

AN INVESTIGATION OF THE PHENOMENON
OF REMINISCENCE IN
MOTOR LEARNING

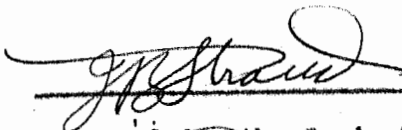
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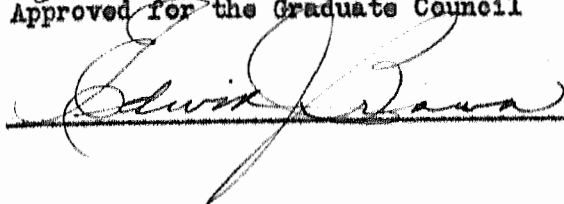
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INTRODUCTION

Statement of the Problem. The primary purpose of this study is to investigate the phenomenon of reminiscence in motor learning. Reminiscence is defined, in this paper, as the "improvement in the ability to execute incompletely learned acts of skill after an interval of time without intervening formal practice." Although many types of learning experiments with verbal materials have yielded reminiscences, not a great deal of attention has been given to the specific investigation of this phenomenon in the field of motor learning.

An incidental aim of this study is to determine the extent to which acquisition of skill with the preferred hand improves or impairs the ability for the same act of skill with the non-preferred hand.

Review of Related Investigations. Numerous investigations have been made relative to the retention of ideational and motor material which have shown that initial forgetting is relatively rapid and that the rate becomes progressively slower with each successive interval. Retention may be defined as the perseverance of impressions over an interval of time. The opposite tendency, which is the loss of impressions, is forgetting. The first systematic studies of forgetting was published by Ebbinghaus in 1885. He measured the time it took one person to relearn a series of nonsense syllables. His method consisted in presenting a list of nonsense syllables to be memorized, and in determining the time, or the number of readings, required to so learn the list that it could be recited without error. He found that it took 42 per cent as much time to relearn the syllables after 19 minutes as to learn the series in the first place, 56 per cent as much time after 63 minutes and

64 per cent as much time after 8 3/4 hours. If retention is measured by the percentage of the original time which is saved in relearning, the following table shows the loss of retention after varying time intervals.

TABLE I
SHOWING THE LOSS OF RETENTION AFTER VARYING
TIME INTERVALS

Time Elapsed Since Original Learning	Percentage of Retention
20 minutes	58
1 hour	44
8.8 hours	36
24 hours	34
48 hours	28
6 days	25
31 days	21

Radosavljevich¹ in a similar experiment, although he required the lists of nonsense syllables to be studied till two successive perfect recitations could be made, found the loss of retention to be not quite so rapid. He found also the loss of retention for meaningful material (poetry) to be less than for nonsense syllables. Ebbinghaus found, even after a period of twenty-two years, a perceptible retention of stanzas of poetry learned to the point of one perfect recitation, and never since seen.

The phenomenon of relatively slow forgetting for acts of skill has long been recognized and validated by many investigators. In some cases actual improvement, or reminiscence, has occurred which would be in accord with

¹ R. F. Radosavljevich, cited by E. O. Finkenbinder, "The Curve of Forgetting," American Journal of Psychology, 24:8-32, 1913.

William James' doctrine that "we learn to skate during the summer, and learn to swim during the winter."

In a motor learning experiment in 1903, using ball-tossing as the activity, Swift² found no deterioration when the subjects were retested every 30 days for five consecutive months. In fact, instead of being a forgetting curve it turned out to be a new curve of learning though the subjects did not touch the balls during the interval. In a retest made in 1904, one year and two hundred and seventy-five days after the close of the original learning series, no loss of skill was found. In a final test in 1908, six years and seventeen days after the conclusion of the experiments by which the skill was first acquired, he found that while much of the acquired skill had been lost, the process of relearning was rapid. Eleven days were required to regain the skill which in the earlier work had required forty-two days of practice. He says in part:

These results would seem to indicate a saving of time and effort by occasional and somewhat prolonged intermissions in the work upon a topic of study, at least after a certain proficiency has been gained. The length of time which may profitably intervene will vary no doubt with different kinds of subject matter and with the age of the pupil, but evidently the mind continues its activity, for a time, in the furtherance of a learning process after practice and study have ceased.

Book,³ in a typewriting experiment, using one subject for the study, found after a 4 1/2 month rest-period a loss of only 75 strokes and an increase of 1.33 per cent in errors. After an interval of one year the subject

² E. J. Swift, "Complex Motor Acts," American Journal of Psychology, 16:131-33, 1905. "Relearning a Skillful Action: An Experiment in Muscular Memory," Psychological Bulletin, 7:17-19, 1910.

³ W. F. Book, The Psychology of Skill, (New York: Gregg Company, 1925), pp. 1-114.

was retested and found to have gained a total of 178 strokes and decreased his errors by a small fractional amount. Book explains this gain not as reminiscence but as "the disappearance with the lapse of time of numerous psycho-physical difficulties, interfering associations, bad habits of attention, incidentally acquired in the course of learning, which as they fade, leave the more firmly established typewriting associations free to act."

Freeman and Abernathy,⁴ in a typewriting-substitution experiment, compared the retention of motor habits with ideational habits. Their findings showed that after a 2-week interval retentive ability was practically the same for both methods, but that after a time interval of 10 weeks the motor method was superior.

The phenomenon called reminiscence was named by Ballard⁵ in 1913, although it had been noted earlier by other investigators. Pyle and Snyder,⁶ Norsworthy,⁷ Myers,⁸ and Winch,⁹ are among the early experimenters who had

⁴ F. N. Freeman and E. Abernathy, "New Evidence of the Superior Retention of Typewriting to That of Substitution," Journal of Experimental Psychology, 23:531ff. 1932.

⁵ P. B. Ballard, "Obliviscence and Reminiscence," British Journal of Psychology Monograph Supplement, 1:1-82, 1913.

⁶ W. H. Pyle and J. C. Snyder, "The Most Economical Unit for Committing to Memory," Journal of Educational Psychology, 2:133-142, 1911.

⁷ Naomi Norsworthy, "Acquisition as Related to Retention," Journal of Educational Psychology, 3:214-218, 1912.

⁸ G. C. Myers, "Recall in Relation to Retention," Journal of Educational Psychology, 5:119-130, 1914. "Confusion in Recall," Journal of Educational Psychology, 8:116-75, 1917.

⁹ W. H. Winch, "Should Poems Be Learnt by School Children as 'Wholes' or in 'Parts'," British Journal of Psychology, 15:64-79, 1924.

incidentally noted the phenomenon.

In a number of experiments on children 12 years of age, Ballard secured an average retention curve that rises during the first two days to a higher point than the immediate recall level. The curve then begins a slow gradual decline. In the following figure the immediate recall level is considered 100 per cent retention. In the delayed recall retention was more than 100 per cent because the average group retention score in terms of lines reproduced exceeded the average score made by the group in the immediate recall. Per cent

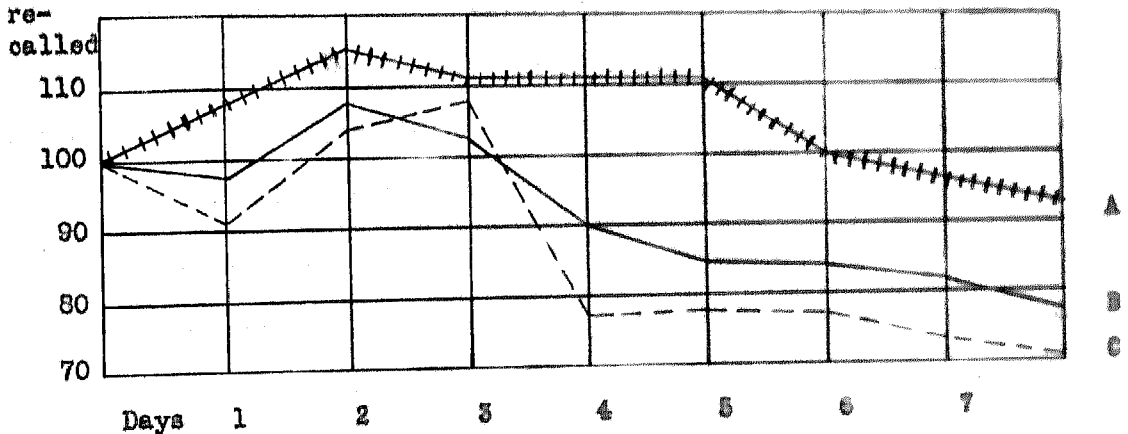


Figure 1. Memory Curves of 12-Year-Old Children¹⁰
 A. Wreck of the Hesperus
 B. Ancient Mariner
 C. Nonsense Syllables

Several possible explanations have been advanced for this phenomenon by Bills.¹¹ In the first place, poetry learning is not identical with nonsense syllable learning in that with the former the subject may utilize the

¹⁰ Ballard, *op. cit.*, p. 5.

¹¹ A. G. Bills, *General Experimental Psychology*. (New York: Longmans Green and Company, 1935), Chapter XV.

factors of rhyme and rhythm in recalling it. This also might introduce a practice effect, as the subject might unthinkingly rehearse it during the rest interval. Ballard attempted to control this, however, by giving the children no intimation that a second recall would be asked of them, and by selecting children from schools in widely scattered sections.

Second, there is a possibility that poetry is unique material. The curves in Figure 1 show the apparent differences for the various materials used in the study. While Ballard secured reminiscence only with poetry and nonsense verse, both Brown¹² and Nicolai¹³ obtained the phenomenon with such disconnected materials as geographical names, familiar objects, and abstract words. There is, therefore, no concert of opinion among the writers regarding the phenomenon as a function of the kind of material used.

There is evidence that only partial learning is an essential condition for the appearance of the phenomenon, as opposed to the Ebbinghaus curve which was based on complete learning and could not possibly show reminiscence. Ballard's conclusion that reminiscence is a function of the age of the subjects has not been corroborated by the studies of Brown¹⁴ or Nicolai¹⁵ as both obtained reminiscence using adult subjects.

12 Warner Brown, "To What Extent is Memory Measured by a Single Recall," Journal of Experimental Psychology, 6:377-82, 1923.

13 Friedrich Nicolai, cited by G. O. McGeoch, "The Conditions of Reminiscence," American Journal of Psychology, 47:68-69, 1936.

14 W. Brown, op. cit., pp. 377-82.

15 F. Nicolai, op. cit., pp. 68-69.

In a similar experiment in 1926, Williams¹⁶ corroborates Ballard's findings and concludes as follows:

(1) The phenomenon of reminiscence is a function of the age of the subjects and also of the material memorized. The degree of reminiscence is slightly dependent on the method of scoring. With a given age group the greatest amount of reminiscence is exhibited by the poorest learners.

(2) The degree of retention for all age groups is a function of the material.

(3) For certain materials the degree of retention is inversely related to the age of the subjects; but for other materials it is independent of age.

(4) Within each age group the degree of retention is inversely related to the amount learned and directly related, for certain materials, to the age of the subjects; while for other materials the degree of retention bears no definite relationship either to age or the degree of learning.

(5) The relation of age to the retention of poetry varied with the method of scoring. Partial learning is obviously one of the essential conditions of the phenomenon of reminiscence.

McGeoch,¹⁷ in 1934, in a study designed to repeat Williams¹⁸ experiment concerning the effect of review upon reminiscence, found that this phenomenon occurs independently of casual revival or intentional review. It, therefore, is a valid phenomenon accompanying disuse. Summarizing the experimental data as a result of this and other investigations McGeoch makes the following conclusions:

(1) Reminiscence is probably a much more widely prevalent phenomenon than is revealed by many experiments on retention the results of which are in terms of the average scores of the whole group, which

¹⁶ Osborne Williams, "A Study of the Phenomenon of Reminiscence," Journal of Experimental Psychology, 9:368-87, 1926.

¹⁷ Grace O. McGeoch, "The Conditions of Reminiscence," American Journal of Psychology, 47:68-89, 1935.

¹⁸ O. Williams, op. cit., pp. 368-87.

scores are inadequate and equivocal measures of reminiscence. The percentages of subjects exhibiting reminiscence and the amount shown by them are adequate and valid measures of reminiscence.

(2) Whether the immediate recall is an essential factor in determining reminiscence has not yet been determined.

(3) The factors of age, sex, intelligence, and familiarity of the learning material have not been demonstrated to affect reminiscence.

(4) The data do not permit formulations of the precise relationships between reminiscence and the nature of the material, the time interval, or the method of learning.

In a recent study the purpose of which was to discover whether reminiscence occurred in maze learning with kinder-garten children, the same writer¹⁸ found no consistent or reliable evidence of reminiscence being present in maze learning by pre-school children. However, from this single experiment it would be unsafe to assume that all acts of skill are not affected by reminiscence.

McGeoch found also that the same subjects did not exhibit evidence of the constancy of the phenomenon in a given learner,¹⁹ that is, some subjects were not reminiscers and others non-reminiscers. According to McGeoch, this seems to suggest that reminiscence is determined more by the conditions under which learning takes place than by the learners.

The studies listed above do not cover the entire field of experimental work which has been done in relation to this learning phenomenon, but they can be considered as the most significant on the subject of the susceptibility of learning to reminiscence.

¹⁸ Grace O. McGeoch, "Reminiscence in Maze Learning by Kindergarten Children," Journal of Genetic Psychology, 50:171-186, 1937.

¹⁹ Grace O. McGeoch, "The Age Factor in Reminiscence: a comparative study of pre-school children and college students," Journal of Genetic Psychology, 47:98-120, esp. 107-108. 1935.

PROCEDURE

Apparatus. The apparatus for this experiment consisted of an oblong wooden cup 2 1/2 inches deep and 1 1/8 inches in diameter, mounted on a stick 12 inches in length. At the base of the cup was attached a string 18 inches long, on the end of which was a round wooden ball. A rough sketch of the apparatus is shown on page 33 of the Appendix.

Task. The subjects were instructed to grasp the stick in the preferred hand near the end opposite the cup. By holding the stick in a horizontal position the ball on the string would hang suspended a few inches from the floor. The learning task consisted of manipulating the apparatus in such a manner so that the ball could be swung into the air high enough to be caught in the cup attached to the stick.

Subjects. The subjects were forty-one students selected at random from the Elementary School and the advanced psychology classes of the Kansas State Teachers College of Emporia. The twenty subjects selected from the Elementary School included children ranging in age from nine to eleven years inclusive. The twenty-one adult subjects were between the ages of twenty and twenty-seven years.

Method. With the exception of the first day, the daily learning period consisted of 50 trials with the preferred hand. These 50 trials were divided into five equal parts, and scored according to the percentage of accurate catches made in each ten trials. The adult subjects were given twelve daily practice periods, excluding Sundays, and for the children the practice period extended over a 5-day interval. On the beginning day of the experiment, each subject was given 30 trials with his non-preferred hand before beginning the

regular practice with the preferred hand. Then on the final day each individual was given a 30-trial retest with the non-preferred hand in order to ascertain the extent to which skill acquired with one hand transfers to the opposite hand which had had no training for this act.

Subjects were retested for retention of motor skill after a 24-hour interval, a 48-hour rest interval, a 7-day interval, a 3-week interval, and a 7-week interval. The phenomenon of reminiscence was assumed to be present when a subject made a higher percentage of successful catches after any rest period than he had scored on the last day of the regular practice period. For an adequate measure of reminiscence the percentage of subjects exhibiting the phenomenon and the amount shown by them was used. Retention in terms of the average score of the group has also been computed, although the phenomenon is probably more prevalent than these data reveal.

Controls. Individual experiments were conducted throughout by the writer. The same experiment room was used for each day's practice by the adult subjects, and a similar room was used at the Elementary School for the children. Conditions, such as the amount of light, heat, and ventilation in the practice room, as well as the time of day for practice, were kept constant. All subjects were urged at the beginning of each day's practice period to attempt to surpass his previous day's score. No other form of motivation was used in the experiment. Unsupervised practice during the several rest periods was not permitted or possible, as the writer requested each subject to refrain from any ball-catching activity during the course of the investigation, even if an apparatus similar to the one used were available.

RESULTS AND DISCUSSION

In order to investigate the susceptibility of motor learning of a particular type, as used in this experiment, to the phenomenon of reminiscence, retests for the retention of skill were given each subject after varying time intervals. The data listed in Table II show the number of subjects exhibiting the phenomenon, the percentage of subjects affected, and the amount of reminiscence¹ exhibited by adults and children after a 24-hour intermission from practice. At this point the adults had had 12 daily practice periods, and the children five.

¹ Amount (or degree of) reminiscence is found by taking the scores of those making a gain after a rest interval, averaging these scores on the last day of the regular practice period and also on the retest, and subtracting the former from the latter, in order to get the amount gained. This number is then divided by the average score made on the last regular practice in order to find the percentage of gain or amount of reminiscence. For instance, if the adults who showed reminiscence had an average score of 45.2 on the last regular daily practice, and an average score of 57.1 after the 24-hour interval, then by subtracting the former from the latter the amount of gain is found to be 11.9. Dividing this number by 45.2 the percentage of increase or amount of reminiscence is found to be 24 per cent.

TABLE II

SHOWING THE NUMBER AND PERCENTAGE OF SUBJECTS AFFECTED, AND THE AMOUNT OF REMINISCENCE EXHIBITED BY ADULTS AND CHILDREN AFTER A 24-HOUR TIME INTERVAL

Subjects	No. of Cases	Number Showing Reminiscence	Percentage of Subjects Exhibiting Reminiscence	Amount of Reminiscence Shown
Adults	21	13	.62	.19
Children	20	13	.65	.28
Men	9	5	.56	.09
Boys	8	5	.63	.30
Women	12	8	.67	.26
Girls	12	8	.67	.34

Read table thus: Thirteen of the 21 adults, or 62 per cent of the group, exhibited the phenomenon of reminiscence to the extent of 19 per cent.

An examination of the data in Table II indicates that while approximately the same percentage of adult subjects and children showed reminiscence, the children exhibited a greater degree of the phenomenon than did the adults. Further examination will reveal that there is a considerable difference existing in the amount of reminiscence exhibited by the men and the boys. While the men subjects showed a 9 per cent increase in skill acquisition, the boys made a gain of 30 per cent. To a lesser extent, the girls have an advantage over the women subjects concerning the amount of reminiscence shown after this rest interval.

Table III shows the number of subjects, the percentage of subjects affected, and the amount of reminiscence exhibited by adults after a 48-hour time interval.

TABLE III

SHOWING THE NUMBER AND PERCENTAGE OF SUBJECTS AFFECTED, AND
THE AMOUNT OF REMINISCENCE EXHIBITED BY ADULTS
AFTER A 48-HOUR TIME INTERVAL.

Subjects	No. of Cases	Number Showing Reminis- cence	Percentage of Subjects Exhibiting Reminiscence	Amount of Remi- niscence Shown
Adults	21	14	.67	.28
Men	9	7	.78	.11
Women	12	7	.58	.38

Read table thus: Fourteen of the adults, or 67 per cent, exhibited the phenomenon of reminiscence to the extent of 21 per cent.

From the data in the table above, it is interesting to note that, although a greater percentage of the men than women exhibited reminiscence, the amount shown by the women was three times as great as that shown by the men.

The data given in Table IV show the number of subjects exhibiting reminiscence, the percentage of subjects showing it, and the extent to which these individuals increased in retention of motor skill after a period of 7 days of no practice.

TABLE IV

SHOWING THE NUMBER AND PERCENTAGE OF SUBJECTS AFFECTED, AND THE AMOUNT OF REMINISCENCE EXHIBITED BY ADULTS AND CHILDREN AFTER A 7-DAY TIME INTERVAL

Subjects	No. of Cases	Number Showing Reminiscence	Percentage of Subjects Exhibiting Reminiscence	Amount of Reminiscence Shown
Adults	21	10	.48	.11
Children	20	8	.40	.18
Men	9	6	.67	.10
Boys	8	4	.50	.54
Women	12	4	.33	.14
Girls	12	4	.33	.29

Read table thus: Ten of the adult subjects, or 48 per cent, exhibited reminiscence to the extent of 11 per cent after a 7-day time interval.

In Table IV, if the adult group is compared with the children's group, it will be evident that approximately the same percentage of both groups exhibited the phenomenon, but that the children were affected to a greater extent by the phenomenon. In the sub-groups the data show that the boys exhibited 44 per cent more reminiscence than the men, and that the girls had a 15 per cent greater degree of reminiscence than the women.

In the table following is given the number of subjects exhibiting reminiscence, the percentage of individuals affected, and the amount of reminiscence shown by adults and children after a 3-week time interval.

TABLE V

SHOWING THE NUMBER AND PERCENTAGE OF SUBJECTS AFFECTED, AND THE AMOUNT OF REMINISCENCE EXHIBITED BY ADULTS AND CHILDREN AFTER A 3-WEEK TIME INTERVAL

Subjects	No. of Cases	Number Showing Reminiscence	Percentage of Subjects Exhibiting Reminiscence	Amount of Reminiscence Shown
Adults	21	11	.52	.12
Children	20	13	.65	.21
Men	9	5	.57	.09
Boys	3	3	.75	.14
Women	12	5	.42	.19
Girls	12	7	.58	.36

Read table thus: Eleven of the 21 adults, or 52 per cent of the group, exhibited reminiscence to the extent of 12 per cent.

As shown in Table V, after an interval of 3-weeks, more than one-half of the adults, and 65 per cent of the children were susceptible to the phenomenon. Again the children showed the greater degree of reminiscence--exceeding the adults by 9 per cent. If the degree of reminiscence shown by the women subjects is compared with the degree shown by the girls, it will be apparent the latter was affected nearly twice as much as the women by the phenomenon during this particular rest period. The boys also exceed the men in amount of reminiscence shown, according to the table above.

Table VI shows the number and percentage of subjects affected by reminiscence, and the amount exhibited by adults and children after a time interval of 7-weeks since the original learning series.

TABLE VI

SHOWING THE NUMBER AND PERCENTAGE OF SUBJECTS AFFECTED, AND
THE AMOUNT OF REMINISCENCE EXHIBITED BY ADULTS AND
CHILDREN AFTER A 7-WEEK TIME INTERVAL.

Subjects	No. of Cases	Number Showing Reminis- cence	Percentage of Subjects Exhibiting Reminiscence	Amount of Remi- niscence Shown
Adults	21	13	.62	.19
Children	20	13	.65	.31
Men	9	6	.67	.16
Boys	8	5	.63	.21
Women	12	7	.58	.22
Girls	12	8	.67	.28

Read table thus: Thirteen of the 21 adults, or 62 per cent of the group, exhibited reminiscence to the extent of 19 per cent after a 7-week time interval.

Attention is called to the fact that, although the percentage of adults and children exhibiting the phenomenon is identical, the amount shown by the latter is 31 per cent, while for the adults it amounts to 19 per cent. The girls exhibited the greatest degree of the phenomenon, as they made an increase in skill acquisition of 28 per cent. It should be noted also that each group listed in the table above exhibited considerable reminiscence, and that there is no appreciable difference existing between the amount shown by the boys, the women, and the girls.

A comparison of the percentages of subjects who exhibited the phenomenon of reminiscence over the several time intervals is shown in Table VII.

TABLE VII

SHOWING THE PERCENTAGE OF SUBJECTS EXHIBITING REMINISCENCE AFTER VARYING TIME INTERVALS

Subjects	TIME INTERVAL					Average
	24-hour	48-hour	7-day	3-week	7-week	
Adults	.62	.67	.48	.52	.52	.58
Children	.65		.40	.65	.65	.60
Men	.56	.78	.67	.67	.67	.67
Boys	.63		.80	.75	.75	.63
Women	.67	.58	.33	.42	.42	.52
Girls	.67		.33	.58	.58	.50
Average	.63	.67	.45	.59	.60	

Read table thus: Sixty-two per cent of the adults exhibited reminiscence after the 24-hour interval, 67 per cent after the 48-hour interval, 48 per cent after the 7-day interval, 52 per cent after an interval of 3-weeks, and 42 per cent after an interval of 7-weeks. The average for the group was 58 per cent.

According to the foregoing table, no true differences seem to exist as to the effect of the different time intervals upon the percentage of subjects exhibiting reminiscence.

Attention is called, however, to the general consistency of the 7-day interval in being least advantageous in producing subjects who showed reminiscence.

Table VIII shows the amount of reminiscence displayed by the adults and children after varying time intervals.

TABLE VIII

SHOWING THE AMOUNT OF REMINISCENCE EXHIBITED BY ADULTS
AND CHILDREN AFTER VARYING TIME INTERVALS

TIME INTERVAL						
Subjects	24-hour	48-hour	7-day	3-week	7-week	Average
Adults	.19	.25	.11	.12	.19	.17
Children	.28		.18	.21	.31	.25
Men	.09	.11	.10	.09	.16	.11
Boys	.30		.54	.14	.21	.24
Women	.26	.33	.14	.19	.22	.23
Girls	.34		.29	.35	.28	.32
Average	.24	.22	.23	.18	.23	

Read table thus: The adults exhibited the phenomenon of reminiscence to the extent of 19 per cent after the 24-hour interval; 25 per cent after the 48-hour interval; 11 per cent after the 7-day interval; 12 per cent after the 3-week interval; 19 per cent after the 7-week interval, making the average amount for all intervals equal 17 per cent.

According to the table above, the average amount of reminiscence exhibited by the children for all time intervals exceeds the amount shown by the adults by 8 per cent. When the cases are divided into sub-groups, it can be seen that the average amount shown by the boys was slightly more than twice that of the men. Comparing the women with the girls an advantage of 9 per cent in favor of the latter group is evident. Attention is directed to the fact that no reliable difference is apparent regarding the effect of the various time intervals on the average amount of reminiscence exhibited by all subjects.

Although average group learning and retention scores tend to obscure

the phenomenon to a certain extent,² the data in Table II show the average group retention scores, expressed in percentage, after varying time intervals for all subjects, both those showing the phenomenon and those not showing it.

TABLE II
SHOWING THE PERCENTAGE OF MOTOR SKILL RETAINED AFTER
VARYING TIME INTERVALS

Subjects	No. Cases	TIME INTERVAL					Average
		24-hr.	48-hr.	7-day	3-wk.	7-wk.	
Adults	21	106	107	99	99	110	104
Men	9	105	105	103	102	112	106
Women	12	107	110	96	97	108	104
Children	20	100		94	106	110	103
Boys	8	98		93	97	108	99
Girls	12	102		96	112	110	108
Average		105	107	97	102	110	

Read table thus: Twenty-one adults, after a 24-hour interval, made a gain in retention of 6 per cent; after the 48-hour interval, a gain of 7 per cent; after the 7-day interval, retention was 99 per cent; after the 3-week interval, retention was 99 per cent; after the 7-week interval, retention was 110 per cent. The average for the group was 104 per cent.

If the score of 100 in the table above is assumed to signify no increase or decrease in retention, then, by an examination of the data it will be apparent that both adults and children have approximately the same average retentive ability when all cases are considered. It should be noted also that there is little difference between the women and girls, men and women.

² G. O. McGeech, op. cit., pp. 65-69.

and men and girls in average retentive ability. All subjects made an average gain in retention, with the exception of the boys, and they had an average loss of 1 per cent for all time intervals.

According to Table IX, the 7-week interval appears to be the most advantageous for the retention of motor skill, while the interval of 7 days seems least beneficial.

While the amount of reminiscence is insignificant when all cases are considered, as was done in Table IX, it might be worth noting that the subjects at least did not show the normal tendency to forget.

A general summary of the preceding discussion includes the following consistent tendencies concerning the phenomenon of reminiscence in motor learning:

1. No true difference seems to exist as to the effect of the different time intervals upon the percentage of subjects exhibiting reminiscence.

2. Concerning the effect of the various time intervals upon the average amount of reminiscence exhibited by all subjects, no true difference is apparent.

3. The children showed a greater degree of reminiscence than the adults after each time interval.

4. The average amount of reminiscence shown by the boys' group more than doubles the average amount shown by the men for all time intervals.

5. The girls exceed the women in amount of reminiscence shown after each time interval.

Transfer of Training. It has long been recognized that practice with one part of the body in performing an act of skill increases the skill of

the bilaterally symmetrical part in performing the same act. An incidental aim of this study has been an investigation of the extent to which practice with the ball-catching apparatus cross-educates the non-preferred hand in lieu of formal practice. The following table has been compiled to show the percentage of adults subjects exhibiting a transfer and the amount of transfer shown.

TABLE I

SHOWING THE PERCENTAGE OF ADULTS EXHIBITING TRANSFER AND THE EXTENT TO WHICH ACQUISITION OF SKILL WITH THE PREFERRED HAND IMPROVES SKILL WITH THE NON-PREFERRED HAND

Subjects	No. of Cases	Subjects Showing Positive Transfer	Subjects Showing Negative Transfer	Subjects Showing Zero Transfer	Amount of Positive Transfer
Adults	21	.81	.14	.05	1.41
Men	9	.89	.11	.00	.89
Women	12	.75	.17	.08	2.01

Read table thus: Of the 21 adult subjects, 81 per cent showed positive transfer of training, 14 per cent showed negative transfer, and 5 per cent showed zero transfer. The amount of positive transfer shown was 141 per cent.

Inspection of the table above shows that 81 per cent of all adults exhibited positive transfer to the extent of 141 per cent. A comparison of the men with the women reveals that 89 per cent of the men subjects had positive transfer, as opposed to 75 per cent of the women. However, the women had the greatest amount of transfer effects as their score after the practice period showed an improvement of 201 per cent. Seventeen per cent of the women's group showed a negative transfer, as compared to 11 per cent

of the men's group. This might indicate a greater variability in the women, or may be due to chance.

Table XI shows the percentage of children exhibiting transfer and the extent to which practice improves skill with the non-used hand.

TABLE XI

SHOWING THE PERCENTAGE OF CHILDREN EXHIBITING TRANSFER AND THE EXTENT TO WHICH ACQUISITION OF SKILL WITH THE PREFERRED HAND IMPROVES SKILL WITH THE NON-PREFERRED HAND

Subjects	No. of Cases	Subjects Showing Positive Transfer	Subjects Showing Negative Transfer	Subjects Showing Zero Transfer	Amount of Transfer Shown
Children	20	.55	.25	.20	2.14
Boys	8	.63	.12	.25	2.08
Girls	12	.50	.33	.17	2.25

Read table thus: Of the 20 children, 55 per cent showed a positive transfer of training, 25 per cent showed negative transfer, and 20 per cent showed zero transfer. The amount of positive transfer was 214 per cent.

According to the table given above, more than one-half of the children showed a positive transfer of training to the extent of 214 per cent. Sixty-three per cent of the boys and 50 per cent of the girls showed a positive transfer in learning the act of motor skill. As a result of the practice with the preferred hand, the boys made an improvement of 208 per cent, while the girls showed 225 per cent improvement, which is 17 per cent more than the amount exhibited by the male subjects. Incidentally, 33 per cent of the girls exhibited negative transfer, as contrasted to the 25 per cent negative transfer shown by the boys, which indicates that the acquisition of skill with the

preferred hand inhibited the learning of the habit with the non-preferred hand

The data in Tables X and XI show that the children had a considerable advantage over the adults with respect to the amount of cross-education exhibited. However, in regard to the percentage of subjects showing a positive transfer the data show that quite a larger proportion of adults than children had a positive transfer. Comparing the percentages of adults and children who do not show any cross-education, it has been found by the writer that 19 per cent of the adults had a negative transfer of 32 per cent, and 48 per cent of the children had negative transfer to the extent of 33 per cent.

In computing the amount of positive transfer shown by adults when all cases are included, the percentage of cross-education has been found to be 80 per cent. For the children, the average amount of positive transfer has been found to be 75 per cent. This figure includes both the subjects who show transfer and those who do not.

CONCLUSIONS

Within the limits of this experiment the following conclusions may be drawn:

1. Approximately the same percentage of adults and children, when considered as mixed groups, exhibited the phenomenon of reminiscence after the various time intervals.
2. Children showed a greater degree of reminiscence than adults after each time interval.
3. Reminiscence consistently occurred to a greater extent with girls than women.
4. Age was a factor in determining the degree of reminiscence shown, but not the percentage of subjects exhibiting the phenomenon.
5. The frequency of appearance and the degree of reminiscence shown are not determined to any appreciable extent by the length of the time interval.
6. The average amount of reminiscence shown by the boys is equal to twice the amount shown by the men for all time intervals.
7. Concerning the part of this study having to do with transfer of training, the conclusion is evident that in the majority of cases the training of the preferred hand was somehow effective upon the non-preferred hand, also. Whether this is due to some alteration of the central nervous system, or to some method, generalization, or plan of work that can be applied equally well to the other hand, is not known to the writer. After the preferred hand has acquired the special techniques, methods, or what-

ever is necessary to accuracy in the ball-catching exercise, the data show that the non-preferred hand, awkward and stiff as it is, can perform the act at least 75 per cent more efficiently than was possible before the training period. The amount of negative transfer for both adults and children was approximately the same.

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APPENDIX

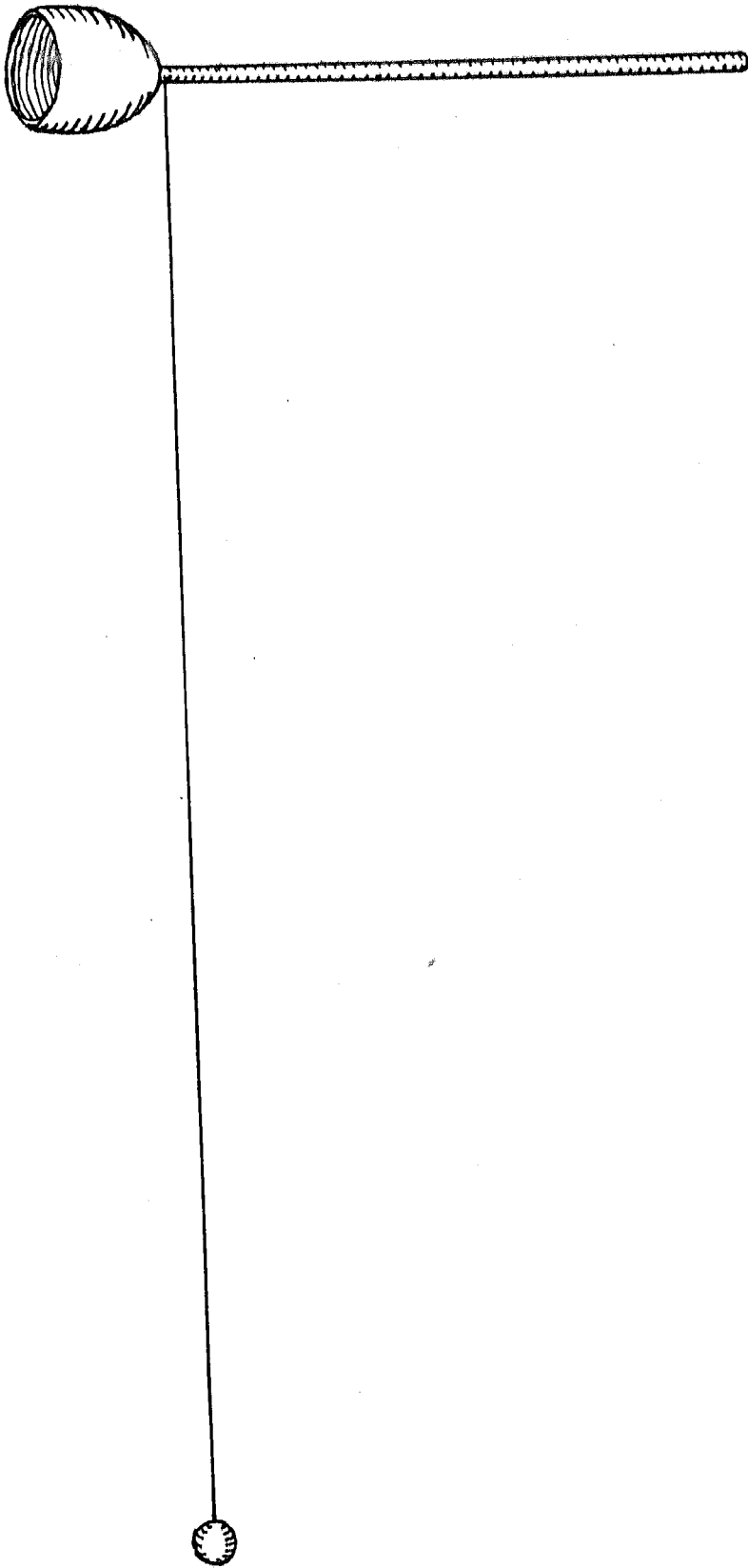


Figure 2. Ball-catching Apparatus

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