

CORRELATIONS OF IMMEDIATE AND DELAYED RECALL

ARTHUR I. GATES

Teachers College, Columbia University

A considerable number of studies have accumulated bearing upon the general relation of "speed of learning" and "retentiveness," yet authorities disagree widely in their interpretation of these results. The terms "speed of learning," "retentiveness" and the like give scarcely an accurate description of the facts, since "speed of learning" has been determined in nearly all cases by an objective measure of the amount of material recalled at a certain time, viz., immediately after a study period and likewise "retentiveness" is determined by a similar measure of amount recalled at a particular later time. It will be seen that the terms "immediate recall" and "delayed recall" give a more accurate description of the functions concerned in the present experiment.

With regard to interpretation of previous studies, we find in current textbooks such conflicting statements as these:

"The one who learns quickly, . . . retains it just as long and on the average longer than the one who learns more slowly . . . Quickly come, slowly go."*

Pillsbury takes a middle ground:

"Individuals who learn easily seem to forget slowly while those who learn slowly forget rapidly. This law holds if one considers pure rote learning. When learning sense materia by logical connections, the man who learns slowly may have an advantage if he gives the added time to understanding the matter. In this case the evidence shows that slow learning is compensated for by retentive memory."†

At the other extreme is Meumann, from whom pertinent statements are quoted. "Learners may, in general, be classified into two groups; rapid learners and slow learners . . . each represents a characteristic mental type. The typical differences persist no matter whether the material to be learned is of significant or a meaningless sort . . . The typically rapid learner is usually a rapid forgetter. The rapid learner possesses no guarantee of permanent retention. The profit which the slow

*STRAYER AND NORSWORTHY. *How to Teach*, N. Y., 1917. p. 81.

†W. B. PILLSBURY. *Essentials of Psychology*, N. Y., 1914. p. 198.

learner derives from practice is, in most cases, relatively much greater. The rapid learner is always found to be at a disadvantage when called upon to reproduce freely without re-learning.**

These statements of Meumann are an illustration of the doctrine of compensation which have been widely voiced by German psychologists. The belief in negative correlations between desirable traits, as the quotation well shows, has usually gone hand in hand with the attempt to classify individuals into types.

Thorndike, in his survey of correlational psychology, has vigorously assailed this doctrine:

"It should be noted that in original nature the rule is correlation, not compensation It is very, very hard to find any case of a negative correlation between desirable mental functions. Divergences toward what we vaguely call better adaptation to the world in any respect seem to be positively related to better adaptation in all or nearly all respects. And this seems especially true of the relations between original capacities."†

It is in connection with the relation of learning and retention, as measured by immediate and delayed recall, that much difference of opinion regarding correlation has arisen. A goodly number of researches have shown that much depends upon the method of testing recall; by choosing the method, one predetermines the result.**

In general these statements seem justified:

1. For this particular purpose, delayed recall should not be measured by relearning since the quicker learners, other things being equal, would excel, on that account, in the relearning test as well as in the original test.

2. The method of allowing the subject to complete the original learning by themselves—to report when they have "just learned it"—is faulty, since many really overlearn in various degrees the whole or, more often, certain portions. The test then, other things being equal, would show large differences depending on the amount of overlearning.

3. The method of giving a lesson which may be studied a given time, and by a standardized method, resulting in different amounts in immediate recall, seems preferable.††

*E MEUMANN. *Psychology of Learning*. 1913 trans. by J. W. Baird. pp. 169 ff.

†*Educational Psychology*, vol. III. p. 362.

**The most complete account of work on this question will be found in LYONS, D. O. "The Relation of Quickness of Learning to Retention," *Archives of Psychology*, No. 30, 1916.

††See LYON, *op. cit.* p. 16 ff.

Elementary school children (grades 3-8) served as subjects in the present study. The material was of two sorts, non-sense syllables and connected sense material in the form of biographies. The children worked in squads of about 8 each, the amount of material at each lesson being such that the best subjects could recall from 75-90% immediately. The tests with non-sense material were repeated by each subject on 5 different days; in the case of sense material 6 tests were given. For the series of tests with each material, a revolving schedule was employed which neutralized the effects of unequal difficulty of texts, fatigue, diurnal differences and the like. The measure for each individual was the sum of the scores from the 5 or 6 tests. Details with regard to materials and methods will be found elsewhere.*

The following table summarizes the schedules:

Grade	No. of Inds.	Material	No. of tests	Length of each test	No. of hours before reten- tion test
8	43	non-sense	5	9'	4
8	43	sense	6	9'	4
6	39	non-sense	5	9'	3
6	39	sense	6	9'	3
5	38	sense	6	9'	3
4	37	non-sense	5	9'	3
4	37	sense	6	9'	4
3	42	sense	6	7' 30"	3

The time of the study periods was kept constant (9 minutes), † the score being determined by the amount immediately recalled. Methods of study were defined, viz.: all must employ the "whole" method, first reading without attempted recall until, following a signal recall was employed as far as possible. Each student studied at his own tempo, and with or without inner speech as he chose. Retention was tested 3 or 4 hours later (always the same for a given class, of course) by simple recall in the case of nonsense syllables and by writing on the board names of the individuals whose biographies were studied to serve as a guide for recall in the case of the sense material.

**Recitation as a Factor in Memorizing*. Archives of Psychology, No. 40, 1917.

†Except for Grade 3 in learning sense material in which the period was 7' 30".

The coefficients of correlation were computed by means of the formula for rank differences:

$$\rho = 1 - \frac{6 \sum D^2}{n(n^2 - 1)}$$

From the values of ρ , the Pearson coefficient r was computed by

$$r = 2 \sin. \left(\frac{\pi}{6} \rho \right)$$

The coefficients of correlation between amount recalled immediately after the learning and amount recalled 3 to 4 hours later, are as follows:

Non-sense Syllables

8th Grade	-	+0.73 ± P. E.	0.04
6th Grad	-	+0.78 ± P. E.	0.04
4th Grade	-	+0.73 ± P. E.	0.05
Average		+0.7 ± P. E.	0.043

Sense Material

8th Grade	-	+0.81 ± 0.04
6th Grade	-	+0.86 ± 0.03
5th Grade	-	+0.79 ± 0.04
4th Grade	-	+0.89 ± 0.03
3rd Grade	-	+0.80 ± 0.04
—		
Average		+0.82 ± 0.036

The evidence is clear that a substantially positive correlation exists between amount recalled immediately and amount recalled 3 or 4 hours later. This has an interesting bearing upon practical affairs but, of course, it is by no means a solution of the relation between "quickness of learning" and "retentiveness." Native retentiveness and other factors being equal, those who recall more immediately after study would recall more after an interval.

Next, consider the correlation between amount recalled immediately and the *proportion of that amount* recalled after the interval. The coefficients of these correlations follow:

Non-sense Material

8th Grade—	+0.41 +P. E.	0.09
6th Grade—	+0.35 +P. E.	0.09
4th Grade—	+0.42 +P. E.	0.09
———		———
Average	+0.39 +P. E.	0.09

Sense Material

8th Grade—	+0.46 +P. E.	0.08
6th Grade—	+0.42 +P. E.	0.09
5th Grade—	+0.28 +P. E.	0.10
4th Grade—	+0.51 +P. E.	0.08
3rd Grade—	+0.40 +P. E.	0.09
———		———
Average	+0.41	0.09

While these coefficients are not as high as those obtained between amount recalled immediately and amount recalled after 3 or 4 hours, they are high enough and consistent enough to indicate a positive relation. It is my belief, after examining the original data in detail, that one factor has some potency in reducing the present coefficients toward zero. Some individuals *overlearn* certain portions of the material unnecessarily before learning other portions. This would, of course, reduce the total amount immediately recalled and thus move these subjects toward the lower end of the scale. The fact of overlearning, however, would, as regards *percentage recalled later* move them toward the upper limit in that respect, not because they possessed superior retentiveness in general, but because they *overlearned a little rather than just learned much*. The subjects were requested, of course, not to do this, and were required to study by the whole method, but there is certainty that several did overlearn considerably. This seems to be indicated by the fact that the coefficients (following section) of the *percentage* recalled after 3 or 4 hours with teachers' estimates of ability are less than the coefficients of *amount* immediately recalled or the *amount* later recalled with the teacher's estimates. Moreover, these coefficients are subject to another source of attenuation not found in the coefficient between amount immediately recalled and amount recalled later. Neither measure of recall is absolutely accurate, each being subject to various variable errors. When *amounts* are

correlated, the coefficient is subject to attenuation according to the unreliability of each individual's score in each of the two tests, *i.e.*, immediate test and delayed test. But the measure of proportion between the two is subject to the combined errors of both since it is a statement of relation between them. This means an increased attenuation of the coefficients between amount immediately recalled and the proportion of that amount later recalled.

Taking into account the two sources of additional attenuation found in the correlation between amount immediately recalled and the proportion of this amount later recalled, it appears that these coefficients fall considerably below the truth. I should estimate that the coefficients as given above should be raised by a fourth, giving an average coefficient for each kind of material of about +0.50.

CORRELATION OF IMMEDIATE AND DELAYED RECALL WITH TEACHERS' ESTIMATES OF GENERAL INTELLIGENCE

Teachers of the various grades tested furnished estimates of the general intelligence of their pupils. They used their own conception of "general intelligence" but were urged not to identify it with marks attained in class work and to disregard the pupil's age. The estimate of but one teacher was obtained for each group.

COEFFICIENT OF CORRELATION OF TEACHERS ESTIMATES WITH

	Immediate recall non-sense	Immediate recall sense	Delayed recall non-sense	Delayed recall sense	Percentage retained non-sense	Percentage retained sense
8th Grade	+0 55 P. E. 0 07	+0 55 P. E. 0 07	+0 44 P. E. 0 08	+0 50 P. E. 0 08	+0 43 P. E. 0 09	+0 45 P. E. 0 09
6th Grade	+0 60 P. E. 0 07	+0 54 P. E. 0 08	+0 57 P. E. 0 07	+0 56 P. E. 0 07	+0 40 P. E. 0 09	+0 50 P. E. 0 08
5th Grade		+0 53 P. E. 0 08		+0 59 P. E. 0 07		+0 48 P. E. 0 08
4th Grade	+0 14 P. E. 0 10	+0 28 P. E. 0 09	+0 30 P. E. 0 09	+0 19 P. E. 0 10	+0 21 P. E. 0 10	+0 28 P. E. 0 09
3rd Grade		+0 48 P. E. 0 08		+0 50 P. E. 0 08		+0 48 P. E. 0 08
Average	+0 43	+0 48	+0 44	+0 47	+0 35	+0 44

Correlations with teachers' estimates of general intelligence vary from +0.14 to +0.60, two-thirds of the coefficients falling between +0.40 and +0.60. The low values are nearly all produced by the 4th grade. For the other grades the central tendency is approximately +0.50. The different measures of recall correlate about

equally with estimated intelligence, the apparently low coefficients with *percentage recalled* being due to the greater attenuation which obtains in this measure, as just explained.

The findings here obtained are not in conflict with the results of most earlier studies, although some very different values varying from almost perfect to almost no correlations may be found. The median results are most numerous and support a prevalent opinion that (as the present findings indicate) immediate and delayed recall are positively but not perfectly correlated with general intelligence.

The following coefficients indicate the relation of results from the two forms of material used, *i.e.* unconnected non-sense and connected sense material.

	Immediate recall non-sense	Delayed recall non-sense
Immediate recall sense	8th = +0.57 ± P. E. 0 07	8th = +0 58 ± P. E. 0 07
	6th = +0 49 ± P. E. 0 08	6th = +0 48 ± P. E. 0.08
	4th = +0 47 ± P. E. 0 08	4th = +0 24 ± P. E. 0.09
Delayed recall sense	8th = +0 50 ± P. E. 0 08	8th = +0.54 ± P. E. 0.07
	6th = +0 46 ± P. E. 0.08	6th = +0 58 ± P. E. 0 07
	4th = +0 43 ± P. E. 0 09	4th = +0 25 ± P. E. 0 10

A positive correlation, large enough to bear some significance, exists between immediate recall of sense material and immediate recall of nonsense material and between delayed recall for the two materials, and likewise between immediate recall of one kind and delayed recall for the other kind of material. Psychologists, I venture to say, would expect a positive but far from perfect correlation (such as here shown) between such functions. These coefficients are about the same as those between any of the tests and a teacher's estimate of general intelligence or ability.

SUMMARY OF RESULTS

(1) A positive and high (0.73 to 0.89) correlation exists between immediate recall and delayed recall when both functions are measured by absolute amounts.

(2) A positive correlation of at least 0.50 exists between the two functions when immediate recall is measured in terms of absolute amount and delayed recall is given in terms of the proportional relation between the two.

(3) All tests of immediate or delayed recall show a correlation with teachers' estimate of general intelligence with a central tendency of about $+0.50$.

(4) Coefficients of approximately $+0.50$ are found between the various single tests for the two kinds of material, senseful and nonsense.

(5) The results so far as they go, give a clear confirmation of the contention that correlation rather than compensation is the rule. Meumann's belief that "the typically rapid learner is usually a rapid forgetter" and that "the typical differences persist no matter whether the material to be learned is of a significant or non-significant sort" finds no support in the data.