SOME COMPARISONS OF CHILDREN OF THE SAME MENTAL AGE BUT OF DIFFERENT CHRONOLOGICAL AGES

A THESIS

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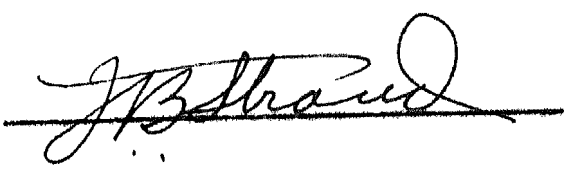

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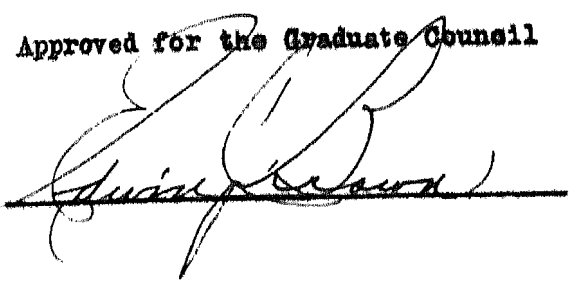

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INTRODUCTION

Statement of Problem The primary purpose of this investigation is to compare the test performances of children of the same mental age but of different chronological ages.

It has long been customary to place individuals in mental age groups when speaking of their possibilities of achievement and wholly disregard their chronological ages. Thus three groups of individuals sixteen, fourteen, and twelve years of age respectively, each group having a mental age of fourteen, are assumed to be equal not only in their ability to make a score on an intelligence test but equal in the separate mental abilities both in and outside that test.

The question has been raised as to whether pupils retarded from the standpoint of mental age, in this case sixteen year olds having mental ability of fourteen years, have certain phases of mental ability in which they as a group exceed the superior group testing fourteen years and likewise certain phases in which they as a group are inferior.

This study has been undertaken in an effort to answer in part the foregoing question and by using material commonly used in the construction of mental tests to serve as a guide to further study of those differences in mental ability strongly related to differences in chronological age of the pupil.

A secondary aim of this study has been to compare the performance of bright and dull children on material commonly used in intelligence test construction when the speed factor is omitted and the tests are given as power tests.

As a third aim, it was hoped that a careful analysis of the material used in the Army Alpha test would throw some light upon the relative value of some of the types of material used in such tests.

Historical Introduction Wilson[1] conducted an experiment on the learning of bright and dull children, with sixty subjects, covering a variety of tests of learning including tracing a star in a mirror, memorising a difficult multiplication table, writing the alphabet with numbers, and the like. He presents evidence that the selection of children by an intelligence test assures fairly well the quality of performance on tasks requiring responses of a character similar to the intelligence test but gives less and less assurance of the quality of performance on other tasks requiring greater proportions of gross muscular responses. He reached the conclusion that tasks requiring a large proportion of gross muscular coordination are performed better by older children with little regard for mental age as such.

Wilson's study would seem to indicate that there are

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[1] Frank T. Wilson, Learning of Bright and Dull Children (Teachers College Contributions to Education, No. 292. New York: Teachers College, Columbia University, 1928.)

differences in the performance of pupils of the same mental age but of different chronological ages, but gives us little basis for prediction of the results to be obtained in the investigation as set up in this paper.

Stroud and Maul[2] in an investigation of the problem of the relation between age and the ability to memorize and retain meaningful and nonsense material found a fairly definite tendency for groups of subjects of a given mental age to excel subjects of the same chronological age but who have a lower mental age; but they found no tendency for older children to excel younger children when mental age was held constant. That is to say, memory ability was found to be associated with mental age, but not related to chronological age when the influence of mental age was ruled out.

These two studies are the only ones, so far as the writer knows which bear in any significant way upon the present problem.

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[2] J. B. Stroud and Ruth Maul, "The Influence of Age upon Learning and Retention of Poetry and Nonsense Syllables," Journal of Genetic Psychology, 42, 1933 pp. 242 ff.

PROCEDURE

In this study, the Army Alpha, Form VIII, was used as the test from which mental age scores were secured. In addition parts two and seven, arithmetic problems and analogies, respectively, of Form VII of the same test were given as power tests. Approximately three times as much time was allowed for the power tests as for the corresponding tests when given as part of the Army Alpha.

These tests were given to approximately one thousand pupils of the seventh and eighth grades of schools in and near Emporia, Kansas.

After grading the tests those with incomplete information and those taken by people with possible language handicaps, Mexicans especially, were eliminated.

Comparisons of the subjects of the same mental ages but of different chronological ages were made in the following fields: the eight tests of the Army Alpha consisting respectively of following directions, arithmetical problems, practical judgment, synonym-antonym, disarranged sentences, number series completion, analogies, and information. In addition, comparisons of the same sort were made on the two tests, arithmetical problems and analogies, given as power tests. This procedure also mades it possible to determine the relative gain of bright and dull students on these two tests given as power tests over their performance on them

when given as speed tests.

Mental ages of the subjects were derived from norms furnished by the Bureau of Educational Measurements, Kansas State Teachers College, Emporia, Kansas and I Q's were calculated on the basis of this information. These mental ages and I Q's were used only to divide the groups and the validity or reliability of this study consequently does not in any way stand upon the reliability of these norms.

Since it was necessary to use some criterion to determine which subjects should be called superior, normal, and inferior and since it was not felt desirable to accept common definitions of I Q's necessary to place a subject in any of these groups, a distribution of the I Q's was made in such a way that the middle 50% (±1 P. E.) was placed in the normal group, the next 16% on each side of the middle were placed in the superior and retarded groups, and the highest and lowest 9% (those outside roughly±2 P. E.) were called the highly superior and the greatly retarded groups respectively. This placed in the highly superior group seventy-four subjects and in the greatly retarded group seventy-six subjects. It was upon these two groups lying outside ±2 P. E. of the distribution that most of the comparisons found in this paper were made.

The range of chronological ages found in two school grades in the case of 1000 children was not found great enough to place highly superior children and greatly retarded

children in the same mental age level. Therefore some method of equating the groups was necessary in order to make an adequate comparison. This was done by dividing the score made by each subject on each of the twelve tests or comparisons by the score made by that subject on the Army Alpha test as a whole. This gave the ratio of the subject's score on each part to his total or mental age score. When multiplied by one hundred it represents the percent of the total score which the subject made on each individual test. Averages of these ratios for the different I Q groups represents the tendency of these groups to make high or low scores on certain parts of the test as compared to their score on the test as a whole.

In order to try this technique of equating scores and to ascertain the validity of it, two groups of Army Alpha papers were selected. In each of these two trial groups the average mental ages roughly equaled the average chronological age. The two groups were separated approximately three years in mental and chronological ages. The results of this trial are presented in Table IV.

RESULTS AND DISCUSSION

Table I shows the relationship between the greatly retarded and the highly superior groups in terms of the percent of the entire test which each test item represents.

TABLE I

AVERAGE RATIOS OF PART OF TEST TO ENTIRE TEST

TEST	RETARDED GROUP	SUPERIOR G.	DIFF.	P.E. Diff.
Test 1 Follow Directions	9.236±.316	6.853±.115	2.483	.335
Test 2 Arith. Problems	9.695±.319	8.054±.140	1.641	.348
Test 3 Prac. Judgment	11.583±.323	8.481±.133	3.102	.349
Test 4 Synonym-Antonym	6.846±.545	15.169±.301	8.323	.623
Test 5 Disarr. Sentences	8.977±.521	11.170±.241	2.193	.574
Test 6 Number Series Comp.	8.449±.320	8.423±.164	.026	.359
Test 7 Analogies	25.164±.699	23.729±.309	1.435	.764
Test 8 Information	19.991±.659	18.027±.258	1.964	.708
Test 9 Arith. Power	12.451±.358	9.985±.185	2.446	.403
Test 10 Analogies Power	33.998±.805	29.748±.379	4.250	.889
Test 11 No. 9 minus No. 2	2.806±.305	1.903±.140	.876	.335
Test 12 No. 10 minus No. 7	9.098±.651	6.002±.344	3.096	.735

Read table thus: In test 1, which was a test of following directions, the retarded group made an average of 9.236% of their entire score while the superior group made an average of but 6.853% of their entire score on this test. The probable error for the average of the retarded group was .316 and for the superior group .115. The differences of the averages was 2.483 and the probable error of the difference was .335. (Note that tests nine to twelve are not part of the Army Alpha test and while their ratio's are computed in the same manner as the first eight tests their scores are not part of the total score.)

Table I offers many interesting comparisons and presents the principal results of the entire study. It will be noticed that the retarded group made more than 9% of their entire score on test one, while the superior group made less than 7% of their total on this test. The difference of these averages exceeds its probable error by more than seven times and can be taken to be statistically reliable. To advance a reason for this seeming strength of the retarded pupils in following directions would lie outside the scope of this study, but one wonders if the explanation lies in the necessity that the pupil of low I Q has found for rather careful attention to directions in order to compete with his classmates on anything like equal terms.

In test two, arithmetic problems, the retarded group has again exceeded the superior group with a difference that is nearly five times its probable error. That this is not due to a possibility that the time limit on the test was rather short for the amount of problems is shown by the results of test nine in which another form of the same test was given with ample time allowed. The retarded group not only retained their superiority when measured in terms of its relationship to their mental age but the score on test eleven indicates, although the difference is but twice its probable error, that the retarded group got more benefit from the increase in time than did the superior group.

In test four, synonym-antonym, or vocabulary test the

superior group went far ahead of the retarded group and made 15% of their entire score on this test. The retarded group made less than 7% of their score here. The difference of these two averages exceeds its probable error by over thirteen times. Again one is led to wonder at the reason. Is it due to the probability of the superior group coming from better homes and consequently being exposed to better conditions so far as possibilities of acquiring a superior vocabulary are concerned?

In test five, disarranged sentences, which apparently measures to some extent ability to read, the superior group was highest with a difference that comes very near to the desirable statistical reliability of four times its probable error.

The probable error greatly exceeds the difference in test six, number completion, and no positive conclusions can be drawn from the results of this test.

Also, little can be determined from the results of tests seven and eight, analogies and information, respectively, in which the probable error of the difference is approximately one-half the difference, although in these instances the retarded group is slightly ahead of the superior group.

It will be seen from the above that the retarded group exceeded the superior group in following directions and practical judgment and fell under the superior group in those tests which emphasized vocabulary and reading ability.

In arithmetic reasoning and analogies, when given as power tests the retarded group was well ahead of the superior group. It may be of significence that in both cases, labeled in the table tests eleven and twelve, when the difference between the test given as a power test and another form of the same test given as part of the Army Alpha were computed, the retarded group apparently took greater advantage of the increase in time than did the superior group.

As will be seen in Table II below the retarded group had an average mental age nearly three years lower than the average mental age of the superior group and in chronological age the retarded group were on an average nearly two and one half years older than the superior group.

We may conclude that upon those tests in which statistically reliable differences are found it is due either to the factor of chronological age and the result of experience which goes with it or to a difference in the mental constitution of the dull and bright individuals.

An interesting sidelight upon the increase in range in abilities from the superior to greatly retarded individuals may also be gained by close analysis of Table I. In every case the probable error of the mean for the retarded group was greater, usually by at least two or three times, than the corresponding probable error of the mean for the superior group. The probable error of the mean when found by the formula: $P.E._{(av)} = \frac{.6745\,\sigma_{di}}{\sqrt{N}}$ reflects directly the

scatter or the variability of the scores of the original distribution.

Table II is presented here to show the average mental and chronological ages of those pupils referred to throughout this study as the greatly retarded and the highly superior groups.

TABLE II

AVERAGE AGES OF THE RETARDED AND SUPERIOR GROUPS

	RETARDED GROUP (76 pupils)	SUPERIOR GROUP (74 pupils)
Average Mental Age (in years)	12.57	15.46
Average Chronological Age (in years)	14.96	12.54

Read table thus: the average mental age of the retarded group was 12.57 years.

One will note that the retarded group were about two and one-third years behind normal children in terms of mental age, and the superior group were advanced nearly three years in this respect.

Some questions arise as to the validity of the method of equating the scores of the groups by dividing the raw score made on each test by the score made by the individual on the Army Alpha test as a whole. It was believed desirable to determine whether the differences in averages of the percent of total score on parts of the test was due to a difference in chronological age of the individuals or was due merely to certain parts of the

test allowing for more gain in the higher age groups. In order to attempt an answer to this question two groups of subjects were selected each of whose mental ages were very nearly equal to their average chronological ages. The mental and chronological ages of these two trial groups are shown by Table III.

TABLE III

AVERAGE AGES OF THE YOUNG AND OLDER GROUPS

	YOUNG GROUP (25 subjects)	OLDER GROUP (25 subjects)
Average Mental Age (in years)	13.11	16.26
Average Chronological Age (in years)	12.50	15.84

Read table thus: the average mental age of the younger group was 13.11 years.

The scores of these two groups were then equated by the same technique as was used with the superior and retarded groups represented by Table I. The results of this treatment is recorded in Table IV.

In only one of the cases in Table IV is the score difference statistically reliable. In all the other cases the difference is less than twice its probable error. In the one case (Test 6) in which the difference is four times its probable error this difference is in favor of the young group. A review of Table I shows that the low group which in that case was also retarded went slightly higher than the superior group

although by a difference considerably less than its probable error. Table IV seems to show rather conclusively that the statistically reliable differences found in comparing the performance of the retarded and superior children was not due to the higher mental age score of the superior group and weakness in the test used in the higher levels but was due to the factor of retardation and superiority of the two compared groups.

TABLE IV

AVERAGE RATIOS OF PART OF TEST TO ENTIRE TEST

TEST	YOUNG GROUP	OLDER GROUP	DIFF.	P.E. Diff.
Test 1	8.268±.310	7.811±.206	.457	.372
Test 2	10.553±.383	9.881±.250	.672	.450
Test 3	9.892±.289	9.216±.270	.676	.395
Test 4	11.098±.788	12.214±.644	1.116	1.017
Test 5	10.329±.645	10.745±.606	.416	.885
Test 6.	11.307±.424	9.184±.305	2.123	.522
Test 7	24.538±.925	26.747±.956	2.209	1.329
Test 8	14.432±.587	14.223±.486	.209	.762

Read Table IV same as Table I.

The writer feels that the treatment of material by finding average ratios of score on part of an intelligence test to total score on the test may offer a valuable technique in test construction. Where a part of a test tends to differentiate more rapidly than the test as a whole, as does

test four in this case, it would seem much more valuable than those parts of the test which differentiate less rapidly as the average age and total score level increases as does test six.

This method was used here merely to test the validity of the method of comparing the superior and retarded groups by trying the Alpha in order to see if a great difference in value of its parts could account for the statistically reliable differences found between the retarded and superior groups treated in this study. The fifty cases used in this trial are of course too few to warrant any positive conclusions as to the value of these parts of the Alpha. However, it is believed that the method might be carried out in a very satisfactory manner in another study.

While as indicated elsewhere in this paper the range of ages was too small to allow direct comparison of the highly superior and greatly retarded groups, a few superior and retarded cases were found falling in the same interval of raw scores when superior and retarded were taken to mean those with I Q's falling above or below $\pm$ 1 P. E. of the distribution of I Q's.

These few cases and the average score made by each as well as the total scores are presented in Table V. Naturally the number of cases is far too few to offer any reliability and is presented here merely as an interesting sidelight upon the

data presented in Table 1. Tests one, three, four, and nine, namely following directions, practical judgment, synonym-antonym, and arithmetic power test are presented here because they were the tests showing the greatest differences in Table I.

TABLE V

DIRECT COMPARISON OF SUPERIOR AND RETARDED GROUPS

		RETARDED GROUP				SUPERIOR GROUP				
Total Score	Number in Interval	*1	*3	4	*9	No. in Interval	*1	*3	4	*9
74	3	6	7.7	9.3	8.7	1	6	5	16	10
76	3	5.7	8.7	7.7	10.7	1	8	8	9	9
85	2	5	8	12.5	9.5	2	6	8	15	9.5
93	3	6.3	9.3	12	10	2	7.5	8	12.5	10
98	1	6	8	16	11	4	6.8	10.8	13.3	8.5

Read table thus: there were three with IQ's placing them in the retarded group and one with a superior IQ who made a score of 74. The retarded group made an average score of six on test one and the superior subject made an average score of six on this test also. *starred items are those in which the retarded group showed highest percent score in Table I.

Table V offers material upon such few cases that almost no reliability can be claimed for it. In one case it agrees markedly with Table I. In others especially test nine it disagrees to some extent.

CONCLUSIONS

I. There are differences in children on test scores due to whether the child is retarded or superior when the mental age of the child is controlled.

II. The superior child seems to excel in tests involving a large amount of reading ability or a good vocabulary while the difference seems to be in favor of the retarded child in following directions.

III. The retarded child seems to make relatively greater use of increased time in test work.

IV. The relative range of ability seems greater among retarded children than among superior children.

V. A further use of the technique of equating scores as is done in this paper, would quite likely throw light upon the relative value of parts of tests as compared to the whole test. This technique might also serve to increase both the reliability and validity of a test if used as an aid to test construction.

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