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INTRODUCTION

This study is designed to throw light upon the following problems in memorization: First, the relation of length of material to its difficulty; second, the length of material in relation to retention; third, the relation of learning to retention; fourth, the correlation between the learning of nonsense material and sense material; fifth, a comparison of the reliability of poetry and nonsense scores; and sixth, a comparison of 'time' and 'trial' scores.

Historical Summary

To Herman Ebbinghaus, a student of Fechner, must be given the credit for the first scientific experimental work on memory. Before Ebbinghaus made his first attempt to apply precise scientific method to the study of the higher mental processes, the subject of memory had been regarded as being too subjective and too personal for exact and quantitative treatment. Ebbinghaus devised the so-called nonsense syllables which have proved to be real assets in the study of memory.

All of Ebbinghaus' experiments were carried out upon himself as the subject. These experiments were preformed in a very careful and highly controlled manner.

Of the Ebbinghaus experiment Garrett[1] said:

In attempting to summarize in brief space Ebbinghaus's chief contribution to experimental psychology, we must certainly

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1 Henry E. Garrett, Great Experiments In Psychology, pp. 76-77

list (1) his introduction and use of quantitative methods in the study of learning and forgetting; (2) his measurement of the factors governing fixation, retention, and recall in verbal learning; and (3) his invention of nonsense syllables. Ebbinghaus's memory methods are to-day standard procedures in the psychological laboratory. His main results may be accepted substantially as he left them. Of his invention of nonsense syllables Titchener remarks. "It is not too much to say that the recourse to nonsense syllables, as a means to the study of association, marks the most considerable advance, in this chapter of psychology, since the time of Aristotle", in brief, Hermann Ebbinghaus was the founder of the quantitative study of association.

(1) Length and Difficulty. Much work has been done upon the effects of the length of the series upon the difficulty of its acquisitions. The results have differed considerably in various investigations but they all tend to show that as the length of the series is increased there was a much greater corresponding increase in the time necessary for its mastery.

It has been the common belief that the longer the material to be memorized, the harder it is to learn to the point of memorization. The question then arises: Will the learning of a ten-stanza poem require twice as much time as will a poem of five stanzas? The foregoing question was attacked by Ebbinghaus in 1885. As would be expected, it required a longer time to learn a long list than it did to learn a shorter list. Ebbinghaus found that, as a rule, he could repeat a list of twelve syllables after seventeen readings, while it took forty-four readings to learn twenty-four syllables.[2] For a comparison, Ebbinghaus' results may be stated as follows:[3]

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2 Darwin Oliver Lyon, "The Relation of Quickness of Learning to Retentiveness" ARCHIVES OF PSYCHOLOGY, No. 34, (January 1916)
3 Henry E. Garrett, Great Experiments in Psychology, p. 54.

Length of lists	Number of readings	Time for lists	Ave. time per syl.
7	1	3 sec.	.4 sec.
10	13	52 sec.	5.2 sec.
12	17	82 sec.	6.8 sec.
16	30	196 sec.	12.0 sec.
24	44	422 sec.	17.6 sec.
36	55	792 sec.	22.0 sec.

It is clear that Ebbinghaus found that as the length of material is increased its difficulty increases at an increasing rate. The rate is not entirely uniform. However, this would probably be too much to expect with a single subject.

Strong,[4] in his study, "The Effect of Length of Series Upon Recognition Memory" presented his 40 subjects with varying lengths of advertisements. He found that the number in a series of stimuli affected the results almost in direct proportion to the increase; that is, as the number of the stimuli increased, the percentage that could be recognized decreased.

In Schmidt's [5] study of advertising the increase of material led to more errors in recognition.

Robinson and Heron [6] in their study, entitled "Results of Variations in Length of Memorized Material", cited the fact that the relation between length of material and effort to learn has been expressed by many writers as a relation between length and

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4 E. K. Strong, "The Effect of Length of Series Upon Recognition Memory", PSYCHOLOGICAL REVIEW, Vol. 19, pp. 447-62.

5 John A. McGeoch, "Memory", PSYCHOLOGICAL BULLETIN, Vol. 35, p. 533.

6 E. S. Robinson and W. T. Heron, "Results of Variation in Length of Memorized Material", JOURNAL OF EXPERIMENTAL PSYCHOLOGY Vol. 5, pp. 428-48.

repetition. Only two or three have realized that one repetition was a unit, the magnitude of which varies directly with the length of material. When the effort required in learning is measured in terms of constant units, e. g., learning time, the relation between length and difficulty usually showed a positive acceleration. That is, as the length increased difficulty increased at an increasing rate.

Robinson and Darrow's [7] study, "Effect of Length upon Memory for Numbers", cited the fact that there was a general, but not a very consistent tendency for the rate of forgetting to vary inversely with the length.

In reference to length and difficulty of learning Lyon [8] in his experiment, "The Relation of the Length of Material to the Time Taken to Learn, and the Optimum Distribution of Time", compared his results to those of Henman, Though both men used only three subjects and only one kind of material, their findings are very significant. Table I shows the results of these two studies.

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7 Robinson and Darrow, "Effect of Length upon Memory for Numbers", AMERICAN JOURNAL OF PSYCHOLOGY, Vol. 35, p. 243.

8 Darwin Oliver Lyon, "The Relation of the Length of Material to the time Taken to Learn, and the Optimum Distribution of Time", JOURNAL OF EDUCATIONAL PSYCHOLOGY, Vol. 5, p. 1.

TABLE I

REPETITIONS REQUIRED TO LEARN VARIOUS LENGTHS OF POETRY

Henman		Lyon	
Number Stanzas	Subjects H. D. P.	Number Stanzas	Subjects C. L. M.
1	3 3 4	2	7 6 5
2	5 6 7	5	17 16 14
3	6 9 10	10	19 22 16
4	7 11 12	25	22 19 16
5	9 14 14	50	30 25 23

Read table thus: Subject number I required three trials to learn one stanza of poetry.

From Lyon's study it is seen that the number of repetitions does not increase as fast as the number of stanzas.

In Miss Washburn's [9] study, "An Experimental Study of Various Graphic, Tabular and Textual Methods of Presenting Quantitative Material", it was found that simple visual pattern and few data favored specific recall; while the more complex the pattern and more numerous the data, the more general the recall. An increase in the number of data shown in a graph affected unfavorably the recall of specific amounts, but did not thus affect the recall of static and dynamic comparisons.

In learning nonsense syllables, Gamble,[10] in her experiment "A Study of Three Variables in Memorizing", stated that the difficulty did not increase in proportion to the increase in the series length, in rate, or in number of presentations. Here the work pointed to important interrelationships between variables of length, rate, and frequency.

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9 J. N. Washburn, "An Experimental Study of Various Graphic, Tabular and Textual Methods in Presenting Quantative Material" JOURNAL OF EDUCATIONAL PSYCHOLOGY, Vol. 18, pp. 361-76, 465-76.

10 E. A. Gamble, "A Study of Three Variables in Memorizing", AMERICAN JOURNAL OF PSYCHOLOGY, Vol. 39, pp. 223-34.

Robinson and Darrow,[11] working on the problem of the relation of length of numbers to time required to learn, established the fact that the amount of time required for memorizing increased at a mounting rate as the lists became longer.

(2) Length and retention. Ebbinghaus [12] found in his experiment, that on retesting twenty-four hours later the longer lists were better retained. The additional work in learning which the long list demanded produced and enduring effect, much as if it had been devoted to the over-learning of shorter lists, according to this author.

E. Meumann,[13] made the following coment, in regard to the Ebbinghaus' experiment in the learning of poetry:

> As to the influence of length of series, it was found that the longer series were more indelibly imprinted, - that is, they were retained better; indeed, the groups of thirty-six syllables were imprinted almost twice as thoroughly as the groups of twelve syllables. Significant material was remembered very much better than meaningless material.

Ludeke's [14] shorter lists of constants, learned by a form of the memory span method, resisted the longer intervals between presentation and recall better than did the longer lists.

In regard to retention Adams [15] found, that a word isolated on a page had no greater recognition value than two or four words per page.

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11 Robinson and Darrow, "Effect of Length upon Memory for Numbers", AMERICAN JOURNAL OF PSYCHOLOGY, Vol.35, p. 243.

12 Darwin Oliver Lyon, "The Relation of Quickness of Learning to Retentiveness" ARCHIVES OF PSYCHOLOGY, No. 34,(January 1916) p. 3.

13 E. Meumann, Psychology of Learning, P. 334.

14 John A. McGeoch, "Memory", PSYCHOLOGICAL BULLETIN, Vol. 35, p. 533.

15 H. F. Adams, "Memory as Affected by Isolation of Material and by Repetition", JOURNAL OF APPLIED PSYCHOLOGY, Vol. 11, pp. 25-32.

Carr [16] is of the opinion that the longer and more difficult the material, the better it is retained. For example, a list of twenty words would be retained more effectively than would a similiar list of ten words. He suggested that this fact probably was due to the greater effort required to memorize the longer list.

McGeoch [17] found that in the case of nonsense syllables and numbers, suceptibile to retroactive inhibition decreased as the lists increased in length. This suggests an inverse relation between the degree of learning and retroaction, since the longer lists were also better learned.

Robinson and Heron [18] in their study, "Results of Variations in Length of Memorized Material", found that shorter materials are more rapidly forgotten than longer materials. The memory curve for all lengths of material studied by these men shows a general negative acceleration. These curves vary regularly according to the length of the material represented.

Abramson [19] found that the more intelligent children recalled better the differential features of objects. The less intelligent children recalled well the location of objects.

(3) The relation of learning ability to retention. Henderson [20] found in his "Study in Memory" that in general those who learn prose quickly are able later to recall a greater percentage of what they have learned than the slow learners. In other words, he

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16 Harvey A. Carr, Psychology, p. 243.
17 John A. McGeoch, "Studies in Memory", AMERICAN JOURNAL OF PSYCHOLOGY, Vol. 41, p.
18 E. S. Robinson and W. T. Heron, "Results of Variations in Length of Memorized Material", JOURNAL OF EDUCATIONAL PSYCHOLOGY. Vol. 5, pp. 424-48.
19 John A.McGeoch,"Memory",PSYCHOLOGICAL BULLETIN,Vol. 25,p.536
20 E. N. Henderson, A Study in Memory," PSYCHOLOGICAL REVIEW MONOGRAPH SUPPLEMENT, No. 25, 1903.

found that the power to learn readily correlated with the power to remember what had been learned. In his experiments, however, he did not allow his subjects to completely learn the material. His method, briefly, was as follows: He requested his subjects to read twice a selection taken from "The Dutch Homestead" by Irving. Three minutes were 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. He found that his older subjects learned somewhat better than the younger and explained this as due to their greater capacity to understand. This capacity, however, seemed to have no influence on the relative retention. Henderson's results cannot be held to apply to nonsense syllables or other meaningless material; and even with respect to connected prose, the material which he used, his results are not directly comparable with those of experiments in which complete memorizing has occured.

From Lyon's [21] study, "Relation of Quickness of Learning to Retention" the following quotation was taken:

> As regards retention, Muller and Schumann found that the persons who memorized a series of nonsense-syllables in the shortest time also relearned it in the shortest time after 24 hours. This was to be expected, since what is forgotten can be relearned more quickly by a quick learner than by a slow learner. But the slow learner saved more time, both absolutely and relatively, than the fast learner. When the relearning was compared with the original learning.... Ogden, in his paper entitled "Ueber den Einfluss der Geschwindigkeit des lauten Lesens auf das Erlernen und Behalten von sinnlosen und sinnvollen stoffen," obtain results much the same as those of Muller and Schumann.... Ogden used both logical as well as nonsense material and his results were practically the same for both.

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21 Darwin Oliver Lyon, "The Relation of Quickness of Learning to Retentiveness" ARCHIVES OF PSYCHOLOGY, No. 34, (January 1916) p. 3.

In Good's [22] study, "The Effect of Extensive Reading on the Reproduction of Ideas or Thought Units", he found that the upper quartile in intelligence was a little better in reproduction of ideas than was the lower quartile. He suggested that, while the lower students did almost as well as the others in the somewhat mechanical process of reproduction, they did less in thought-requiring performances.

In regard to individual differences, Whitehead, [23] in his experiment dealing with visual and aural processes, stated that the slow learners, in a shorter time, both relearn and retain a larger amount than did the rapid learners.

In 1911, Busemann, [24] in an article "Learnen und Behalten", published the results of seven years' work on various aspects of the memory problem. From his results he concluded that, of two individuals, the one who required the greater amount of time in memorizing a series of words would require less time, relatively, in relearning them.

Buseman's results, however, as far as they go, would seem to point against the assumption that it is the quick learners who forget quickly. In summing up his work on this subject he said; "It has not yet been proven that a greater ability to learn corresponds to a smaller ability to retain; - on the contrary it is probably true that the good learner is at the same time a good retainer".

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22 C. V. Good, "The Effect of Extensive Reading on the Reproduction of Ideas or Thought Units" EDUCATIONAL PSYCHOLOGY, Vol. 18, pp. 477-85.

23 -- Whitehead, "Study of Visual and Aural Memory Processes", PSYCHOLOGICAL REVIEWS, Vol. 3, p. 258.

24 D. O. Lyon, "Relation of Quickness of Learning to Retention", ARCHIVES OF PSYCHOLOGY, No. 34, (January 1916) p. 14.

Myers,[25] in "A Study of Confusion", used fifty girls as subjects. Time was recorded but the subjects were given all the time needed to memorized a list of words and figures. The distribution for both learning and relearning time showed wide variations toward the upper limit. The upper quartile for learning time was 383 seconds; the lower quartile was 672 seconds. The recall times were 268 and 90, respectively. The correlation between learning and recall time was -.38 ± .0816. This negative correlation indicated that when the learning time was high the recall time was low and vice versa. It probable meant that the girl who took plenty of time in making certain her learning was more certain of her reproduction.

(4) Relation between learning of nonsense material and sense material. Experiments conducted by Achilles in "Recall and Recognition" led him to state that, persons who recalled well one form of material might not recall another form well.[26]

The nature of the material memorized played and important role in all of the previous studies. Carr [27] stated that meaningful material was usually more easily remembered than was a list of disconnected items - at least when retention was measured by the relearning method.

Key,[28] in his study "Recall as a Function of Perceived Relations", found the learning values for words with commonplace relations from the Kent-Rosanoff list were from one and one-half to two times as great as for words with unique relations.

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25 G. C. Myers, "A Study of Confusion", PSYCHOLOGICAL REVIEW, Vol. 7, pp. 546-47.
26 Edward S. Robertson, "Memorizing", PSYCHOLOGICAL BULLETIN, Vol. 21, pp. 576-77.
27 Harvey Carr, Psychology, p. 243.
28 C. B. Key, "Recall as a Function of Perceived Relations", ARCHIVES OF PSYCHOLOGY, No. 83, Vol. 13, p. 106.

In an experiment, "Repetition and Association in Learning", Reed[29] reported the following results: (1) The memory span for words in a sentence is four times as great as for disconnected words: (2) Prose which arouses familiar associations requires less than half the time for memorization than does prose not arousing such associations.

Maul[30] in her recent study "An Investigation of Relation Between Age And The Ability To Memorize And Retain Meaningful And Nonsense Material", found a correlation of .67 ±.02 between syllable and poetry scores. She suggests that this correlation is probably about as great as the reliability coefficient of either kind of material.

The following findings in relation to the learning of "significant versus nonsense" material were given by Hunter:[31]

Significant material, i. e., prose, poetry, pictures, ect., is more readily memorized than an equal amount of nonsense material, and, moreover, it is better retained.... Radowwasljewitsch, work-with the saving method... found the relative retention of poetry and nonsense material to be as follows:

Period since learning was completed	Percent of nonsense material retained	Percent of poetry retained
5 minutes	98	100
20 "	89	96
1 hour	71	78
8 "	47	58
24 "	68	79
2 days	61	67
6 "	49	42
14 "	41	30
30 "	20	24
120 "	3	..

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29 H. B. Reed, "Repetition and Association in Learning", PEDAGOGICAL SEMINARY, Vol. 31, pp. 147-55.

30 R. B. Maul, An Investigation of Relation Between Age and The Ability to Memorize and Retain Meaningful and Nonsense Material, Unpublished Master's Thesis, Kansas State Teachers College, Emporia, Ks.

31 W. S. Hunter, General Psychology, University of Chicago Press, Chicago, 1924, p. 318.

(5). The reliability of memory scores. The literature relative to the reliability of material and scores was extremely limited. No better treatise of this subject could be made other than quoting John A. McGeoch: [32]

> The Reliability of Memory Experiments. There has been no systematic investigation of the reliability of memory experiments, such as has been made by Hunter and his students in the case of the maze experiment. Coefficients of reliability have been, however, reported occasionally and in an incidental fashion. The largest set of reliability coefficients has been given by Woodrow (134) in connection with his study of transfer. His correlations are between end-tests similar in form but different in content. The coefficients are: rote poetry 0.67, rote prose 0.49, facts (substance) 0.48, historical dates 0.60, Turish-English vocabulary 0.70, auditory memory span for consonants 0.55. Lemmon (67a), correlating either repeated trials or alternate items, obtains the following coefficients: logical memory 0.60, auditory paired associates 0.85, visual paired associates 0.94, and Turkish-English substitution 0.91.
>
> The correlation between the number of exposures required for two 8-syllable lists given a week apart is 0.66 according to Baxter (10); memory for ideas correlated to the extent of 0.78, even when the repetition of the experiment did not occur under exactly similar conditions; and logical memory materials given twice a week apart, gave a coefficient of 0.76. Shaffer (107) obtains self-correlation of 0.61 and 0.71 for two units of logical memory material.
>
> The reliability coefficients listed have been obtained with widely varying numbers of subjects and under diverse conditions. The striking thing about them is that they are uniformly higher than the coefficients obtained for the maze experiment.

PURPOSE

(1) Experiments generally have found that as the length of material is increased its difficulty increases at an increasing rate. This is commonly accepted as a universal tendency. Most of the evidence, however, rests upon studies in which nonsense syllables and digits constituted the experimental material.

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32 McGeoch, "Memorizing", THE PSYCHOLOGICAL BULLETIN, Vol. 25, pp. 513-49.

As a matter of fact Henmon and Lyon, cited above, found that this was not the case with poetry. Increasing the length of poetry increased the number of trials to learn but not in proportional amounts. In as much as these two investigators only used three subjects each, it has seemed desirable to set up an experiment with a more adequate number of subjects in which the comparative effect of increasing the length of nonsense syllables and poetry upon their difficulty may be determined with the same subjects and the same experimental technique. This is one of the aims of the present study.

(2) Authorities usually agree that a greater percentage of longer lists is retained than that of shorter lists. This opinion seems to rest upon no ample or systematic body of facts. It was deemed advisable to obtain retention scores upon all of the subjects for both kinds of material and incorporate the extension of this problem into this study. Especially did it seem worthwhile to be able to compare the two kinds of material with respect to this problem.

(3) The relation obtained between learning and retentive ability is perhaps to some extent a function of the methods used. It isthe aim in the present feature of this study to determine the relationship between learning and retentive ability, when three different measures of retention are employed.

(4) As noted above several investigators have reported determinations of relationships between learning rote and meaningful material. Such comparisons suffer, however, from the fact that the reliability of either set of material was not known. It seem

particularly advisable therefore, in the present study to make such a determination since the reliability of each type of material used is known. A correlation of .50, for example, between rote and meaningful material should be interpreted in the light of the reliability of the scores in question. Should the reliability of the scores be .90 the correlation of .50 would be considered low. If the reliability of the scores should be in the neighborhood of .50, a high degree of relationship between learning rote and meaningful material would be indicated.

(5) The problem of individual differences in retentivenes has been subjected to much investigation. The relation of sex, age, learning ability, and many other problems, to retention has been studied. In the present study an attempt will be made to determine the extent to which individuals of the same learning capacity differ in retentive ability and the consistency with which these differences obtain. In the present experimental set-up the author is fortunate in having a complete set of 8 learning and retention scores upon each of the 39 subjects.

(6) While the present expermental procedure is not ideally arranged for the determination of the relation of length of learning material to the reliability of the scores, it is nevertheless, possible to make rough approximations. A brief section of this manuscript is devoted to a consideration of this problem.

(7) The wide usage of nonsense syllables in memory experiments is doubtless due in a large measure to the supposition that they are more reliable than of meaningful material, such as poetry or prose. The literature apparently contains no very systematic attempt to compare their reliability. In the present study it is possible

to compare syllables and poetry with respect to reliability, under the same experimental conditions and with the same subjects.

(8) Experimenters have usually sought to express rate of learning and degree of retention both in time and trial scores. It seems desirable, therefore, to compare them as to reliability.

Material and Subjects

The material used in this experiment was both sense and nonsense in nature. The sense material was composed of portions of two poems, namely, the first thirty-two lines of Scott's William and Helen, and the first twenty-four lines of Coleridge's poem Love. The poems used were rather uniform with respect to content and metrical arrangement. There were four lines to the stanza and about four feet to the line. These stanzas were disunited, placed face down and thoroughly mixed. They were then drawn out by chance and as a result no two stanzas fell in their original order in the poem.

The stanzas were thus arranged so that they could be shifted systematically from one experimental list to another in order to exercise some control over their varying difficulty. Differences in results in a complex experimental arrangement such as this might be due to differences in the difficulty of the lists used. Each subject learned four lists of stanzas, one each on four consecutive days. The four lists consisted of 2,3,4, and 5 stanzas respectively. Thus 14 stanzas were used altogether. Seven series of lists were prepared in such a way as to shift the stanzas from list to list. For example in series 1, list 1 was made up of stanzas

1 and 2, list 2, of stanzas 3,4 and 5; list 3, of stanzas 6,7,8 and 9; and list 4 consisted of stanzas 10,11,12,13 and 14. In series 2, list 1 consisted of stanzas 3 and 4; list 2 of stanzas 5,6 and 7; list 3 of stanzas 8,9,10, and 11; list 4 of stanzas 12, 13,14,1, and 2. This process was continued until 7 such lists were made out. Thus in the 7th series, list 1 consisted of stanzas 13 and 14, list 2,of 1,2 and 3, list 3 of 4,5,6, and 7, and list 4 of 8,9,10,11,and 12. The first subject would learn the lists according to series 1, the second according to series 2, and so on for the seven series. The eight subject would learn them according to series 1, the ninth according to series 2, and so on. A detailed arrangement is given in appendix I.

The nonsense material consisted of three letter syllables constructed according to definite rules suggested by Muller and Schumann.[33] Combinations of letters which spelled words were excluded. From the group of ninety syllables, forty were selected at random and used in the experiment. Care was taken that rhymes and meaningful combinations of syllables should be excluded. No syllables were used the second time with any subject.

The syllables were presented in pairs, in vertical order, with double-spaces between syllables of a pair and four spaces between each pair.

Four lists of syllables were used, consisting of 4,8,12,and 16 syllables each. The subjects learned one list each for four consecutive days. They were arranged into series and the particular syllables shifted from list to list as in the case of the stanzas. Appendix I, shows the complete arrangement. The subjects learned a list of syllables and stanzas at the same sitting, as 2 stanzas

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33 E. Meumann, Psychology of Learning, D. Appleton and Company, New York, 1913, pp. 365-68.

and 16 syllables, 3 stanzas and 12 syllables, etc.

The subjects were 39 college students of the following classifications, 12 graduates, 12 seniors, 5 juniors, 5 sophomores, and 5 freshmen.

Procedure

The progressive part method by direct recall was used in learning and relearning both the sense and the nonsense material. Individual testing was conducted throught the study. Each subject was met on four consecutive days for learning and was retested on four consecutive days one week later. At each sitting, the subject learned (to one correct repetition) one list of sense material and one list of nonsense material. In order that a fair test of retention might be obtained, the subjects were instructed not to attempt to recall the material after leaving the laboratory.

Each subject learned all the material in the same room, seated in the same chair, at the same hour each day, with the same environmental conditions.

In learning, the subject was instructed to read aloud each stanza of poetry three times and repeat as much of it as he could. The nonsense material was read twice and then repeated. Thereafter repetitions and recall alternated in the case of both kinds of material, a recall following each repetition until the material was mastered. The syllables were recalled verbally by spelling them out. Scores were kept both in terms of time and trials.

RESULTS AND DISCUSSIONS

(1) Relation of length of material to its difficulty. The relation of length of material to its difficulty as expressed in time and trials required to learn for nonsense syllables is shown in Tables II and III, and figures I and II respectively. Figures I and II are graphical representations of the data of Tables II and III. Table II and figure I show the effect in terms of time. Table III and figure II show the results in terms of trials.

TABLE II

RELATION OF LENGTH OF LIST OF NONSENSE SYLLABLES TO TIME REQUIRED TO LEARN

Length	4 syl.	8 syl.	12 syl.	16 syl.
Time in min.	1.1	6.0	13.0	19.0

Read table thus: In learning the 4-syllable list, it required 1.1 minutes, 8-syllable list 6 minutes.

An examination of the data in Table II and of figure 1 indicates very clearly that there was a progressive increase in time as the length of the series increased. Attention is called to the relative, short time required to learn the 4-syllable list. As would be expected, this length of list is within the memory span of every subject.

TABLE III

RELATION OF LENGTH OF LIST OF NONSENSE SYLLABLES TO TRIALS REQUIRED TO LEARN

Length	4 syl.	8 syl.	12 syl.	16 syl.
Trials	5	12	20	28

Read table in same manner as Table II.

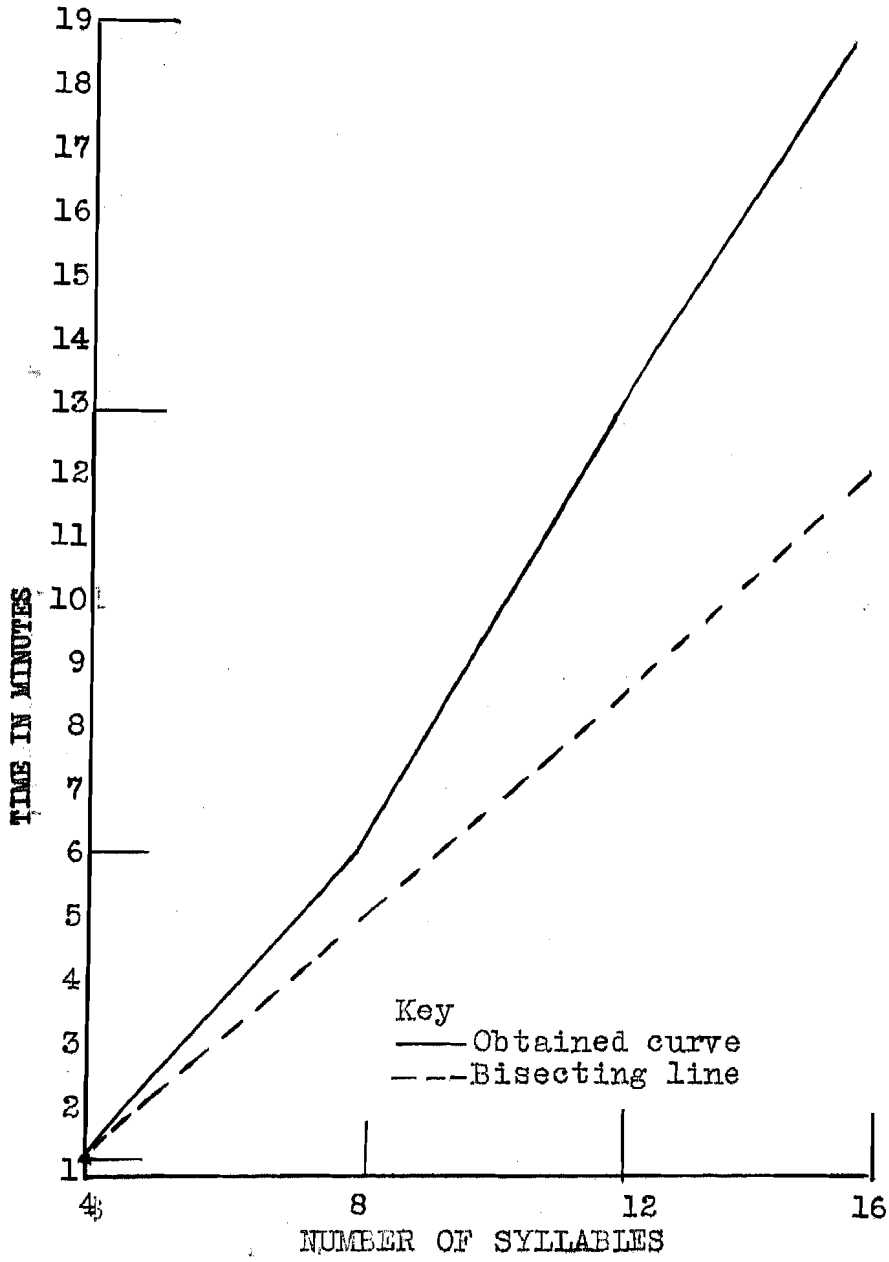

FIGURE 1. RELATION OF LENGTH OF LIST OF NONSENSE SYLLABLES TO TIME REQUIRED TO LEARN.

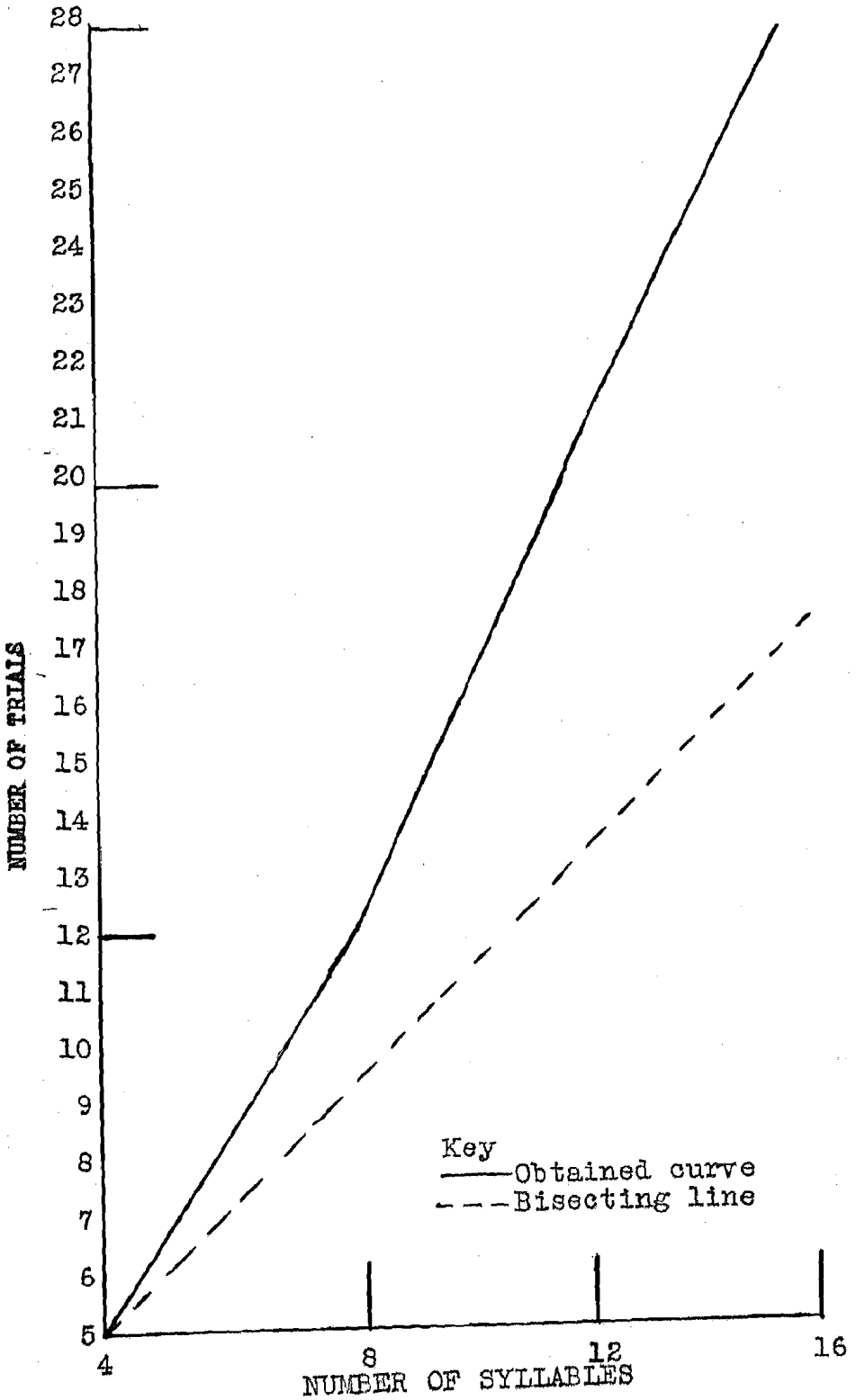

FIGURE 2. RELATION OF LENGTH OF LIST OF NONSENSE SYLLABLES TO TRIALS REQUIRED TO LEARN.

It will be observed by comparison of the foregoing data that practically the same effect of increasing length upon difficulty is expressed by time and trials. These results confirm those of Ebbinghaus [34], Robinson and Heron, [35] and others relative to the effect of length of rote material upon its difficulty.

These curves may be more easily interpreted by comparing the obtained curves with the broken diagonal line. If length and difficulty increased at the same ratio, the curves should approximate this line. Since in the case of learning the lines (curves) are steeper than (the slope of the broken diagonal line) it is clear that the difficulty is increasing faster than length.

Tables IV and V and figures 3 and 4 show the effect of increasing length of poetry upon difficulty. Table IV and figure 3 give results in terms of time, while Table V and figure 4 show the effect in terms of trials.

TABLE IV

RELATION OF LENGTH OF POEM TO TIME REQUIRED TO LEARN

No. lines	8	12	16	20
Time in min.	5	9	13	15

Read table thus: In learning the 8-line list, it required 5 minutes, 12 line list 9 minutes.

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34 Hermann Ebbinghaus, op. cit. p. 6.
35 E. S. Robinson and W. T. Heron, op. cit. p. 3.

TABLE V

RELATION OF LENGTH OF POEM TO TRIALS REQUIRED TO LEARN

No. lines	8	12	16	20
Trials	10	13	18	21

Read table thus: In learning the 8-line list it required 10 trials, 12-line list 13 trials.

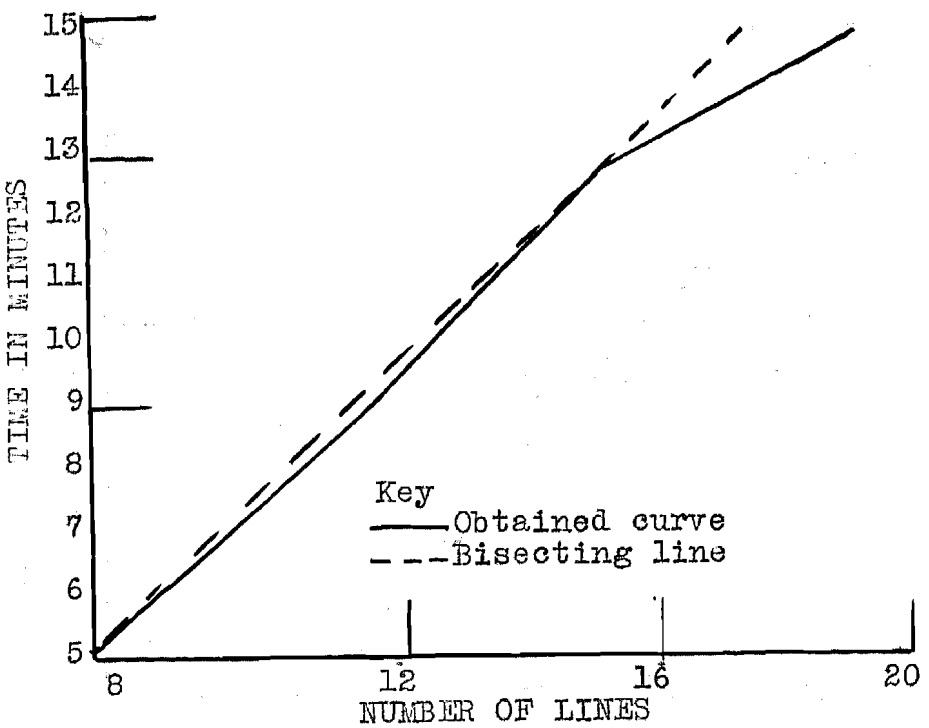

FIGURE 3. RELATION OF LENGTH OF POEM TO TIME REQUIRED TO LEARN.

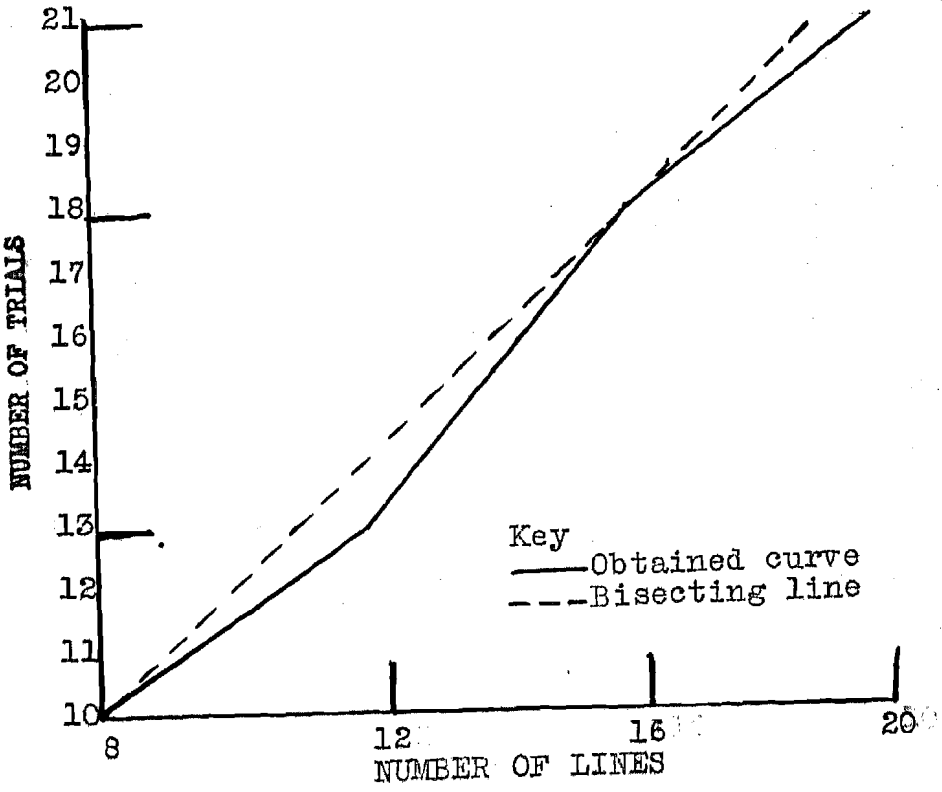

FIGURE 4. RELATION OF LENGTH OF POEM TO TRIALS REQUIRED TO LEARN.

Examination of Tables IV and V and figures 3 and 4 reveals that increasing the length of poetry does not have as great an effect upon difficulty as does increasing the length of nonsense syllables. The curves exhibit somewhat the characteristics of negatively accelerated curves. They reveal a slight tendency for difficulty to increase slower than length. They seem to show that the effedt of increasing length of material upon difficulty is different for the two kinds of material.

These results partially confirm those of Lyon and Henman.[36] They agree in showing that difficulty of poetry does not increase proportionally with increase in length. They differ from their results, however, in that they show a much slighter tendency for difficulty to increase at a decreasing rate with length than they found. Two or three reasons may be suggested for this disparity in the qualtitative aspects of the results. Their subjects were too few to insure reliable results. They offered no insurance that their long and short lists were of even difficulty. On the other hand breaking up the logical sequence of stanzas in the present study may have influenced the results in the direction of a more nearly proportioned increase in difficulty with increase in length.

The results of the present study would seem to indicate that in the case of rote material difficulty increases with length at an increasing rate, while that in the case of meaningful material difficulty increases with length at a slightly decreasing rate.

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36 Darwin Oliver Lyon, op. cit. p. 5.

(2) Relation of length of material to retention.

Following are the results of the study of the relation of length of material to retention. Retention is expressed in saving scores and relearning scores. Table VI contains the results for poetry and Table VII contains those for syllables.

TABLE VI

AVERAGE SAVING AND RELEARNING SCORES FOR EACH LENGTH OF POETRY

	Saving scores		Learning scores*		Relearning scores	
Lines	Trials	Time	Trials	Time	Trials	Time
8	.70	.60	10	5.0 min.	3	2.0 min.
12	.69	.67	13	9.0 min.	4	3.0 min.
16	.67	.69	18	13.0 min.	6	4.0 min.
20	.67	.60	21	15.0 min.	7	6.0 min.

Read table thus: The saving score on eight lines of poetry was .70 for trials and .60 for time.

TABLE VII

AVERAGE SAVING AND RELEARNING SCORES FOR EACH LENGTH OF SYLLABLES

	Saving scores		Learning scores*		Relearning scores	
Syl.	Trials	Time	Trials	Time	Trials	Time
4	.40	.55	5	1.1 min.	3	.5 min.
8	.42	.50	12	6.0 min.	7	3.0 min.
12	.45	.54	20	13.0 min.	11	6.0 min.
16	.50	.52	28	19.0 min.	14	9.0 min.

Read this table in the same manner as Table VI

*Learning scores are given for comparative purposes.

An examination of these results shows that in the case of poetry the percentage of material retained as measured by re-learning does not vary with the different lengths used either in time or trials. In case of nonsense syllables the percentage of retention increases with length with respect to trials. No clear tendency is indicated for time scores. This confirms Robinson and Herons [37] results with respect to nonsense syllables (they used nonsense syllables and digits). Perhaps this result would be anticapted for poetry since difficulty of poetry, in this study was found to increase almost proportionally (although not quite) with length. This suggests the possibility that the relation of length to retention is contingent upon the relation of length to learning. It is possible that percentage of material retained will be found to increase with length only when difficulty of learning increases at an accelerating rate with increase in length. Further experimentation may discover such a law.

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37 E. S. Robinson and W. T. Heron, op. cit. p. 7.

(3) The relation between learning and retentive ability. The relation between learning ability and retentive ability as determined by this study is given below. The comparisons are made with respect to three expressions of retentiveness, namely, relearning scores, saving scores, and direct recall scores. Correlation coefficients were computed between the combined 'mean' learning scores and the combined 'mean' relearning and saving scores, and between the combined 'extreme' learning scores and combined 'extreme' relearning and saving scores in terms of trials for both kinds of material. By combined 'mean' scores is meant the combined scores of 3 and 4 stanzas of poetry and 8 and 12 syllable list. By combined extreme scores is meant the combined scores for 2 and 5 stanzas and 4 and 16 syllable lists.

Tables VIII and VIX contain the results.

TABLE VIII

INTERCORRELATIONS BETWEEN LEARNING AND RELEARNING AND SAVINGS TRIAL SCORES FOR NONSENSE SYLLABLES

Learning scores	Relearning scores		Saving scores	
	Means	Extremes	Means	Extremes
Means	.29 ± .09		.26 ± .09	
Extremes		.74 ± .04		-.16 ± .10

Read table thus: The coefficient of correlation between the means learning scores and the means relearning scores is .29 with a P. E. of .09.

TABLE IX

INTERCORRELATIONS BETWEEN LEARNING AND RELEARNING AND SAVING TRIAL SCORES FOR POETRY

Learning scores	Relearning scores		Saving scores	
	Means	Extremes	Means	Extremes
Means	.82 ±.03		.19 ±.10	
Extremes		.62 ±.06		.10 ±.10

Read table thus: The coefficient of correlation between the mean learning scores and the means relearning scores is .82 with a P.E. of .03.

Furthermore, correlation coefficients were computed between the combined 'mean' learning scores and the combined mean relearning scores and between the combined 'extreme' learning and relearning scores in terms of time for both kinds of material. Table X shows the results.

TABLE X

INTERCORRELATIONS BETWEEN LEARNING AND RELEARNING AND SAVING TIME SCORES FOR POETRY AND SYLLABLES

Syllables			Poetry		
Learning scores		Relearning scores	Learning scores		Relearning scores
	Means	Extremes		Means	Extremes
Means	.24 ±.10		Means	.44 ±.08	
Extremes		.36 ±.08	Extremes		.48 ±.08

Read table thus: The coefficient of correlation between means learning scores and means relearning scores is .24 with a P.E. of .10.

As an aid in interpretation of the foregoing correlations the following statement is taken from Rugg:[38]

> The experience of the present writer in examining many correlation tables has led him to regard correlation as "negligible" or "indifferent" when r is less than .15 to .20: as being "present but low" when r ranges from .15 to .20 to .35 or .40 as being "markedly present" or "marked," when r ranges from .35 or .40 to.50 or .60; as being "high" when it is above .60 or .70. With the present limitations or educational testing few correlations in testing will run above .70, and it is safe to regard this as a very high coefficient.

In the light of Rugg's opinion the foregoing correlations would be regarded as showing a marked relationship between learning and relearning scores.

Two methods for testing retention were used in this study, namely, the direct recall and the relearning. It will be noted that relearning was the major method used while the direct recall was used as an incidental test.

On reporting for relearning, each subject was asked to repeat any or all portions of either kind of material that he had learned seven days previous. He was given all the time he wished for this purpose. Only one subject was able to recall any portion of the nonsense material and that portion was too negligible to be considered. The subjects were able to recall a considerable portions of poetry as shown in Table XI.

The subjects were divided into quartiles upon the basis of their learning scores. Comparison is made between learning ability and direct recall and relearning scores for each length of material. Table XI shows the comparison between learning and direct recall and relearning scores for poetry trials.

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38 Harold O. Rugg, Statistical Methods Applied to Education, Houghton Mifflin Company, Boston, 1917, p. 256.

TABLE XI

PER CENT DIRECT RECALL AND AVERAGE NUMBER TRIALS REQUIRED TO RELEARN DIFFERENT LENGTHS OF POETRY BY SUBJECTS OF EACH QUARTILE

	8 lines		12 lines		16 lines		20 lines	
Quartile	% D.R	Tri-als	% D.R	Tri-als	% D.R	Tri-als	% D.R	Tri-als
1	50	1.8	28	2.5	25	4.6	16	5.7
2	10	2.4	6	3.8	0	5.4	4	7.3
3	0	3.1	0	5.1	5	5.9	6	7.2
4	5	4.2	8	6.0	8	7.6	0	7.6

Read table thus: The subject of the first quartile has a 50% and an average relearning score of 1.8 for 8 lines of poetry.

TABLE XII

AVERAGE PER CENT SAVING SCORES FOR DIFFERENT LENGTHS OF POETRY

	8 lines	12 lines	16 lines	20 lines
Q	% Saving	% Saving	% Saving	% Saving
1	72.9	74.1	50.1	46.8
2	71.9	65.4	63.6	65.4
3	69.5	59.5	66.5	64.7
4	63.5	57.3	66.6	65.7

Read table in same manner as Table XI.

Table XIII shows the relation between learning ability for nonsense syllables to their retention as measured by saving and relearning scores for each length of list.

TABLE XIII

PER CENT SAVING SCORE AND AVERAGE NUMBER OF TRIALS REQUIRED TO RELEARN DIFFERENT LENGTHF OF NONSENSE MATERIAL BY SUBJECTS OF EACH QUARTILE

	4 syl.		8 syl.		12 syl.		16 syl.	
Q	% Sav.	Tri-als	% Sav.	Tri-als	% Sav.	Tri-als	% Sav.	Tri-als
1	49.7	3.3	49.9	10.6	40.9	17.3	32.6	23.1
2	49.4	4.8	45.2	11.5	30.6	16.2	13.0	26.2
3	49.5	5.0	46.3	13.1	46.1	23.0	44.4	29.8
4	42.2	5.3	52.3	15.3	47.7	26.5	34.2	33.3

Read table thus: The subjects of the first quartile has a saving score of 49.7% and an average relearning score of 3.3.

The direct recall scores for poetry (none were obtained for syllables) and the relearning scores for poetry and nonsense syllables show that superiority in learning is correlated with superiority in retention. Measured in terms of saving scores the better learners show a higher percentage of saving for the shorter material. For the longer lists, the poor learners show a higher percentage of saving in the case of both kinds of material. This tendency is marked and consistent.

The quartiles in Tables XI, XII and XIII were determined from a composite score of trials taken by the subject in learning 56 lines of poetry and 40 nonsense syllables. Again a very wide range in number of trials was found.

(4) The relation between nonsense syllables and poetry scores. Correlation coefficients have been computed between the poetry and syllable scores for the four different lengths of material, e.g., 8 lines against 4 syllables, 12 lines against 8 syllables, etc. These computations are given in Table XIV.

TABLE XIV

CORRELATION OF POETRY TRIAL SCORES WITH NONSENSE TRIAL SCORES

Poetry	4 syl.	8 syl.	12 syl.	16 syl.	40 syl.
8 lines	.46 ±.08				
12 lines		.66 ±.06			
16 lines			.85 ±.02		
20 lines				.60 ±.06	
56 lines					.81 ±.03*

Read table thus: 8 lines of poetry correlated with 4 nonsense syllables gives a coefficient of .46 and a P. E. of .08.

It will be observed that all these correlations were positive and are high enough to be very reliable. The lowest correlation was found between shortest lengths of material which points to the fact that length is an important factor.

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*The 56 lines of poetry and the 40 nonsense syllables were not learned as a unit. The correlation of their composite scores was found to be .81.

(5) Reliability of poetry and nonsense syllable scores. As stated above the experimental procedure followed in this study is not ideal for purposes of determining reliability. However, the method followed in making these determinations may be sufficiently valid to serve as a suggestion of the reliability of each type of material. The procedure is that of correlating the scores of each length of material with those of every other length. The procedure is easily seen from the appropriate tables. The results for trial scores follow in Tables XV and XVI

TABLE XV

CORRELATION COEFFICIENTS FOR POETRY TRIAL SCORES

	12 lines	16 lines	20 lines
8 lines	.74 ±.04	.87 ±.02	.86 ±.02
12 lines		.87 ±.02	.82 ±.03
16 lines			.83 ±.02

Read table thus: 8 lines of poetry correlated with 12 lines of poetry gives a coefficient of .74 with a P.E. of .04.

Since all the correlations in the above Table are over sixteen times their probable error, it is safe to regard these findings as highly reliable.

TABLE XVI

CORRELATION COEFFICIENTS FOR NONSENSE SYLLABLES TRIAL SCORES

	8 syllables	12 syllables	16 syllables
4 syllables	.53 ±.08	.62 ±.06	.29 ±.09
8 syllables		.57 ±.06	.67 ±.06
12 syllables			.60 ±.06

Read table same as in Table XV.

The correlation coefficient found with nonsense material shows no such high relationship as was found for sense material. With the exception of the correlation of .29 between 4-syllable list and 16-syllable list, the other correlations are reasonably high. Although this .29 is too low to insure absolute dependibility, there is still a fair degree of reliability shown.

Tables XVII and XVIII give the so-called reliability coefficients for both kinds of material, in terms of time scores.

TABLE XVII

CORRELATION COEFFICIENTS FOR POETRY TIME SCORES

	12 lines	16 lines	20 lines
8 lines	.80 ±.03	.55 ±.06	.49 ±.08
12 lines		.66 ±.06	.73 ±.04
16 lines			.69 ±.05

Read table thus: eight lines of poetry correlated with twelve lines of poetry gives a coefficient .80 with a P.E. of .03.

As in the case of correlations of poetry trials scores, the poetry time scores show a 'marked' degree of relationship. The above correlations are somewhat lower than are the correlations for trials scores, but as has been shown frequently in this study, trial scores are a much more reliable criterion than are time scores.

TABLE XVIII

CORRELATION COEFFICIENTS FOR SYLLABLE TIME SCORES

	8 syllables	12 syllables	16 syllables
4 syllables	.35 ±.08	.17 ±.10	.11 ±.10
8 syllables		.62 ±.06	.58 ±.06
12 syllables			.58 ±.06

Read Table same as Table XVII

The correlation between 4-syllable list and 12-list and between 4-syllable and 16-syllable list are too low to have any great degree of reliability. It might again be stated that length of lists plays an important role in memorizing of nonsense material.

(6) A comparison of the reliability of poetry and nonsense syllables. The foregoing data show a fair degree of reliability for both poetry and nonsense material, with the poetry scores proving the more reliable by all comparisons. It seemed desirable to make a furthur attempt to compare their reliability by correlating the combined mean scores against the combined extreme scores for each type of material. The results are given in the following table.

TABLE XIX

CORRELATION COEFFICIENTS OF MEAN AND EXTREME SCORES FOR POETRY AND NONSENSE SYLLABLES

	Poetry		Syllables	
	Mean (time)	Mean (trials)	Mean (time)	Mean (trials)
Extreme (time)	.66 ±.06		.63 ±	
Extreme (trials)		.79 ±.03		.83 ±.02

Read table thus: The correlation coefficient of poetry mean time scores and poetry extreme time scores is .66 with a P.E. of .06.

As shown in Table XIX, the correlation coefficients between mean scores and extreme scores range from .63 to .83. These coefficients are both high and positive. The lowest correlation .63, between mean and extreme time scores, is still highly significant since it is about ten times its P.E. To insure a satisfactory de- of reliability, most research workers insist that the coefficient be at least four times its probable error. This method of comparison shows the two types of material to be about equal in reliability.

A comparison of the reliability of trial and time scores (when material is learned by the progressive part method and direct recall). On the basis of 50 correlation coefficients in time and trials, which were computed in this study, it is possible to bring these two together and make a comparison between the reliability of the two measures of learning. These comparisons are given in Table XX.

TABLE XX

COMPARISON OF CORRELATION COEFFICIENTS OF TIME AND TRIAL SCORES FOR NONSENSE SYLLABLES AND POETRY

	Trial scores			Time scores		
	Poetry vs Poetry	Poetry vs Syl.	Syl. vs Syl.	Poetry vs Poetry	Poetry vs Syl.	Syl. vs Syl.
	.74	.46	.53	.80	.17	.35
	.87	.66	.62	.17		.55
	.86	.85	.29	.49		.11
	.87	.60	.59	.66		.62
	.82	.81	.67	.73		.58
	.83		.60	.69		.58
	.82	.17	.26	.66	.42	.24
	.79	.83	.46	.48	.27	.63
	.62		.74	.44		.36
	.19		.26			.36
	.10		-.16			
Ave.	.68	.62	.44	.56+	.28+	.34+

Read table thus: Correlation coefficient between the first two lengths of poetry is .74.

An analysis of Table XX leaves but little ground for argument on behlaf of the time scores. The coefficients obtained for trial with trials are almost without exception appreciably higher than those of time with time. The average of trials for both types of material without regard for length is .68 for poetry and while it is .44 for nonsense. On the other hand, the average reliability of time with time for poetry is .55 and for nonsense only .34. We may conclude then, on the basis of the above correlations, that trials are more reliable criterion for both types of material than is time. Also there is evidence to the effect that sense material is more reliable than nonsense.

CONCLUSIONS

Within the limits of this experiment the following conclusions are warranted.

(1) As the length of lists of nonsense syllables is increased their difficulty increases at an increasing rate. In the case of poetry difficulty does not increase at a rate quite proportional to increase in length.

(2) As measured by relearning, a greater percentage of the longer lists of nonsense syllables is retained than that of shorter lists. Retention of poetry does not vary with length of material.

(3) The relearning and direct recall scores confirm previous studies which have shown that superiority in learning is closely associated with superiority in retention. Better learners show a higher percentage of saving for shorter lists while poorer learners show a higher percentage of saving for longer lists.

(4) There is a high correlation between poetry scores and nonsense scores. The coefficients were found to range from .46 ±.08 to .85 ±.02 with an average of .67.

(5) Reliability of both kinds of material appears to be high enough to insure dependable results where group comparisons are involved. In most instances poetry scores were found to be slightly more reliable than nonsense syllable scores.

(6) Scores in terms of 'trials' seem to constitute a more reliable criterion than 'time scores, when the progressive part method together with direct recall is used.

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Appendix I

Meaningful material. A portion of two poems comprised the meaningful material.

LOVE

Order	
14	All thoughts, all passions, all delights, Whatever stirs this mortal frame, All are but ministers of Love, And feed his sacred flame.
9	Oft in my waking dreams do I Live o'er again that happy hour When midway on the mount I lay, Beside the ruined tower,
12	She lean'd against the armed man, The statue of the armed knight; She stood and listened to my lay, Amid the lingering light.
5	Few sorrows hath she of her own, My joy! my joy! my Genevieve! She loves me best, whene'er I sing The songs that make her grieve.
7	I played a soft and doleful air, I sang an old and moving story- An old rude song, that suited well That ruin wild and hoary.
1	She listened with a flitting blush, With downcast eyes and modest grace; For well she knew, I could not choose But gaze upon her face.

Coleridge

Appendix I

WILLIAM AND MARY

Order	
8	From heavy dreams fair Helen rose, And eyed the dawning red: "Alas, my love, thou tarriest long! O art thou false or dead?"
2	With gallent Frederick's princely power He sought the bold crusade, But not a word from Judah's wars Told Helen how he sped.
13	With Paynim and with Saracen At length a truce was made, And every knight returned to dry The tears his love had shed.
11	Our gallant host was homeward bound With many a song of joy; Green waved the laurel in each plume, The badge of victory.
4	And old and young, and sire and son, To meet them crowd the way, With shouts and mirth and melody, The debt of love to pay.
6	Full many a maid her true-love met, And sobbed in his embrace, And fluttering joy in tears and smiles Arrayed full many a face.
3	Nor joy nor smile for Helen sad, She sought the host in vain; For none could tell her William's fate, If faithless or if slain.
10	The martial band is past and gone; She rends her raven hair, And in distraction's bitter mood She weeps with wild despair.

Scott

APPENDIX I

Order in which stanzas of poetry were presented for learning in study.

List	Series 1	Series 2	Series 3	Series 4	Series 5	Series 6	Series 7
1	1	3	5	7	8	11	13
	2	4	6	8	10	12	14
2	3	5	7	9	11	13	1
	4	6	8	10	12	14	2
	5	7	9	11	13	1	3
3	6	8	10	12	14	2	4
	7	9	11	13	1	3	5
	8	10	12	14	2	4	6
	9	11	13	1	3	5	7
4	10	12	14	2	4	6	8
	11	13	1	3	5	7	9
	12	14	2	4	6	8	10
	13	11	3	5	7	9	11
	14	2	4	6	8	10	12

APPENDIX II

Nonsense material. The nonsense syllables used, are listed below with their corresponding numbers:

1. CEK	21. TUV
2. PEQ	22. KAJ
3. KEF	23. REG
4. MOJ	24. QIN
5. ZIR	25. PAQ
6. BEH	26. CIK
7. LAJ	27. QUR
8. XAV	28. LEK
9. QUH	29. SIJ
10. LOD	30. NOF
11. REK	31. KEF
12. CUH	32. XAP
13. POB	33. QAS
14. XIR	34. XOL
15. KIB	35. VOP
16. ZEQ	36. PIZ
17. XAK	37. SOR
18. ZOJ	38. KIQ
19. VAS	39. BEJ
20. KIR	40. VIB

APPENDIX II

GROUPINGS OF NONSENSE SYLLABLES

Series	A	B	C	D	E	F	G	H	I	J
List	1	5	9	13	17	21	25	29	33	37
	2	6	10	14	18	22	26	30	34	38
I	3	7	11	15	19	23	27	31	35	39
	4	8	12	16	20	24	28	32	36	40
	5	9	13	17	21	25	29	33	37	1
	6	10	14	18	22	26	30	34	38	2
	7	11	15	19	23	27	31	35	39	3
II	8	12	16	20	24	28	32	36	40	4
	9	13	17	21	25	29	33	37	1	5
	10	14	18	22	26	30	34	38	2	6
	11	15	19	23	27	31	35	39	3	7
	12	16	20	24	28	32	36	40	4	8
	13	17	21	25	29	33	37	1	5	9
	14	18	22	26	30	34	38	2	6	10
	15	19	23	27	31	35	39	3	7	11
	16	20	24	28	32	36	40	4	8	12
	17	21	25	29	33	37	1	5	9	13
III	18	22	26	30	34	38	2	6	10	14
	19	23	27	31	35	39	3	7	11	15
	20	24	28	32	36	40	4	8	12	16
	21	25	29	33	37	1	5	9	13	17
	22	26	30	34	38	2	6	10	14	18
	23	27	31	35	39	3	7	11	15	19
	24	28	32	36	40	4	8	12	16	20
	25	29	33	37	1	5	9	13	17	21
	26	30	34	38	2	6	10	14	18	22
	27	31	35	39	3	7	11	15	19	23
	28	32	36	40	4	8	12	16	20	24
	29	33	37	1	5	9	13	17	21	25
	30	34	38	2	6	10	14	18	22	26
	31	35	39	3	7	11	15	19	23	27
IV	32	36	40	4	8	12	16	20	24	28
	33	37	1	5	9	13	17	21	25	29
	34	38	2	6	10	14	18	22	26	30
	35	39	3	7	11	15	19	23	27	31
	36	40	4	8	12	16	20	24	28	32
	37	1	5	9	13	17	21	25	29	33
	38	2	6	10	14	18	22	26	30	34
	39	3	7	11	15	19	23	27	31	35
	40	4	8	12	16	20	24	28	32	36