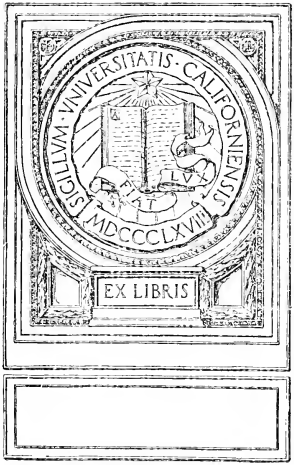
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Another use of Van Wagenen's Table I: to compute spelling ages from the Buckingham Extension of the Ayres Spelling Scale

By

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THESIS

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The Purpose of the Study

Educators have been concerned for some time to know just what relationship exists between the general mental ability and the spelling ability of school children. Age norms have been available for some time now for scores on such tests as the Woody-McCall Mixed Fundamentals, the Trabue-Kelley Completion Test Exercises, the Thorndike Handwriting Scale, the Thorndike-McCall Silent Reading Scales, and the Thorndike Visual Vocabulary Scales. Heretofore, however, there have been no age norms set up for performance in spelling. As a result, it has been impossible to determine accurately just what relationship the spelling ability of school children bears to their general intelligence. The purpose of this study is to set forth a method of determining the amount of co-relationship - or correlation - existing between these two functions.

General Method of the Study

The method followed in this study was (1), to determine by an adequate group test of mental ability the Group Intelligence Quotients of the pupils to be tested; (2), to obtain by a method to be established, the spelling quotients of the same

pupils: (c), to compute the coefficient of correlation of the two sets of quotients.

The Pupils Tested

The pupils selected for testing were those in grades 6-A to 8-B, inclusive (A indicating the low half of the grade, and B indicating the upper half), in the [illegible] School of Alameda, California. These grades were selected since the tests depend upon [illegible] teaching, and because it is in these grades that spelling ability may most easily be measured. The total number of pupils tested was 203. Of these, however, some missed one or the other of the tests. Moreover, a number of the tests had to be thrown out for lack of information, such as the chronological age of the pupil. The result was that both mental tests and spelling tests were finally available for only 182 of the total 203 pupils.

The Group Intelligence Quotients

The mental test selected was the Terman Group Test of Mental Ability, of which Form A was administered to the pupils. The Group Intelligence Quotients (G.I.Q.'s) were obtained by the method proposed by Dr. [illegible], Assistant Director of Research, in a report to Dr. Virgil E. Dickson, Director of Research and

Guidance, Oakland (Cal.) Public Schools, in May, 1921. The mental age norms for scores on the Terman Group Test which were used in this study were those established by Dr. Terman, not those adapted therefrom by Dr. Dector. The norms used follow.

Table I

Mental Age Equivalents for Scores on the

Terman Group Test of Mental Ability

Years	Months											
	0	1	2	3	4	5	6	7	8	9	10	11
10	[illegible]	11	12	14	15	17	18	2[illegible]	21	23	24	26
11	27	29	30	32	33	35	36	38	39	41	42	44
12	45	47	48	50	51	53	54	56	57	59	60	62
13	63	65	66	68	69	71	72	74	75	77	78	80
14	81	83	84	86	87	89	90	92	93	95	96	98
15	99	101	102	104	105	107	108	110	111	113	114	116
16	117	119	120	122	123	125	126	128	129	131	132	134
17	135	137	137	139	140	142	143	145	146	148	149	151
18	153	155	155	156	15[illegible]	161	162	164	165	167	168	170
19	171	172	174	175	177	179	1[illegible]	182	184	185	186	188
20	189	191	192	194	195	197	198	200	201	203	204	206
21	207	209	210	212	213	215	216	218	219	221	222	224

The method of determining the Group Intelligence Quotients on the basis of scores made on the Terman Group Test may be exemplified by the following case. Paul X made a score of 90 on the test. The mental age equivalent for a score of 90 on the Terman Group Test is 14 years, 5 months. This must be reduced to months is 174 months. The pupil's chronological age at the time of taking the test was 13 years, 7 months, or 163 months. The Group Intelligence Quotient, like the I. Q. derived from the Binet-Simon individual test is the quotient obtained by dividing the mental age by the chronological age. In this case the mental age is 174 months, the chronological age 153 months. The quotient obtained by dividing 174 by 163 is 1.07, a G. I. Q. of 107.

Using this process and the norms given in Table I, the scores made by the pupils were converted into mental ages. Considering only the 182 cases for which both G. I. Q.'s and Spelling Quotients were obtained, the following results were found:

1. Total range of G. I. Q.'s = 70 - 155
2. Mean G. I. Q. = 105.51
3. Standard deviation of G. I. Q.'s = 10.74 $\pm$ .538

[illegible]

Since there were no available age norms for achievement in spelling, it was necessary either to establish such norms, or to adopt some other procedure which would be equally valid for obtaining spelling ages. It was the suggestion of Mr. Raymond Franzen, of the Des Moines (Ia.) Bureau of Research, that the grade norms for the 50% lists of the Buckingham extension of the Ayres Spelling Scale be converted into age norms, and that Van Wagenen's Table I (Teachers' College Record, November, 1920) be adapted to determine, from the pupils' scores on these lists, the exact point of 50% success and failure.

Age Norms for the Grades

The first task in this connection was to decide upon age norms for the grades. After some search and communication some fifty thousand (50,455) cases were located, distributed by half-year of age in half-year of grade. In each case the term "year" signified between nine and three months, while "half-year" meant between three and nine months. Thus, in each case, the six year group included all pupils between five years nine months and six years three months of age; while the six and one-half year group included all pupils between six years three months and six

years [illegible].

The number of pupils in each half-year of grade is as follows:

Table II

Distribution of 50,456 Pupils,

Grades 1-b to 8-a, inclusive.

Grade	1-b	1-a	2-b	2-a	3-b	3-a	4-b	4-a	5-b	5-a	6-b	6-a	7-b	7-a
No. of Cases	4887	[illegible]515	36[illegible]	[illegible]	[illegible]41	[illegible]14	[illegible]57	2873	3457	[illegible]	3170	[illegible]548	2[illegible]	3594

Grade	8-b	8-a	Total
No. of Cases	2405	2130	50456

The mean ages for half-year of grade obtained from the above cases are:

Table III

Mean Ages for Half-Year of Grade, 50,456 Pupils

Grades 1-b to 8-a, inclusive.

Grade	1-b	1-a	2-b	2-a	3-b	3-a	4-b	4-a	5-b	5-a	6-b	6-a	7-b	7-a
Mean Age	6.24	7.04	7.47	8.12	8.30	[illegible].33	[illegible].73	10.18	10.[illegible]	11.41	11.91	1[illegible].36	[illegible].78	13.[illegible]1

Grade	8-b	8-a
Mean Age	13.36	14.1[illegible]

The cities in which the pupils were located, and the number in each, are: Fresno, Calif. - 1[illegible]5; Seattle, Wash. - 6332; Rockford, Ill. - [illegible]28; Des Moines, Ia.,-154[illegible]4; and St. Paul, Minn.- 20776; total - 5[illegible]456.

Averaged, the above mean ages give age norms for whole year of grade:

Table IV

Mean Ages for Whole Year of Grade, 50,456 Pupils

Grades 1 - 8, incl.

Grade	1	2	3	4	5	6	7	8
Mean Age	[illegible].34	7.[illegible]	9.07	9.[illegible]	11.[illegible]	[illegible]	[illegible]	1[illegible].8[illegible]
No. of Cases	[illegible]03	6278	5855	62[illegible]	[illegible]	[illegible]816	[illegible]	45[illegible]

By using the mean increment of age, 1.0357, which is the number of years required by the average of the 50,456 children to complete one year of grade, the above norms were extended to:

Table V

Age Norms for Grades 9-12 incl.

Extended by Use of Mean Increment of Age Between Grades.

Grade	[illegible]	10	11	12
Mean Age	14.[illegible]3	15.96	17.[illegible]	18. 3

A summary of the above data is given in Table VI.

Technique for Obtaining Spelling Age

After having established norms for the grades, the next step was to evolve (or adopt) a technique of testing and scoring which would result in spelling ages. The following is the process which was used.

Giving the Tests

The first ten words were selected from each of the 50% lists T, U, V, X and Z, and to the first eight words in list a b were added one word of approximately equal difficulty from each of lists a and c. Ordinary spelling paper was distributed, the pupils being given detailed instructions for placing at the top of the sheet the following items of information: name, grade (for purposes of identification), date, and age in years and months (to the nearest fifteen days.)

The words were dictated clearly, each being repeated in a sentence or definition, so that there should be no unnecessary confusion of similar words. The pupils wrote the words in ink. Each list was dictated separately, the pupils being instructed to place at the head of each list of ten words the proper literal designation, indicating the 50% list from which they were taken. The dictation was as rapid as was felt to be consistent with fairness to the pupils, care being taken that the pupils

should not copy from one another. [illegible] collected as soon as the dictation is completed.

Marking the Papers

The papers, when collected, were marked by the examiner. All words actually misspelled or omitted were marked by a check (✓), the number of such misspelled or omitted words being placed at the head of each list. All words were considered correct unless manifestly incorrect or omitted, erasures or changes not being considered errors if the words were clearly correct.

Scoring the Tests and Computing Individual Spelling Ages

In order to determine which was the more economical administratively, two methods of scoring the tests and of computing the individual spelling ages were used: (1), that used with the Trabue-Kelley Completion Test Exercises for determining individual performance levels, and (2), the method proposed by Dr. Wagener, which is based on the former method.

The Completion Test Exercise Scales

For obtaining individual scores on the Trabue-Kelley Completion Test Exercises, a [illegible] calculation sheet is printed on the reverse of each Completion Test blank. This sheet consists in a table of six columns, respectively as follows: I, Group of Sentences; II, Average Difficulty; III, Raw Score; IV, Decrease in Raw Scores; V, Mid-point Between Groups; and VI, Products, IV × V. The Performance Level or Score is then obtained by dividing by 1 the sum of the products obtained by multiplying each Decrease in Raw Score by the corresponding mid-point (of difficulty) between Groups.

Completion Test Exercise Method Adapted for

The Purpose of Computing Spelling Age

In order to use this method in computing spelling age, it was necessary to determine the mid-points of age between the grades. These mid-points, based on the mean ages in Tables IV and V, are:

Table V[illegible]

Mid-points of Age Between Grades, 50,453 Pupils

Grades 1 to 8 [illegible], and extended to Grade 12

Grades	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Mid-point	7.[illegible]2	8.44	[illegible]	10.51	11.57	[illegible]	[illegible]	14.41	15.4[illegible]	16.[illegible]9	17.52

Then, to obtain spelling age, a table was constructed based on the [illegible] the Completion Test Exercises. In this

e[illegible] the "Group of [illegible]" column became a column headed "[illegible] List"; the "Average [illegible]" column became a column of "Mean Age"; the column of "Total Score" was changed to a column of "Errors" (errors were used since they are in smaller numbers than total scores and therefore fewer errors are apt to be made in calculation); the column of "Decrease in Mean Scores" was called "Deviation"; the column "Mid-point Between Groups" was retained as a column of "Midpoints"; and the sixth column remained a column of products called "Deviation x Mid-point."

Table VIII

Table for Calculating Spelling Ages from the Buckingham-Ayres Spelling Scale: based on the [illegible]-Kelley Completion Test Exercise Record and Calculation Sheet.

I	II	III	IV	V	VI
50% List	Mean Age	Errors	Deviation	Mid-Point	Dev. x Mid-point
N	9.96			9.52	
T	11.05			10.51	
V	12.[illegible]9			11.57	
X	1[illegible]			12.5[illegible]	
Z	13.89			1[illegible].4[illegible]	
a-b-c	14.[illegible]			14.41	

Total [illegible]

[illegible] / 10 = [illegible]. A.

In the above table item I [illegible] the letters given by Ayres and Buckingham to the lists of words from which those used

were taken. Item II is the mean age of pupils at the grade for which 50% is the average score on the lists indicated in Item I. (See Tables IV and V.) Item III is the number of words misspelled in each list of ten. Item IV is the difference between the number of errors in each list and the number of errors in the preceding list (the deviation in error from one list to the next.) Item V is the mid-point in age between each grade and the preceding grade (see Table VII). Item VI is the product of items IV and V, i.e., deviation times mid-point. The spelling age is obtained by dividing the sum of items under VI by the total amount of deviation, which is always 10 (since the deviations are in errors, which range from 1 to 10).

Thus, the pupil's spelling age is found by dividing by ten the sum of the Product Moments obtained by multiplying the mid-points in age between grades by the amount of deviation in errors between grade lists of words. The sum of the Product Moments is divided by ten because ten is the sum of the deviations and therefore the number of cases; the quotient is then the true weighted mean or average.

The following example gives a concrete illustration of the method used:

Table VII

I	II	III	IV	V	VI
50? List	Sp. Age	Errors	Dev.	Mid-point	Dev. x Midpoint (IV × V)
[illegible]	[illegible]	0		9.52	
[illegible]	11.05	2	2	10.51	21.02
V	1[illegible]	3	1	11.57	11.57
X	[illegible]	5	2	12.50	[illegible]
Z	13.[illegible]	8	3	13.46	40.38
a-b-c	14.[illegible]	10	2	14.41	[illegible].82
	Total ——	10			123.31

$\frac{123.31}{10}$ = 12.331 = Spelling Age

In the above case the pupil made 0 errors in list R, 2 in T, 3 in V, 5 in X, 8 in Z and 10 in a-b-c. The deviations in errors are: from 0 to 2, or 2; from 2 to 3, or 1; from 3 to 5, or 2; from 5 to 8, or 3; and from 8 to 10, or 2: total - 10. Multiplying deviations by mid-points, the products 21.02, 11.57, etc., are obtained. The sum of these products is 1[illegible]6.31. This sum, divided by the sum of the deviations, 10, gives the quotient 1[illegible].331, which is the spelling age of the pupil in this case.

The above method proved rather lengthy and involved, the Van Wagenen method promising to be much more economical of time, since it eliminates a number of the operations necessary to the former.

The V[illegible] [illegible] Method of

[illegible] [illegible] [illegible] Performance Levels

[illegible] [illegible] [illegible] [illegible] [illegible]

After some investigation it was found that spelling ages could be computed with considerable facility by adopting Van Wagenen's Table I and using his Table II.

Van Wagenen's Table I is simply a table of performance levels or scores which would correspond to any number of errors from one to ten made at any scale step from one to fifteen on an educational scale. Since the table is constructed on the basis of a given number of errors at a given scale step, correction must be made for the number of errors made at less difficult scale steps. This is done by subtracting from the score obtained in the above manner one-tenth the sum of the errors made at the less difficult scale steps.

Table II is a table of corrections to be made (values to be added to the amount to be subtracted from the score) when the least difficult scale value has two or more errors.

Since Van Wagenen's Table I is in terms of whole-number scale steps, it was found necessary to interpolate for the decimal part of the age-norms for grades, when the latter were used as scale steps. For this purpose a complete sheet of his Table I was made for the purpose of this study, giving interpolated scores.

Table IV

Excerpt from Van Wagenen's Table I, for Computing Mean Individual Scores in Educational Scales, Adapted to Compute Spelling Ages.

Scale Steps Errors	9	10	11	12	13	14	15
1	11.5	12.5	13.5	14.5	15.5	16.5	17.5
2	10.6	11.6	12.6	13.6	14.6	15.6	16.6
3	10.2	11.2	12.2	13.2	14.2	15.2	16.2
4	9.8	10.8	11.8	12.8	13.8	14.8	15.8
5	9.5	10.5	11.5	12.5	13.5	14.5	15.5
6	9.2	10.2	11.2	12.2	13.2	14.2	15.2
7	9.0	10.0	11.0	12.0	13.0	14.0	15.0
8	8.8	9.8	10.8	11.8	12.8	13.8	14.8
9	8.6	9.6	10.6	11.6	12.6	13.6	14.6
10	8.5	9.5	10.5	11.5	12.5	13.5	14.5

Interpolation can be made on the above table by adding to each V. W. Value the correction necessary, the correction in each case being the difference between the V. W. Scale Step and the mean Age used in its place. Thus the following table was obtained:

Table V

Table of Interpolations for Computing Spelling Ages

Adapted from Van Wagenen's Table I

Grade	4	5	6	7	8	9	10
Mean Age	9.96	11.05	12.09	12.90	13.89	14.93	15.96
Errors							
1	12.46	13.05	14.59	15.40	16.39	17.43	18.46
2	11.56	12.65	13.69	14.50	15.49	16.53	17.56
3	11.16	12.25	13.29	14.10	15.09	16.13	17.16
4	10.76	11.85	12.89	13.70	14.69	15.73	16.76
5	10.43	11.55	12.59	13.40	14.39	15.43	16.46
6	10.16	11.25	12.29	13.10	14.09	15.13	16.16
7	9.86	11.05	12.09	12.90	13.89	14.93	15.96
8	9.76	10.85	11.89	12.70	13.69	14.73	15.76
9	9.56	10.65	11.69	12.50	13.49	14.53	15.56
10	9.46	10.55	11.59	12.40	13.39	14.43	15.46

Van Wagenen's Table II, rearranged, is as follows:

Table XI

Table of Corrections to Scores on Educational Scales for Errors on Lowest Values in Scale

Errors	9	8	7	6	5	4	3	2
Add to Amount to be Subtracted	2.1	1.3	1.0	.7	.5	.3	.2	.1

This table should be read: when the lowest value (list of words) has 9 errors, add 2.1 to the amount to be subtracted (from value obtained from Table X); when it has 8 errors, add 1.3 to the amount to be subtracted, etc.

By using the two table above (Tables X and XI), the process of obtaining spelling ages was rendered extremely simple.

Steps in Obtaining Spelling Age

Using Van Wagenen's Table I, adapted, and Table II

The entire process was reduced to a maximum of five- a minimum of four - simple steps.

1. Add the number of errors made above the last list of words attempted.

2. Divide this sum by ten.

3. In case two or more errors are made on the easiest list attempted, find in Table XI the amount to be added to the quotient obtained in 2.

4. Find in Table X the interpolated Van Wagenen Value corresponding to the number of errors made on the last (most difficult) list of words attempted.

5. Subtract from the interpolated V. W. Value obtained in 4 either the quotient obtained in 2, or the sum obtained in 3.

TABLE I. THE SPELLING AGE.

To exemplify the method used, two cases will be cited: (1), that of a pupil who made no errors on the easiest list of words; and (2), that of a pupil who made two or more errors on the easiest list attempted.

Example 1

List	Mean Age	Errors	T	
I	9.96	0		
T	11.05	2		
V	12.09	3		
X	12.90	5		
Z	13.86	8	18	= 1.8
a-b-c	14.43	10	10	

In Example 1, the pupil made 18 errors above the last list attempted. One-tenth of 18 is 1.8. Looking for 14.93 (the mean age for the last list attempted), in the Mean Age column at the top of Table X and following down the column until opposite 10 (the number of errors made in the last list attempted) in the Error column, gives us the interpolated V. E. Value, 14.43. Subtracting from 14.43 one-tenth the sum of the errors made above the last list attempted, which is 18 divided by 10, or 1.8, gives us 12.63, the spelling age of the pupil.

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	. [illegible]	[illegible]
[illegible]	1. [illegible]	[illegible]
[illegible]	12. [illegible]	[illegible]
[illegible]	. [illegible]	[illegible]
[illegible]	1. [illegible]	8
[illegible]	1 . [illegible]	[illegible]

[illegible], [illegible] 2 [illegible] list attempted. [illegible] of [illegible]. [illegible] also [illegible] errors [illegible] list attempted. [illegible] value of .1 to be [illegible] to the amount to be subtracted, the 2 just obtained. Adding these gives 2.1. Looking for 14.75 ([illegible] for the last list attempted) in the [illegible] columns at the top of Table X and following down until [illegible] 10 [illegible] of errors made in the last list of words attempted, [illegible] the value 14.45. Subtracting from 14.45 the [illegible] above, 2.1, gives 12.35, the spelling age of the pupil.

[illegible] [illegible] [illegible]

[illegible] of the [illegible] of [illegible]'s Table I [illegible] were computed for 132 of the pupils [illegible]'s [illegible] of the [illegible] Test of [illegible]. The [illegible] converted into Spelling [illegible] by the [illegible] of the pupil at the time of taking the test, [illegible] the following results:

1. Total Range of Spelling Quotients ... 61 - 137

2. Mean Spelling Quotient 98.01

3. Standard Deviation of Spelling Q's... 13.86 ± .4876

Comparison of G. I. Q.'s and Sp. Q.'s.

A comparison of the results may be given briefly.

Number of Cases 182

Ranges

Rg. G. I. Q. = 70 - 166 Rg. Sp. Q. = 61 - 137

Standard Deviations

S. D. $_{G.I.Q.}$ = 15.94 ± .5938 S. D. $_{Sp.Q.}$ = 13.86 ± .4876

Standard Deviation Difference

$$S.D._{G.I.Q.} - S.D._{Sp.Q.} = 3.08$$

Means

$$M._{G.I.Q.} = 105.51 \qquad M._{Sp.Q.} = 98.01$$

Mean Difference

$$M._{G.I.Q.} - M._{Sp.Q.} = 7.50$$

Correlation between General Mental Ability

And Spelling Ability

Applying the Pearson product-moment formula for computing

the correlation coefficient to the two series of 182 quotients resulted in a correlation coefficient of +.7515 ± .0218.

Significance of the Correlation

A positive correlation so high as .75, with so low a Probable Error as .02, based upon nearly 200 cases, and with a standard deviation difference of only three points (3.08), is very highly significant indeed. The low Probable Error and the slight difference between the Standard Deviations mean that the correlation itself is valid. The high degree of correlation here shown indicates a very close, positive relationship between general mental ability and ability to spell. The fact of such a close relationship should be taken into account in teaching practise, and no teacher should rest content until the pupil's accomplishment in spelling closely approximates his mental accomplishment: that is, until his Accomplishment Quotient for spelling (Intelligence Quotient divided by Spelling Quotient) approximates 100. Until this is the case, the pupil is not learning to spell as well as he is capable of learning. For the inevitable corollary of low accomplishment quotients is inadequate teaching.

Further Correlation Between G.I.Q.'s and Sp.Q.'s

In order to carry the investigation a little farther an attempt was made to measure the increase, if any, in the correlation between the general mental ability and the spelling ability of a graduating class. Of this class, 34 pupils were given a second spelling test. The Spelling Quotients were computed, and the correlations between G.I.Q. and the Spelling Quotients derived from the two spelling tests were calculated. It was found that the correlation on the first set of Sp. Q.'s was .37, while that on the second set of Sp. Q.'s was .39, the latter being an increase of .02 over the former.

The results are as follows:

Number of Cases = 34

Ranges

$R_{G.I.Q.} = 70 - 141$ $R_{Sp.Q^1} = 70-116$ $R_{Sp.Q^2} = 70 - 130$

Standard Deviations

$S.D._{G.I.Q.} = 16.16 \pm 1.87$ $S.D._{Sp.Q^1} = 12.18 \pm 1.40$ $S.D._{Sp.Q^2} = 12.26 \pm 1.41$

Standard Deviation Differences

$S.D._{G.I.Q.} - S.D._{Sp.Q^1} = 3.99$ $S.D._{G.I.Q.} - S.D._{Sp.Q^2} = 3.82$

$S.D._{Sp.Q^2} - S.D._{Sp.Q^1} = .07$

Means

$M_{G.I.Q.} = 109.20$ $M_{Sp.Q.1} = 98.2$ $M_{Sp.Q.2} = 98.7$

Mean Differences

$M_{G.I.Q} - M_{Sp.Q.1} = 11.$ $M_{G.I.Q.} - M_{Sp.Q.2} = 10.50$

$M_{Sp.Q.1} - M_{Sp.Q.2} = .50$

Correlations between General Mental Ability and Spelling Ability

$r_{G.I.Q. Sp.Q.1} = +.67 \pm .05$ $r_{G.I.Q. Sp.Q.2} = +.69 \pm .05$

$r_1 - r_2 = .02$

The increase in correlation is probably due to the fact that the class was studying lists of words in which were included some of the words also included in the Buckingham-Ayres lists. The text being used was Pearson and Suzzallo's "Essentials of Spelling." Undoubtedly the increase in the amount of correlation would have been greater, had it not been for the unfavorable conditions under which the tests were given the second time. Pressure of work caused the giving of the tests to be delayed until close to the graduation period (three months from the date of the first tests). The pupils were of course excited and nervous, their attention and concentration dissipated. Under normal conditions the correlation would therefore probably

have been increased considerably more than it actually was.

Correlations between G.I.Q., Aritimetic, Quotients, Spelling Quotients, and Completion Quotients.

Another short study, not especially pertinent perhaps to this study, but of allied interest, was made to determine the difference between correlations between general mental ability and spelling ability, general mental ability and ability to perform in the Kelley-Trabue Completion Test Exercise alpha, and general mental ability and ability in arithmetic as measured by the Woody-McCall mixed Fundamentals test.

The following figures give the facts discovered:

Number of Cases 77

Ranges

$Rg._{G.I\ Q.} = 75 - 166$ $\qquad$ $Rg._{Sp.\ Q.} = 61 - 142$

$Rg._{Compl.Q} = 62 - 155$ $\qquad$ $Rg._{Arith.Q.} = 55 - 138$

Standard Deviations

$S.D._{G.I.Q.} = 18.460 \pm 1.004$ $\qquad$ $S.D._{Sp.\ Q.}\ 15.197 \pm .826$

$S.D._{Compl.Q.} = 16.603 \pm .903$ $\qquad$ $S.D._{Arith.Q.}\ 14.257 \pm .775$

Standard Deviation Differences

$S.D._{G.I.Q.} - S.D._{Sp.\ Q.} = 3.263$ $\qquad$ $S.D._{Sp.\ Q.} - S.D._{Compl.\ Q.} = 1.406$

$S.D._{G.I\ Q.} - S.D._{Compl.\ Q.} = 1.857$ $\qquad$ $S.D._{Sp.\ Q.} - S.D._{Arith.\ Q.} = .840$

$S.D._{G.I.Q.} - S.D._{Arith.Q.} = 4.203$ $\qquad$ $S.D._{Compl.\ Q.} - S.D._{Arith.\ Q.} = 2.346$

Means

$M._{G.I.Q.} = 109.13$ $M._{Sp.Q.} = 101.42$

$M._{Comple.Q.} = 105.13$ $M._{Arith.Q.} = 92.65$

Mean Differences

$M._{G.I.Q.} - M._{Sp.Q.} = 7.71$ $M._{Sp.Q.} - M._{Comple.Q.} = 3.71$

$M._{G.I.Q.} - M._{Comple.Q.} = 5.00$ $M._{Sp.Q.} - M._{Arith.Q.} = 7.77$

$M._{G.I.Q.} - M._{Arith.Q.} = 12.48$ $M._{Comple.Q.} - M._{Arith.Q.} = 11.48$

Correlation Coefficients

$r_{G.I.Q.-Sp.Q.} = +.8113 \pm .026$ $r_{G.I.Q.-Comple.Q.} = +.8417 \pm .022$

$r_{G.I.Q.-Arith.Q.} = +.9020 \pm .053$

The above data present facts of considerable significance. All three of the correlations are extremely high, with extremely low Probable Errors. And yet the Mean differences are so great as to seem to indicate, if they stood alone, that there was no great relationship between the functions involved in the four types of activity here called for. This is, of course, in view of the correlations obtained, a clear case of inadequate teaching. Especially so is this true in the case of arithmetic. That all the pupils of the group should be so far below their mental accomplishment in their arithmetical achievement, might be explicable

on the grounds that the abilities involved are not related. But the high correlation shown - much higher even than in the case of Spelling or Population quotients - obviates this belief. It is simply a case wherein the instruction is at fault, so grievously at fault that not even the brightest pupils in the group are getting therefrom nearly all of what should be expected of them. It is evident that the pupils are learning in direct ratio to their ability - but the mentally 15-year-old is only about 12 years old in arithmetic ability, while the mentally 11-year-old is only about 8 years old in terms of arithmetic accomplishment.

In the situation here depicted is clearly represented the need for a close study of instructional methods, in all of the subjects involved, but more specifically in arithmetic and spelling. A study of the marks received by these 77 pupils shows that approximately one-third (31%) are chronic failures in spelling, while over one-half (50%) consistently fail in arithmetic. It is the purpose of such studies as this to point out the defects in the instructional methods. It is the duty of the school administrator to determine just wherein instruction is at fault: whether the fault lies with the text-book, the teacher, or the physical plant of the school.

Table V[illegible]

Mean Ages of 50,456 Pupils.
Grades 1 - 8

Grade	Mean Age	No. of Cases: Butte 1914	Des Moines 1921	[illegible] 1921	Rockford 15-16	St. Paul 1917	Total
1 - B	[illegible].24	8[illegible]8	15[illegible]7	1[illegible]3	7[illegible]	1410	4687
1 - A	7.04	[illegible]8	867	57	57[illegible]	1551	[illegible]513
2 - B	7.47	506	12[illegible]	84	5[illegible]	1[illegible]84	[illegible]
2 - A	8.1[illegible]	[illegible]	7[illegible]9	55	4[illegible]	13[illegible]	3289
3 - B	8.80	555	1251	3[illegible]	510	1291	3641
3 - A	9.33	[illegible]7	808	[illegible]	451	1528	3214
4 - B	[illegible].73	444	1140	77	505	11[illegible]1	3357
4 - A	10.18	346	822	59	416	12[illegible]	2873
5 - B	10.5[illegible]	443	114[illegible]	[illegible]5	552	1[illegible]	3467
5 - A	11.41	346	789	50	[illegible]64	1321	2870
6 - B	11.81	[illegible]	1058	90	478	1155	3170
6 - A	12.36	[illegible]1	581	57	[illegible]	1286	2548
7 - B	12.78	[illegible]18	1[illegible]	78	3[illegible]	1014	2906
7 - A	13.01	213	702	[illegible]8	3[illegible]0	1321	2594
8 - B	13.55	2[illegible]	921	59	[illegible]41	675	2405
8 - A	14.12	15[illegible]	511	5[illegible]	256	105[illegible]	2130
Total		[illegible]	15,4[illegible]4	1,[illegible]5	[illegible]928	20, 736	50, 456

Mean Age per grade:-

Grade	1	[illegible]	3	4	5	[illegible]	7	8
Age	[illegible].54	7.80	9.[illegible]7	[illegible].96	11.[illegible]5	[illegible]	12.[illegible]	13.89
Mid-Points	7.[illegible]2	[illegible].475	[illegible].515	10.[illegible]	11.57	12.4[illegible]5	1[illegible].[illegible]95	

Mean Increment 1.0357

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