

THE RELIABILITY OF NONSENSE SYLLABLES

AS PRESENTED BY A GROUP TECHNIQUE

A THESIS

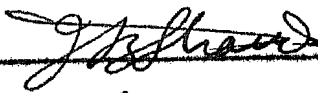
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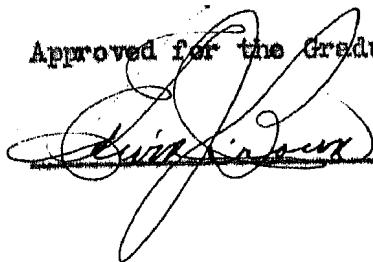
JAMES H. ALTER

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INTRODUCTION

Statement of the problem. The major purpose of this study is to determine the reliability of nonsense syllable scores derived by a group technique. As an incidental aim of the study an attempt will be made to compare this group technique with commonly used individual techniques in relation to its general fitness and adequacy as a method of experimentation.

Importance of the study. The use of nonsense syllables in memory studies has become universal. In spite, however, of the general recognition of their value to experimental investigation, systematic reports of their reliability have been few and inadequate. Furthermore, all coefficients of reliability thus far published have been obtained through presentation of material by the individual method, which, as applied to studies in learning, has certain limitations. Probably the greatest criticism of learning experiments has been that in many instances the number of cases involved was too small to justify statistical reliability. Use of the group method of presenting material would overcome this difficulty and also insure a large saving of time. The group technique likewise appears to be favored by a motivational factor.

In addition, then, to throwing further light upon reliability, this study will be of value if it can point the way to a satisfactory method of conducting group experiments.

Definitions of terms used. (1) Nonsense syllables. Nonsense syllables were first employed by Herman Ebbinghaus in a series of studies published in 1885. Since the materials employed in learning experiments must be homogeneous in character and at the same time relatively equal in associative value to the various subjects, they have been widely used in psychological experimentation. A nonsense syllable ordinarily consists of one vowel between two consonants, as ZOM or BUC. Occasionally one vowel is used with three syllables. This study employs three-letter syllables.

(2) Reliability. The reliability of a test is defined as being an expression of the degree to which that test measures consistently whatever it measures. This reliability is determined by correlating the test with itself in one of three ways. Two sets of scores on the test may be correlated with each other; one half of the test may be correlated with the other half; or the scores of two equivalent forms of the same test may be correlated. The method of correlating equivalent forms of the same test is here used.

HISTORICAL SUMMARY

Reliability. There has been little systematic investigation of the reliability of memory experiments; however, reliability coefficients have in several instances been published somewhat incidentally.

Woodrow¹ in his experiment dealing with the possibility of teaching a general technique of memorizing has reported one set of reliability coefficients. Three groups of subjects were employed in this experiment. The control group consisted of one hundred and six university sophomores who were given no practice in memorizing but were tested in six forms of memorizing at the beginning and end of a period of four weeks and five days. The two other groups, the practice and training groups, numbered thirty-four and forty-two students, respectively. They were given the same tests as the control group, the final and initial forms being similar in form but different in actual material.

The obtained coefficients of reliability of the six end-tests, which were the coefficients of correlation between the initial and final forms, were as follows: rote poetry $.67 \pm .05$, rote prose $.49 \pm .07$, facts (substance) $.48 \pm .07$, historical dates

¹ Herbert Woodrow, "The Effect of Type of Training upon Transference," The Journal of Educational Psychology, XVIII, (March, 1927), pp. 159-172.

.60 \pm .06, Turkish-English vocabulary .70 \pm .05, and memory span (auditory, for consonants) .55 \pm .07.

Shaffer² in connection with a learning experiment in social studies wished to determine the reliability of his logical memory test material. Administering the tests to one hundred school children, he found self-correlations on units a and b of the test of .61 \pm .4 and .71 \pm .03.

Garrett's³ study concerned with the relation of memory and learning to general intelligence reports incidental reliability coefficients. In this experiment a battery of memory-learning tests was administered to one hundred and fifty-eight Columbia University college men above the freshman grade. The coefficients are as follows: digit-span (visual) .68, digit-span (auditory) .80, paired-associates (visual) .95, paired-associates (auditory) .90, and logical memory .60. Garrett likewise correlated the sum of his memory learning test with the sum of an equal number of identical tests and obtained a result of approximately .93.

² Laurance F. Shaffer, "A Learning Experiment in the Social Studies," The Journal of Educational Psychology, XVIII, (September, 1927), pp. 577-591.

³ Henry E. Garrett, "The Relation of Tests of Memory and Learning to Each Other and to General Intelligence in a Highly Selected Adult Group," The Journal of Educational Psychology, XIX, (December, 1928), pp. 601-613.

Baxter⁴ as a part of her experimental study of the differentiation of temperaments, gave a nonsense-syllable test to thirty-seven young women, students in the University of Michigan. Two series of eight syllables each were learned a week apart by the subjects. A modification of the Wirth exposure apparatus was used, in which the syllables, fastened to a revolving drum, were exposed in succession in an opening $1 \frac{1}{8} \times 1 \frac{5}{8}$ inches. Subjects were required to spell the syllables aloud during the exposure and immediately thereafter to write all the syllables they could recall. Repetition of exposures continued until the series was reproduced correctly twice with no exposures between recalls. The number of exposures required constituted the rate score. From the trial scores of the two series Baxter obtained a coefficient of reliability for the rate of learning of $.66 * .062$.

Tomlinson⁵ in his "Studies in Memory" has sought to compare the use of nonsense syllables and the use of meaningful material in memory experiments with respect to reliability. He has also compared time and trial scores as to reliability. In this experiment the sense material consisted of fourteen stanzas of poetry, rather uniform as to content and metrical arrangement. These stanzas were

⁴ M. F. Baxter, "An Experimental Study of the Differentiation of Temperaments on a Basis of Rate and Strength," The American Journal of Psychology, XXXVIII, (January, 1927), pp. 59-96.

⁵ Charles Tomlinson, "Studies in Memory," (unpublished Master's thesis, Kansas State Teachers College, Emporia, Kansas, 1932), pp. 1-40.

so arranged as to be shifted systematically from one experimental list to another, thereby exercising some control over their varying difficulty. Seven series of experimental lists were prepared.

The nonsense material consisted of forty three-letter syllables. Four lists consisting of four, eight, twelve, and sixteen syllables each were constructed. These lists were arranged into four series and the particular syllables shifted from list to list as in the case of the stanzas.

Each of the thirty-nine college students who served as subjects learned one list of sense material and one list of nonsense material on four consecutive days and was retested on four consecutive days one week later. In learning the subjects read aloud each stanza of poetry three times and repeated as much of it as they could. They read the nonsense material twice and then repeated. Thereafter repetitions and recall were alternated until the list was mastered.

In his correlation of trial scores Tomlinson found an average coefficient of .83 for the six poetry coefficients and an average of .546 for the six nonsense syllable coefficients. The correlation coefficients for the time scores averaged lower in the case of both poetry and nonsense material than for the trial scores. The average time coefficient for poetry was .65 and for nonsense syllables .40. Tomlinson also made a comparison of the reliability of poetry and nonsense syllables. To do this he correlated the combined extreme

scores for each type of material with the following results: for poetry the time scores correlated $.66 \pm .06$ and the trial scores $.79 \pm .03$; for nonsense syllables the time scores correlated $.63 \pm .02$ and the trial scores $.83 \pm .02$.

Stroud, Lehman, and McCue⁶ recently published an experiment devoted to the study of the effect of length of list, practice, and degree of learning upon the reliability of nonsense syllable scores. To the writer's knowledge this is the only paper devoted specifically to the reliability of memory scores which has appeared. Seventy-six upperclass and graduate college students, acting as subjects, were required to learn six lists of three-letter syllables, one a day for six consecutive days. Two lists each of six, twelve, and eighteen syllables were employed in order that the effect of length of list upon reliability might be determined by correlating paired scores for comparable lists. By correlating the scores of the first day with those of the second, those of the third day with the fourth, and those of the fifth day with the sixth, the effect of practice upon reliability was determined. Likewise by correlating the number of trials required to learn the odd numbered items with that required to learn the even numbered items, it was possible to compute reliability coefficients for each of the six days. Effect of practice was controlled by counter-balancing the order of presenting

⁶ J. B. Stroud, A. F. Lehman, and Celia McCue, "The Reliability of Nonsense-syllable Scores," The Journal of Experimental Psychology, XVII, (April, 1934), pp. 294-304.

the lists, and effect of differences in difficulty by systematically shifting the seventy-two syllables throughout the lists. In the experiments the syllables were presented by the method of anticipation, the subjects spelling them out upon presentation and recalling them verbally.

The summary of the results of the study is reported as follows:⁷

The correlations between trial scores of comparable lists show greater reliability for the longer lists. Coefficients of .61, .75, and .77 were obtained for the 6-, 12-, and 18-syllable lists respectively.

Correlations of .68, .87, and .62 were obtained between the paired time scores of the 6-, 12- and 18- syllable lists. It is not known whether the comparatively low coefficient of .62 for the 18-syllable lists indicates that the reliability of time scores breaks down with the longer lists or whether it is due to chance factors. Other measures of reliability indicate that the time scores of the 18-syllable lists are more reliable than those of the 12-syllable lists.

Correlations between the trials required to learn odd- and even-numbered items show significantly greater reliability for the 12- and 18-syllable lists than for the 6-syllable lists. They show no advantage of the 18-syllable lists over the 12-syllable lists.

The coefficients of variation and the P. E.'s indicate significantly greater reliability for the longer lists in all cases except when 12-syllable trial scores are compared with 6-syllable trial scores.

Correlation coefficients were computed between the third and fourth days, and between the fifth and sixth days. There was no tendency for the coefficients to vary consistently either up or down. Coefficients were computed between the trials required to learn the odd- and even-numbered items for each of the six days. The results failed to show that reliability is increased by practice.

⁷ Ibid. pp. 303-304.

The foregoing results indicate that, in the case of the 8-syllable lists, the greater the degree of learning the more reliable are the scores. The reliability of the longer lists is unaffected by the degrees of learning considered in this experiment.

Generally speaking, nonsense-syllable scores may be said to be fairly reliable. This is indicated by the obtained correlation coefficients of .80 to .80 and by the rather close correspondence between the first and second scores of even small groups of subjects, when practice effect is discounted.

Earlier methods of testing. Since it is an aim of this study to compare the group with the individual techniques of administering learning experiments, it would seem advisable to review briefly a few of the changes which have taken place in the field of method during the last half century.

To Herman Ebbinghaus must go the credit for the first experimental investigation of memory. By his invention of nonsense syllables, he made possible scientific study in this field which hitherto had been considered too subjective for experimental and quantitative treatment. Despite the fact that his experiments were performed on himself alone and consequently are limited in their significance, Ebbinghaus' work is of great historical importance.

In his monograph published in 1885 Ebbinghaus⁸ reported the results of several related memory problems, such as retention, the effect of review upon retention, and the nature of the connections formed in learning. However, his method of investigation is the question of primary importance relative to the present study.

⁸ Herman Ebbinghaus, Memory (New York: Teachers College, Columbia University, 1913), pp. 22-33.

Ebbinghaus first constructed series of nonsense syllables of different lengths, a group of several series being designated as a "test." The aim of these tests, as Ebbinghaus stated it, was "by means of repeated audible perusal of the separate series, to so impress them that immediately afterwards they could voluntarily just be reproduced."⁹ He considered his aim attained when, the initial syllable being given, he could recite the series at the first attempt, at a certain rate, and with a confidence of being correct.

In the process of memorizing, the separate series were always read through completely; immediately following the reading the recitation took place at a constant rate as measured first by a metronome and later by the ticking of a watch. When one series had been completely learned, a fifteen second pause was made to tabulate results, and the learning of the next series of the same test was immediately begun.

At first the measurement of the number of repetitions required for memorizing a series was determined indirectly by measuring in seconds the time required to memorize it. The purpose of this method was to avoid undue distractions connected with counting. Later, however, small wooden buttons were strung on a cord. Each tenth button was black; the others were natural wood color. During the process of memorization the cord was held in the

⁹ Ibid. p. 22.

hand and a button was pushed several centimeters from left to right at the completion of each repetition. The division into tens made it possible by a glance at the cord to ascertain quickly the number of repetitions that had been necessary in learning a given series. Such was the method employed by Ebbinghaus in his pioneer experiments in the field of memory.

One of the greatest criticisms of Ebbinghaus' method lay in the fact that he simply read off the series of syllables which appeared in lists upon a sheet of paper. Thus it was possible for his eye and attention to sweep back over parts which he had already learned even though he intentionally avoided doing so. Since an accurate enumeration of repetitions is possible only when a purely successive presentation is employed, it has become customary since Ebbinghaus' day to present memory material in laboratory experiments with the aid of some mechanical apparatus.

One such apparatus is the tachistoscope, an instrument by means of which words or syllables, for example, may be presented to the eye for a brief measured period. Several forms of the tachistoscope have been devised: the fall tachistoscope, the rotary tachistoscope, and the pendulum tachistoscope.¹⁰

¹⁰ Charles S. Myers, A Textbook of Experimental Psychology, (London: Edward Arnold, 1909), pp. 415-416.

In the fall tachistoscope a screen carrying a fixation mark is allowed to drop, and in so doing momentarily exposes a card to the subject. In the rotary tachistoscope there is a narrow vertical blackened tube through which the subject must look to see the periphery of a large horizontally rotating white disc. This disc, which is motor driven, has a sector cut out from its margin, the open sector allowing the subject to see the letters on the card below the disc. Rate of rotation and area of the sector can be varied at will to adjust the time of exposure.

The third type, the pendulum tachistoscope, has an oblong screen with an opening in the center of it. This screen is fastened to the free end of a pendulum which is held up by an electro-magnet and released when desired. As it swings, the screen momentarily exposes the card which lies behind it.

Still another form of mechanical apparatus used in presenting memory material is the memory drum. G. E. Muller¹¹ having studied Ebbinghaus' method was led to make improvements upon it. Collaborating with Schumann, he worked to introduce uniform conditions of learning into experiments. The syllables, equally spaced, were written upon bands of paper which could be passed around a drum and rotated at a uniform rate of speed by means of a clock-work device. Before the drum was placed a screen with an aperture at the height of the

¹¹ E. Meumann, The Psychology of Learning (New York: D. Appleton and Company, 1913), pp. 163-165.

observer's eye. During the rotation of the drum the syllables came into view successively and thus insured that learning was taking place in a continuously progressive manner.

Subsequently Muller working with Pilzecker¹² introduced another method of presenting syllables, this one to be used with the paired-associated method of presentation. A paper band carrying the syllables was fastened around a twelve-sided drum, the whole drum being hidden by a screen except the small slit through which appeared the syllable. The drum could be rotated through thirty degrees to expose the syllable at the instant when the shutter in front of the slit was opened. In order that the reproduction-time for the pronunciation of the associated syllable might be determined the apparatus was so arranged that an electric contact set a chronoscope into motion and at the first instant of the subject's pronunciation of the syllable the chronoscope was stopped by means of a lip-key.

At the present time the memory drum is regarded as a part of the standard equipment of an experimental psychology laboratory. Improvements upon the type of drum used by Mueller have been made, but in principle the drum remains the same. Probably the most significant change lies in the fact that the drum may now be

¹² Ibid., p. 167.

operated by electricity instead of by hand, thus insuring accurate timing in the presentation of material. The speed of the machine may likewise be adjusted to suit the needs of the experiment.

METHOD OF EXPERIMENTATION

Materials and subjects. The material used in this experiment included two comparable lists of nonsense syllables chosen from the Glaze 20 per cent associative value list.¹³ Each of the two lists was comprised of twenty syllables which were arranged with eighty others to make a total of one hundred syllables, all of approximately the same associative value. The syllables were next arranged in twenty rows with five to a row, each row containing one of the syllables to be learned. Random selection governed the position of the twenty syllables although it was determined that they did not in any case fall into an easily recognizable pattern. The two lists were mimeographed on mimeograph paper, the rows spaced one-half inch apart.

The twenty syllables to be learned, which may be called the significant syllables, were then chemically treated on the mimeographed sheets. This treatment consisted of applying to the important syllables a standard solution of phenolphthalein by means of a small wood stylus bluntly rounded on the point. Much experimenting was done in selecting the best solution of phenolphthalein so that when applied it would neither smear the syllables nor leave a recognizable mark on the paper. The solution as finally used was fifty-five per cent alcohol to forty-five per cent water.

¹³ A. J. Glaze, "The Association Value of Non-sense Syllables," The Pedagogical Seminary and Journal of Genetic Psychology, XXXV, (June, 1928), pp. 255-269.

The subjects were provided with black ink to which had been added a standard solution of sodium hydroxide. This mixture was approximately half ink and half sodium hydroxide. During the experiment when the subject made the correct response, i.e., checked the significant syllable on the mimeographed sheet, a chemical reaction took place causing the area of the syllable to turn red. If the syllable checked was incorrect, no reaction occurred, and the subject was immediately made aware of his error.

These mimeographed sheets were then made up into packages of thirty each. The subject upon entering the room found on his desk a bottle of ink and a pen, a package of mimeographed sheets, and a cardboard box. The lid of this box contained a slot into which a sheet folded once might easily be inserted.

The syllables were presented visually during the experiment by means of a specially constructed apparatus on which were fastened cards twenty-two inches long and four inches wide. The twenty significant syllables in black letters two and one-half inches high were presented individually on the cards at a uniform rate of speed. Order of presentation was the same as the order in which the significant syllables appeared on the mimeographed sheets. Subjects learned one list of syllables the first day of the experiment and a second list in similar manner on the following day.

The subjects chosen for the experiment were students in three elementary and one advanced psychology class, none of whom had

previous training in learning nonsense syllables. This group comprised eighty-four students ranging from freshman to graduate classifications. Absence from class on the part of one student and the failure of three others to master one of the two lists decreased the number of subjects to eighty.

Procedure. As is heretofore described, the syllables were presented to the class by the serial exposure method at a uniform rate of approximately three seconds per syllable. Learning was then measured in terms of the subject's ability to recognize the significant items when they were presented in a list of mixed items. The following instructions which were read to each class on the first day will explain the method of procedure.

You are about to take part in a new type of psychological experiment. Will you, therefore, cooperate to the fullest extent possible in making this experiment a success. You will be shown twenty nonsense syllables in rapid succession. Do not attempt to pronounce them, but spell them out silently as the cards are turned.

Each of the twenty rows on the pages before you contains one and only one of the syllables here presented. Find the syllable and make a cross on the middle letter of it. Be sure to check only one syllable in each row. Every time you make a successful response the area of the syllable will turn red. Get as many of these right as you can following each presentation. You will be given as many trials as necessary to learn the list of twenty syllables which I am about to show you. You may know when you have finished by the fact that you will have twenty syllables in red and none in brown. When you have completed learning the list, do not mark any other pages. Do not leave the room until everyone has finished. Ask no questions after the experiment begins.

After the syllables were presented the first time, the subjects were told that they would be given one minute and forty

seconds to complete the checking of the mimeographed sheets. They were cautioned to check lightly and neatly. At the end of the time allotted for checking they were instructed to fold the page on which they had been working and place it in the box. The syllables were presented in this manner as many times as was necessary for all subjects to learn the list.

On the second day of the experiment a similar procedure was employed. However, with successive groups the cards presented on Day I and Day II were retated in order so that half of the subjects learned List I first and List II second and an equal number learned List II first and List I second.

RESULTS AND DISCUSSION

Reliability. The reliability coefficient for the trial scores of the two lists of syllables presented on Day I and Day II, in the case of the eighty subjects who completed the learning of both lists, is $.61 \pm .048$. A comparison of this result with those of the investigations previously described in the study indicates that it parallels rather closely those obtained by individual procedures.

The group technique. Further analysis of the data obtained in this study tends to show that the group method is very similar to the individual method in its results. The rate of learning, as indicated by learning curves, the effect of practice upon the form of the learning curves, and the order of learning as illustrated by these results parallel closely those found in previous studies conducted by individual methods. Table I shows the rate of learning and the effect of practice as expressed in the number of syllables recalled per trial.

THE RATE OF LEARNING AND THE EFFECT OF PRACTICE
UPON THE FORM OF LEARNING CURVES

		Number of syllables recalled per trial														
Trials		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Day	No. S's															
1	6	10.1	15.5	16.8	20											
2	10	11.3	15.6	16.9	20											
1	5	9.2	14.8	16.	15.4	20										
2	7	11.4	15.1	16.9	17.4	20										
1	5	7.4	8.8	16.	15.2	17.8	20									
2	12	10.8	13.	15.2	16.4	17.2	20									
1	9	8.3	12.7	14.7	16.6	17.4	17.7	20								
2	7	9.	12.5	15.5	14.7	17.5	17.4	20								
1	12	8.	11.9	14.	15.2	16.6	17.5	17.8	20							
2	6	11.8	12.6	14.5	15.6	17.1	17.	17.5	20							
1	5	7.4	11.6	13.8	13.4	15.2	15.3	16.4	17.8	20						
2	10	9.4	12.1	13.4	14.8	15.	17.4	16.8	18.4	20						
1	1	5.	12.	12.	14.	16.	15.	18.	19.	18.	20					
2	6	8.3	10.5	13.	13.6	14.6	15.	15.6	15.1	17.3	20					
1	6	9.5	13.1	14.5	13.6	16.1	16.6	16.8	17.6	17.8	17.6	20				
2	2	5.	10.5	9.5	11.	13.	14.	14.5	14.	15.	16.5	20				
1	8	7.1	11.1	13.3	13.	13.6	15.	15.7	16.	17.2	17.7	18.5	20			
2	2	7.	7.5	9.5	13.5	14.	13.5	13.	13.	16.5	17.5	18.	20			
1	3	7.6	9.6	13.3	11.3	14.	14.6	16.3	16.	17.3	18.6	18.6	18.3	20		
2	5	9.4	11.	11.6	13.	14.6	15.	14.4	15.	17.	16.6	17.6	18.6	20		
1	6	5.6	8.8	11.6	11.6	11.6	13.	13.2	14.	14.8	16.5	17.3	17.5	18.3	20	
2	1	7.	12.	14.	16.	14.	15.	15.	16.	17.	18.	19.	17.	18.	20	
1	3	7.	10.	11.	10.3	12.3	13.	13.	12.3	13.	14.	17.	18.	17.	16.6	20
2	2	11.5	10.5	11.5	15.	13.	13.	11.	15.5	12.5	16.5	15.5	17.	18.	19.	20

Read table thus: On Day I six subjects mastered 10.1 syllables on the first trial; 15.5 on the second trial; 16.8 on the third trial; and all twenty on the fourth trial. Read similarly for all days up to fifteen trials.

Learning curves plotted from the data given in the above table all show negative acceleration. In other studies negatively accelerated curves have repeatedly been found to be typical of material of this kind. Four figures are here included for illustration. It will be noticed that the rise of the initial slope of each curve is for the most part directly proportional in steepness to the learning ability of the subjects. For example, on Day I those subjects learning the syllables correctly in five trials recalled an average of 14.8 on the second trial; those requiring seven trials recalled 12.7; those requiring nine trials recalled 11.6; and those requiring fifteen trials recalled 10.

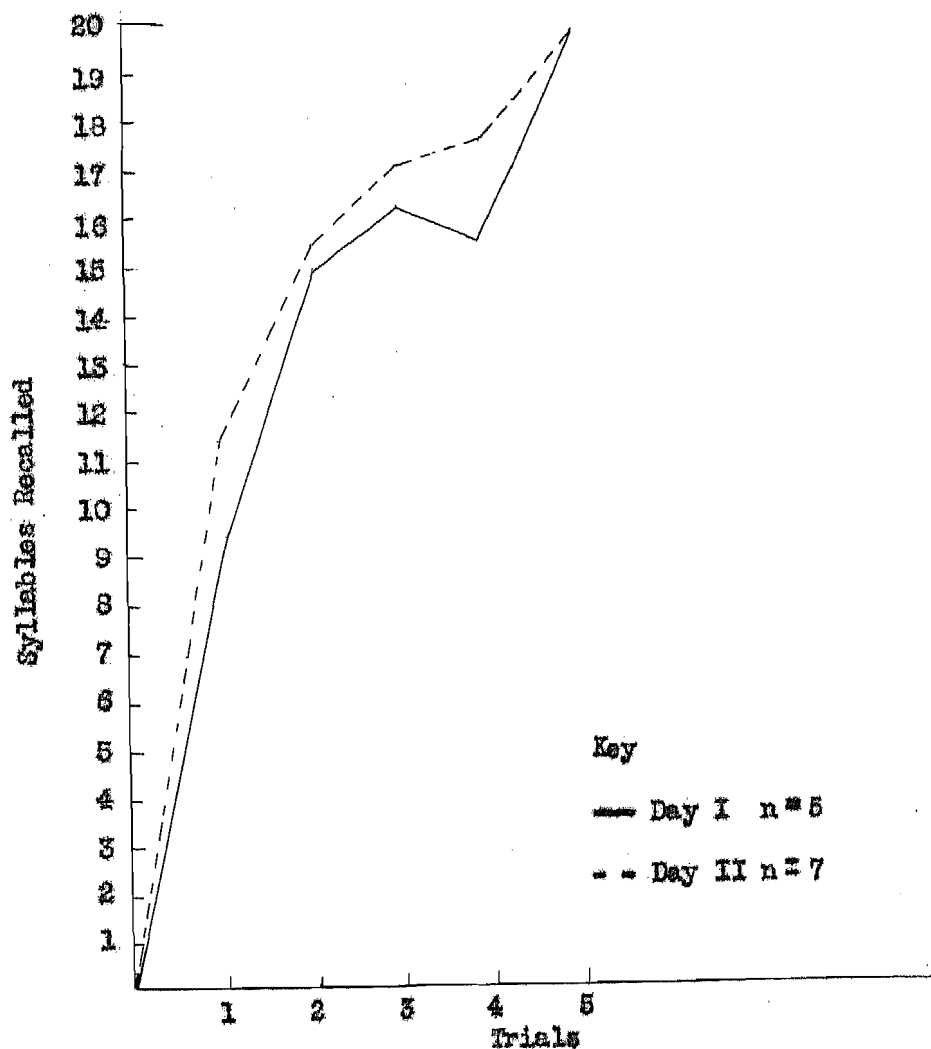


FIGURE 1

LEARNING CURVES FOR SUBJECTS MASTERING
THE LIST IN FIVE TRIALS

Read Figure thus: On Day I five subjects learned an average of 9.2 syllables on the first trial; on Day II seven subjects learned an average of 11.3 syllables on the first trial. Read similarly for other trials.

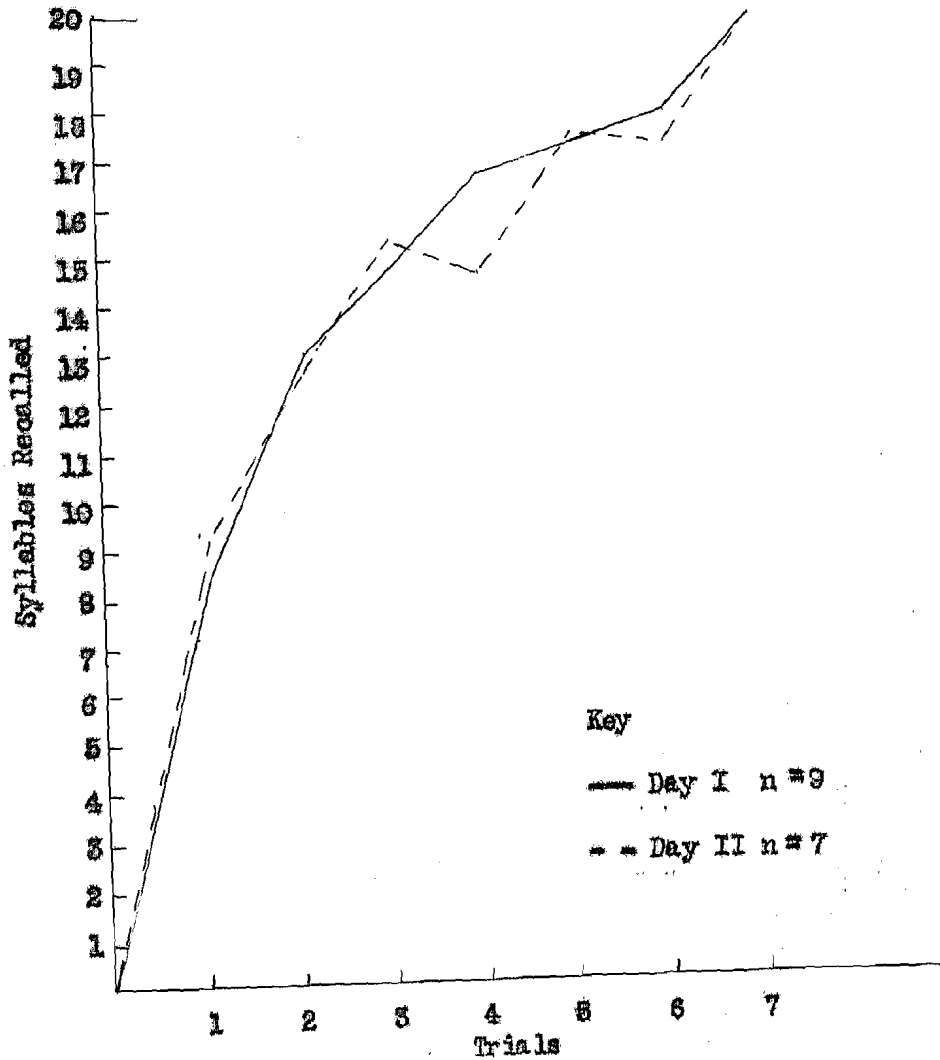


FIGURE 2

LEARNING CURVES FOR SUBJECTS MASTERING
THE LIST IN SEVEN TRIALS

Read Figure thus: On Day I nine subjects learned an average of 8.3 syllables on the first trial; on Day II seven subjects learned an average of 9.0 syllables on the first trial. Read similarly for other trials.

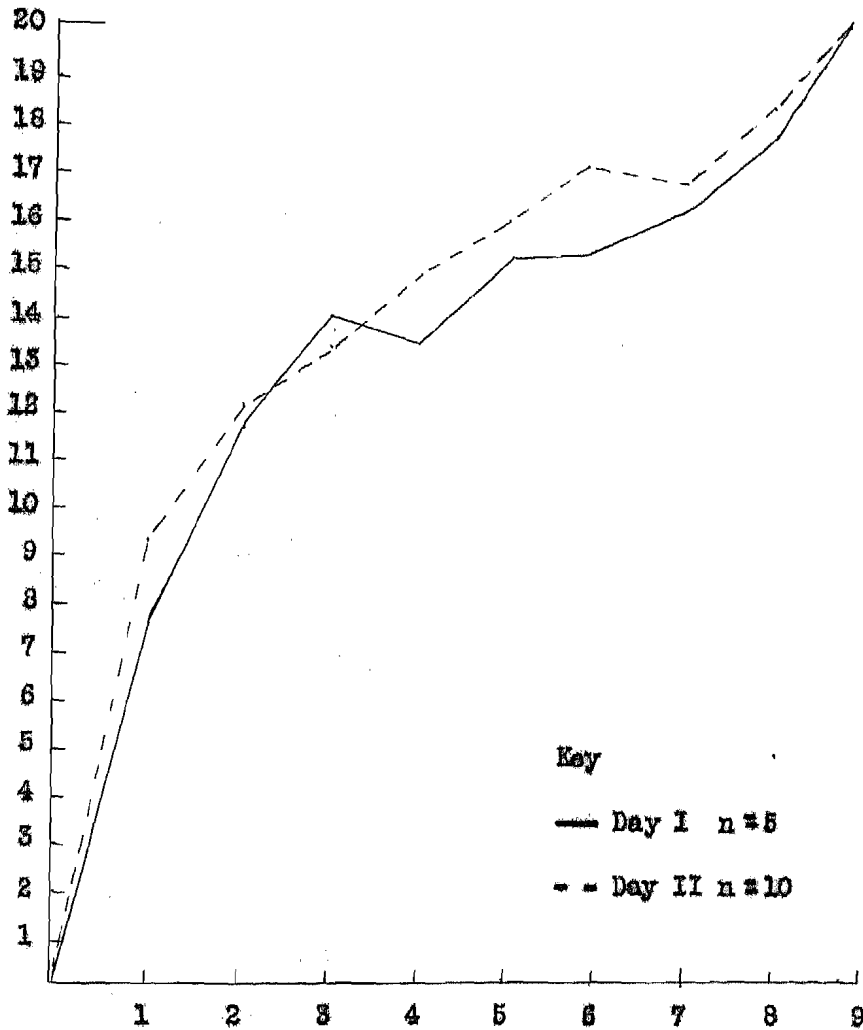


FIGURE 3

LEARNING CURVES FOR SUBJECTS MASTERING
THE LIST IN NINE TRIALS

Read Figure thus: On Day I five subjects learned an average of 7.4 syllables on the first trial; on Day II ten subjects learned an average of 9.4 syllables on the first trial. Read similarly for other trials.

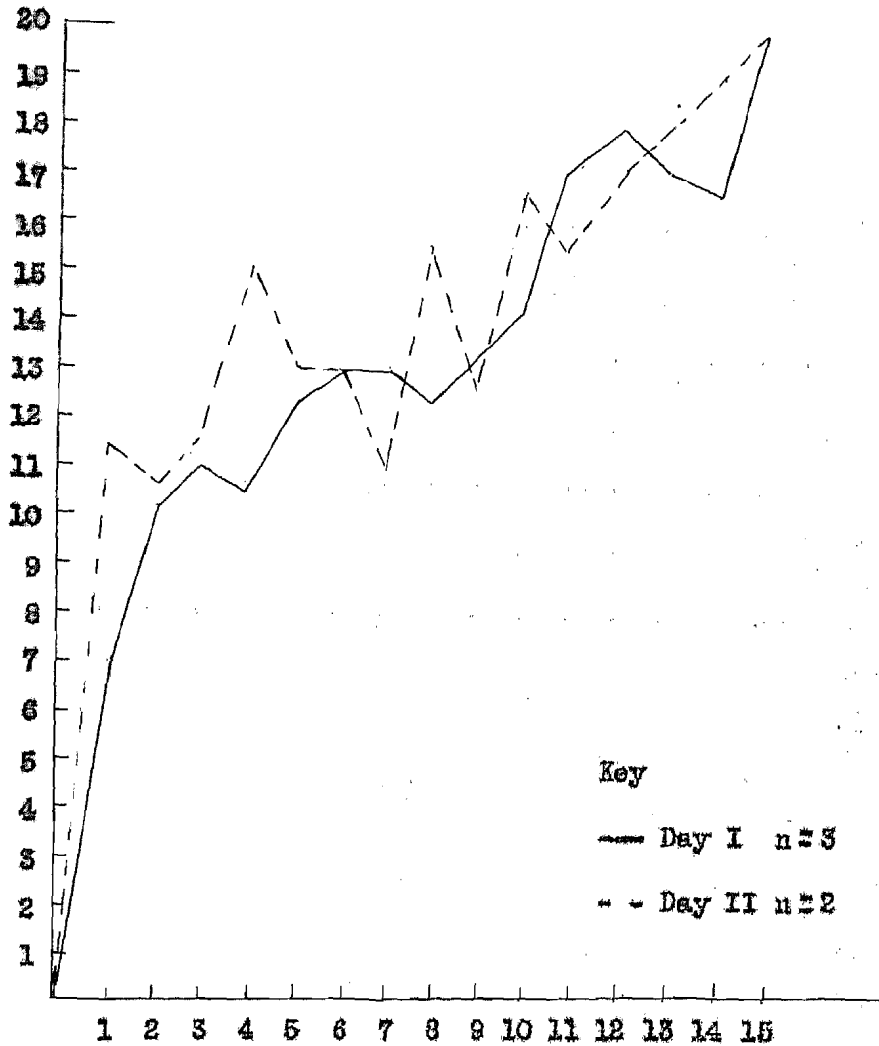


FIGURE 4

LEARNING CURVES FOR SUBJECTS MASTERING
THE LIST IN FIFTEEN TRIALS

Read Figure thus: On Day I three subjects learned an average of 7.0 syllables on the first trial; on Day II two subjects learned an average of 11.5 syllables on the first trial. Read similarly for other trials.

The effect of practice on learning curves is likewise evident, the initial rise generally being steeper on the second day of practice than on the first. For example, in the group of subjects who mastered the list in five trials on Day I the average number of syllables recalled on the first trial was 7.4; on Day II the average number was 10.8. In the group who required fifteen trials for mastery the number recalled on the first trial on Day I was 7; on Day II, 11.5.

The order of learning the syllables in this experiment also agrees with the findings of investigators in the field of individual method who have almost universally found that the first and last terms in a series are learned quickest and best.

Robinson and Brown¹⁴ in a recent study using the anticipation method of learning nonsense syllables obtained results for lists of 6, 9, 12, 15, and 18 syllables as learned by ten subjects. They report a pronounced advantage for both primacy and finality. Primacy showed an even greater advantage than finality, the primacy effect extending in some degree over several items in the first portion of the list, although the finality effect proved much more limited.

¹⁴ Edward S. Robinson and Martha A. Brown, "Effect of Serial Position upon Memorization," The American Journal of Psychology, XXXVII (October, 1926), pp. 538-552.

Warden¹⁵ conducted an experiment in stylus maze learning in an effort to study the order of elimination of culs-de-sac. The mean number of trials required to eliminate the culs-de-sac in the first section was 16.4; in the middle section 34.8; and in the end section 23.7. Thus the primacy-recency order obtains, those near the entrance being eliminated first, those near the goal next, and the middle group last.

Jersild¹⁶ in his study related the problem of primacy and recency to the recall of narrative material. In dealing with meaningful material he reported primacy as being far superior to recency as an aid to recall.

In the present investigation in order to determine the order of learning the writer recorded the average number of times each syllable was scored correctly and then ranked the various positions in the series accordingly. The assumption was that if a syllable was learned early in the series, it would be responded to correctly in the total number of times more frequently than a syllable learned late. The syllable learned last would likewise be responded to correctly the fewest number of times.

¹⁵ Carl John Warden, "Primacy and Recency as Factors in Culs-de-sac Elimination in a Stylus Maze," Journal of Experimental Psychology, VII, (April, 1924), pp. 98-116.

¹⁶ Arthur Jersild, "Primacy, Recency, Frequency, and Vividness," Journal of Experimental Psychology, XII, (February, 1929), pp. 58-70.

Table II shows the order in which the syllables were presented, the average number of times each was scored correctly, and the order in which the syllables were learned. It will be noted that primacy here evidences an advantage over finality. The average rank order of the initial portion of the list was 6.68, of the final portion 9.00, and of the middle portion 14.75.

TABLE II
SYLLABLES IN ORDER OF LEARNING

Order presented	Number of times correctly scored	Order learned
1	74.55	1
2	69.605	3
3	61.315	8
4	64.91	5
5	53.34	17
6	63.76	6
7	59.92	10
8	53.70	16
9	54.86	14
10	56.58	12
11	58.255	11
12	53.045	19
13	60.28	18
14	47.615	20
15	54.01	15
16	56.175	8
17	53.145	18
18	62.735	7
19	69.505	4
20	60.96	2

Read table thus: Syllable 1 was scored correctly 74.55 times in the total number of trials; therefore in order of learning it ranks first. Read similarly for other syllables.

There are other methods of determining the order of learning, such as recording the first trial in which a syllable was correctly checked and cited. However, such a method might well be criticized on the grounds that there is a good deal of the chance factor in the checking of any particular syllable on any particular occasion. A subject might check a syllable correctly on the third trial, for example, and fail to do so on the fourth. For these reasons there seems to be an advantage in taking the average of all the trials.

CONCLUSIONS

This study was undertaken for the purpose of determining the reliability of nonsense syllable scores derived by a group technique. As an incidental aim an attempt was made to compare this group technique with the customary individual techniques. The results seem to warrant the following conclusions:

The reliability coefficient for nonsense syllables presented by a group technique in the present investigation is $.61 \pm .048$. This compares favorably with the findings previously reported by other investigators.

The group method of procedure appears to be as satisfactory as the commonly used individual method. That the group procedure measures about the same thing as does the individual method is illustrated by the learning curves, the effect of practice upon the form of the curves, and the order of learning, all of which are essentially the same as those reported in other experiments.

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20-I						20-II					
1	GEB	ZYF	GOM	NAH	PIY	1	QEB	QED	BYJ	KAJ	VEJ
2	ZYR	ZUT	XAW	KEH	ZOV	2	ZAS	QIY	SAJ	TYZ	KEX
3	ZYL	ZOM	GIK	ZIR	XUT	3	QUP	MEJ	CEH	RIX	QUH
4	YOT	VUZ	JIW	HUW	BYV	4	VOH	GYC	FYK	NAX	HYZ
5	XOB	ZUJ	ZOG	XES	NIJ	5	JUC	JEH	XID	VIB	KYB
6	WOS	XAY	KIV	ZYC	DYW	6	RUQ	SIH	TEV	WUP	XEG
7	YUB	XYL	ZOY	FEP	XON	7	JYX	YAB	DYQ	TUH	XAR
8	TYW	ZOB	RUY	CUH	YIN	8	CEX	HYJ	QYG	NOJ	GUC
9	LEB	XYJ	JEC	JYK	XYM	9	FUB	GIC	BEP	XEY	VIQ
10	ZIS	XOV	ZOK	VEP	KYW	10	QEF	XUF	QID	JUL	TUV
11	ZAT	YIQ	ZAW	GED	WUC	11	FOQ	YOH	MIV	QOD	HEG
12	XUJ	KAQ	ZOR	MUW	GYB	12	MYZ	QOX	PAF	KIH	ZEH
13	YIH	WUG	ZAX	PYD	VEQ	13	POH	XAZ	RYX	YIJ	KAJ
14	YIB	ZYK	KIZ	ZIN	XIG	14	NYQ	GEP	GIY	KUQ	QOY
15	GOK	RYJ	NUB	ZYH	GEX	15	CUX	MYP	JIK	KIG	SEB
16	BUQ	VYT	GUH	KAZ	MEZ	16	DEJ	QEP	WYB	LEQ	XAF
17	JUZ	NYB	QOH	RYQ	TIV	17	HYW	JEG	MYB	QUK	VUM
18	QUS	XUG	BIP	QEY	ZIC	18	VIH	WUT	QON	TYF	GIH
19	QUN	XAP	SYQ	WUX	TYQ	19	GYZ	KUH	ZOP	MOX	QAM
20	SIK	FUP	CYJ	LIW	NUK	20	BEJ	VOJ	KEJ	QYW	WYH