup> in a study made in 1940 found that the speed fluctuations of the beginning typewriting student

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<sup>1</sup>Fuller, Donald C., "Reading Factors in Typewriting," Pennsylvania State College, State College, Pennsylvania, 1943 Delta Pi Epsilon Research Award, Published by Oklahoma A. and M. College.

<sup>2</sup>Shipley, Clifford B., "A Study to Determine the Relative Difficulty of a Series of Typewriting Tests and the Reliability of the Series," University of Iowa, Iowa City, 1940.

are more likely caused by variation in the difficulty of pieces of typewriting copy than by changes in the student's typewriting ability. A study conducted by Mary LaVerne Bell<sup>3</sup> indicated that performance by typists on samples of copy material varied with changes in stroke intensity, syllabic intensity and the per cent of frequently used words. The evidence revealed in these studies shows that certain factors contained in copy material influence the development of typewriting skill, and the measurement of the skill attained.

In learning to typewrite students use copy material as one of the means by which skill is attained. Copy of regulated difficulty would enable the student in building skill to progress from easy copy to more difficult copy. This would lead to a simplification of the learning process in typewriting.

Educational institutions and business organizations have established typewriting rates which typists are expected to attain. Copy material is used as a measure of the rate at which a typist can perform. An accurate measure of that rate is not obtained if the measuring instrument varies. Identification of those factors which contribute to the difficulty of copy material would enable the administrators of timed writings to determine more accurately the performance of typists on various timed writings.

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<sup>3</sup>Bell, Mary LaVerne, "Some Factors of Difficulty in Typewriting Copy," (Unpublished Ed. D. dissertation) The University of Oklahoma, Norman, Oklahoma, 1950.

There is little evidence to indicate that authors of typewriting textbooks have given concerted attention to the factors which may influence the ease or difficulty of the material incorporated in typewriting copy. The investigator feels that there is a definite need for this study in order that authors of typewriting copy may recognize stroke intensity of words as a factor influencing the typewritability of copy material. A recognition of this factor will enable authors of copy to prepare graduated copy to be used in skill building and provide teachers and business with an accurate measuring instrument.

#### Purpose of the Study

The purposes of this study are as follows:

1. To determine whether or not stroke intensity of words has any effect upon the typewritability of copy material. Stroke intensity of words means the number of strokes in the average word.

2. To determine whether or not there is a relationship or correlation between stroke intensity of words and per cent of frequently used words.

In other words, the specific purposes of this study are to find out if the length of words in copy material influence the typewritability of the material, and whether or not there is a correlation between the stroke intensity of words and the per cent of frequently used words found in copy material.

### Hypothesis

Vandegrift and McMillon<sup>4</sup> in 1942 made a graphic motion study in typewriting classes of WAVES. As a result of this study, the authors reported that greatest speed was attained on two and three letter words. Copy composed of many long words was found to be more difficult to typewrite.

In beginning typewriting, students learn to typewrite on the letter by letter level, gradually increasing from this procedure to combinations of two or more letters. These letter combinations may be whole words, syllables and combinations of syllables. Short words such as it and the are automatized by the students thus decreasing the need for typewriting these words by the letter combination or syllable techniques. Automatization of a word would indicate that the student recognizes a word-whole and thus typewrites the word in its entirety rather than breaking it down into groups of letters. Those words most often automatized by the student are relatively short in length. From the foregoing statements, the investigator concludes that longer words are not frequently automatized by students of typewriting and are, therefore, more difficult to typewrite.

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<sup>4</sup>Vandegrift, J. R., and McMillon, Roy, "Recent Research in Graphic Time Studies in Typewriting," The National Business Education Quarterly, XII (Winter, 1943), 5-9.



Evidence obtained from a study conducted by Lingerfelt<sup>5</sup> states that the greater the length of syllables contained in words, the less difficult the word becomes to typewrite. This would indicate that longer syllables may be recognized by the typist as word-wholes or shorter words and thus lessen the difficulty encountered in typewriting the word.

The hypothesis established by this writer assumes that it is more difficult to typewrite copy containing an average word length of 6.50 strokes for example, than it is to typewrite copy containing an average word length of 5.50 strokes. This is based upon the assumption that each piece of copy material is equally long by the standard word count, five strokes per word, and that other things are equal. Thus it is assumed that shorter words are easier to read in detail and thus less difficult to typewrite.

#### Definition of Terms

Stroke intensity of words is the number of strokes in the average word. The total number of strokes in the copy, counted as if written on one continuous line, divided by the total number of words in the copy, yields word stroke intensity or stroke intensity of words.

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<sup>5</sup>Lingerfelt, Mildred C., "The Relation Between Syllabic Stroke Intensity and Typewritability," (Unpublished Master's Thesis), Blacksburg, Virginia, Virginia Polytechnic Institute, 1952.

Per cent of frequently used words refers to the number of times all words which appear in a list of 500 most-used words occur in a given piece of copy. The total number of frequently used words in the copy is divided by the total number of words in the copy to yield the per cent of frequently used words.

Copy material is connected paragraph material reproduced on the typewriter exclusive of tabulations, business forms and the like. Copy material used in this study was selected from the prepared timed writings and practice material of five typewriting texts.

Definitions of the terms syllabic intensity, factors, typewritability and strokes may be found in the study conducted by Lingerfelt.<sup>6</sup> A definition of timed writing may be found in the study made by Witten.<sup>7</sup>

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<sup>6</sup>Ibid., pp. 7-8.

<sup>7</sup>Witten, Mildred A., "The Relationship Between Syllabic Intensity of Words and Typewritability," (Unpublished Master's Thesis), Blacksburg, Virginia, Virginia Polytechnic Institute, 1952.

CHAPTER II  
RELATED STUDIES

A realization that certain factors influence the typewritability of copy material has led to a few experiments and articles which support the hypothesis established by this investigator.

Bell<sup>8</sup> cites studies by Flesch, Dale, Chall and others which suggest that typewriting material may be graded in difficulty or at least controlled to some extent.

Bell<sup>9</sup> also refers to a study by Kochka who attempted to discover a reliable means of measuring typewriting achievement. He composed three timed writings in which the factors held as constant as possible were length of the test, stroke intensity, sentence structure, reading quality of the test and validity of the test. Through these tests, Kochka attempted to discover a reliable means of measuring typewriting achievement.

In 1940, Shipley<sup>10</sup> conducted a series of typewriting tests and found that the fluctuation in a learner's typewriting

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<sup>8</sup>Bell, op. cit., p. 6.

<sup>9</sup>Ibid., p. 6.

<sup>10</sup>Shipley, op. cit.

speed is not necessarily caused by changes in his typewriting ability, but more likely by the variation in difficulty of various pieces of copy.

Vandegrift and McMillon in 1942<sup>11</sup> made a graphic motion study in typewriting classes of the WAVES. They reported that all their subjects attained the greatest speed on two and three letter words.

Bell<sup>12</sup> conducted a study to determine the effect of stroke intensity, percentage of frequently-used words, and syllabic intensity on typewriting performance. The study was divided into three experiments each concerned with one of the above factors. This study, however, is primarily concerned with one factor, stroke intensity of words, therefore, in reviewing Bell's work only that phase will be considered here.

Bell composed five tests in which the syllabic intensity and percentage of frequently-used words were regulated while the stroke intensity was varied. Bell stated in her conclusion that, "In general, there appears to be a tendency for strokes to decrease with an increase in stroke intensity."

Lingerfelt<sup>13</sup> in a study conducted on the relation between syllabic stroke intensity and typewritability, found that an increase in syllabic stroke intensity of words produced a

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<sup>11</sup>Vandegrift and McMillon, op. cit.

<sup>12</sup>Bell, op. cit.

<sup>13</sup>Lingerfelt, op. cit.

corresponding increase in the number of strokes typewritten. The number of strokes per syllable ranged from 3.484 to 4.285. Lingerfelt's study, in the opinion of this investigator, indicates that these longer syllables which were found easier to typewrite might in reality only be short words.

A recent study conducted by Witten<sup>14</sup> on the effect of syllabic intensity of words upon typewritability, gives further evidence that the variation in the typewritability of copy material is influenced by certain factors. This study and others reviewed here support the need for further investigation of the variables influencing the typewritability of copy.

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<sup>14</sup>Witten, op. cit.

## CHAPTER III

## PROCEDURES

Selection of the Problem

The investigator selected the problem of stroke intensity of words because of an interest in aiding Business Education teachers to overcome some of the difficulties encountered in building and measuring the typewriting skill of students.

A detailed explanation of the procedures followed in selecting and securing the data necessary for this study may be found in recent studies conducted by Witten<sup>15</sup> and Lingerfelt.<sup>16</sup> Therefore, an outline of the techniques employed in selecting and securing the necessary data is presented here.

Sponsorship

Sponsorship of the Business Education Service of the State Department of Education, Richmond, Virginia was obtained.

Selection of Experimental Subjects

Letters requesting permission to conduct the study were sent to Principals and Business Teachers in 52 public schools

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<sup>15</sup>Ibid.

<sup>16</sup>Witten, op. cit.

selected at random throughout the state. These letters contained mimeographed reply cards. The reply cards from those schools having 30 or more second year typewriting students were chosen as a basis for selecting the 660 participants. The investigators drew at random from these cards until a total of 660 students had been obtained.

#### Selection of Experimental Design

An 11 x 11 lattice design secured from the text by Cochran and Cox<sup>17</sup> was selected as a basis for determining the pattern to follow in administering the 121 timed writings. A detailed explanation of the experimental design may be found in the study conducted by Lingerfelt.<sup>18</sup>

#### Selection of Timed Writings

Publishers of five typewriting textbooks used in high schools granted the investigators permission to reproduce

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<sup>17</sup>Cochran, William G., and Cox, Gertrude M., Experimental Designs, John Wiley and Sons, New York, 1950, 364-365.

<sup>18</sup>Lingerfelt, op. cit., p. 13.

material from their texts. All copy material in the five texts<sup>19,20,21,22,23</sup> was numbered consecutively giving the investigators a total of 239 timed writings, each having no more than 1250 strokes. From three random drawings a total of 121 were selected. These selected timed writings were numbered from 1 to 121, and coded to conceal the identity of the text from which they were taken.

#### Preparation of Timed Writings

The 121 timed writings used in the experiment were duplicated on 7" x 8 1/2" mimeograph paper. The timed writings were then collated into 660 booklets according to the 11 x 11 lattice design. Instructions to the students were placed on the front of each booklet, and instructions to the teacher administering the timed writings accompanied each group of booklets sent out. The 7260 timed writings were then distributed to the schools participating in the study.

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<sup>19</sup>Blanchard, Clyde I., and Smith, Harold H., Typing for Business, Two-Year Course, The Gregg Publishing Company, New York, 1946.

<sup>20</sup>DePew, Ollie, Complete Typewriting, Allyn and Bacon, Boston, 1948.

<sup>21</sup>Lessenberry, D. D., and Crawford, T. James, 20th Century Typewriting, Fifth Edition, South-Western Publishing Company, Cincinnati, 1947.

<sup>22</sup>Maxwell, W. C., Mursell, James L., and Fries, Albert C., Rhythmic Typewriting, The Ronald Press Company, New York, 1948.

<sup>23</sup>White, Walter T., and Reigner, Charles G., Rowe Typing, Second Edition, Baltimore, 1944.



Collection of Data

The timed writings received from the schools were carefully checked for errors. Incomplete returns from a number of schools made it necessary for the investigators to reduce the number of booklets used to 330. The basic data to be utilized in the study were then secured from these timed writings.

CHAPTER IV  
ANALYSIS OF DATA

Analysis of Timed Writings

The criterion for measuring the performance of the students on the timed writings used in this experiment was the total number of strokes typed and the total number of errors made by the students during five-minute testing periods. Therefore, the total strokes and errors were carefully computed for the 3630 timed writings used in the study.

In analyzing the data, the purpose was to determine whether or not the performance of the students on the timed writings was affected by variations in stroke intensity of words. The total words were found for each of the 121 samples of copy material. By dividing the number of words into the number of strokes, the stroke intensity of words was determined for each timed writing. The stroke intensity of words on the 121 timed writings ranged from 4.767 to 6.143. Table 1, pages 19-24 shows the tabulation of these data for the timed writings. The table includes test number, number of words, number of strokes, stroke intensity of words, corrected production means, corrected error means. The means refer to the average number of strokes and errors typewritten by five students.

Table 1

Summary of Total Words, Total Strokes, Stroke Intensity of Words, Corrected Production Means and Corrected Error Means for the 121 Samples of Timed Writing Material

No.	Words	Strokes	Stroke Intensity of Words	Corrected Production Means	Corrected Error Means
A-1	154	837	5.44	6196.83	35.42
A-2	175	947	5.41	6429.83	54.83
A-3	175	957	5.47	6108.00	48.15
A-4	183	1055	5.77	5937.5	57.23
A-5	210	1041	4.96	6003.00	57.64
B-6	206	1068	5.18	6255.17	46.20
B-7	211	1041	4.93	5876.50	57.65
B-8	203	1014	5.00	6322.83	58.83
B-9	169	871	5.15	6430.33	39.34
B-10	231	1213	5.25	6442.16	50.35
B-11	203	1012	4.99	6410.33	53.79
B-12	186	1065	5.73	6284.50	45.28
B-13	173	950	5.49	6155.33	46.05
B-14	192	1061	5.53	6236.16	39.95
B-15	233	1225	5.26	6366.16	49.02
B-16	203	1095	5.39	6257.16	49.99
B-17	138	720	5.22	6434.33	48.55
B-18	225	1185	5.27	6369.83	46.53
B-19	202	1061	5.25	6320.83	57.75
B-20	182	930	5.11	6146.50	44.66
B-21	129	767	5.95	6241.66	46.34

Table 1  
(Continued)

No.	Words	Strokes	Stroke Intensity of Words	Corrected Production Means	Corrected Error Means
B-22	157	859	5.47	6359.33	49.58
B-23	156	823	5.28	6146.16	42.98
B-24	210	1169	5.57	6266.00	41.10
B-25	214	1192	5.57	6106.16	45.18
B-26	181	1105	6.10	5968.16	54.19
B-27	196	1019	5.20	6201.00	50.06
B-28	155	819	5.28	6204.83	43.66
B-29	169	940	5.56	6235.33	50.25
B-30	169	961	5.69	6123.00	44.69
C-31	184	957	5.20	6334.66	56.96
C-32	168	880	5.24	6358.50	49.26
C-33	227	1082	4.77	6457.16	49.64
C-34	139	765	5.50	5649.33	50.74
C-35	176	1026	5.83	5883.50	43.85
C-36	170	963	5.67	5962.17	49.64
C-37	149	836	5.61	5792.83	50.84
C-38	186	1029	5.53	6045.33	50.38
C-39	230	1154	5.02	6300.83	41.37
D-40	193	977	5.06	6454.67	42.84
D-41	223	1106	4.96	6053.67	51.06
D-42	205	1146	5.59	6013.16	46.10

Table 1  
(Continued)

No.	Words	Strokes	Stroke Intensity of Words	Corrected Production Means	Corrected Error Means
D-43	206	1099	5.34	5721.00	57.74
D-44	177	1011	5.71	5954.17	56.69
D-45	188	1133	6.03	6581.67	51.95
D-46	196	1039	5.30	6284.83	56.88
D-47	182	1118	6.14	5958.50	47.83
D-48	174	1014	5.83	6081.33	48.65
D-49	187	1132	6.05	5887.67	50.78
D-50	195	1058	5.43	6169.83	50.42
D-51	181	1073	5.93	5816.33	51.48
D-52	174	948	5.45	6091.83	49.67
D-53	133	817	5.14	5834.83	52.97
E-54	154	889	5.77	5963.17	58.44
E-55	184	1027	5.58	5923.67	49.11
E-56	172	913	5.31	5567.66	42.14
E-57	190	1133	5.96	6197.16	53.94
E-58	168	981	5.84	6190.83	43.08
E-59	155	889	5.74	6026.50	49.32
E-60	199	1045	5.25	5943.00	43.05
E-61	166	902	5.43	6017.50	40.01
E-62	180	1017	5.65	5989.00	48.89
E-63	203	1089	5.36	6154.17	49.55

Table 1  
(Continued)

No.	Words	Strokes	Stroke Intensity of Words	Corrected Production Means	Corrected Error Means
E-64	176	1047	5.95	5996.33	56.33
E-65	212	1149	5.42	6265.16	42.52
E-66	175	1060	6.06	6035.50	46.41
E-67	172	823	4.78	6267.67	57.60
E-68	134	697	5.20	5926.83	50.98
E-69	194	955	4.92	6157.17	53.07
E-70	197	993	5.04	5937.50	55.43
E-71	184	888	4.83	6572.83	49.41
E-72	222	1121	5.05	6095.50	58.92
E-73	191	1100	5.76	6135.66	43.42
E-74	199	1171	5.88	5135.67	48.78
E-75	221	1206	5.46	5999.33	53.95
E-76	175	968	5.53	5861.83	56.47
E-77	179	976	5.45	6101.16	54.69
E-78	221	1195	5.41	6185.33	46.77
E-79	175	864	4.94	5659.67	50.88
A-80	185	969	5.24	6455.00	46.12
A-81	214	1036	4.84	6069.00	42.90
B-82	209	1103	5.28	5589.50	49.92
B-83	140	769	5.49	6164.33	50.11

Table 1  
(Continued)

No.	Words	Strokes	Stroke Intensity of Words	Corrected Production Means	Corrected Error Means
B-84	171	928	5.43	5795.50	47.71
B-85	164	850	5.18	6314.33	49.62
B-86	201	1060	5.27	5993.67	50.96
B-87	213	1139	5.35	5978.50	50.32
B-88	191	1076	5.63	6116.67	47.12
B-89	137	736	5.37	6447.33	45.28
B-90	145	796	5.49	6196.83	45.31
B-91	184	984	5.35	6578.50	50.67
C-92	208	1091	5.25	6102.83	43.70
C-93	145	835	5.76	6256.33	55.22
C-94	182	1022	5.62	6095.33	51.25
D-95	175	910	5.20	6416.33	43.10
D-96	211	1116	5.29	5830.67	55.48
D-97	163	954	5.85	5746.00	45.30
D-98	181	1054	5.82	6289.83	51.68
D-99	173	974	5.63	6034.33	50.17
D-100	161	888	5.52	6173.33	53.75
E-101	180	972	5.40	6062.50	44.16
E-102	195	1070	5.49	6181.50	49.16
E-103	200	1065	5.33	6219.83	54.19
E-104	178	1000	5.62	6283.83	46.70

Table 1  
(Continued)

No.	Words	Strokes	Stroke Intensity of Words	Corrected Production Means	Corrected Error Means
E-105	175	952	5.44	6078.67	49.85
E-106	163	848	5.20	6091.83	48.58
E-107	193	942	4.88	6025.50	56.02
E-108	181	959	5.30	6026.16	49.86
E-109	169	942	5.57	6255.50	43.94
E-110	204	1104	5.41	5984.00	44.40
E-111	229	1150	5.02	6086.33	51.57
E-112	158	797	5.04	6653.83	57.05
E-113	168	944	5.62	6366.17	52.16
E-114	184	970	5.27	6234.83	45.90
D-115	195	1119	5.74	6015.83	52.14
E-116	203	1145	5.64	6165.83	50.53
D-117	171	1022	5.98	5861.50	54.51
B-118	174	1001	5.75	5851.33	51.57
A-119	195	1046	5.36	6031.67	53.55
D-120	172	1032	6.00	6123.17	58.30
D-121	198	998	5.04	6050.67	59.18



Results of Analysis of Variance for Errors Made

The Snedecor's F Test which gives as a result, the probability that the differences which occur do so by chance, was utilized in the analysis of variance for errors made.

The F test applied to variability due to replications or squares indicated that there is a positive difference between replications at the 0.1% level. These differences arose between groups of 55 students taking timed writings in each replication. The effect of rows or differences between groups of five students was likewise statistically significant at the 0.1% level. An analysis of variance for errors made is found on page 26, Table 2.

Another difference with respect to errors made appeared between columns. A significant difference at the 0.1% level was noted in the effect of the order in which the timed writings were taken. Figure 1, page 32 shows the total errors made for each column as indicated in the design, plotted against the column number in sequence. The resulting picture graphically shows that there were increasingly more errors as the timed writings progressed. In plotting the graph, (Figure 2, page 33) of the number of strokes typewritten versus number of errors made, there appeared to be no correlation between the two. Likewise, there appeared to be no correlation between the number of errors made and the stroke intensity of words.

Table 2  
 Analysis of Variance for Errors Made

Source	d/f	Sum of Squares	Mean of Squares	F- ratio	
Replication	5	55,154.83	11,030.97	134.82	0.1%
Treatments	120	28,770.86	239.76	2.93	0.1%
Rows, Adjusted	60	60,026.82	1,000.45	12.23	0.1%
Columns, Adjusted	60	13,756.03	229.27	2.80	0.1%
Error	<u>480</u>	<u>39,273.48</u>	81.82	-----	----
Total	725	193,982.03			

Figure 3, page 34 shows a plotting of the stroke intensity of words versus number of errors made. The absence of a general trend or pattern in this graph indicated there was no justification for a correlation study between stroke intensity of words and number of errors made.

Results of the Analysis of Variance  
For Strokes Typewritten

A significant difference between the rows, columns and replications at the 0.1% level was indicated in the analysis of variance for strokes typewritten. These are shown in Table 3, on page 28.

An examination of the analysis of variance for errors and the analysis of variance for strokes indicates that the two are roughly proportional to each other. However, a primary difference existed between the column factors of the two. The linear trend of errors made versus order of tests given (Figure 2, page 33) did not reappear for the strokes typewritten. In other words the column factor for errors made indicated a trend of increasing errors with time, while the linear effect with regard to strokes typewritten only showed what seemed to be random or unexplained fluctuations.

A minus correlation was indicated in the graph of number of strokes typewritten versus stroke intensity of words, Figure 4, page 35. A greater production of strokes on the

Table 3  
 Analysis of Variance for Strokes Typewritten

Source	d/f	Sum of Squares	Mean of Squares	F- ratio	
Replication	5	73,764,723	14,752,945	226.67	0.1%
Treatments	120	58,509,345	487,578	7.49	0.1%
Rows, Adjusted	60	108,964,557	1,816,076	27.90	0.1%
Columns, Adjusted	60	8,881,249	148,021	2.27	0.1%
Error	<u>480</u>	<u>31,239,237</u>	65,081	-----	-----
Total	725	281,359,111			

timed writings containing lower stroke intensity of words was indicated by the downward slope of the graph.

Correlation of Stroke Intensity of Words  
and Strokes Typewritten

As a first approximation to determine whether or not correlation studies might be justifiable, graphs were made of the data and carefully studied. The graph of stroke intensity of words versus errors made is shown in Figure 3, page 34. An examination of this figure showed a lack of correlation. Therefore mathematical correlation attempts were not made.

It appeared there was a definite correlation between stroke intensity of words and number of strokes typewritten as evidenced by the graph of stroke intensity of words versus strokes typewritten, Figure 4, page 35. Mathematical studies were made which showed that the correlation coefficient for these two factors is 0.249. The analysis of variance for this correlation is found in Table 4, page 30. An F test applied to the analysis of variance showed that chances are less than 1 in 1000 that there is no correlation inherent in the data.

Confidence limits placed on the estimate of rho show that, with a probability of 95% the true value of rho lies between .0748 and .4094. With a probability of 99% the true value of rho lies between .017 and .4565.

Table 4  
Analysis of Variance for Correlation

---

---

Source	Sum of Squares	Degrees of Freedom	Mean of Squares
Correlation	0.062	1	.062
Residual	<u>0.938</u>	<u>119</u>	.0077
Total	1.000	120	

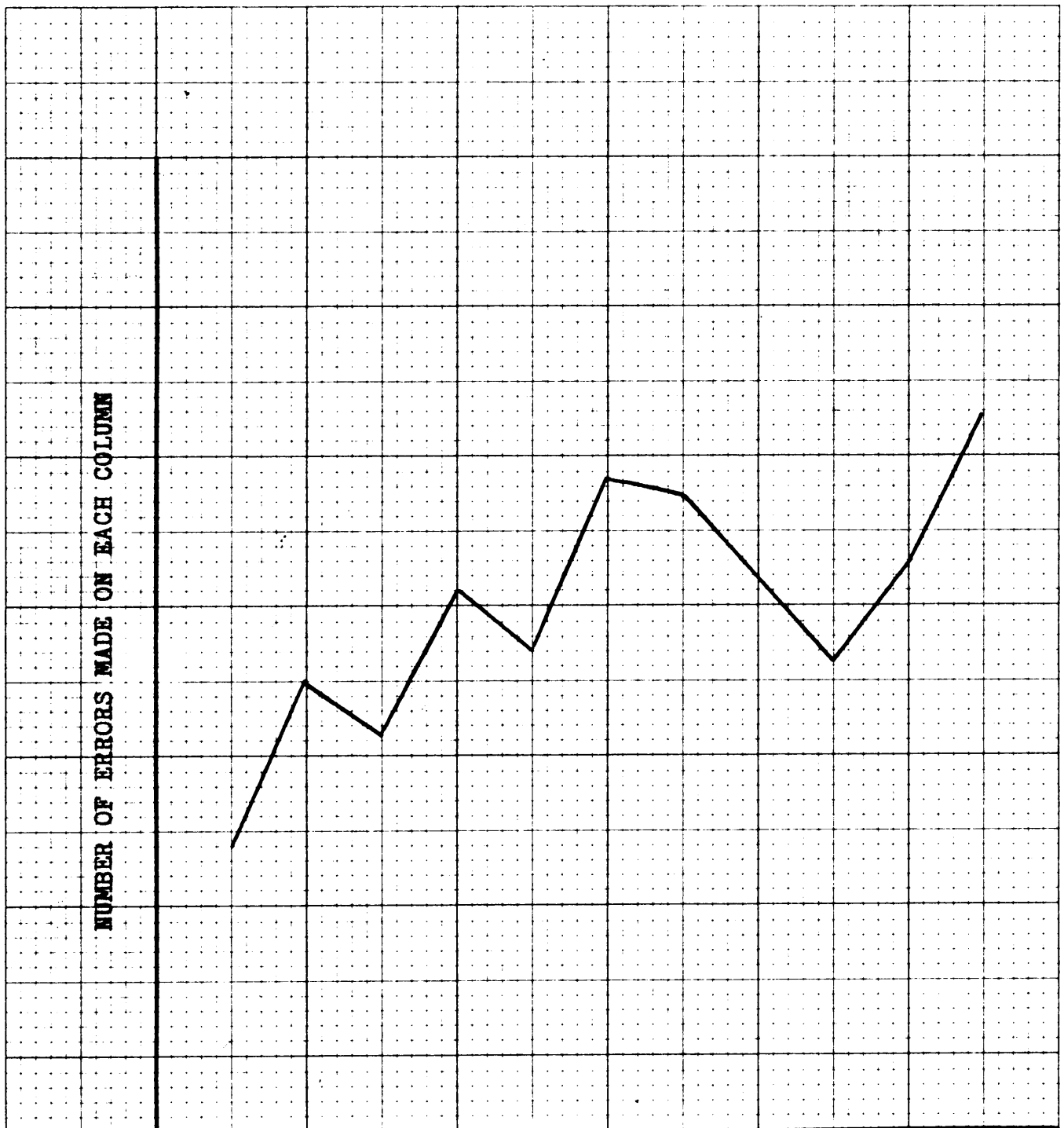
---

F-ratio = 7.7

---

Correlation of Stroke Intensity of Words  
and Per Cent of Frequently Used Words

A mathematical study was made which revealed that there is a correlation of .33 between stroke intensity of words and per cent of frequently used words.



1 2 3 4 5 6 7 8 9 10 11

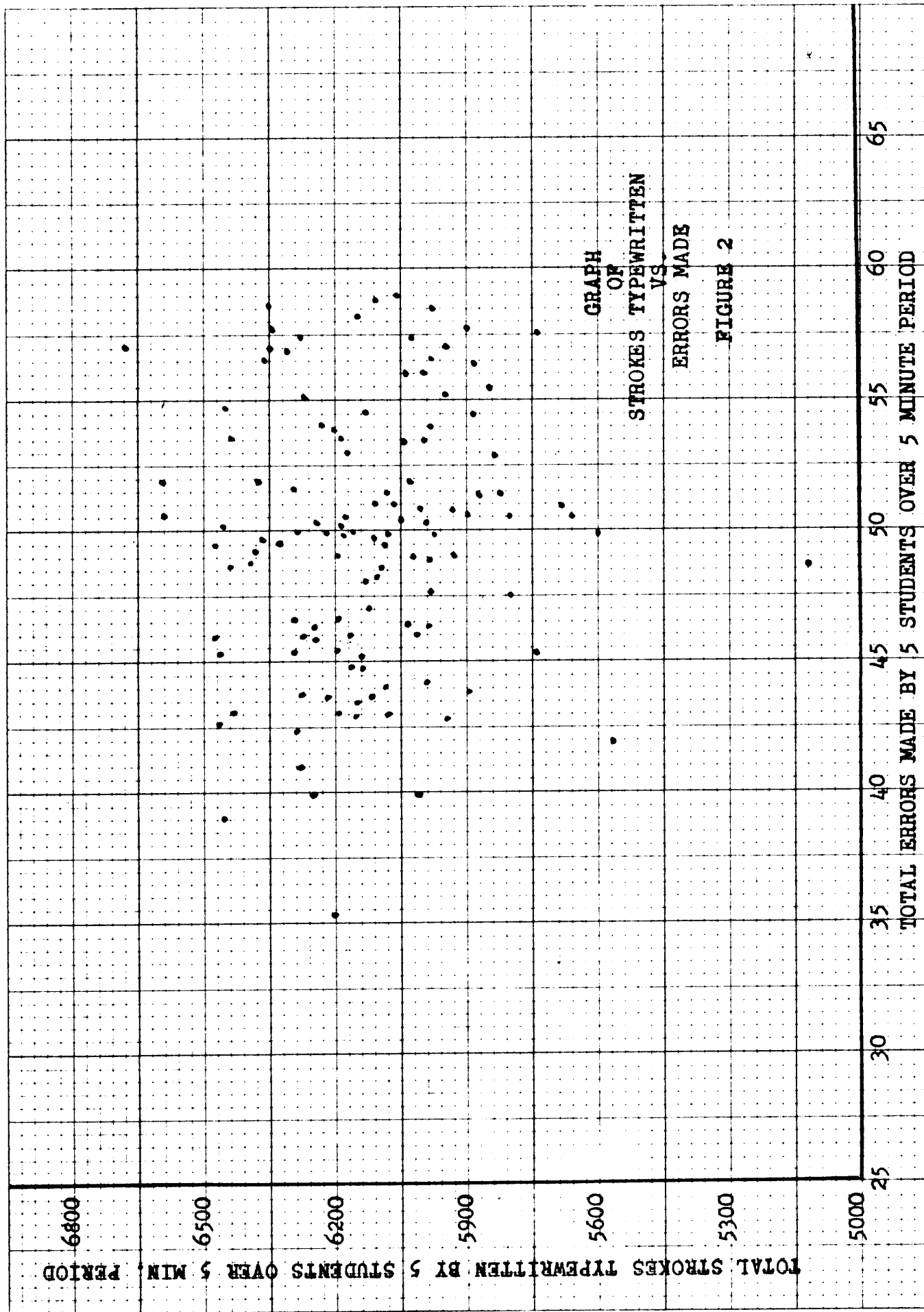
COLUMN NUMBER

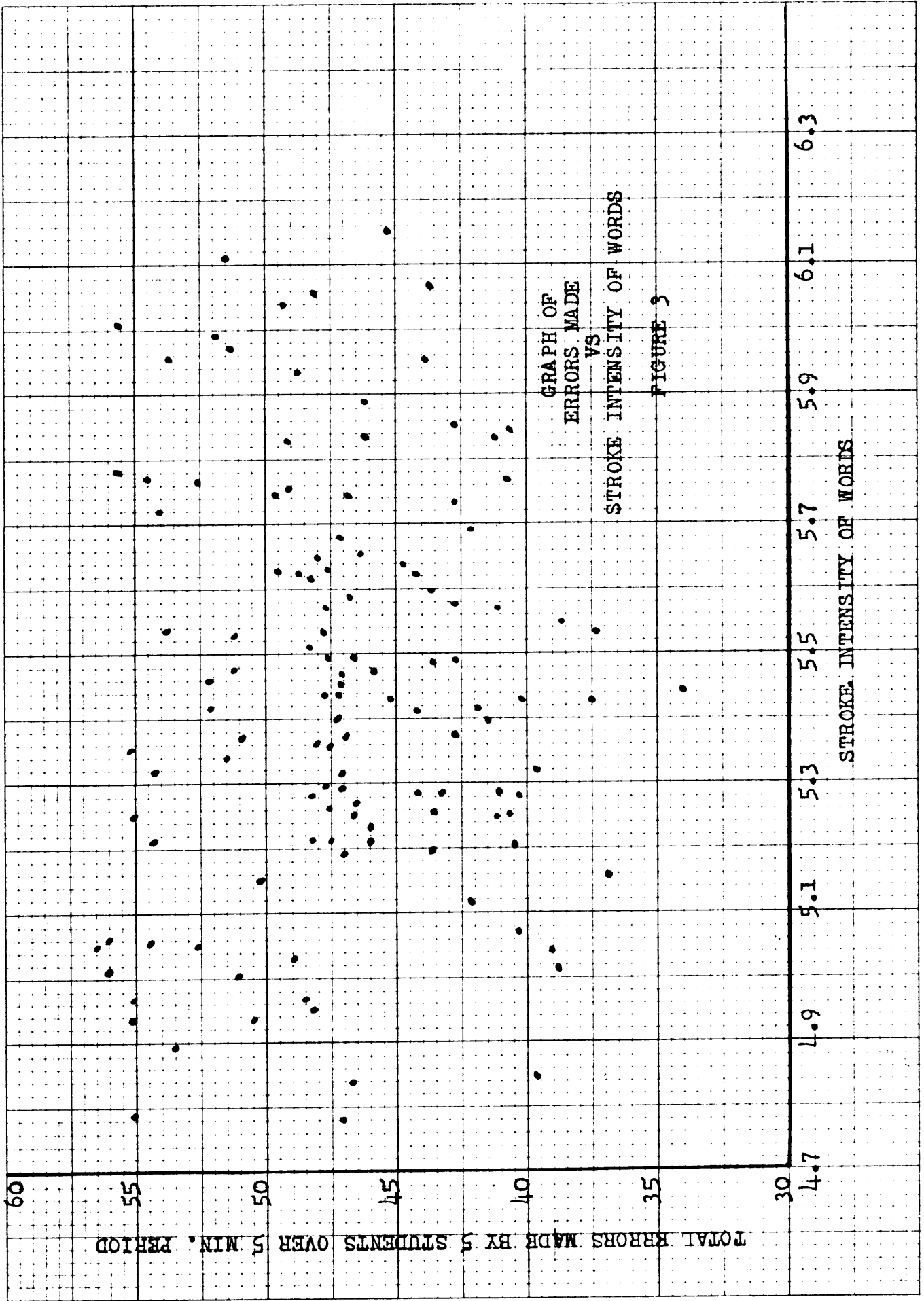
TREND EFFECT OF ERRORS

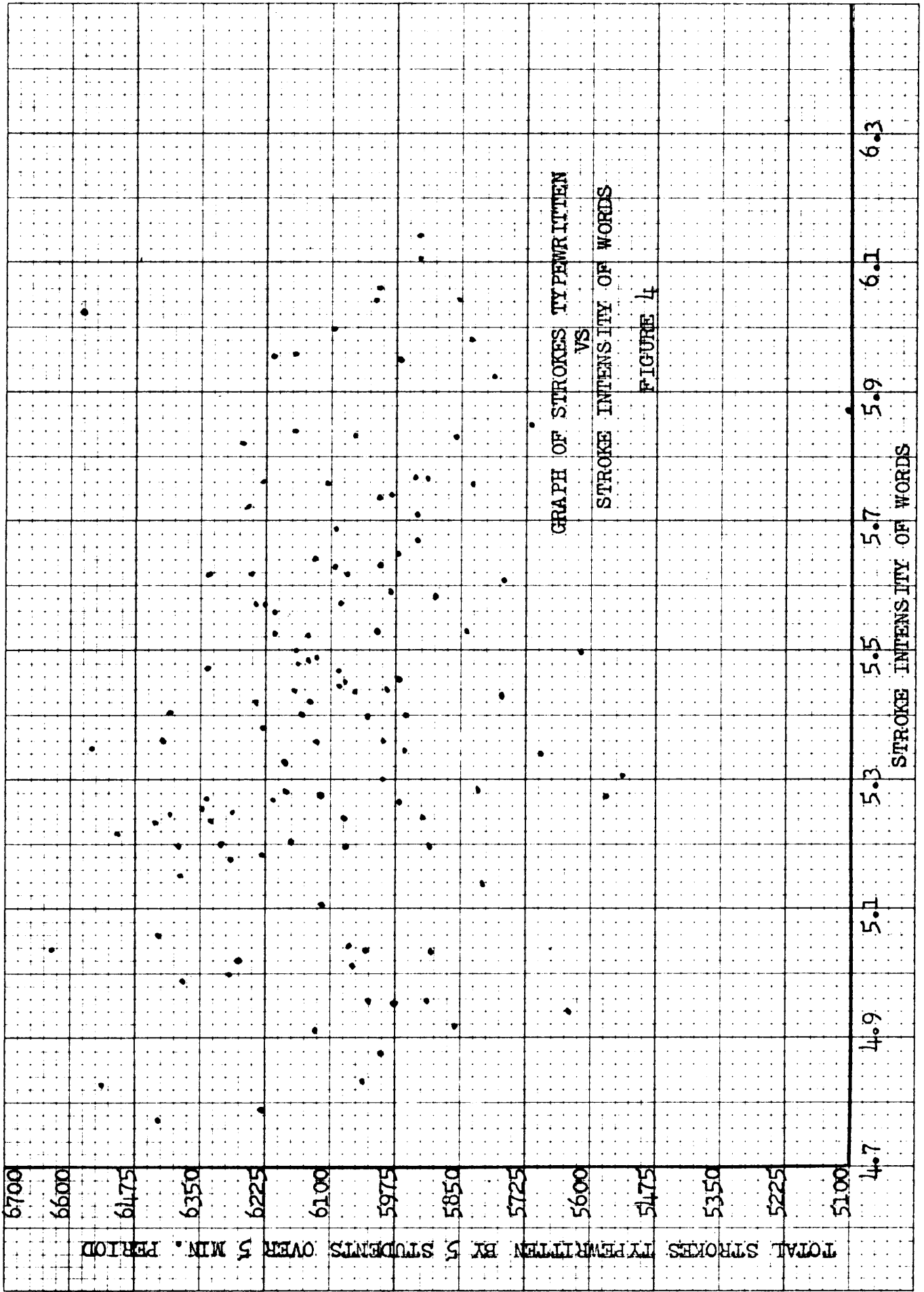
Made in Order of Tests Given

FIGURE 1









CHAPTER V  
CONCLUSIONS AND RECOMMENDATIONS

General conclusions drawn from the results of the study are as follows:

1. There is a correlation between stroke intensity of words, and the amount of copy produced on the typewriter in a given time.

A correlation coefficient of  $-0.249$ , although not extremely high, indicates that stroke intensity of words is a factor in the typewritability of copy material. The correlation indicated that an increase in stroke intensity within the range of 4.77 to 6.14 produced a decrease in the number of strokes typewritten. In other words, the longer the words to be typewritten, the fewer number of strokes the student will produce in a given time.

2. There appeared to be no correlation between stroke intensity of words and the errors made within a given time. The absence of a correlation between stroke intensity of words and the errors made leads the investigator to believe that the errors might possibly be chance occurrences.
3. The study indicated that there is apparently no correlation between the number of errors made and the number of strokes typewritten.

4. The study indicated that the errors made on the tests seemed to increase as the tests were progressively taken.

The cause of this trend is unknown. The absence of the usual motivation, an element of fatigue, or possibly boredom on the part of the subjects may have contributed to the increase in errors.

5. The study indicated a correlation of .33 between stroke intensity of words and the per cent of frequently used words. This leads the investigator to believe that in general, the words that are most frequently used are words which contain fewer strokes.

#### Recommendations

On the basis of the results of the investigation, the following recommendations are made:

1. Stroke intensity of words should be considered as a difficulty factor in the preparation of copy material.
2. Copy material used by students in typewriting should be arranged according to difficulty. There is a need for some means of converting the results of timed writings to standard measures as to difficulty.

3. The low correlation between stroke intensity of words and the number of strokes produced in typewriting copy, and between stroke intensity of words and the per cent of frequently used words, indicates that further work should be done with the factor, stroke intensity of words, to determine whether or not it is a true variable.

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VITA

**The vita has been removed from  
the scanned document**

**APPENDIX A**

## SAMPLE LETTER SENT TO TEXTBOOK PUBLISHERS

Gentlemen:

We are writing you at this time to request permission to use material from your textbook in a thesis study which we are planning to conduct.

Material is to be drawn at random from five typewriting texts to aid in conducting a testing program for a graduate study. This is a study concerning the effect of syllabic intensity, per cent of frequently used words, stroke intensity, and the like upon difficulty in typewriting copy.

This study is to be conducted under the guidance of Dr. Harry Huffman, Head, Department of Business Education, Virginia Polytechnic Institute, Blacksburg, Virginia.

We would like to reproduce from your textbook certain straight-copy matter for use in testing. In our study we are by no means endeavoring to make a comparison of typewriting texts.

It is our hope that the results of this study will prove useful in the business field.

Thank you in advance for your cooperation, and we shall sincerely appreciate it if you will grant us permission to use material from your book. Please let us hear from you in the near future.

Very truly yours,

Business men and women have a keen interest in the work that students and teachers are doing in the classrooms of our schools, for they realize that out of the schools will come the men and women who will be the next leaders in business. Leadership is not now the exclusive privilege of men. There is quite a large number of women who lead the parade, so to speak, of those who achieve the unusual and worth while in business. There is just as much chance for success now as there has ever been, but the world of business requires more of its workers now than it did before.

As I talk with business men and women, I often ask them to tell me just what I shall say to young men and women who are now enrolled in the business education curriculum. For the most part, I get the same suggestion--in different words, of course, but the same in thought. They say business requires workers who can work without constant supervision, who can prove their own work and know that it is right or wrong. They say, too, that employers expect students, while yet in school, to learn to work up to capacity, to form the habit of holding themselves to their best work at all times. There is no place in business for the lazy man or woman.

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Reproduced from TWENTIETH CENTURY TYPEWRITING, by special arrangement with and permission of the publishers, South-Western Publishing Company, Cincinnati New York, Chicago, Dallas, San Francisco.

There is another point which cannot be put in the form of a rule,	65
but which it is very necessary for you to understand if you wish to	132
learn effectively. Briefly it is this: Improvement is not regular,	200
but goes in waves. If you observe yourself while learning to type-	267
write, or indeed in doing anything else, you will notice this. There	336
will be periods, perhaps lasting considerable time, during which you will	409
not progress. Then all of a sudden, you will make a big advance. In	478
the language of technical psychology these periods of no progress are	547
called "plateaus" and the moments of swift advance are called "spurts."	618
Plateaus and spurts are found in every kind of learning, so you need not	690
be surprised or disturbed about them. You should know what to do to	758
make the plateaus as brief as possible, and to encourage the arrival	826
of spurts.	836

Reproduced from RHYTHMIC TYPEWRITING, by special arrangement with—and permission of—the publishers, The Ronald Press Company, New York.

From time to time you set yourself to the task of forming new habits	68
or of breaking yourself of bad habits into which you may have fallen.	137
To save time and to aid you to reach your goal, you ought to know the	206
best way to go about the job.	235
First of all, you must have clearly in your mind all the details of	302
the new habit you wish to form. If, for instance, you wish to form	369
habits that will make you a good pole vaulter, you need to study correct	441
form in all the aspects of that sport.	479
Next, you will want to make sure that you have clearly in your mind	546
the goal at which you are aiming. If you wish to learn to write a better	619
hand, you need to learn correct posture at the desk; but you also need	689
to have in your mind a picture of how well-written letters look.	753
Of course, you always want your typewritten notes and letters to look	822
neat and attractive. For that reason you will need to study the well-	892
written and properly arranged typewritten notes and letters which appear	964
in this book.	977

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Reproduced from ROWE TYPING, Second Edition, by special arrangement with--and permission of--the publishers, The H. M. Rowe Company, Baltimore, Chicago, San Francisco.



When the secretary writes a letter, she has a plan by which she works. She may carry that plan in her mind, or she may make notes or an outline of the letter she is to write; then she sits down at her typewriter and writes the letter.	59 123 187 232
A business letter is a good letter when it achieves the result at which it is aimed. Unless it actually gets that result—unless it collects the bill, answers the question, makes the adjustment, sells the goods or produces a mental attitude which leads to a sale—it is not a good letter, no matter how attractive its arrangement or how perfect its English may be. If you aspire to be a secretary, rest assured that one of the qualifications you will need to possess is the ability to write business letters—write them in a human, interesting, and forceful way. Letters are the shuttles which fly back and forth to weave the big web of commerce. The secretary is a secretary largely because she has the ability to sit down at her typewriter and compose letters which will favorably represent her employer to the outside world.	287 354 422 488 558 627 693 758 821 884 947 1014 1058

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Reproduced from *ROWE TYPING*, Second Edition, by special arrangement with— and permission of—the publishers, The H. M. Rowe Company, Baltimore, Chicago, San Francisco.

How many residents of your town are not now buying power from you but would gladly come on your line if they were sure that their bills each month would not exceed a certain nominal figure, such as, for instance, \$1 a month?

How many additional users of your power do you think you could get if you could guarantee that the bills would never exceed \$1 a month?

In every town there are always a number of people who would like to have electricity, but who feel that they cannot afford it. Yet, if these same people were sure that their bills would never be more than a certain amount, they would buy their power from you and would constitute a very satisfactory increase in your load.

You can obtain this additional load by offering power to this class of customers at a "flat rate" and limiting the maximum demand by the use of an Excess Indicator, which, as you undoubtedly know, is a device that causes all the lamps in the house to flicker if more lights than the customer agrees to pay for in his flat-rate agreement with you are turned on at any one time.

E--70

A week went by, as I have said, and the season of the line storm was near at hand. On the morning in question there were flags at the top of the pole by the south light telling of a gale that was slowly creeping up the coast. It was Monday, and during the night the barometer had gone down very rapidly and the sky showed such signs of coming bad weather that not one of the fishermen cared to venture out of the harbor; but all busied themselves with going aboard their boats and tying up the sails and rigging and making everything secure against what all knew was surely to come.

At the regular time, however, Mr. Nemo and the young woman came down from the cottage with the usual basket of luncheon and went aboard the "Maud." As the man was untying the sails a gray-haired old veteran of the sea walked to the edge of the wharf and said: "I say, Cap, there is bound to be a regular clewed topsail gale before night, and there is going to be a mighty nasty sea; I would stay on shore if I were you."

---

Reproduced from TYPING FOR BUSINESS, by special arrangement with--and permission of--the publishers, The Gregg Publishing Company, New York, Chicago, San Francisco, Dallas.

Most pupils think they know how to read, but very few of them really	68
do. There are two methods of reading in the preparation of lessons.	136
The first of these is the general reading which you give your subject	205
matter to see what it is all about. In this preliminary reading, go as	276
fast as you can while still getting the main points and ideas. Read all	348
the words of a line at once, if you can. Practice making as few stops	418
with your eyes as possible, and you will save time, just as the limited	489
train saves time over the local. In all reading, read ideas, not words.	561
For your second reading, concentrate upon the difficult portions of	628
your work. You do not need to spend time upon easy things. Have a	695
dictionary close at your elbow, and look up the words which you do not	765
know and which are necessary for the understanding of the lesson. When	836
you have finished a paragraph or a section, stop and think about it. Sum	909
up the facts in your mind. Make good notes in outline form.	969

---

Reproduced from COMPLETE TYPEWRITING, by special arrangement with—and permission of—the publishers, Allyn and Bacon Company, Boston.

B--90

What are these "other factors" that all beginning workers must	62
have to make their skill worth while? It was the lack of these quali-	132
ties that had caused Ray to fail. Businessmen seemed to feel that	198
Ray was not alone in his failure because of the lack of these traits. In	271
finding for Ray the key to his own puzzling failures, I may give help	340
to some other beginner who needs to unlock the door to new oppor-	405
tunities. The starting point must be what the businessman wants--	470
and he says that he wants workers who are accurate and careful. Tact	539
and courtesy, too, must be ingrained traits. These four traits help	607
one to get along with others. They are just a few of the "other	671
factors" that make for success, but they offer an excellent beginning	740
for the student who would train for success in business.	796

Reproduced from TWENTIETH CENTURY TYPEWRITING, by special arrangement with--  
and permission of--the publishers, South-Western Publishing Company, Cincinnati,  
New York, Chicago, Dallas, San Francisco.

There is hardly an hour in the day when the secretary does not	62
exercise initiative in small things as well as in great things. She	130
makes sure that a sufficient supply of working materials is always	196
at hand. She thinks ahead and senses that her employer will need	261
certain papers in arriving at a conclusion on a business problem;	326
she uses her initiative and gets those papers together so that they	393
will be ready when they are needed. From time to time she brings to the	465
attention of her superior news items or other material which she knows	535
will be of interest to him. For that reason she scans trade papers	602
that come to her employer's desk. Often she is able to "boil down"	669
an article and then present it, in abstract form, to her employer.	735
In all these ways she makes herself useful--and indeed indispensable--	805
in activities which lie entirely beyond the plane of the mechanical	872
and the routine.	888

Reproduced from ROWE TYPING, Second Edition, by special arrangement with--and permission of--the publishers, The H. M. Rowe Company, Baltimore, Chicago, San Francisco.

That is just what happened to the system by which correspondence had	68
been conducted when the typewriter made its appearance. From that day	138
a new meaning was given to the word "amanuensis"; it had always been	206
translated as "one who writes for another," but it has meant ever	271
since "one who takes dictation in shorthand and transcribes that dictation	345
on a typewriter." It is not necessary to follow the history of the	412
machine for it is known to everybody: first the upper case only; then	482
the machine using capitals and small letters, now known as the invisible;	555
then the visible writing machine, and we have it in that form alone today.	629
Now then, having the machine in its most up-to-date form, let us	693
look at it a little and see what it is good for--wherein it is really of	765
worth and what service it renders to the world. There is one peculiar	835
thing about this combination of keys and levers; it has such a hold in	905
business life that, were it possible to wipe it out entirely in a single	977
day, on that day the wheels of commerce would be stopped as effectually	1048
as if they were overthrown by some convulsion of nature.	1104

---

Reproduced from TYPING FOR BUSINESS, by special arrangement with—and permission of—the publishers, The Gregg Publishing Company, New York, Chicago, San Francisco, Dallas.

D—120

A good stenographer is also distinguished by the fact that she	62
always uses apostrophes correctly. The confusion of words similarly	130
pronounced and the incorrect use or omission of the apostrophe are	196
two of the most glaring faults found in transcripts produced by	259
poor stenographers. Remember that secretaries come from the ranks	325
of good stenographers, not from the ranks of poor stenographers. The	394
rules for the use of the apostrophe are easily mastered. Keep in	459
mind, first of all, that the possessive forms of pronouns are written	528
without any apostrophes. Some people confuse contractions with the	595
possessive forms of pronouns. Keep your eyes open for a noun with	661
an s-ending followed immediately by another noun. In all probability	730
the first of the two nouns is in the possessive case and requires an	798
apostrophe.	809
The chief reason for the omission of apostrophes where they	868
are required does not at all lie in failure to understand how to	932
form the possessive case, but failure to understand that a particular	1001
noun is in the possessive case.	1032

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and permission of--the publishers, The H. M. Rowe Company, Baltimore,  
Chicago, San Francisco.



SAMPLE LETTER SENT TO PRINCIPALS  
OF PARTICIPATING SCHOOLS

Dear Sir:

Under the direction of Dr. Harry Huffman, Head, Department of Business Education, Virginia Polytechnic Institute, Blacksburg, Virginia, we are planning a thesis study in typewriting.

To date, we have selected five typewriting texts from which we shall draw at random samples of typewriting copy to be used in preparing tests for 660 advanced typewriting students in the State of Virginia. This testing program shall in no way try to prove that students of one school are more efficient in typewriting than students in another school. In fact, when the tests are returned to us from the various schools we shall mix them together before attempting to determine the results. Our sole aim shall be to determine the ease or difficulty in typewriting copy now in use.

At this time we are requesting that you grant us permission to use your advanced typewriting students in our testing program. If you will grant us this permission, we feel you will be participating in a study which we sincerely hope will contribute to the improvement of business education.

Please return the enclosed card at your earliest convenience indicating your pleasure relative to this matter. We are writing the Head of your Business Department at this time, but we shall not proceed with the study until we have received your authorization.

Thank you for your cooperation.

Very truly yours,

SAMPLE LETTER SENT TO BUSINESS TEACHERS  
IN PARTICIPATING SCHOOLS

Dear Business Teacher:

Under the direction of Dr. Harry Huffman, Head, Department of Business Education, Virginia Polytechnic Institute, Blacksburg, Virginia, we are planning a thesis study in typewriting.

To date, we have selected five typewriting texts from which we shall draw at random samples of typewriting copy to be used in preparing tests for 660 advanced typewriting students in the State of Virginia. This testing program shall in no way try to prove that students of one school are more efficient in typewriting than students in another school. In fact, when the tests are returned to us from the various schools we shall mix them together before attempting to determine results. Our sole aim shall be to determine the ease or difficulty in typewriting copy now in use.

At this time we are requesting that you grant us permission to use your advanced typewriting students in our testing program. If you will grant us this permission, we feel that you will be participating in a study which we sincerely hope will contribute to the improvement of business education.

Please return the enclosed card at your earliest convenience indicating your pleasure relative to this matter. If you are willing for us to use your students, please include the number of advanced typewriting students you have available.

We have written your principal requesting permission to use your students in conducting this study, and we are sincerely hoping you and your principal will cooperate with us. A complete manual of instructions for administering the tests will be mailed you with the tests. This study shall in no way evaluate the efficiency of your teaching or the progress of your students.

Very truly yours,

## INSTRUCTIONS TO STUDENTS PARTICIPATING IN THE EXPERIMENT

This is not a test of your typewriting skill. You are participating in an experiment to determine the factors that contribute to the difficulty of the material you are copying. Therefore, you need not calculate net words per minute unless otherwise instructed by your teacher.

- a. Type in upper right-hand corner code number which is given in the upper right-hand corner of each test.
- b. Use a 70-space line and double spacing.
- c. Upon completion of timed writing, circle errors, write total strokes and number of errors at the top of your timed writing.

## INSTRUCTIONS TO TEACHERS ADMINISTERING THE TESTS

We are sending you, in booklet form, the timed writings which you so generously agreed to administer for us in our thesis study. In the preliminary request we sent you, we asked for the number of second-year typewriting students you have available. This was an attempt to place the tests at a level in typewriting speed of 40 words per minute. In a number of cases, we are not sending a test for each student because of the difficulty in mailing. Therefore, please administer the 11 timed writings to students in accordance with the number of booklets we are sending you.

It is extremely important that regulations be followed in administering these timed writings in order to have uniformity in all schools participating. Will you please consider the following in administering the timed writings.

1. Each booklet is designed for one student and that student must complete all of the timed writings in the booklet in the order in which they are arranged.
  - a. A student may make up a timed writing on another day if he should be absent and miss the writings given one day. Do not permit another student to complete the writings in that BOOKLET, however, every timed writing in the booklet must be completed.
  - b. Unless this regulation is followed, the timed writings typed from that booklet will not be valid.
2. Each timed writing is to be five minutes in length. If the material is completed before time is called have student repeat the material.
3. Upon completing the 11 timed writings (in each of the booklets we send you) have students staple their copies together in the order in which the timed writings have been taken.
4. Please destroy or return to us the booklets which we send you. This is extremely important in order that we may be protected from infringement of the copyright law.

## INSTRUCTIONS TO TEACHERS ADMINISTERING THE TESTS (concluded)

5. You need not check these tests. You may utilize the results of these timed writings as you would any other timed writings you administer. We are interested only in the copy typed by the student and his output as evidenced by the errors and strokes. By this evidence we shall attempt to measure the difficulty of the material.

We would like for these timed writings to be completed and returned to us by May 22. You are at liberty to administer as many of these timed writings within one day as you wish.

You will be notified individually concerning return postage.

APPENDIX B

CALCULATION SHEET FOR ANALYSIS OF VARIANCE  
OF STROKES TYPEWRITTEN

I. Sum of Squares, Total:	
Raw Sum of Squares	27,546,130,264
Correction Term	<u>-27,264,771,153</u>
Corrected Sum of Squares	281,359,111
II. Sum of Squares, Treatments:	
Raw Sum of Squares	163,939,682,988
Divisor	6
Raw Sum of Squares, Divided	27,323,280,498
Correction Term	<u>-27,264,771,153</u>
Corrected Sum of Squares	58,509,345
Divisor	120
Mean Square	487,578
III. Sum of Squares, Replicates:	
Raw Sum of Squares	3,307,962,841,040
Divisor	121
Raw Sum of Squares, Divided	27,338,535,876
Correction Term	<u>-27,264,771,153</u>
Corrected Sum of Squares	73,764,723
Divisor	5
Mean Square	14,752,945
IV. Sum of Squares, Rows (Adj.):	
Raw Sum of Squares	197,482,212
Correction Term	<u>-88,517,655</u>
Corrected Sum of Squares	108,964,557
Divisor	60
Mean Square	1,816,076
V. Sum of Squares, Columns (Adj.):	
Raw Sum of Squares	97,398,904
Correction Term	<u>-88,517,655</u>
Corrected Sum of Squares	8,881,249
Divisor	60
Mean Square	148,021
VI. Correction to Rows,	
Correction to Columns,	0.01753
Adjusted Mean Square of Treatments	0.0101877
Effective Error Mean Square	38,896,170
	243,826

CALCULATION SHEET FOR ANALYSIS OF VARIANCE  
OF ERRORS MADE

I. Sum of Squares, Total:	
Raw Sum of Squares	1,986,373.00
Correction Term	<u>-1,789,390.97</u>
Corrected Sum of Squares	196,982.03
II. Sum of Squares, Treatments:	
Raw Sum of Squares	1,818,161.83
Correction Term	<u>-1,789,390.97</u>
Corrected Sum of Squares	28,770.86
Divisor	120
Mean Square	239.76
III. Sum of Squares, Replicates:	
Raw Sum of Squares	1,844,545.80
Correction Term	<u>-1,789,390.97</u>
Corrected Sum of Squares	55,154.83
Divisor	5
Mean Square	11,030.97
IV. Sum of Squares, Rows (Adj.):	
Raw Sum of Squares	126,213.22
Correction Term	<u>-66,186.40</u>
Corrected Sum of Squares	60,026.82
Divisor	60
Mean Square	1,000.45
V. Sum of Squares, Columns (Adj.):	
Raw Sum of Squares	79,942.43
Correction Term	<u>-66,186.40</u>
Corrected Sum of Squares	13,756.03
Divisor	60
Mean Square	229.27
Vi. Correction to Rows,	.01669
Correction to Columns,	.01169



## CALCULATIONS FOR CORRELATIONS

- I. Raw Sum of Squares, Stroke Intensity of Words 3581.57  
 Correction Term -3569.52  
 Corrected Sum of Squares 12.05
- II. Raw Sum of Squares, Test Score 4,533,552.066  
 Correction Term -4,527,087.720  
 Corrected Sum of Squares 6,464.346
- III. Raw Sum of Cross Products 4,018,127  
 Correction Term -4,020,325  
 Corrected Sum of Cross Products - 2,198
- IV. (Correlation coefficient)<sup>2</sup> =  $\frac{4,831,204}{77,895,369} = 0.0620$
- V. Correlation Coefficient -0.249