

AN INVESTIGATION OF THE RELATION BETWEEN
AGE AND THE ABILITY TO MEMORIZE
AND RETAIN MEANINGFUL AND
NONSENSE MATERIAL.

A THESIS

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I N T R O D U C T I O N

Statement of the Problem: This study is an investigation of the influence of age upon the acquisition and retention of meaningful and rote material.

Historical Summary. The following is a summary of the experimental facts pertaining to the relation of age to acquisition and retention. Needless to say, many of the results are incidental to other experiments. The comparability of the subjects as to intelligence has usually not been determined. In other studies the number of cases is small and the statistical reliability of the results has not been determined.

Animal studies on the age factor in learning should enlighten phases of the human problem as in animals it is possible to control very carefully the educative factors and experiences throughout the entire lifetime. A number of important experimental studies have been made with white rats of various ages. Stone¹ used rats in the problem box and maze, of four different life periods: 31 days, 56 days, 456 days, and 730 days. The diet of the rats was carefully controlled through its effect upon their body weights. All age

¹ Stone, C. P. "The Age Factor in Animal Learning: I. Rats in the Problem Box and the Maze"; in GENETIC PSYCHOLOGY MONOGRAPHS, Vol. 6, No. 1, pp. 1-131, (January, 1929).

groups worked with as nearly the same degree of hunger incentive as dietary restrictions could insure. From Stone's results it is clear that no difference in the progress of mastery of the problem box and maze can be correlated with the different ages of the subjects. The number of trials and the total time required for mastery likewise fail to show significant age differences.

Liu² conducted an investigation with 206 rats of 30, 45, 60, 75, 100, 150, and 250 days of age. He found that under the conditions of his experiment, ability to master his maze increases with the age of the rats from 30 to 75 days and decreases thereafter. The results may be due to the accidental selection of the animals, of the unreliability of the maze, or of a faulty control of incentives in the various age groups.

Hubbert³ used the Watson circular maze with an attachment which made it possible to record the pathways followed by the subject. The age groups of the 110 rats used were 25, 65, 200, and 300 days. She concludes that the old rats do not learn the maze as rapidly as the young ones, and that the rapidity of forming the habit also decreases as age increases. However, there is a great deal of overlapping of the records made by

² Liu, S. Y. "Relation of Age to the Learning Ability of the White Rat"; in THE JOURNAL OF COMPARATIVE PSYCHOLOGY, Vol. 8, pp. 75-85, (February, 1928).

³ Hubbert, H. B. "The Effect of Age on Habit Formation in the Albino Rat"; in BEHAVIOR MONOGRAPH, Vol. 2, No. 11, (January, 1915).

the various age groups and consequent unreliability of results. The experiments with rats do not consistently demonstrate variations in learning ability with age.

In the case of human experimentation, Sorenson⁴ proposed, in his study to provide evidence that the decrease in ability to learn with age is due to disuse. Three extra-mural classes or groups were used. The classes consisted of elementary public school teachers who took courses offered for the Bachelor's degree in Education at the University of Minnesota. One was composed of teachers who were resuming study after a long period of absence from it. The other two classes were made up of teachers who had recently taken several university courses. Ages ranged from 20 to 56 years. The data, collected to provide information which could be used for finding the effect of age on learning, included intelligence or college ability as obtained from the Miller Analogies Test; achievement by a very comprehensive objective examination; and amount of study by weekly report. The correlation between age and achievement was found to be $-.09$ which suggests that a slight disability for learning sets in with increasing age.

Dr. L. H. V. Kennen⁵ of the Institute of Educational Research, conducted an extensive experiment in the learning of

⁴ Sorenson, H. "Adult Ages as a Factor in Learning"; in THE JOURNAL OF EDUCATIONAL PSYCHOLOGY, Vol. 21, No. 6, pp. 451-9, (September, 1930).

⁵ Thorndike, Edward L., Bregman, Elsie O., Tilton, J. Warren, and Woodyard, Ella. Adult Learning. The Macmillan Company, New York, 1925. pp. 44-46.

the artificial language, Esperanto. Each subject spent ten hours in individual study and ten hours in class under the same instructor. Progress was measured by the difference in score between a series of four tests given before any study and after the twenty hours of study. Three groups of practically equal ability, as determined by a standard intelligence test, were used. One group consisted of eighteen individuals who were from 20 to 25 years old, the second group consisted of 9 individuals who were from 26 to 34, and the third group consisted of 21 individuals who were 35 or over. The first group gained 31.5; the second 26.3; and the third 24.7. Results of this experiment show a falling off of about 20 per cent between ages 22 and 40 in ability to learn a logical systematic language. The difference is found largely in the oral testing.

Thorndike⁶ collected comparative data on the learning of Esperanto by children and adults. Pupils from 9 to 18 years of age in a private school, having twice as much class study as a group 35 years old and over, gained a little more than half as much as the older group. The younger the group the smaller is the amount of gain shown.

Thorndike⁷ and his colleagues made a study of the inmates of Sing Sing Prison who had less than 7th grade ability. These

⁶ Ibid., p. 46.

⁷ Ibid., pp. 57-58.

prisoners are assigned to grades and the school is conducted by a civilian head teacher. They compared the rate of learning of these adult men in reading, vocabulary, spelling, and other forms of school learning with that of children by finding the number of school months required by children to make the same amount of gain in the subjects in question as made by the adults in 11 months. The children required 9 months to reach the same level of proficiency as the adults. However, there is evidence to show that the children spent more hours per month upon the work than did the adults. Also, the children were of average intellect, while the adults studied were below average intellect.

Thorndike⁸ and his co-workers made a study of the relation between age and motor learning of a simple sort. The subjects were 18 individuals with an average age of 22 and 12 individuals with an average age of 42. Their task was to learn to draw by a quick thrust, upon a given signal, lines 3, 4, 5, and 6 inches in length, starting from a straight edge with the eyes closed. The subject first drew 600 lines without any statement of right or wrong. Then, on each of seven consecutive days, he drew 600 lines with a statement of right or wrong. Finally a few days later he drew 600 lines again without the statement of right or wrong. When subjects were grouped on a basis of intellect (CAVD) the younger group made an average score of 412,

⁸ Ibid., pp. 96-106.

while the older group made an average score of 419. In the series of 600 before any training by the announcement of right or wrong, the average per cent of lines drawn which would have been called right was 11.4 for the young and 15.0 for the old. In the training period the young have 59 per cent right and the old have 49 per cent right. In the last series the young drop to 30 per cent right and the old drop to 21 per cent right.

Gould and Perrin⁹ studied fourteen adults and ten children in stylus-maze learning. The adults had fewer errors, trials, and shorter excess distance, and took less time, on the average, but they made poorer records in the first two trials where chance factors weighed heavily. Their elimination of errors and excess distance was more rapid and regular. All experiments show increasingly cautious behavior in humans, with advance in years and experience.

Peterson¹⁰ at the conclusion of his chapter in "A Handbook of Child Psychology" says:

This survey of experiments on learning in children has revealed considerable similarity between such learning and that in adults.... Both in the acquirement of new motor coordinations and specific skills and in the rational organization of

⁹ Gould, M. C. and Perrin, F. A. C. "A Comparison of Factors involved in the Maze Learning of Human Adults and Children"; in THE JOURNAL OF EXPERIMENTAL PSYCHOLOGY, Vol. 1, pp. 122-154, (January, 1916).

¹⁰ Peterson, Joseph. "Learning in Children", Chapter 10 in A Handbook of Child Psychology, Carl Murchison, ed. Clark University Press, Worcester, Mass., 1931, p. 372.

responses to complex problems involving generalizations on successively higher planes, there is much similarity between children with language habits and adults. At no level of growth do sudden and marked differences in learning appear.

Shaw¹¹ conducted an experiment on immediate memory of logical ideas with subjects from the third grade to the university status. He found that the learning capacity of boys increased from the third grade to the ninth grade 17 to 42 per cent; girls 18 to 43 per cent; high school boys averaged 40 per cent increase and girls averaged 47 per cent increase. University students did no better than the high school students.

Henderson¹² tested the memory of different age groups without regard for I. Q. He requested his subjects to read twice a selection taken from "The Dutch Homestead" by Irving. Three minutes was allowed for this. The subjects were then requested to write down as much as they could remember. Two days later they were again called upon to write down as much as possible, and after a lapse of four weeks a third recall was requested. His data permit comparisons of adults in summer session with pupils 14, 15, and 16 years of age; of college students with high school students; of graduate students with college students. In every case the older groups were superior, the four week memories showing the same differences as the immediate memories.

¹¹ Shaw, J. C. "A Test of Memory in School Children"; in PEDAGOGICAL SEMINARY, Vol. 4, pp. 61-78, (July, 1896).

¹² Henderson, E. N. "A Study of Memory for Connected Trains of Thought"; in PSYCHOLOGICAL REVIEW, Vol. 5, No. 23, (May, 1903).

Lyon¹³ carried on an experiment with the following class groups:

1. 40 grammar-school students. Modal age, 14.
2. 24 grade-school students. Modal age, 16.
3. 60 high-school students. Modal age, 17.
4. 24 state reformatory inmates. Modal age, 20.
5. 132 normal-college students. Modal age, 21.
6. 32 Columbia College seniors. Modal age, 22.
7. 14 Barnard College seniors. Modal age, 22.
8. 24 asylum attendants. Modal age, 25.
9. 12 workhouse inmates. Modal age, 30.
10. 24 clerks and business men. Modal age, 30.
11. 16 graduate students and instructors. Modal age, 32.
12. 24 prison inmates. Modal age, 34.

I. Q. was not considered. The material consisted of 5 different kinds: digits, nonsense syllables, words, prose, and poetry.

He found that the clerks and business men were slightly inferior to the high school students in both learning and re-learning. The high school students retained more of the poetry than the grammar school students or the older college students. Memory scores showed a small but steady increase with age. It was found that the increase in memory scores with age was greater in the case of prose than it was in poetry. The increase for digit and nonsense syllable scores was relatively small.

McGeoch¹⁴ made a study of the influence of age on the ability to report upon prose selections which were read to the

¹³ Lyon, D. O. "The Relation of Quickness of Learning to Retentiveness"; in ARCHIVES OF PSYCHOLOGY, No. 54, (January, 1916).

¹⁴ McGeoch, J. A. "The Influence of Sex and Age upon the Ability to Report"; in THE AMERICAN JOURNAL OF PSYCHOLOGY, Vol. 40, pp. 458-466, (July, 1928).

subjects. He used subjects between the ages of 7 and 14, inclusive. He concludes that ability to report in the narrative or the interrogation form increases with age. However, differences between successive age levels are small and statistically unreliable. But they accumulate so that the differences between the extremes of the age range are much larger and of a satisfactory degree of reliability.

Peterson¹⁵ measured the ability of 18 individuals to learn his mental maze, which required a mixture of reasoning and memory. Ten of the learners were college students and one was a high school student. The other seven were older, comprising a college instructor, two graduate students, an electrical engineer, a doctor, a woman of fifty, and a bond clerk. The older group did somewhat better than the younger. The average number of trials necessary was 5.0 for the older group and 7.2 for the younger group. The average number of errors was 139 and 243 for the respective groups.

Rugg¹⁶ made a study of 413 students at the University of Illinois, of ages from 17 to 26, concerning the influence of training upon more general abilities in dealing with spatial facts and relations as taught in descriptive geometry. Primarily he was interested in studying various phases of

¹⁵ Peterson, Joseph. "Experiments in Rational Learning"; in PSYCHOLOGICAL REVIEW, Vol. 25, pp. 443-467, (November, 1918).

¹⁶ Rugg, H. O. The Experimental Determination of Mental Discipline in School Studies, G. M. Whipple, ed. Warwick and York, Inc., Baltimore, 1916, 132 pages.

transfer of training. Incidentally, he compared the susceptibility of adults of varying ages to the effect of training. He found no influence attributable to age.

Purpose. One finds in the psychological literature varying statements regarding the relation of age to memory ability. According to one point of view children are supposedly superior to adults in all memory functions; others state that children learn with greater difficulty but retain what they have learned in a more effective manner than adults. Some authors state that children excel in rote memory while adults excel in logical memory. Another possibility is that adults are superior to children in all memory activities.

The following study was planned for the purpose of investigating the plausibility of these statements. The following specific aspects of the general problem have been studied:

1. The relation between age and learning scores for meaningful material.
2. The relation between age and learning scores for rote material.
3. The relation between age and retention of meaningful material.
4. The relation between age and retention of rote material.
5. The comparative influence of chronological age and mental age.

P R O C E D U R E

Material. The meaningful material consisted of three poems written for the experiment by Dr. Norman Triplett, author of "Nursery Rhymes". Each poem consisted of five stanzas of four lines each with approximately four words in each line. The poetry was of such a nature as to be within the interest and comprehension of even the youngest subject. Six series of nonsense syllables, ten to a series, comprised the nonsense material. These were selected at random from a large number of nonsense syllables.

Subjects. The subjects were students selected at random from the Training Schools and the Freshmen class of the Kansas State Teachers College of Emporia. They included students from grade 2 to grade 6, inclusive, students from grade 9, and a group of college Freshmen. One hundred fifty-seven students were used for the experiment.

Method. The progressive part method of learning was used for both the meaningful and nonsense material. Individual experiments were conducted throughout by the writer. Each subject was given 15 minutes in which to learn the meaningful material, and 10 minutes in which to learn the nonsense material. The material was read aloud by the subject. Presentation and recall were alternated. The scores consisted of

the number of lines of poetry learned and the number of nonsense syllables learned in the allotted time. Subjects were retested for retention one week later by the relearning method. The subjects in grades 2, 4, and 6 were given an additional retention test approximately 6 weeks later. In relearning the subject read the material aloud with presentation and recall alternating as in learning. The whole method of learning was used. Saving scores were computed by finding what per cent of the number of trials in the first learning is the number of trials saved in the relearning. That is, the difference between the number of trials taken for first learning and the number of trials taken for relearning was divided by the number of trials taken for the first learning. An intelligence quotient and mental age for each subject was derived from the Kuhlman-Anderson Intelligence Test appropriate for each age level.

Controls. Individual experiments were conducted throughout by the writer. Subjects were not told that they would be retested. No subjects tested consecutively were given the same poem or the same list of nonsense syllables to learn. No subjects tested consecutively were selected from the same school grade. These precautions, it was hoped, would eliminate coaching. If one subject learned the poetry first, the next subject learned the nonsense syllables first. Thus should the subjects have felt any fatigue toward the end of the experiment, its

effect was divided equally between the learning of poetry and the learning of nonsense syllables. Students at the Teachers College are so accustomed to experiments and tests of various kinds that there is little likelihood of their discussing such a usual thing among themselves.

RESULTS AND DISCUSSION

Table I shows the relation between chronological age and the obtained memory scores.

TABLE I

THE AVERAGE POETRY AND NONSENSE SYLLABLE SCORES FOR EACH YEAR GROUP

Year group	Av. poetry score	Av. nonsense syll. score	I. Q. av.
7	10.6 ± .75	4.9 ± .25	120.3
8	10.8 ± .45	5.0 ± .21	113.8
9	13.5 ± .65	5.3 ± .30	115.3
10	16.1 ± .69	6.4 ± .32	114.9
11	17.7 ± .64	6.9 ± .29	102.1
14	22.3 ± .97	7.4 ± .33	110.7
19	24.6 ± .70	10.2 ± .55	110.3

Read table thus: In the 7-year group the average poetry score is 10.6 ± .75, the average nonsense syllable score is 4.9 ± .25, and the average I. Q. is 120.3.

These results show that the average number of lines of poetry learned by any year group is larger than the average number learned by any preceding year group. The average number of lines of poetry memorized by the 7-year group is 10.6 lines, while the average for the 8-year group is 10.8 lines. This small difference may be explained by the fact that a number of subjects making exceptionally high scores were found in the 7-year group. Table II shows the median score for the 7-year group to be only 8.9 while the median score for the 8-year group is 10.0. The average number of nonsense syllables

learned by any year group is larger than the average number learned by any preceding year group.

The median scores for poetry and nonsense syllables made by the subjects in each year group are shown in Table II.

TABLE II
MEDIAN POETRY AND NONSENSE SYLLABLE
SCORES FOR EACH YEAR GROUP

Year group	Median poetry s.	Median syll. s.
7	8.9	5.4
8	10.0	5.5
9	13.0	5.8
10	15.6	6.9
11	16.8	7.5
14	23.3	7.7
19	25.0	10.7

* Read table thus: In the 7-year group the median poetry score is 8.9 and the median syllable score is 5.4.

It is a very significant fact that the averages and medians for both types of material show an increase for each year group.

Figures I and II show graphically the relation between age and median poetry and nonsense syllable scores for each year group. A decided increase is seen from age group to age group showing that within the limits of this experiment ability to memorise poetry and nonsense syllables increases with age. Attention is called to the fact that no year groups were studied between 11 and 14 nor between 14 and 19. Figures I and II are shown on pages 16 and 17 respectively.

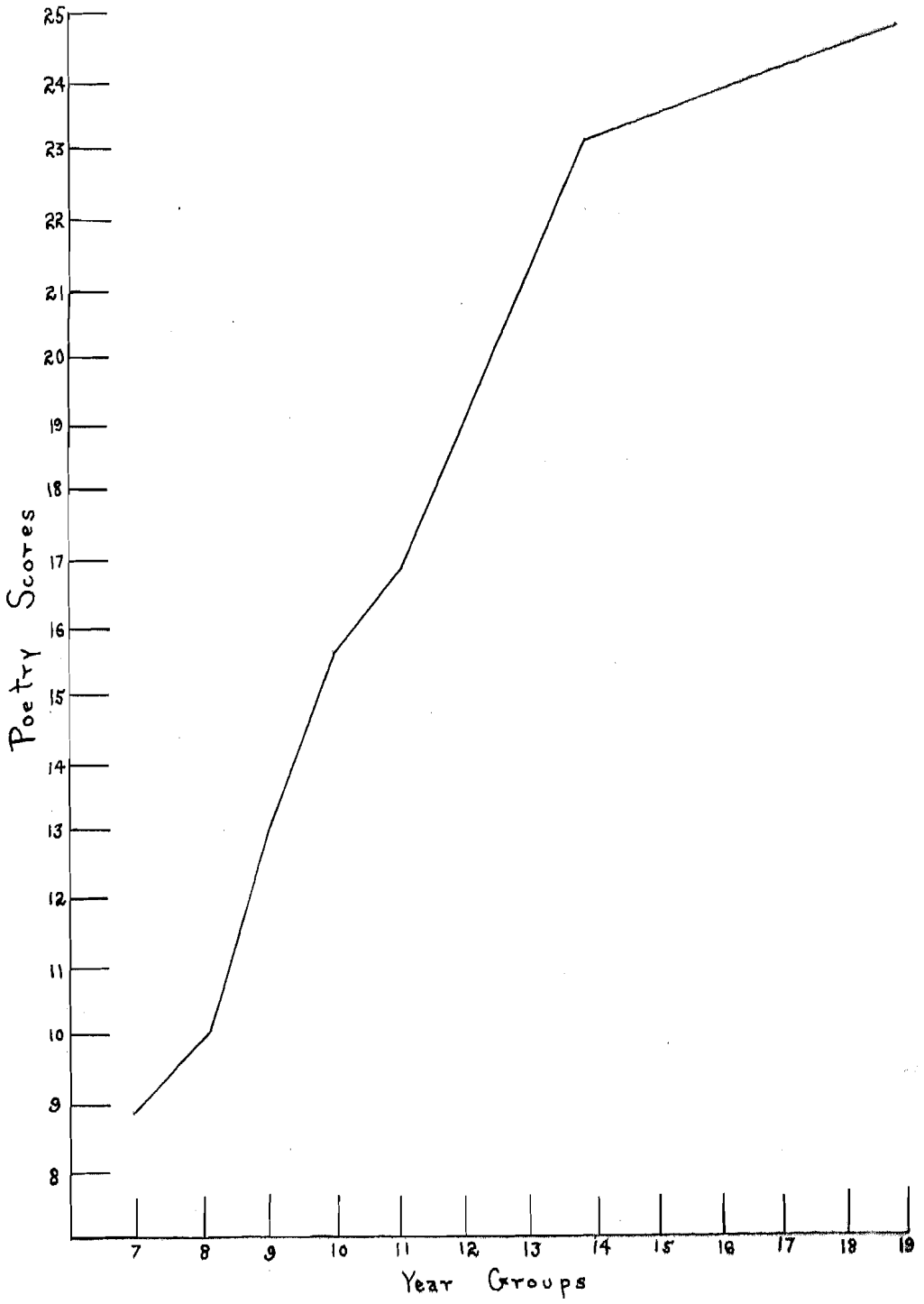


Figure 1. The Relation Between C. A. And Poetry Scores.

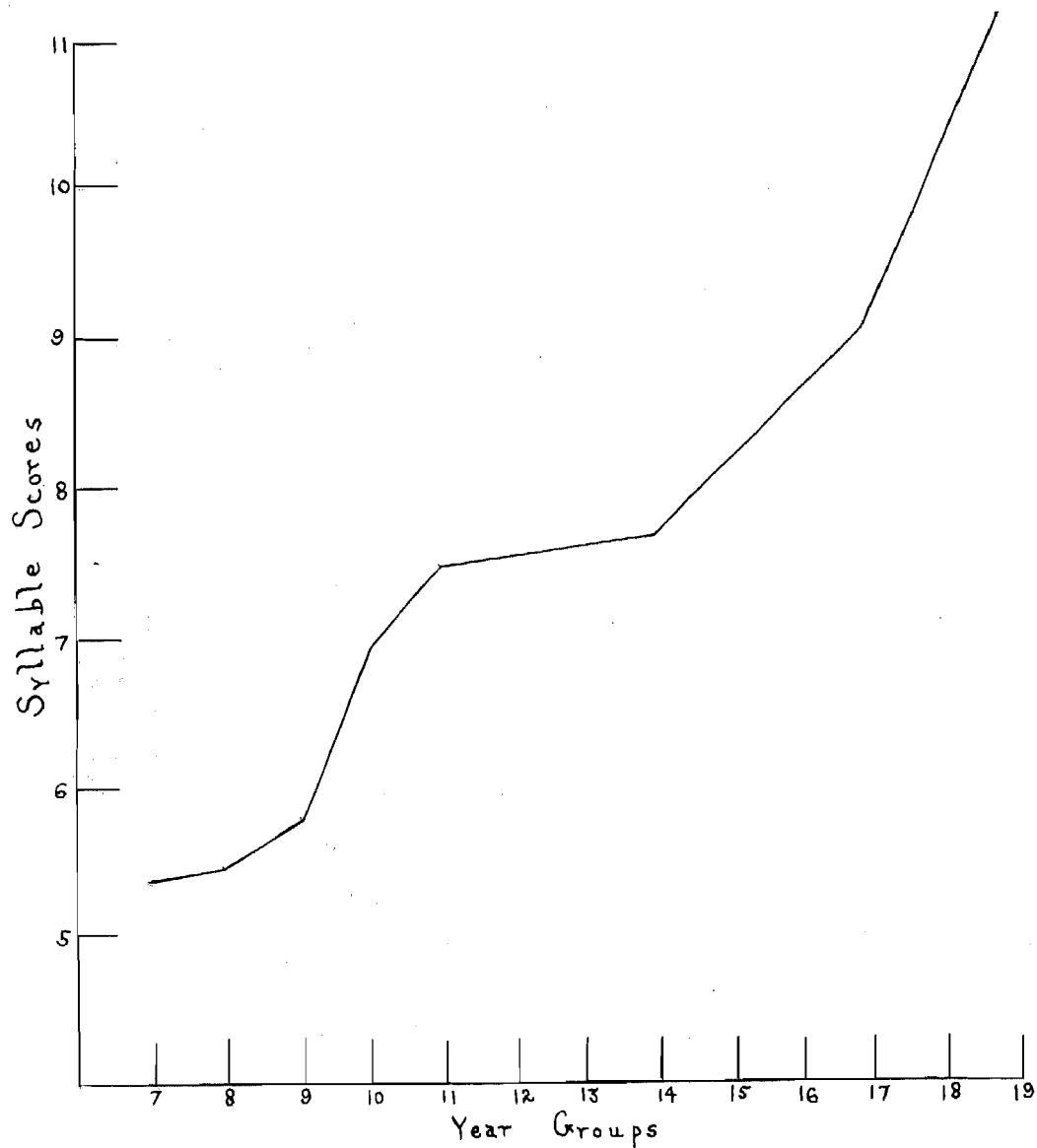


Figure 2. The Relation Between C.A. and Nonsense Syllable Scores.

The difference between the average poetry scores for the various year groups has a high degree of reliability as indicated by their probable errors. Table III bears out this statement.

TABLE III

THE RELIABILITY OF THE DIFFERENCE BETWEEN THE POETRY MEANS FOR THE VARIOUS YEAR GROUPS IN TERMS OF THE PROBABLE ERROR OF THE DIFFERENCE

Year groups	Actual diff.	PE diff	D/PE diff	Chances in 100
7 and 8	.2	.86	.23	56
7 and 9	2.7	.99	2.72	97
7 and 10	5.3	1.02	5.19	100
7 and 11	6.9	.98	7.03	100
7 and 14	11.5	1.22	9.42	100
7 and 19	13.8	1.02	13.52	100
8 and 9	2.9	.76	3.81	99
8 and 10	5.5	.80	6.87	100
8 and 11	7.1	.77	9.22	100
8 and 14	11.7	1.06	11.03	100
8 and 19	14.0	.83	16.86	100
9 and 10	2.5	.94	2.66	97
9 and 11	4.2	.91	4.61	100
9 and 14	8.8	1.16	7.59	100
9 and 19	11.1	.95	11.57	100
10 and 11	1.6	.94	1.65	87
10 and 14	6.2	1.19	5.21	100
10 and 19	8.5	.98	8.65	100
11 and 14	4.6	1.16	3.96	100
11 and 19	6.9	.94	7.32	100
14 and 19	2.3	1.19	1.93	91

Read table thus: Between the year groups of 7 and 8 there is an actual difference of .2 lines of poetry memorized which divided by the probable error of the difference, .86 is .23 and means there are 56 chances in 100 that the true difference is greater than zero.

The further apart the year groups are the more reliable the difference is. For instance, the results given in Table III, show that there are only 56 chances in 100 that the true difference between the 7-year group and the 8-year group will be greater than zero, while there are 97 chances in 100 that the true difference between the 7-year group and the 9-year group will be greater than zero, and there are 100 chances in 100 that the true difference between the 7-year group and each other succeeding group will be greater than zero.

The average D/PE_{diff} (actual difference divided by the probable error of the difference) for all adjacent year groups is 2.08. This means that there are 92 chances in 100 that the true difference between an adjacent year group will be greater than zero.

The average D/PE_{diff} for all alternate year groups is 4.55. This means that there are 100 chances in 100 that the true difference between alternate year groups will be greater than zero.

The average D/PE_{diff} for year groups with more than one year group intervening is much larger than 4 which statistically insures a true difference greater than zero in all such cases.

Of the 21 differences for which the reliability was found, Table III shows that 14 had a D/PE_{diff} much larger than is needed to insure a true difference greater than zero; 3 had a D/PE_{diff} large enough to indicate complete reliability; 2 had a D/PE_{diff} large enough to insure a true difference greater

than zero 97 chances in 100; 1 had a D/PE_{diff} large enough to insure a true difference greater than zero 87 chances in 100; and 1 had a D/PE_{diff} large enough to insure a difference greater than zero 56 chances in 100. The last difference is between the 7-year and 8-year groups. As pointed out previously, the 7-year groups contained a number of exceptional cases which gave it an average score very near the average score for the 8-year group. However, Table II shows that the median score for the 7-year group is considerably below the median score for the 8-year group.

The difference between the average nonsense syllable scores for the various year groups likewise has a high degree of reliability as indicated by their probable error. The further apart the year groups are, the more reliable the difference is. For instance, the results given in Table IV, show that there are only 58 chances in 100 that the true difference between the 7-year group and the 8-year group will be greater than zero while there are 76 chances in 100 that the difference between the 7-year group and the 9-year group will be greater than zero, and there are 99 chances in 100 that the true difference between the 7-year group and the 10-year group will be greater than zero, and there are 100 chances in 100 that the difference between the 7-year group and each other succeeding group will be greater than zero.

TABLE IV

THE RELIABILITY OF THE DIFFERENCE BETWEEN THE
NONSENSE SYLLABLE MEANS FOR THE VARIOUS
YEAR GROUPS IN TERMS OF THE PROBABLE
ERROR OF THE DIFFERENCE

Year groups	Actual diff.	PE diff	D/PE diff	Chances in 100
7 and 8	.1	.32	.31	58
7 and 9	.4	.39	1.03	76
7 and 10	1.5	.40	3.75	99
7 and 11	2.0	.38	5.27	100
7 and 14	2.5	.41	6.09	100
7 and 19	5.3	.60	8.83	100
8 and 9	.5	.36	.84	72
8 and 10	1.4	.37	3.78	99
8 and 11	1.9	.35	5.42	100
8 and 14	2.4	.39	6.15	100
8 and 19	5.2	.58	8.96	100
9 and 10	1.1	.43	2.56	96
9 and 11	1.6	.41	3.90	100
9 and 14	2.1	.44	4.77	100
9 and 19	4.9	.62	7.90	100
10 and 11	.5	.43	1.16	78
10 and 14	1.0	.45	2.22	93
10 and 19	3.8	.63	6.03	100
11 and 14	.5	.43	1.16	78
11 and 19	3.3	.62	5.32	100
14 and 19	2.8	.64	4.37	100

Read table thus: Between the year groups of 7 and 8 there is an actual difference of .1 nonsense syllable memorized which divided by the probable error of the difference, .32, is .31 and means that there are 58 chances in 100 that the true difference between the two groups is greater than zero.

Of the 21 differences for which the reliability was found, Table IV shows that 12 had a D/PE_{diff} much larger than is needed to insure a true difference greater than zero; 2 had a D/PE_{diff} large enough to insure complete reliability; 1 had a D/PE_{diff} large enough to insure a true difference greater than zero 98 chances in 100; 1 had a D/PE_{diff} large enough to insure a true difference greater than zero 93 chances in 100; 2 had a D/PE_{diff} large enough to insure a true difference greater than zero 78 chances in 100; 1 had a D/PE_{diff} large enough to insure a true difference greater than zero 76 chances in 100; 1 had a D/PE_{diff} large enough to insure a true difference greater than zero 72 chances in 100; and 1 had a D/PE_{diff} large enough to insure a true difference greater than zero 58 chances in 100.

The average D/PE_{diff} for all adjacent year groups is 1.22. This means that there are 79 chances in 100 that the true difference between adjacent year groups will be greater than zero.

The average D/PE_{diff} for all alternate year groups is 4.55. This means that there are 100 chances in 100 that the true difference between alternate year groups will be greater than zero.

The average D/PE_{diff} for year groups with more than one intervening year group is much larger than 4 which statistically insures a true difference greater than zero in all such cases.

The relation between age and memory scores may also be demonstrated by the use of correlation coefficients. Table V contains the results,

TABLE V
CORRELATION COEFFICIENTS

Variables	Correlations
Poetry scores and C. A.	.57 ± .03
Syllable scores and C. A.	.51 ± .03
Poetry scores and M. A.	.70 ± .02
Syllable scores and M. A.	.54 ± .03
Poetry and syllable scores	.67 ± .02

Read table thus: The coefficient of correlation between poetry scores and chronological age is $.57 \pm .03$.

It is statistically certain that the true correlation between poetry scores and chronological age lies between .45 and .69, while the true correlation between nonsense syllable scores and chronological age lies between .39 and .53. The true correlation between poetry scores and mental age lies between .62 and .78, while the true correlation between nonsense syllable scores and mental age lies between .42 and .66. There is practically the same correlation between chronological age and poetry scores as there is between chronological age and nonsense syllable scores. The correlation between mental age and poetry scores is much higher than the correlation between mental age and nonsense syllable scores.

The correlation between poetry scores and nonsense syllable

scores is relatively high and reliable, as it is statistically certain that the true correlation lies between .59 and .75. This means that a subject who memorizes poetry easily will also tend to memorize nonsense syllables easily.

If memory ability is greatly influenced by training and experience, it seems reasonable to suppose that the correlations between I. Q. and memory scores should decrease for the successive year groups since differences in such abilities would be widened by the differences in training and experience. There is, however, no tendency for the correlations between memory scores and I. Q. to increase or decrease with age as inspection of Table VI will show.

TABLE VI
CORRELATION COEFFICIENTS BETWEEN MEMORY
SCORES AND INTELLIGENCE QUOTIENTS
FOR EACH YEAR GROUP

Year groups	Poem scores and I. Q.	Syll. scores and I. Q.
7	.47 ± .12	-.01 ± .15
8	.41 ± .09	.22 ± .14
9	.45 ± .11	.06 ± .15
10	.40 ± .12	.22 ± .12
11	.45 ± .11	.25 ± .13
14	.47 ± .11	.41 ± .12
19	.42 ± .14	.09 ± .17

Read table thus: In the 7-year group, the coefficient of correlation between poem scores and I. Q. is $.47 \pm .12$, and between nonsense syllable scores and I. Q. it is $-.01 \pm .15$

In all but 2 year groups the correlations between poem scores and I. Q. are at least 4 times their probable errors which makes them statistically reliable. The correlation between poetry scores and I. Q. for the 10-year group is 3.3 times its probable error. The correlation between poetry scores and I. Q. for the 19-year group is 3 times its probable error. The correlation coefficients between the nonsense syllable scores and I. Q. vary greatly for the various year groups. The highest positive correlation is .41, and the lowest is .06, for the 14-year and 9-year groups respectively. The 19-year group has a positive correlation of only .09. A correlation of $-.01$ is found for the 7-year group. The correlation coefficients for the poetry scores and I. Q. are fairly consistent, ranging from .40 to .47. The correlation coefficients for the nonsense syllable scores and I. Q. vary greatly and are insignificant in many cases, ranging from $-.01$ to .41. The lower correlations in the case of the nonsense syllables may be due in part to the shorter time interval (10 minutes) allowed for learning the syllables. This comparatively short time doubtless lowers the reliability of the syllable scores.

An attempt was made to determine the specific relation between chronological age and memory ability. This was done by comparing scores of subjects with the same mental age but different chronological age. Table VII, on the following page, shows the results. It would have been interesting to include groups of subjects who are older chronologically than mentally.

However, only a few such cases were found among the subjects and each of a different age, that is, 1 had a mental age of 8 and a chronological age of 9 and another had a mental age of 10 and a chronological age of 11.

TABLE VII

AVERAGE SCORES FOR GROUPS OF SUBJECTS WITH THE SAME MENTAL AGE BUT DIFFERENT CHRONOLOGICAL AGE.

Av. M. A.	Av. C. A.	Av. I. Q.	Av. poem score	Av. syll. score	No.
8	6	125	7.5	4.5	2
8	7	119	8.1	4.4	9
8	8	108	9.8	4.0	5
9	7	126	13.3	5.3	7
9	8	112	10.1	5.0	8
9	9	108	10.0	6.0	2
10	8	121	10.0	6.0	5
10	9	110	11.4	4.4	9
10	10	101	16.5	5.7	4
11	9	123	17.1	6.1	8
11	10	112	17.0	6.7	14
11	11	103	18.1	7.2	8
12	10	117	18.9	7.1	7
12	11	109	22.0	6.1	4

Read table thus: In a group of subjects whose average mental age is 8 and whose average chronological age is 6, the average I. Q. is 125, the average poem score is 7.5, the average nonsense syllable score is 4.5, and the number of subjects is 2.

Subjects with a mental age of 8 and those with a mental age of 10 have higher poetry scores than younger subjects with the same mental age but lower nonsense syllable scores. Subjects with a mental age of 9 excel younger subjects with

the same mental age in ability to memorize both types of material. Subjects with a mental age of 11 and those with a mental age of 12 excel younger students of the same mental age in ability to memorize both types of material. Owing to the small number of cases fitting the requirements, the difference may be due to chance, as there is no consistent tendency shown.

A comparison was also made between groups of subjects with the same chronological age but different mental age. These results are given in Table VIII which is shown on the following page.

TABLE VIII

AVERAGE SCORES FOR GROUPS OF SUBJECTS WITH THE SAME
CHRONOLOGICAL AGE BUT DIFFERENT MENTAL AGE

Av. C. A.	Av. M. A.	Av. I. Q.	Av. poem score	Av. syll. score	No.
6	8	125	7.5	4.5	2
7	8	119	8.1	4.4	9
7	9	126	13.3	5.3	7
8	8	108	9.8	4.0	5
8	9	112	10.1	5.0	6
8	10	121	10.0	6.0	5
9	9	108	10.0	6.0	2
9	10	110	11.4	4.4	9
9	11	123	17.1	6.1	8
10	10	101	16.5	5.7	4
10	11	112	17.0	6.7	14
10	12	117	18.9	7.1	7
11	11	103	18.1	7.2	8
11	12	109	22.0	8.1	4

Read table thus: In a group of subjects whose chronological age is 6 and whose mental age is 8, the average I. Q. is 125, the average poem score is 7.5, the average nonsense syllable score is 4.5, and the number of subjects is 2.

A fairly definite tendency is shown for groups of students of a given mental age to excel subjects of the same chronological age but who have a lower mental age.

Further attempt was made to determine the specific relation between memory scores and chronological age by the use of partial correlations. Table IX on the following page gives the results.

TABLE IX
PARTIAL CORRELATIONS

Meaning of Numbers	Correlations
1 = M. A.	$r_{13.2} = .53$
2 = C. A.	$r_{14.2} = .24$
3 = Poem scores	$r_{23.1} = .16$
4 = Syllable scores	$r_{24.1} = .24$

Read table thus; First column, number 1 stands for mental age, etc.; second column, the correlation between mental age and poem scores with chronological age held constant is .53.

The correlation between poetry scores and chronological age with the mental age held constant is -.16. The correlation between nonsense syllable scores and chronological age with the mental age held constant is .24. The correlation between poetry scores and mental age with the chronological age held constant is .53. The correlation between nonsense syllable scores and chronological age with mental age held constant is .24.

The results of the partial correlations are in substantial agreement with those presented in Tables VII and VIII in that they tend to point to the relative unimportance of chronological age as compared with mental age. This is clearly borne out in the case of the poetry scores. The partial correlations in the case of the syllable scores do not substantiate the results of Table VII and VIII with regard to the relative importance of chronological age and mental age as determining factors in these

scores. Again this may be due to the apparent unreliability of the syllable scores.

An effort was made to determine the effect of grade placement upon the scores. This was carried out by comparing groups of subjects of the same mental age but of different school placement.

TABLE X

AVERAGE SCORES FOR GROUPS OF SUBJECTS WITH THE SAME MENTAL AGE BUT DIFFERENT SCHOOL GRADE PLACEMENT

Av. M. A.	School grade	Av. I. Q.	Av. poem score	Av. syll. score	No.
8	2B	116	6.6	3.6	7
8	2A	117	11.0	5.0	7
9	2A	120	13.8	5.0	4
9	3	116	11.3	5.3	13
10	3	117	11.2	5.0	10
10	4	113	12.8	5.3	6
10	5	101	15.6	6.2	5
11	4	120	17.5	6.4	7
11	5	113	15.1	6.5	15
11	6	104	19.1	7.1	7
12	4	122	15.5	6.5	4
12	5	117	12.5	6.5	4
12	6	106	12.2	6.2	14

Read table thus: In a group of subjects whose average mental age is 8, and whose school grade is 2B, the average I. Q. is 116, the average poem score is 6.6, the average syllable score is 3.6, and the number of subjects is 7.

By inspection of Table X, it is seen that students in the

higher grades have a tendency to memorize poetry more readily than students with the same mental age who are in lower grades. This tendency is a little more pronounced in the case of nonsense syllables.

The final problem arises concerning the relation of age to retentive ability. Saving scores were computed from the retention tests given one week after the first experiment. Judging from these there is no significant difference between the retention ability of one year group and the retention ability of another year group. Table XI shows that the average saving scores of the various year groups for memorizing poetry range from .67 to .82, but no definite relationship is indicated. The average saving scores for memorizing nonsense syllables range from .49 to .65 and again no relationship is indicated between the various year groups. It is interesting to note in Table XI that the highest average saving score for the retention of nonsense syllables is lower than the lowest average saving score for memorizing poetry.

TABLE XI

ONE WEEK RETENTION SAVING SCORES FOR MEMORIZING
POETRY AND NONSENSE SYLLABLES

Year group	Av. poem sav. score	Av. syll. sav. score
7	.72	.60
8	.67	.49
9	.68	.63
10	.75	.56
11	.68	.54
14	.82	.65

Read table thus: For one week retention in the 7-year group, the average poem saving score is .72 and the average nonsense syllable saving score is .60.

Saving scores were computed on the retests given approximately 6 weeks after the first experiment. The averages for the respective year groups are given in Table XII.

TABLE XII

SIX WEEK RETENTION SAVING SCORES FOR MEMORIZING
POETRY AND NONSENSE SYLLABLES

Year group	Av. poem sav. score	Av. syll. sav. score
7	.69	.11
9	.72	.48
11	.69	.44

Read table thus: For six week retention in the 7-year group, the average poem saving score is .69, and the average nonsense syllable saving score is .11.

There is little difference between the average saving scores for poetry retention computed on the retests given

approximately 6 weeks after the first experiment and these average saving scores computed on the retests given 1 week after the first experiment. It will be observed that a much larger percentage of the poetry is retained over the six weeks period than that of nonsense syllables. This is in agreement with the well known fact that meaningful material is retained relatively long as compared with nonsense material.

In order to throw further light on the retention ability of the various year groups, groups of subjects who made the same score on the poetry and groups of subjects who made the same score on the nonsense syllables were studied. Table XIII summarizes the results for poetry.

TABLE XIII

AVERAGE POETRY SAVING SCORES FOR GROUPS OF SUBJECTS IN DIFFERENT YEAR GROUPS WITH THE SAME POETRY SCORES FOR ONE WEEK RETENTION

Year groups	Score 8		Score 16		Score 20	
	No.	Av. sav. score	No.	Av. sav. score	No.	Av. sav. score
7	5	.67	3	.66		
8	6	.70				
9	3	.79	5	.67	4	.61
10	5	.62	6	.67	5	.77
11			4	.69	7	.80

Read table thus: In the 7-year group, the 5 subjects who made a poetry score of 8 have a one week retention average saving score of .67; the 3 subjects who made a poetry score of 16 have a one week retention average saving score of .66.

As age increases the average saving scores for one week

retention increase for groups of subjects who have memorized the same number of lines of poetry in 15 minutes. While the number of cases meeting these conditions is extremely small, there is an indication that older students with a certain poetry score retain better than younger students with the same poetry score. All groups which were sufficiently large for comparison were used.

Similar comparisons show that as age increases the average nonsense syllable saving scores increase for groups of subjects who have memorized the same number of nonsense syllables in 10 minutes. This is shown in Table XIV.

TABLE XIV

AVERAGE SYLLABLE SAVING SCORES FOR GROUPS OF
SUBJECTS IN DIFFERENT YEAR GROUPS WITH
THE SAME NONSENSE SYLLABLE SCORES
FOR ONE WEEK RETENTION

Year groups	Score 4.		Score 5	
	No.	Av. sav. score	No.	Av. sav. score
7	7	.21	5	.47
8	7	.49		
9	8	.56	7	.48
10			10	.68
11			5	.65

Read table thus: In the 7-year group the 7 subjects who made a nonsense syllable score of 4 have a one week retention average saving score of .21; the 5 subjects who made a nonsense syllable score of 5 have a one week retention average saving score of .47.

Only the seven groups as shown in Table XIV were found that were sufficiently large for comparison. They indicate as in the case of poetry that older subjects with a certain nonsense syllable score retain better than younger subjects with the same score.

C O N C L U S I O N S

1. There is a significant relation between mental age and poetry scores, also between mental age and nonsense syllable scores.
2. The relation between chronological age and poetry and nonsense syllable scores is negligible when mental age is controlled.
3. No significant relation is indicated between age and retention.

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A P P E N D I X

Meaningful material. The three parts of the following poem comprised the meaningful material.

The Story of the Jabberwock
by
Dr. Norman Triplett

Part I

Away down south
Where the monkeys talk
They tell this tale
Of the Jabberwock.

They say this beast
Is very dumb,
But the strangest thing is,
He has no thumb.

They say his paws
Are so big and fat
That he can't do a thing
With his ball and bat.

His great big legs
Are so fat and thick
That even a football
He can't kick.

And when he tries
To run a race
He falls down flat
On his big fat face.

Part II

They say this beast
Is so dull and slow
That he doesn't know a thing
That he ought to know.

He can't do this,
And he can't do that,
And he doesn't even know
How to spell his hat.

He thinks that three
And three make four,
Why, he doesn't know enough
To shut the door.

Five and five,
He doesn't know,
He can't even tell
Which is his sore toe.

You'd think a fellow
Who is such a fool
Would be mighty glad
To go to school.

Part III

But he lies around
In the shade of a tree
And eats paw paws
Till half past three.

Then he stuffs himself
On the luskly lime
And ripe jujubes
Till past bed time.

And when his maw
Says "Go to bed"
He makes a fuss
And paints things red.

No wonder the monks
In the trees all mock
At the funny ways
Of the Jabberwock.

I'm sending the story
To Margaret Stroud
If she'll accept it
I'll be quite proud.

Rote material. The following six lists of nonsense syllables comprised the rote material.

List I

vax
sor

xif
lij

fuj
pez

baf
sax

sov
fab

List II

jod
naq

gak
kef

baj
yox

sek
heb

buh
jie

List III

bij
geh

rix
fih

gok
soz

dah
fud

vas
heg

List IV

gag
lej

vop
gik

lih
ceg

kir
deh

tob
zug

List V

gan
pis

taj
rog

gip
xoz

roo
tes

dak
reh

List VI

bih
kij

nix
soz

vaj
fub

kol
guf

vif
nis

71240

6