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RECALL IN RELATION TO RETENTION.

GARRY C. MYERS, PH.D.

Brooklyn Training School for Teachers

Experimental studies of the value of recall in the learning process have been made by E. E. Abbott¹, Katzaroff², Witasek³, and Knors⁴. These writers have been interested chiefly in the value of recall in the process of study, of learning a lesson, for example. Perhaps it is of equal importance to know what is the value of recall in relation to retention, i. e., after the lesson is learned what value has recall in retaining it? To find an answer to this question is the purpose of the following study.

Three hundred and thirty-two boys and girls of normal school, academy, and seventh and eighth grades were tested by the writer. As stimuli the following ten words were pronounced with regular tempo,—shovel, tongue, spool, kettle, feather, clock, pickle, dirt, grocer, onion. The subjects were made to believe it was a real spelling test. Each word was pronounced only once, and the records of those who did not get the words as pronounced were discarded. For the recalls the subjects were provided with a sheet of paper and, after labeling it, were surprised by the request to write as many of

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¹*On the Analysis of Recall in the Learning Process.* Psychol. Rev., Monograph Supplement, XI, No. 1 (1909).

²*Le rôle de la récitation comme facteur de la mémorisation.* Arch. de Psychol., VII, pp. 225-253 (1908).

³*Über Lesen und Rezitieren u. s. w.* Zeitsch. f. Psychol., XLIV, pp. 161-185 (1907).

⁴*Experimentelle Untersuchungen über den Lernprozess.* Archiv. f. d. gesamte Psychol., XVII, pp. 297-361 (1910).

the words they had previously spelled as they could remember. (No directions as to order were given). Three minutes were given for all the recalls. The whole experiment was conducted closely after the method used in my study of *Incidental Memory*. This method was successful in throwing the subjects off their guard, making them believe that each recall was the last one. Therefore there was little danger of promiscuous recalls. After each recall no opportunity was given to check up results, and during the intervals before recalls (excepting the recalls after three weeks) all subjects were kept busy with their regular work. Two groups from each grade were tested for the purpose of comparison. Four series of tests were made on the following groups:

Juniata Academy.

1. Recall after thirty minutes.
2. Immediate recall and recall after thirty minutes.
3. Immediate recall, recall after five minutes and recall after thirty minutes.

Tyrone, Seventh and Eighth Grades.

1. Recall after one hour.
2. Immediate recall and recall after one hour.

Huntingdon, Seventh and Eighth Grades.

1. Immediate recall and recall after three weeks.
2. Immediate recall, recall after one hour and recall after three weeks.

Normal School.

1. Immediate recall and recall after three weeks.
2. Immediate recall, recall after five minutes and recall after three weeks.

TABLE I

JUNIATA ACADEMY

Group No Subj. No. Words	MALES									FEMALES									M. & F.		
	Immed.			After 5 Min.			After 30 Min.			Immed.			After 5 Min.			After 30 Min.			After 30 Min.		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	(11)	(8)		(11)	(2)	(3)	(11)	(8)	(17)	(12)	(8)		(12)	(2)	(3)	(12)	(8)	(17)	(23)	(16)	(34)
10	..	..	.	..	..	..	3	..	.	..	.	.	1	..	.	6	.	..	9	..	..
9	1	..	..	1	..	..	..	..	..	..	..	..	2	..	..	2	1	..	2	1	..
8	..	1	.	1	..	..	..	2	1	3	..	..	3	.	..	2	3	..	2	5	1
7	3	1	.	3	..	..	2	2	2	3	1	.	4	.	..	1	1	6	3	3	8
6	3	2	.	3	.	..	6	1	5	1	2	..	1	.	..	1	2	4	1	3	9
5	3	3	..	2	..	..	..	1	3	5	3	..	1	.	..	.	1	5	.	2	8
4	.	.	..	.	.	..	..	2	5	.	2	..	..	..	.	..	..	2	.	2	7
3	1	1	.	1	.	..	..	..	..	..	.	..	..	..	..	..	.	..	..	..	1
2	..	..	.	..	.	..	..	.	1	..	.	.	..	.	..	..	.	.	..	..	.
1	.	.	.	.	.	..	..	.	..	..	..	.	..	.	..	..	.	.	.	..	.
0	.	..	..	.	..	..	..	..	..	..	..	..	..	..	..	..	..	.	.	.	.
Per Cent.	60	56.2		62.7	..	..	72.7	61.2	52.3	63.3	52.5	..	75.8	..	..	89.2	71.2	58.2	81.3	66.2	55.3

TABLE II

TYRONF. 7TH AND 8TH GRADES

Group No. Subjects No. Words	MALES				FEMALES				M. & F.			
	Immed.		After 1 Hour		Immed.		After 1 Hour		Immed.		After 1 Hour	
	1 (24)	2	1 (24)	2 (28)	1 (41)	2	1 (41)	2 (30)	1 (65)	2	1 (65)	2 (58)
10	..	.	..	..	..	..	2	..	..	..	2	..
9	..	.	1	..	1	..	11	..	1	..	12	..
8	2	.	5	..	5	..	11	..	7	..	19	..
7	8	.	6	2	7	..	8	2	15	..	14	4
6	8	.	2	3	19	..	6	2	27	..	8	5
5	4	.	6	4	5	..	3	10	9	..	9	14
4	2	.	2	7	4	.	.	7	6	..	2	14
3	..	.	2	9	..	..	..	8	..	.	2	17
2	..	.	..	3	..	.	.	1	..	..	..	4
1	..	..	..	..	..	.	.	..	..	..	..	..
0	..	..	..	..	..	..	..	..	..	..	..	..
Per Cent.	61.7		61.2	40.4	61.7		76.6	43.3	61.7		70.3	41.9
By 7th Gr.	58.3		52.5	37.5	59.4		69.4	41.2	58.9		62.2	39.6
By 8th Gr.	65		70	42.5	73.2		81.2	45.7	70.5		77.3	44.0

Tables I, II, III, and IV show the comparative records for the recalls after the various intervals of time. The vertical column of figures to the left in each table indicates the number of words recalled. The figures in parenthesis near the top of the tables give the number of subjects. Above them are the group numbers. The bottom horizontal row shows the total per cent. of recall, i. e., of the whole number of stimulus words. The other figures in vertical columns indicate the number of subjects who recalled each word. In Table I for example, we read under "Males", Group 1, of "Immediate Recall", "1 recalled 9 words; 3, 7 words; 3, 6 words; 3, 5 words; and 1, 3 words." The position of the group numbers and columns indicate that group number one recalled the words immediately after the stimuli were given, after five minutes and after thirty minutes; group number two, immediately and after thirty minutes, group number three, only after thirty minutes.

The results for final recall are best with two intervening recalls, and for only one intervening recall much better than for none. The gain by the five minute over the immediate recall is noticeably greater in its effect on the final recall, than the gain of immediate recall over no intervening recall. This is especially true for girls, whose figures give 89, 71, and 58 per cent. for final recall after two, one and no intervening recalls.

TABLE III

HUNTINGDON. 7TH AND 8TH GRADES.

Group No. Subj. No. Words	Immed.		MALES After 1 Hour		After 3 Weeks		Immed.		FEMALES After 1 Hour		After 3 Weeks		Immed.		M. & F. After 1 Hour		After 3 Week*	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	(23)	(16)*	(23)		(20)	(25)	(32)	(11)*	(32)		(32)	(27)	(55)	(27)	(55)		(52)	(52)
10	..	..	..	..	..	.	..	..	..	.	..	.	..	..	..	..	..	.
9	..	.	1	.	..	..	.	..	1	.	..	.	..	..	2	.	..	.
8	1	..	..	.	1	.	1	..	2	.	.	.	2	..	2	.	1	.
7	2	..	3	.	..	.	3	2	5	.	3	..	5	12	8	.	3	.
6	2	6	7	.	3	2	10	1	10	.	9	7	12	7	17	.	12	9
5	9	5	6	.	4	5	5	4	3	.	8	6	14	9	9	.	12	11
4	9	4	4	.	5	8	10	3	7	.	3	4	19	7	11	.	8	12
3	..	1	2	.	4	6	2	1	3	.	5	7	2	2	5	.	9	13
2	..	..	..	.	2	3	1	..	1	..	2	2	1	..	1	.	4	5
1	..	..	..	.	1	..	..	.	..	.	1	1	..	..	.	.	2	1
0	.	..	..	.	..	1	..	.	..	.	1	..	.	..	..	.	1	1
Per Cent	50	50	53.9		41.5	37.2	50.6	50	54.4		45.9	42.2	50.4	50	51.2		44.4	39.8

*Record for 7th grade lost.

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TABLE IV.
C. V. S. N. S.

Group No.	FEMALES					
	Immed.		After 30 Minutes		After 3 Weeks	
Subjects....	1 (16)	2 (16)	1 (16)	2	1 (16)	2 (16)
No Words						
10	..	..	..	..	1	..
9	1	..	1	..	..	..
8	2	1	2	..	..	1
7	1	7	3	.	1	1
6	7	4	8	..	3	6
5	4	3	1	..	4	2
4	1	1	1	..	4	4
3	..	..	.	..	1	1
2	..	..	..	..	2	1
1	.	..	..	..	..	..
0	..	..	..	..	..	..
Per Cent	61.2	62.5	64.4	..	48.7	51.2

The girls show a higher total gain as a result of the intervening recalls. For the boys the corresponding figures are 73, 61, and 52. The tables of frequency show very clearly the effect of the recalls upon retention. (See "After 30 minutes" for males and females combined.) The modes for each final recall are at 10, 8, and 6 respectively.

Table II gives the results for final recall after one hour, with and without immediate recalls, for the seventh and eighth grades combined. Here the total percentages show a strong gain in efficiency after one hour, as a result of immediate recall. As found above the gain for girls is greater than that for the boys, and their general efficiency is better. This is also obvious in the tables of frequency. The last two horizontal rows of figures at the bottom of the table give the total percentages for each of the seventh and eighth grades. The same tendency is shown for the respective grades, but the efficiency of the eighth grade is constantly better than for the seventh grade.

The effect of intervening recalls upon retention when the final recall was taken after three weeks, and the intervening recalls were taken immediately and after one hour respectively, is much less obvious than in tests where the final recalls were made after one hour and after one-half hour. (Compare Tables I and II with III.) While the total record for the two

groups, each of 52 girls and boys (Table III), shows a gain of only about 4½ per cent., the frequency tables make the difference more evident.

The two groups of normal school students (Table IV) with immediate recall and recall after 30 minutes, show, after three weeks no gain as a result of a 30 minute recall added to an immediate recall, but rather indicate a slight loss. The writer hazards no explanation, but simply suggests that since these are the only groups tested in which the group to be tested had a chance to communicate with the group already tested (the opportunity here possible during exchange of classes), some duplicate answers might have been given by the second group. Of course this difficulty was not at all present with the other groups. Assuming that all conditions were perfect, it is probable that with this group as well as with the Huntingdon group, the disturbing element of having a second recall unexpectedly, thereby causing a state of confusion, may contribute less to a recall after three weeks than it hinders, for here complexity would confuse after the second recall rather than clarify.

TABLE V

HUNTINGDON AND TYRONI.

	Immed. Recall			After 1 Hour			After 3 Weeks		
	Males (63)	Females (84)	M. & F. (147)	Males (75)	Females (103)	M. & F. (178)	Males (45)	Females (59)	M. & F. (104)
10	..	..	..	..	2	2	..	..	..
9	..	1	1	2	12	14	..	..	..
8	3	6	9	5	13	18	1	..	1
7	10	12	22	11	15	26	..	3	3
6	16	30	46	12	18	30	5	16	21
5	18	14	32	16	16	32	9	14	23
4	15	17	32	13	14	27	13	7	20
3	1	3	4	13	11	24	10	12	22
2	..	1	1	3	2	5	5	4	9
1	..	..	..	..	..	..	1	2	3
0	..	..	..	..	..	..	1	1	2
Per Cent.	54.4	56	55.3	51.2	60.0	56.3	39.1	44.2	42.0
A. D. in words	.98	1.04	10.5	1.40	1.65	1.64	1.11	1.67	1.37

Table V gives the combined records of those groups of the two schools to which were given the same time intervals for recall.⁶ All those recorded "After one hour" had "Imme-

⁶The larger number of subjects for recall after one hour is due to the fact that the records for immediate recall by the seventh grade were lost.

mediate Recall", and all "After three weeks" had recall "After one hour." The total percentages show a slight loss for boys and a gain for girls after one hour. The decided loss shown after three weeks is greater for the boys than for the girls. Between records for "One hour" and "Three weeks" the opposite is true. The girls are noticeably superior to the boys and their mode is one degree higher, for each period of time. For immediate recall and recall after one hour, the mode for the boys is at 5, for the girls at 6. After three weeks it is at 4 and 6 respectively. The average deviation from the mode is consistently greater for the girls than for the boys.

A study was made of a comparison of the individual records for first, second and third recalls by 120 boys and girls of the seventh and eighth grades.

First Recall minus Second Recall.

(47 boys)	(73 girls)
21 plus cases	45 plus cases
14 minus cases	12 minus cases
12 like cases	16 like cases
C.E.+2 words	C.E+.97 words

This means e. g. that for the boys 21 gave more words in the second recall (after one hour) than in the first (immediate recall), 14 gave less and 12 gave the same number, with an average of two-tenths of a word more in the second than in the first recall. The superiority of the girls is obvious.

Second Recall minus Third Recall.

(20 boys)	(32 girls)
3 plus cases	3 plus cases
11 minus cases	17 minus cases
6 like cases	12 like cases
C.E.—.95 words	C.E.—.78 words

In 76 per cent. of the (120) cases the words which were given in the second recall appeared also in the first recall—for boys 81, for girls 73.8 per cent., and in a total of 75.7 per cent. of

the cases the words given in the third recall were present in the second recall—boys 85.3, and girls 70.5 per cent.

On the other hand, of the 47 boys, 18, or 38 per cent. had in the second recall only words which were included in the first recall. Eighteen added 1 correct word, 6 added 2 words, 4 added 3 words, 1 added 5 words. For example 18 gave 1 correct word which was not included in the first recall. Of 73 girls, 13, or 18 per cent. had in the second recall only words which were included in the first recall. Eighteen added 1 correct word, 25 added 2 words, 13 added 3 words, 4 added 4 words.

Of 20 boys, 12 had in the third recall only words which were included in the second recall. Five added 1 correct word, 2 added 2 words, 1 added 3 words. Of 32 girls, 7 had in the third recall only words which were included in the second recall. Thirteen added 1 correct word, 6 added 6 words, 5 added 3 words, 1 added 4 words.

While there is a high degree of consistency in the successive recalls it is remarkable that so many words appear in subsequent recalls which were not in the preceding recalls. Perhaps such words were just on the threshold of consciousness during the preceding recalls or were blocked by interfering associations. It is obvious that the girls do not carry over from the first to the second and third recalls as many words as the boys, but are more likely to substitute words not given in the first recall. It would seem from this that the boys are more consistent than the girls. A Pearson coefficient of correlation between the first and second recalls was computed for the 73 girls with a result of $+0.71$. This means that the individuals who answered well in the first recall could be expected to do well in the second recall and those who did poorly in the first recall, poorly in the second recall.

CONCLUSION.

There is a decided gain in final recall as a result of intervening recalls without re-presentation of the stimuli, and this gain is greater for a 5 minute recall than for an immediate recall. The effect of intervening recall is very much greater when the final recall is taken after 30 minutes or one hour

than when taken at the end of three weeks. The gain by the girls is greater than that by the boys, and their general efficiency is higher.

AN ADDED EXPERIMENT.

The following experiment illustrates how the relation of recall to retention may be studied in a very practical way. Two prose readings, one of 464 words, the other of 1242 words, were learned for the first time by a lady student* of my class of College Seniors in Psychology, and recited before the College Literary Society. The shorter one was recited two weeks before the longer one; each was recited successfully and was prepared within a few days before recitation. Having learned that this student had recited these selections, the writer asked her one week after the last one was recited to recall the last selection. She recalled it perfectly. Then she recalled it at the end of each of seven successive weeks. She made no other recalls of it in the meanwhile, nor did she see the original. At the end of the seven weeks she was still able to recall it *verbatim*. Seven weeks after the learning of the first selection it was recalled (no intervening recalls). The subject in the meantime did not know this selection would be called for. Only 200 of the 464 words were recalled. In this reading the first and last parts were remembered best.

Thus we find that the longer selection, recalled on seven successive weeks after it was learned, was remembered perfectly while more than half the shorter selection, which had no intervening recalls was forgotten.

PEDAGOGICAL SIGNIFICANCE.

Much has been written about the value of the proper presentation of the stimuli (lesson) and about the value of the recitation as a means to aid the child properly to interpret and learn the stimuli. There is a third purpose in the process of education which is too much ignored, namely, to help the child retain what he has learned.

Simple recall of stimuli wholly or partially learned aids in their retention. Teachers and pupils would profit greatly by

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*Miss Margaret Griffith.

frequent recalls of things they have learned, while the material is fresh in mind, rather than have long and arduous reviews that require an extensive re-study of the material once learned. There should be more frequent but shorter reviews, reviews that demand little or no extra study, but a recall of materials already learned. It is often the custom in our secondary schools and colleges to give examinations after long intervals of one, two, three or more months. The students often go through cruel and torturous processes of cramming and after the examination is over are happy to forget about what they learned. A five or eight minute test given unannounced, demanding recall of the things recently learned, as well as those more remotely learned, with a final survey-test of the whole field studied, will aid the student to master a subject with little or no conscious effort at re-study. In fact this would be merely an application of the laws of apperception in the process of learning.

Some educators have courted wide applause by denouncing examinations as foolish, impractical, ineffective and barbarous. Examinations that put the emphasis on measuring what a pupil knows, that induce children to worry and become nervous, examinations that put a premium on cramming, admit of criticism. Not the principle of examination but its method is at fault. The true purpose of the examination is to compel reorganization and recall of things already learned. From the "measuring" viewpoint the examination naturally comes at long intervals for convenience to the examiner and consequently the teacher feels that the examination must be long and comprehensive. The field covered is covered for all time. From the viewpoint of recall, the field is never covered, the student always feels responsible for all he has learned. He does not have to go through a cramming process once every month or half year. He must always be ready; examinations are brief experiences to which he habituates himself.

Life demands constant recall of a part or of all of one's experience, at irregular intervals and seldom with much warning. Life demands, moreover, quick recall of one's best experiences immediately to solve situations that come unannounced.

The discipline that comes from definite recall on short notice develops habits of quickly marshalling one's mental forces and necessarily makes one constantly mindful of the fact that what one learns will have to be learned not merely for one occasion, not merely for one recitation, or for one examination but for times whose number will depend upon the variety of experiences and the length of one's life.

Every possible incentive for the pupil to recall in his study and recitation should be afforded by the teacher. In the grades each study should be so presented as to compel the student to recall again and again what he has learned not merely of any one particular study but in so far as possible what he has learned of every other study.

Ideal methods may be at the hand of the teacher but it is a fact too evident that the teacher is generally handicapped by poor text books and most teachers follow the text almost entirely. Surely the value of recall has not been duly recognized by writers of text books.

Some recent spellers have been carefully written observing the value of recall as applied to the spelling per se. Perhaps no speller has been written wholly applying the value of recall in relation to other studies. The speller should be so constructed and the curriculum so outlined that each spelling lesson the pupil studies will deal with words used at the same time in his English, History, Geography, etc. Thereby the use of words in one subject will necessarily recall the words used in other subjects. In short, the ideal course of text books for any given school would be such that the things learned in each subject will have to be recalled in as great measure as possible in the study of any other subject.

Finally, the curriculum should be so arranged that not merely while the student deals with books will he be compelled to recall what he has previously learned, but also later in life. However, life does not tend to fit the curriculum. The curriculum will have to fit life. No incentive to recall can be so great as the natural life incentives. Let the curriculum be such that life will constantly make the student recall what he has learned in school and that the school will compel the student constantly to recall life's experiences.