THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report

of

Committee on Thesis

The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by Eva Abigail Fillmore for the degree of Master of Arts. They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts.

Mabel R. Fernald
Chairman

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May 27 1921

THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report

of

Committee on Examination

This is to certify that we the undersigned, as a committee of the Graduate School, have given Eva Abigail Fillmore final oral examination for the degree of Master of Arts . We recommend that the degree of Master of Arts be conferred upon the candidate.

Minneapolis, Minnesota

May 27 1921

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THE RELATIONSHIP BETWEEN RESULTS OBTAINED BY VARIOUS MEMORY TESTS.

A thesis submitted to the

Faculty of the Graduate School of the

University of Minnesota

by

Eva Abigail Fillmore

In partial fulfillment of the requirements

for the degree of

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CONTENTS.

STATEMENT OF THE PROBLEM.

The problem about which this study centers is that of investigating various activities, all of which involve memory, with a view to determining what degree of relationship exists between them. For such a study any performances may be selected which involve the ability to recall and recognize what has once been a part of one's experience.

However, it would be admitted that memory is not a separate and isolated process. For example, in the case of a child repeating a story which he has been told, one would grant that certain other factors, such as closeness of attention, intent to remember, the appeal of the story, or its associations, all influence the child's ability to recall. These factors are apparently disregarded when we speak of the performance as indicative of good or poor memory; by designating the level of attainment in terms of the amount of correspondence between the material originally learned and the amount reproduced we seem to pick memory out and, with disregard for its shaping factors, we seek to measure it in a quantitative manner. This is the thing apparently done in so-called "memory tests," which are, in fact, only performances which involve memory in some conspicuous way.

Such memory tests may be classified in various ways, according to the sense department to which the material for learning is presented, the type of material, or the method of reproduction. Thus we speak of auditory, visual, auditory-visual, motor or kinaesthetic memory indicating the mode of appeal, or such a classification may also refer to the kind of imagery a person uses

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when he recalls memory material. Again, we refer to rote and logical memory in which we emphasize the general type of material and the method of reproduction.. Whipple describes the tests of rote memory as "a series of discrete impressions (e.g, letters, digits, words), which is, if possible, to be reproduced in correct order and exactly as presented. These tests are to be contrasted with the so-called tests of 'logical' memory, in which the material presented is a logically connected whole, and in which the requirement is to reproduce the substance, or the meaning of what has been presented."[1] A still different way in which we refer to memory is that of emphasizing its relation to material; hence we speak of memory for digits, words, or pictures. Another division of memory considers the time at which the material is recalled, which may be either immediate or delayed.

Any such classification as that just outlined has its foundation in the belief that in any realm of knowledge, analysis and classification will lead to insight and control. The older psychology, with this same purpose, considered mind as something made up of various separate factors, such as imagination, attention, memory, and so on, each of which could be again subdivided into its component parts. Such was the assumption of the old "faculty" idea of mind. It should be understood, however, that such a division of the various kinds of memory as is made in the first part of this paper need not imply the "faculty" notion, in which one claimed to separate the thing in which he was interested from all the rest of the mental functions and proceeded to examine it as though it were something apart from and influenced by the other mental processes.

Another common conception, closely allied with the "faculty" view, though not involving all of its fallacies, has been that any one of the types of

1. Whipple, G. M.: Manual of Mental and Physical Tests, Complex Processes, P. 150, (516).

mental activity, such as memory, would always appear quite similar, regardless of content, material, or mode of presentation. This is an error in opinion about mental relations which Thorndike says "may be roughly described as the supposition that for any one operation that is the same in form, such as discrimination of differences, attention, observation, inference and the like, the varieties of different data or content are perfectly correlated."[1] Such an opinion is apparently based on the idea that mental functions that appear to be similar have a common component which, through its presence in all of them, closely relates them. "On the contrary, measurements reveal a high degree of independence of different mental functions, even where to the abstract psychological thinker they have seemed nearly identical. There are no few elemental 'faculties' or forms of mental activity which work alike with any and every kind of content."[1]

Having put aside any acceptance of the faculty view or the view which holds that there must be close connections within the realm of any one mental function, the experimenter of the present day can still find it possible to investigate what amount of relationship actually exists between the performances involving memory. He can perfectly well start with any classification as a basis upon which to construct his experiments and at the same time be aware of the fact that in his tests of a certain kind of memory he is not dealing with separate entities.

This problem of relationship, which has been attempted in this study, can be approached from two points of interest. The first is concerned with sizing up activities in which memory is prominent to determine what degree of relationship exists and what the theoretical implications of such may be; the second is the practical problem of prediction. In studying relations one

1. Thorndike, E. L.: Educational Psychology, Vol. III, P. 365.

would try to discover whether any two processes, each of which includes memory as one of its components, can be shown to be more related than either one is related to a third process, which to the observer appears to have nothing to do with memory. The obvious way in which to answer this would be by a comparison of the results of experiments in which many kinds of memory activities on the one hand and seemingly unrelated processes on the other had been tested. If such a procedure is impracticable, then one may test various performances involving memory and determine inter-relationship by means of the coefficients of correlation. If these turn out constantly high there would seem to be grounds for considering the possibility that this high degree of correlation was determined by a certain fundamental similarity between the tests involving memory, no matter how different they may be in other respects. On the other hand, if the correlations, any or all of them, were extremely low it might be possible that the apparent similarity of the tests had not been fundamental, or that it was sufficiently minor in importance to have been obscured by other factors.

With a similar purpose one may conduct his study along the lines suggested by the sub-groups of the memory activity, experimenting with different methods of presentation, materials, and modes of reproduction. One question is whether a certain kind of presentation with any sort of material will show higher relationship than can be shown if some other method is used. For instance, will the results of tests in which several kinds of material are used presented by the auditory method show higher relation than tests in which the same material is presented by the visual method? Then we may ask whether among the several methods of presentation some seem more closely related than others. In this study visual, auditory and visual-auditory presentations were used. Another problem concerns the possible inter-relations between the kinds of material used--which kinds show the highest correlation?

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Digits, words, stories and pictures were used for this purpose. Again, do rote and logical memory bear any relation to each other, or do all forms of rote memory show more relation to each other than any of them do to logical memory? Immediate and delayed recall have interested several investigators from the standpoint of relationship, but a consideration of them does not enter into the present problem.

Relationship as a basis for prediction is a practical question. One of the aims of psychology as well as other sciences is to arrive at knowledge which will make greater control possible. In order to control, prediction is necessary. Prediction in relation to memory would be especially valuable in connection with clinical psychology and educational adjustment. It would be desirable to know that if a person had a certain ability in visual memory he would do equally well in other tests of visual memory, or that a high score in one performance would be accompanied by a low score in another, or that no relationship existed. This would lead on to the question whether any one "memory test" or any few "memory tests" can be found which will warrant one in predicting from a given performance in such a test what kind of attainment an individual would make in any activity involving memory.

Such tests would be especially valuable to those persons who are interested in devising composite tests for the purpose of rating intelligence by means of testing various factors, such as imagination, reasoning, will power, judgment and memory. If a memory test could be devised which would have a fair degree of diagnostic value it would aid materially in the attempt to size up individuals in the manner advocated by Rossolimo.

Those who are developing general intelligence scales are no doubt also interested to ascertain what relation memory bears to general intelligence. The ordinary observer feels that the two are certainly connected in some way, but how?

Such questions as these suggested must be answered by means of correlations which indicate the degree of relationship between two measures. But when one has once found relationship, he must guard against feeling that he has an adequate basis for prediction. True it is, relationship has to do with prediction, but relationship must be of a high degree before prediction becomes at all reliable. This point will be dealt with at more length in the discussion of the results of the present experiments.

RESULTS OF PREVIOUS STUDIES.

Since the time of Ebbinghaus, who began the scientific investigation of memory, experimenters have been interested in the results obtained from different types of memory tests, from the point of view of determining which kind of presentation or which kind of material yielded the best results; that is, which gave the highest scores. This interest seemed to be largely of pedagogical importance, for by their findings workers hoped to arrive at conclusions which would determine the best methods of presenting the subject matter of the school curriculum.

The results of such experiments are not in agreement. Hawkins,[1] Wissler,[2] Kemsies,[3] Pohlman,[3] Schuyten,[3] and Henmon[3] found auditory memory to surpass visual, though Pohlman found this to be true with words only. He and Hawkins agree that auditory memory surpasses visual, but that this is true only in the case of young children, who, as they advance in age, become superior in the visual type. Wissler and Henmon contradict such a conclusion,

1. Hawkins: Experiments on Memory Types. Psychological Review IV, pp. 289-294.
2. Wissler, C.: The Correlation of Mental and Physical Tests. Psychological Review, Monograph Supplement, III, pp. 32-34.
3. Henmon, V. A. C.: The Relation Between Mode of Presentation and Retention. Psychological Review XIX, pp. 79-94.

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for their subjects were adults. Meumann,[1] Münsterberg,[2] Calkins,[3] and Kirkpatrick[3] found visual presentation to give superior results. Münsterberg, Smedley and Henmon found visual-auditory superior to either type alone. Kemsies found the combined method was of little advantage.

Content, as a factor which determines ability in memory, has been emphasized somewhat. Münsterberg found memory for numbers stronger than that for colors. Calkins' study showed memory for pictures to surpass that for words. Kirkpatrick had like results.

Winch[4] found that general ability is accompanied by a good memory. He also found that memory improves with age, but principally in so far as increased age implies increased general proficiency.

Correlation of ability in various memory tests, with which the present problem is concerned, has not been investigated so widely. Thorndike[5] correlated the ability to remember twelve words from auditory presentation with the same ability in the case of a list of five three-place numbers, with a result of .4 1/2 ± .1, which he corrected to .51/2. He worked with 38 adult subjects. He also found that memory for twelve words correlated with memory for twelve single digits .6, corrected to .7.

Bennett's correlation of auditory nouns with numbers was .32 (9 subjects). Henmon's correlation of nouns with syllables was .77 (6 subjects). Bennett's with nouns and syllables was .75 (9 subjects). Achilles[6] correlated words

1. Henmon, V. A. C.: The Relation Between Mode of Presentation and Retention. Psychological Review XIX, pp. 79-94.
2. Münsterberg, H.: Memory. Psychological Review I, pp. 34-38, pp. 453-458.
3. Calkins, M. W.: A Study of Immediate and Delayed Recall of the concrete and of the Verbal. Psychological Review V, p. 451.
4. Winch, W. H.: Immediate Memory in School Children. British Journal of Psychology I, pp. 127-134.
5. Thorndike, E. L.: The Relation Between Memory for Words and Memory for Numbers, and the Relation Between Memory over Short and Long Intervals. American Journal of Psychology XXI, pp. 487-8.
6. Achilles, E. M.: Experimental Studies in Recall and Recognition, Archives of Psychology, No. 44, 1920.

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with syllables, as follows: 52 adults, set A material, .48; 44 adults, set B material, .16; children, grade 5A, .16, grade 5B, .28. Thorndike correlated the results of immediate recall with those of delayed recall in his experiment with words and numbers, with a result of .5 1/2 ±.1, corrected to .8 ±.1. Bennett's correlations of immediate with delayed recall range from -.72 to .81. Brown[1] correlated the results of recall after 24 hours with those of recall two weeks later, for nonsense syllables and poetry, with a result of .49 (66 boys); with forty boys his result was .38. Wissler correlated the number of digits written correctly in the auditory and visual memory tests (144 cases) with a result of .29; while the number of digits correctly placed in each test correlated .39. Bennett found the correlation between auditory and visual digits to be .62. Achilles correlated words with proverbs for the 52 adults, set A material, .52; for the 44 adults, set B material, .18. For the first group syllables correlated with proverbs .12; for the second group, -.04. Wissler's correlation of memory for ideas with the correct position in the auditory digits test was .04; ideas correlated with the number of digits correctly written .05. Wissler's results came from a considerable number of cases, ranging from 144 to 94 in the different tests. Bennett found a correlation between auditory numbers and auditory ideas of -.5, between auditory numbers and visual ideas .03. Achilles correlated recall for geometrical forms with words as follows: Group of 52 adults, set A material .84; group of 44 adults, set B material .16; children of grade 5 A, -.04; grade 5 B, .18. For each of these groups, respectively, forms correlated with syllables -.02, -.04, -.12, -.10. For the first two group forms with proverbs correlated .12 and -.12 respectively. Brown, who was also interested in the relation of general intelligence to memory, found a correlation of intelligence with memory for poetry of .57; and of intelligence with mechanical memory .49. Owing to the number of Bennett's correlations, they are presented in

1. Brown, W.: Some Experimental Results inCorrelation of Mental Abilities. British Journal of Psychology, III,1910, pp. 304-309.

Table I, but it is to be noted that these coefficients were computed from the scores gotten from a group of nine highly selected subjects. This fact would, of course, raise the amount of the probable error in each case, which in turn would reduce the amount of reliability of these coefficients. Table XIV, which will follow with a discussion of our own data, gives a summary of the correlations which have been found in the survey of the literature on the subject.

Although these experiments, to which reference has been made, have been fairly numerous, they have been limited in certain respects which tend to lessen their scientific value. The most conspicuous limitation is in the number of cases, upon which the correlations are based, which, in all except a few instances has been too small to warrant the use of the findings in making any sound judgments concerning relationship between memory performances. The small amount of work on any one division of the problem, that of material, method of presentation, or kind of recall, along with the wide variety of the numbers of subjects in each case makes for inconclusive findings. Most of the experimenters have worked with groups of adults, some of which were far from being random samples. Consideration of these facts would seem to be evidence that there is still opportunity for more investigation. Such has been attempted in the experiments to be described, which were performed with fifty children of uniform age, and with several kinds of material and modes of presentation.

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TABLE I.

CORRELATION BETWEEN VARIOUS TESTS OF IMMEDIATE AND MEDIATE MEMORY.[1]

Immediate Memory.

		Visual					Auditory			
		Syllables	Numbers	Nouns	Prose	Faces	Syllables	Numbers	Nouns	Prose
Immediate Visual	Syllables		.28	.25	-.24	-.01	.51	.27	-.01	-.13
	Numbers	.28		.44	-.07	-.02	.62	.62	.50	-.78
	Nouns	.25	.44		.20	.70	.85	.28	.88	.57
	Prose	-.24	-.07	.20		.52	.02	.03	.31	.40
	Faces	-.01	-.02	.70	.52		.43	.07	.60	.05
Immediate Auditory	Syllables	.51	.62	.85	.02	.43		.52	.75	-.66
	Numbers	-.27	.62	.28	.03	.07	.52		.32	-.50
	Nouns	-.01	.50	.88	.31	.60	.75	.32		-.63
	Prose	-.13	.78	-.57	..40	.05	-.66	-.50	-.63	
Mediate Visual	Syllables	-.01	.48	.45	.47	.40	.56	.45	.67	-.25
	Numbers	-.14	-.10	.02	.23	.38	-.08	.40	.40	-.13
	Nouns	.20	.25	.22	.51	.33	.38	.37	.29	.08
	Prose	-.20	-.37	.13	.76	.67	-.03	.12	.18	.54
Mediate Auditory	Syllables	.06	.61	.25	.45	.15	.42	.48	.43	-.33
	Numbers	-.03	-.20	-.28	-.09	.22	.19	.26	-.30	.14
	Nouns	-.17	.28	.56	.53	.51	.58	.24	.81	-.21
	Prose	-.37	-.72	.08	.56	.58	-.19	-.39	.10	.58
	Average	00	.11	.28	.29	.35	.29	.22	.30	-.04

1. Bennett, Faye: The Correlation Between Different Memories, Journal of Experimental Psychology, Vol. I, P. 409.

EXPERIMENTS.

Subjects.

The subjects in the experiments to be described were 50 ten-year-old children in the Longfellow School (Minneapolis). In order to get a group of uniform age which would be composed of bright, average, and less capable pupils, children were included from grades above and below the fifth grade, in which the ten-year-old children are usually found. The following grades were represented:

6 c	8 cases
5 b	4 cases
5 c	19 cases
4 b	9 cases

There were 24 boys and 26 girls

Material.

The materials used were selected according to their adaptability to the purpose of the tests. The material for testing rote memory consisted of digits presented both by auditory and by visual methods, words presented by the combined auditory-visual method, and pictures of objects visually presented. Stories with auditory presentation were the only tests of logical memory.

The length of any particular series or the amount of material presented in a given trial was chosen with a view to offering a fairly wide range of possible scores on either side of the average. For such a purpose it was important that the average should not be close to zero on the one hand, or perfection on the other. The lengths of series adopted were chosen as a result of brief preliminary trials by the present writer.

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A more detailed description of the material follows:

1. Memory for digits--visual presentation.

   a. Trial series used the first time the visual digits test was given:

   6 1 3 5

   9 4 7 3 1 6 8

   b. Trial series used the second time the visual digits test was given:

   5 3 6 1 9 7

   c. Series used for the actual test I and II indicate the first and second experiments with the visual digits:

I	II
2 6 3 7 1 9 4 8 5	4 6 3 9 2 8 5 7 1
6 9 2 5 7 4 1 8 3	5 9 4 7 2 1 3 6 8
8 1 5 3 6 2 7 9 4	4 1 5 8 2 6 9 3 7

2. Memory for digits--Auditory presentation.

   a. Trial series for the first test with auditory digits:

   2 5 3 1 6

   8 6 1 3 9 7 4

   b. Trial series for the second auditory digits test:

   4 7 3 1 5

   c. Series used for the actual test I and II again indicate the first and second experiments:

I	II
2 5 8 4 9 1 3 7	7 3 9 6 2 8 5 1
9 7 2 6 3 5 1 4	5 7 2 1 8 9 3 6
3 8 1 4 7 5 2 9	8 6 1 3 2 7 4 9

For the group test (visual) the digits, 1 1/4 in. in height, were printed on cardboard 12 X 3 1/2 in. For the individual test gummed numbers, 1/2 in. in height, were mounted on cardboard 9 X 3 in.

3. Memory for words--Auditory-visual presentation.

The following lists of words used were taken from Whipple's tests for rote memory:

a. Trial series for the first word test:

spoon

horse

chair

stone

cat

b. Actual tests. Two lists were given:

I	II
ball	coat
sponge	girl
glass	house
hat	salt
fork	glove
stove	watch
post	box

c. Trial series for the second word test:

milk

card

floor

ground

pen

d. Actual series.

I	II
dish	hand
paper	street
table	ink
dog	lamp
cake	clock
grass	boy
door	chalk

For the group test letters 5/8 - 7/8 in. in height were used, printed on cardboard 10 X 6 1/2 in. For the individual tests the gummed letters, 1/2 in. in height, were put on cardboard 8 X 4 1/2 in.

4. Logical memory--Auditory presentation.

a. The following story, The Fire,[1] was used as a preliminary to the actual test, How Mr. Lincoln Helped the Pig.[1]

> New York, September 5th. A fire last night burned three houses in Water Street. It took some time to put it out. The loss was fifty thousand dollars, and seventeen families lost their homes. In saving a girl who was asleep in a bed, a fireman was burned on the hands.

b. The story which follows, How Mr. Lincoln Helped the Pig, was the first test of memory for ideas.

> One day| Mr. Lincoln| went out riding.| As he passed along the road,| he saw a pig| sinking| into a mud-hole.| Poor| piggy would climb| part way| up the slippery| bank,| then down he would fall again.|
>
> "I suppose I should get down| and help| that pig,"| thought Mr. Lincoln. "But I have on my new suit,| and it will be quite spoiled if I do so.| I think I'll let him get out| the best way he can."|
>
> He rode on.| When nearly| two| miles away,| he turned| and came back.| Not minding the new| clothes,| he stooped,| and taking piggy in his arms,| he dragged him| out| of the mud.

[1] Whipple, G. M.: Manual of Mental and Physical Tests--Complex Processes. P. (573) 207.

The new| suit| was quite| spoiled,| but Mr. Lincoln| said| he had taken a pain| out of his mind.|

c. The story of The Sailor[2] was the second test of memory for ideas.

If a sailor| on the ocean| is shipwrecked| in a wild country,| he must first look for water| to drink,| then he must find a place| to sleep| where wild animals can't get at him,| and after that he can take time| to look for food,| but he must be careful| not to eat poisonous berries| or fruit.| Next he had better hunt for other people| on the land| and put up a flag| to stop ships| which may be going by.|

5. Memory for objects.

The objects test consisted of pictures of things with which children are familiar. The pictures, colored for the most part, were cut from advertisements and mounted on heavy gray cardboard. In selecting the pictures care was taken to find such as had no distracting features about them, such as printing or numbers. Pictures of a single object, or objects of the same kind, as a pair of shoes, or two or three nuts, were selected.

a. The first card of pictures was the preliminary for the first actual objects test. The following pictures were mounted on cardboard 12 X 18 in. in the position indicated below:

---

cocoanut Jack-o-Lantern

star

child peach

eggs chick

bowl

---

[2] Wm. Healy and Grace M. Fernald: Tests for Practical Mental Classification, Psychological Review, Monograph Supplement, Vol. 13, 1911, P. 36.

b. Pictures used in the first actual objects test were on cardboard 18 X 22 in., as were those for the second objects test. Arrangement was as follows:

---

cup and saucer

strawberries

teakettle

spoon

shoes

chair

clock

cake

bed

dog

baby

house

---

c. The pictures indicated below were the second test:

---

watch

automobile

kettle

knife

bread

apple

brush

nuts

cow

star

flowers

boy

Procedure.

As stated in the description just concluded, each test consisted of two different sets of similar material; one set was used at one time, the other at another time later, so that there was a chance to get scores on the same type of performance at two times quite far apart. This reduced the error arising from rating a child on a performance which might not have been indicative of his real ability, owing to the operation of factors such as strangeness of the experimenter, and the novelty of being tested in this manner with which he had no previous experience.

For each of the series of each type of test, except the second test of logical memory (The Sailor) and the second test of memory for objects, there was a preliminary trial with material similar to that used in the actual test. These trial tests were provided in order that the child might get used to what he was expected to do and therefore in the actual test could give better attention to the material which he attempted to remember.

The order and manner of presentation of the tests, and the time for the giving of each one is indicated below. Numbers refer to those used in description of the material.

Individual tests:

Objects - 5 a - 10 seconds exposure
5 b - 15 seconds exposure

Ideas - The Fire. 4 a - 25 seconds for reading by experimenter

How Mr. Lincoln Helped the Pig. 4 b - 55 seconds for reading by experimenter

Group tests:

Digits - Visual - 1 a
1 c, I - 5 seconds exposure of card with digits on it

Words - Auditory-visual - 3 a
3 b, I and II
Read by experimenter at the rate of 1 word per second

Digits - Auditory - 2 a
2 c, I
Read at rate of 1 digit per second

Individual tests:

Words - Auditory - Visual - 3 c
3 d, I and II
1 word per second

Objects - 5 c Exposure 15 seconds

Digits - Auditory - 2 b
2 c, II
Read at the rate of 1 digit per second

Ideas - The Sailor - 4 c
35 seconds for reading by experimenter

Digits - Visual - 1 b
1 c, II

The group method, with about 12 children in a group, used for one part of the material was abandoned because in the judgment of the experimenter it seemed that the results might not be as reliable as those gained in the individual tests. However, since the scores on the individual tests did not correlate as highly with one another as the combined scores of individual and group results, it was thought advisable to use the group results, combined with individual results, in working out the final correlations. This was in accordance with the usual procedure of giving two tests of any given variety on different days and then combining their scores into an amalgamated measure which was considered less liable to error than either of the separate tests taken alone.

The conditions under which the tests were given were unusually favorable. The experimenter worked in a large, light, well-aired room situated where no noise interfered.

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The first time that each child came to be tested he was given the objects test and the ideas test. The time of exposure, 15 seconds, in the objects test was established by means of a preliminary test with 5 children, in which it was found that they remembered, on the average, 6 objects after an exposure of 15 seconds. For the objects test the experimenter gave the following directions: "I am going to show you a card with some pictures on it. When I say 'Ready,' I will turn the card over and you look carefully at the pictures. Then when I turn the card back you will name for me all the pictures you saw. First, we will look at a picture just for a trial." Then the trial card was shown and upon its removal the child named the pictures he remembered. The experimenter wrote the record, which procedure was followed in all cases except the group tests.

For the ideas test these directions, adapted from Whipple, were given: "I am going to read you something to see how well you can remember it afterward. You must pay careful attention, as I shall read it but once. As soon as I have finished, you will tell the story to me. If you can remember it in just the words you heard, use those words, but if you can't do that, tell in your own words, as well as you can, what it was that I read to you." As the child told the story the experimenter underlined the ideas on a typed copy of the story.

The second time that the children came to be tested the group method was used; digits visual, words (auditory-visual), and digits auditory, with their trial series, were given in the order named. The experimenter explained that the digits and words would be read only once and that as soon as she was through reading the children were to write what they had heard or seen in the order in which it had been presented. In the case of the digits, slips of paper marked into squares, 9 for the visual digits and 8 for the auditory, were used for the records, one digit being placed in each square. They were

written across the sheet, while the words were written on separate slips in columns.

The third group of tests was given individually again, the five tests being given at one sitting. The directions given were the same as for the similar material in the previous tests.

Method of Scoring Material.

The score for the objects test was determined by the number of pictures that the child named. If he named six, his score was 6, and so on. The ideas test was scored on the basis of the correct number of ideas reproduced. The division into ideas of How Mr. Lincoln Helped the Pig was used as Whipple gives it. This division is indicated in the story which is quoted in the description of the material used in these tests. The division of ideas in The Sailor was adapted from Healy and Fernald's division, though the story as used in these tests was broken up into a few more ideas. The number of ideas is indicated in the story as it is given in the description of the test material.

The digits tests, both auditory and visual, were scored by the following device:

> Score of 2 for each correct digit correctly placed
> Score of 1 for each correct digit in a pair each member of which was transposed
> Score of 1 for each correct digit one place removed
> Any digit farther than one place removed received no credit

On this basis a score was computed for each of the three trials that made up one test, and an average of these three scores gave the final score for the test. This method was used in getting the scores for the word tests; in that case two scores were averaged for the final test score.

The word tests were scored in the following manner:

Score of 3 for each correct word in the correct position
Score of 2 for each correct word one place removed from the correct position
Score of 1 for each correct word more than one place removed

Determination of Method of Treatment of Data.

In order to determine the proper method of dealing with the result of the tests, coefficients of reliability were compiled by the rank difference method. The scores in Test I and Test II of each type of material were correlated with the following results:

Objects I and Objects II	$\rho = .16$
Ideas I and Ideas II	$\rho = .52$
Digits Visual I and II	$\rho = .44$
Digits Auditory I and II	$\rho = .40$

A similar fluctuation in the value of the scores from one test to another with material of the same kind was found by Brown[1] in his study of the correlation of mental abilities. For two groups of subjects (I and IV), to which he gave the same memory test two weeks apart, he gives the following data:

Group	Reliability coefficient, r, (indicates the degree of correlation between two tests with similar material).
I (66 boys, 11-12 years old)	.51
II (56 college students)	.50

Brown also gives a formula[2] by means of which one can determine from a given reliability coefficient the number of repetitions which would be necessary in order to get a reliability coefficient of a certain desired magnitude. Suppose we take a reliability coefficient of .40, which we found as the coefficient between the first and second trials of the digits auditory, and

1. Brown, W.: Some Experimental Results in Correlation of Mental Abilities; British Journal of Psychology III, P. 309.

2. $r_n = \frac{nr_i}{1+(n-1)\,r_i}$

n = number of trials.
r_n = coefficient of reliability that one desires.
r_i = coefficient of reliability between any two trials.

that we desired to get a reliability coefficient of .90 which would mean a high degree of stability in the measures, thirteen applications of the test would have been necessary. Such continuation would obviously have been impossible with the time limitations which controlled the experiments.

With such fluctuations and instability between the two tests with similar material it would seem desirable to use for correlation purposes a score made up of the combined scores obtained on the first and second tests. However, in the present study there might seem to be a possible objection to such procedure. In view of the fact that the first trial of certain test material was individual, as has been indicated already, and that the second trial of the same material was given by the group method, it might seem that the results of the two could not be fairly combined to use for correlation purposes.

In order to find out what the effect of the use of the group series would be, certain correlations were computed in two different ways. One method was to use the scores made on individual tests alone; the other was to use a combined score made up of the score on an individual test of one sort plus the score gotten on the similar test by the group method. The results were as follows:

Digits Visual (Individual Test) and Digits Auditory (Individual Test)	$\rho = .48$
Digits Visual (Individual Test) and Words (Individual Test)	$\rho = .44$
Digits Visual (Individual + Group) and Digits Auditory (Individual + Group)	$\rho = .56$
Digits Visual (Individual + Group) and Words (Individual + Group)	$\rho = .58$

The last two coefficients show that the use of a score secured by combining group and individual test scores raised the correlations over those computed from the individual scores alone. Since the aim was to get the correlations that would show the highest relationship that the available material

made possible, the generally recognized practice of combining scores made on two trials of the same test when their reliability coefficient is low was therefore adopted in the computation of the correlations quoted in this study. Our data do not make it possible to compute the actual degree of reliability attained by an amalgamation of the scores from two trials of a test, but an estimation can be made by means of Brown's formula, which has previously been mentioned. For our data the estimated degree of reliability of the combinations used would be as follows:

Type of Test	Reliability coefficient for Amalgamated Measure (two trials).
Test of memory for objects	.27
Test of memory for ideas	.68
Test of memory for visual digits	.61
Test of memory for auditory digits	.57

Presentation of Correlation Data.

The plots of the correlation tables (III-XII) are included in order that the reader may get a more graphic idea than the coefficient of correlation gives him of the sort of relationship found to exist between the various kinds of memory. It will be noted that the scores represent the sums of the scores made on two tests.

In connection with the correlation coefficients it is interesting to note the variability of the tests, which is shown in Table II. It will be seen that the test having the lowest coefficient of variability is the one which correlated the lowest with all other tests.

TABLE II.

VARIABILITY OF MEMORY TESTS.

Test	Mean [1]	Standard Deviation	Coefficient of Variability
Digits Auditory	14.54	5.01	34
Digits Visual	18.34	4.83	26
Ideas	34.72	7.12	20
Words	18.02	3.7	20
Objects	13.9	2.1	15

1. Mean based on sum of two scores. For method of scoring, see P. 20.

TABLE III.

CORRELATION BETWEEN MEMORY FOR DIGITS PRESENTED BY THE VISUAL METHOD AND MEMORY FOR DIGITS PRESENTED BY THE AUDITORY METHOD.

Scores in Tests of Digits Auditory.

Digits Visual.	5-7	7-9	9-11	11-13	13-15	15-17	17-19	19-21	21-23	23-25	25-27	Totals
28-30						1					1	2
26-28										1		1
24-26					1		1	1	1		1	5
22-24				2	1				1			4
20-22		1		1	1	1		1				5
18-20			1		2	1	1			1		6
16-18		1	2		5	2	2					12
14-16			1	1	1			1	1			5
12-14	2	3				1						6
10-12		1		1	1							3
8-10			1									1
Totals	2	6	5	5	12	6	4	3	3	2	2	

Digits Visual: Mean.....18.4 Standard Deviation.....4.6
Digits Auditory: Mean.....14.64 Standard Deviation.....5
Coefficient of Correlation..r..... .61 ± .06

TABLE IV.

CORRELATION BETWEEN MEMORY FOR WORDS AND MEMORY FOR DIGITS PRESENTED BY THE VISUAL METHOD.

Scores in Tests of Memory for Digits Visual.	Scores in tests of Memory for Words. 12-	13-	14-	15-	16-	17-	18-	19-	20-	21-	22-	23-	24-	25-	26-	27-	28-	29-	Totals
29-													1						1
28-													1						1
27-																			0
26-							1												1
25-										1	1								2
24-							1					2							3
23-				1														1	2
22-	1								1										2
21-										2				1					3
20-		1		1															2
19-								1	1										2
18-							1	2		1									4
17-				1		2	2				2								7
16-	1			2	1					1									5
15-			1	1															2
14-				1		1					1								3
13-				1															1
12-				1	2	1	1												5
11-	1		1																2
10-	1																		1
9-																			0
8-				1															1
Totals	4	1	2	10	3	4	6	3	2	5	4	2	2	1	0	0	0	1	

Words: Mean.....18.02 Standard Deviation.....3.7

Digits Visual: Mean.....18.34 Standard Deviation.....4.83

Coefficient of Correlation: r.... .60 ± .06

TABLE V.

CORRELATION BETWEEN MEMORY FOR DIGITS PRESENTED BY THE AUDITORY METHOD AND MEMORY FOR WORDS.

Scores in Tests of Memory for Words.	Scores in Tests of Memory for Digits Auditory.											Totals
	5-7	7-9	9-11	11-13	13-15	15-17	17-19	19-21	21-23	23-25	25-27	
28-30					1							1
26-28												0
24-26					1	1					1	3
22-24			1		1			1	2		1	6
20-22			1	1	2	1	1	1				7
18-20					3	2	2			2		9
16-18	1	2	1		1		1	1				7
14-16	1	3	2	2	2	1			1			12
12-14		1		2	1	1						5
Totals	2	6	5	5	12	6	4	3	3	2	2	

Digits Auditory: Mean..... 14.64 Standard Deviation..... 5

Words: Mean..... 18.48 Standard Deviation..... 3.6

Coefficient of Correlation;..r..... .52 ± .07

TABLE VI.

CORRELATION BETWEEN LOGICAL MEMORY AND MEMORY FOR WORDS.

Scores in Tests of Logical Memory.	Scores in Tests of Memory for Words.									Totals
	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	
45-47		1		2	1		1				5
43-45					1						1
41-43			1			2	2				5
39-41		1	1	1		1					4
37-39		1	1	3							5
35-37		2	1	1		1			1		6
33-35	1					1					2
31-33	1	2		1	2	1					7
29-31		2	1		1						4
27-29	1	1		1							3
25-27	1		1		1						3
23-25		1	1		1						3
21-23	1										1
19-21											0
17-19		1									1
	5	12	7	9	7	6	3	0	1		

Words: Mean.....18.48 Standard Deviation.....3.6
Logical Memory: Mean.....34.72 Standard Deviation.....7
Coefficient of Correlation: r..... .39 ± .08

TABLE VII.

CORRELATION BETWEEN LOGICAL MEMORY AND MEMORY FOR DIGITS PRESENTED BY THE VISUAL METHOD.

Scores in Tests of Memory for Digits. Visual.	Scores in Tests of Logical Memory. 17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	Totals
29																									1						1
28																														1	1
27																															0
26																					1										1
25								1												1											2
24															1									1						1	3
23														1					1												2
22																	1													1	2
21									1							1									1						3
20												1							1												2
19												1	1																		2
18																					1			1				1		1	4
17							1	1									1			1	1		1			1					7
16														1	1	1										1			1		5
15																						1	1								2
14											1											1				1					3
13																			1												1
12									1				1		2					1											5
11	1									1																					2
10						1																									1
9																															0
8																	1														1
Totals	1	0	0	0	1	0	1	2	2	1	1	2	2	2	4	3	2	0	3	3	3	2	2	2	2	3	0	1	1	4	

Logical Memory: Mean.....34.72 Standard Deviation.....7.12
Digits Visual: Mean.....18.34 Standard Deviation.....4.83
Coefficient of Correlation: r..... .30 ± .09

TABLE VIII.

CORRELATION BETWEEN LOGICAL MEMORY AND MEMORY FOR DIGITS PRESENTED BY THE AUDITORY METHOD.

Scores in Logical Memory.

Scores in Digits Auditory.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	Totals
26-																				1											1
25-																									1						1
24-																															0
23-												1									1										2
22-																															0
21-														1										1		1					3
20-															1																1
19-									1														1								2
18-																				1											1
17-													1													1				1	3
16-																														1	1
15-															1	2								1					1		5
14-								1									1		1		1		1		1					1	7
13-				1				1							1						1		1								5
12-												1										1								1	3
11-	1																1														2
10-							1				1																		1		3
9-																1										1					2
8-															1				1												2
7-										1				1	1					1											4
6-									1																						1
5-																			1												1
Totals	1	0	0	0	1	0	1	2	2	1	1	2	2	2	4	3	2	0	3	3	3	2	2	2	2	3	0	1	1	4	

Logical Memory: Mean.....34.72 Standard Deviation.....7.12
Digits Auditory: Mean.....14.54 Standard Deviation.....5.01
Coefficient of Correlation: r..... .23 ± .09

TABLE IX.

CORRELATION BETWEEN LOGICAL MEMORY AND MEMORY FOR OBJECTS.

Scores in Tests of Memory for Objects.	Scores in Tests of Logical Memory.																															Totals
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46		
20																				1												1
19																																0
18																1														1		2
17															1						1											2
16														1			1					1										3
15											1		1		1											1						4
14									1			1							1		1			1				1	1	1		8
13	1				1										1	1				1	1		2	1	1	2				2		14
12								2				1				1			1	1												6
11							1		1				1	1								1			1							6
10										1					1	1			1													4
Totals	1	0	0	0	1	0	1	2	2	1	1	2	2	2	4	4	1	0	3	3	3	2	2	2	2	3	0	1	1	4		

Logical Memory: Mean.....34.72 Standard Deviation.....7.7
Objects: Mean.....13.9 Standard Deviation.....2.1
Coefficient of Correlation: r..... .21 ± .09

TABLE X.

CORRELATION BETWEEN TESTS OF MEMORY FOR WORDS AND MEMORY FOR OBJECTS.

Scores in Tests of Words.

Scores in Tests of Objects.	11-	12-	13-	14-	15-	16-	17-	18-	19-	20-	21-	22-	23-	24-	25-	26-	27-	28-	29-	Totals
20-						1														1
19-																				0
18-												1		1						2
17-								1			1									2
16-			1	1	1															3
15-					1			1		1		1								4
14-			1		2		1	1		1	1		1							8
13-		1		1	3	1	1	3	2			1			1					14
12-		1			1				1		1	1							1	6
11-					1	1	2				1			1						6
10-		1			1						1		1							4
Totals		3	2	2	10	3	4	6	3	2	5	4	2	2	1	0	0	0	1	

Words: Mean.....18.54 Standard Deviation.....3.7
Objects: Mean.....13.9 Standard Deviation.....2.1
Coefficient of Correlation..r.... .01 ± .09

TABLE XI.

CORRELATION BETWEEN MEMORY FOR DIGITS PRESENTED BY THE VISUAL METHOD AND MEMORY FOR OBJECTS.

Scores in Tests of Memory for Objects.	Scores in Tests of Memory for Digits Visual.																						Totals
	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
20					1																		1
19																							0
18										1											1		2
17									1	1													2
16								1							1	1							3
15					1		2					1											4
14					1	1			1		1		1		1		1		1				8
13	1		1	1	1			1	1	3	3			1			1						14
12									1	1		1				1		2					6
11					1		1		1	1				1								1	6
10				1									1	1			1						4
Totals	1	0	1	2	5	1	3	2	5	7	4	2	2	3	2	2	3	2	1	0	1	1	

Digits Visual: Mean.....18.34 Standard Deviation.....4.83
Objects: Mean.....13.9 Standard Deviation.....2.1
Coefficient of Correlation: r..... .07 ± .09

TABLE XII.

CORRELATION BETWEEN TESTS OF MEMORY FOR OBJECTS AND MEMORY FOR DIGITS PRESENTED BY THE AUDITORY METHOD.

Scores in Tests of Digits Auditory.

Scores in Tests of Objects.	5-	6-	7-	8-	9-	10-	11-	12-	13-	14-	15-	16-	17-	18-	19-	20-	21-	22-	23-	24-	25-	26-	Totals
20-			1																				1
19-																							0
18-										1		1											2
17-									1	1													2
16-							1	1									1						3
15-						1					1		1				1						4
14-	1	1				1		2			1						1		1				8
13-			1		2		1		3	3	1		2	1									14
12-									1	2	1								1			1	6
11-			1	1		1									2						1		6
10-			1	1							1					1							4
Totals	1	1	4	2	2	3	2	3	5	7	5	1	3	1	2	1	3	0	2	0	1	1	

Digits Auditory: Mean.....14.54 Standard Deviation.....5.01
Objects: Mean.....13.9 Standard Deviation.....2.1
Coefficient of Correlation:..r..... .07 ± .09

TABLE XIII.

CORRELATIONS IN RANK ORDER.

Table number of correlation plot.	Material correlated	Coefficient of correlation. (Pearson Product Movement.)
III	Digits visual and digits auditory	.61 ±.06
IV	Digits visual and words	.60 ±.06
V	Digits auditory and words	.52 ±.07
VI	Ideas and words	.39 ±.08
VII	Ideas and digits visual	.30 ±.09
VIII	Ideas and digits auditory	.23 ±.09
IX	Ideas and objects	.21 ±.09
X	Objects and words	.01 ±.09
XI	Objects and digits visual	-.07 ±.09
XII	Objects and digits auditory	-.07 ±.09

TABLE XIV.

SUMMARY OF COEFFICIENTS OF CORRELATION FOUND BY OTHER INVESTIGATORS.

Rote Material with Rote Material	Coefficient of Correlation	Number of Cases	Investigators
Words and forms (Set A material)	.84	52	Achilles
Nouns and syllables	.77	6	Hermon
Nouns and syllables	.75	9	Bennett
Auditory digits and visual digits	.62	9	Bennett
Auditory words and auditory numbers	.55	38	Thorndike
Words and syllables (Set A material)	.48	52	Achilles
Auditory and visual digits (Correctly placed)	.39		Wissler
Words and numbers	.32	9	Bennett
Auditory digits and visual digits (Number correctly written)	.29	144	Wissler
Words and forms (Set B material)	.16	44	Achilles
Words and syllables (Set B material)	.16	44	Achilles
Average recall of words with forms and syllables (children)	.095	638	Achilles
Average recall of forms with words and syllables (children)	.07	638	Achilles
Average recall of syllables with words and forms (children)	.12	638	Achilles
Syllables and forms (Set A material)	-.02	52	Achilles
Syllables and forms (Set B material)	-.04	44	Achilles
Rote Material with Logical Material			
Words and proverbs (Set A material)	.52	52	Achilles
Poetry and nonsense syllables	.49	66	Brown
Poetry and nonsense syllables	.38	40	Brown
Words and proverbs (Set B material)	.18	44	Achilles
Forms and proverbs	.12	52	Achilles
Syllables and proverbs	.12	52	Achilles
Ideas and digits (number correctly written)	.05	94	Wissler
Ideas and digits (correctly placed)	.04	94	Wissler
Auditory numbers and ideas (visual)	.03	9	Bennett
Syllables and proverbs	-.04	44	Achilles
Forms and proverbs	-.12	44	Achilles
Auditory numbers and ideas	-.5	9	Bennett

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Discussion of Data.

The discussion of these data may center around certain questions, such as the following:

1. Do the relationships show any general tendency?

2. Does this tendency seem related to a certain type of presentation or to a certain kind of material?

3. What are the possibilities of prediction concerning memory performances?

4. What relationship exists between memory and general intelligence?

The correlations arranged in rank order (Table XIII) seem to fall in three distinct groups--the fairly high correlations: .61, .60, .52; those considerably lower: .39, .30, .23, .21; and those of the 0 or slightly negative group: -.01, -.07, -.07. The natural manner in which to consider these results seems to be to examine each group or level in its relation to mode of presentation and kind of material.

The first group (Tables I-III) shows no predominance of one kind of presentation, since visual, auditory and visual-auditory methods were used.

The materials employed were digits and words, which may be classed as disconnected, verbal rote material. This factor of one kind of material within this group appears to be the common element which may have determined the degree of correlation which exists.

In the second group of correlations (Tables IV-VII) the several methods of presentation again appear. The material--digits, words and ideas--offers a combination of the logical with the rote; with correlations between rote and logical material the coefficients become lower than those in which rote material was correlated with rote material.

The third group or lowest level (Tables VIII-X) again shows the various kinds of presentation. The material--objects, digits and words--is again rote but the correlation is found to be considerably lower than that of the other rote group. How is one to account for this decided change? The one way in which this group of comparisons differs from the first is in the introduction of one new kind of material, namely, objects. One wonders why objects should not have correlated as well as any other rote material. Several alternatives suggest themselves. It may be that the memory for objects is a distinctly different kind of performance from that involved in memory for other kinds of rote material, or it might be that the nature of the objects test is such that it is less discriminative than the other tests. An indication of the latter may be found in the preliminary correlations. It will be noted that the coefficient of reliability for the objects test was the lowest of any that were determined, and that the coefficient of variability was also the lowest one found, both of which facts would have a tendency to reduce the correlation when this test was brought into relationship with others.

In considering the data we may look to see whether our results are confirmed by other investigators whose findings are shown in Table XIV. These results show that the highest correlations have been found between rote ma-

terials more or less verbal in character--e.g., digits, nonsense syllables, words, etc. However, some of the lowest correlations have been found between rote material and rote material, such as those stated by Achilles, who correlated forms with other kinds of rote material. These, it will be seen, are similar to our own findings, in which we used objects in relation with other rote materials. This tends to support the suggestion, previously made, that memory for concrete material--objects and forms--may be something quite different from memory for the verbal types of material. The correlations between rote and logical materials cover a wide range, .52 to -.5, which does not show close correspondence with our findings, which are restricted to a relatively narrow range. It may be suggested that such a wide range is at least partially accounted for by the various numbers and kinds of cases upon which these results have been based. A few specific instances of quite close agreement between our results and those of others may be mentioned. Bennett found digits visual to correlate with digits auditory .62, our coefficient being .61. Digits auditory and words were correlated by Thorndike with a result of .55; our result was .52. Wissler's correlation between ideas and digits in the correct position was .34; our correlation was .30.

The practical question to be discussed is concerned with prediction, from a given performance in one memory test, to the probable performance in some other memory test or in some activity involving memory. One may also be interested to predict from a given memory score a person's level of general intelligence, or vice versa.

The common practice has been to use the coefficient of correlation as the basis for prediction, but this may be questioned, as Ruml sets forth in a paper Coefficients of Diagnostic Value. He says, "Now, although it is clear that a close relation between performance in tests and the ability in question is associated with the possibility of accurate diagnosis, and al-

though any increase in the closeness of the relationship is accompanied by an increase in the accuracy of diagnosis, it does not follow that an index which is used in describing the relationship can be taken directly as an index of the diagnostic value of mental tests (or as he states elsewhere, other tests). In fact, the coefficient of correlation, a widely used index of relationship, gives a decidedly misleading notion of diagnostic value." [1] He proposes the standard error of estimation ($\sigma\sqrt{1-r^2}$) as an "index of the accuracy of diagnosis," which he says "expresses directly the magnitude of the error made in predicting the values of one variable from the values of another."

"As r decreases from 1, or increases from -1, the standard error increases with extreme rapidity." According to Ruml's graph of this relation, the highest coefficient of correlation in this study, .61, would have a standard error of eight-tenths its maximum size; that is, the error made in predicting on the basis of such a correlation is eight-tenths as great as the error would be if it were made by guessing on the basis of a zero correlation. With the smaller coefficients, of course, the errors would greatly increase.

Further, the wide range of the coefficients in this study shows a lack of consistent inter-relation which destroys any hope of finding one "memory test" which will be the means of determining what one's ability would be in all other memory performances.

An attempt was made to find whether any relationship exists between memory and intelligence, in so far as that is rated by a standard intelligence examination. Haggerty's Delta 2 was given to all the subjects in the memory

1. Ruml, B.: Coefficients of Diagnostic Value. Journal of Phil., Psych., and Scientific Methods, XIV, 23, P. 633, 635, 636.

experiments and correlations computed as follows:

Digits visual - Delta 2	.26 ±.09
Digits auditory - Delta 2	.41 ±.08
Ideas - Delta 2	.38 ±.08
Objects - Delta 2	.08 ±.09
Words- Delta 2	.27 ±.08

The degree of relationship though positive does not appear to be very close. With such low coefficients there would seem to be no satisfactory basis for prediction based simply on correlations between scores in memory tests and scores in intelligence tests.

CONCLUSIONS.

From the points brought out in the discussion of the data certain conclusions, in regard to the amount of relationship found between the so-called "types" of memory, can be drawn:

1. Similarity in the material used seems more effective in producing correlation than does the similarity in mode of presentation.

2. Any statement concerning material as a basis for correlation must be made with reference to certain specific varieties, any rough generalization that would cover a wide scope would not be an adequate description of the facts as they have appeared in these data.

    (a) The comparisons which gave the highest correlation coefficients were those in which rote material of the disconnected verbal type was correlated with other material of the same sort.

    (b) On the other hand, another variety of rote material, namely, objects, correlated with rote material of the verbal sort to a very low degree.

3. The magnitude of the coefficients of correlation would not warrant their use in making a prediction from a performance in one test to the most likely performance in another test, with any high degree of reliability.

These findings are in accord with the idea in Thorndike's statement quoted earlier, in which he says "there are no few elemental 'faculties' or forms of mental activity which work alike with any and every kind of content." Memory, as it came into function in these tests, shows itself to be a variable

thing, this fact leads us to believe that memory can best be thought of as specialized according to the conditions under which it operates; which means that there is no close inter-relation among so-called types of memory, but rather that there are independent "memories" varying with the activity in which they are employed.

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