

THE RÔLE OF ARTICULATION IN MEMORIZING

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Economic procedure in learning, in so far as it touches the use of articulation, can be studied by way of memorization. This paper attempts to find the advantage, if any, possessed by explicit laryngeal responses over implicit, or non-laryngeal, responses in memorization.

The subject-matter consisted of two 20-word lists of three-letter syllables that conveyed no obvious meaning. Each syllable contained a vowel between two consonants. They were printed upon strips of paper in such a way that they could be exposed singly for a given period of time. The exposures were made by means of a frame-like apparatus of wood with two rollers vertical to one another.

Subjects to the number of 327 memorized the learning material. These pupils range in school from the second to the ninth grade, in addition to 51 students of college grade. Each grade took the test in two groups, so as to learn the word-lists in balanced order. Half of the class practiced first the A-list or vocalization-list, then the B- or non-vocalization list. The other half learned the lists in the reverse order. This procedure distributes practice gains about equally between the two lists.

The instructions were approximately as follows. "I am going to show you a list of words one at a time. You are to learn as many of these words as you can. As an aid in learning them you are to repeat the words over and over to yourself as you study them. Use your tongue and lips as you say them in whispering tones. When you have seen the words four times each, and when I say 'write,' you are to write as many of the words as you can remember. If you are not sure of the word, guess."

The experimenter exposed each syllable four times, allowing three to four seconds for each syllable.

The instructions for the second list were; "Now I am going to show you a second list of new words. You are also to learn as many of these words as you can. This time you are to practice without saying the words over to yourself. To help you in this you are to hold your pencil between your teeth like this (experimenter demonstrated what was wanted by placing and holding a pencil crosswise between his teeth, the tongue being unrestrained)." For pupils who learned the B-list first, instructions were given which differed from the foregoing only in such a way as to take into consideration the necessary difference in procedure.

The subjects were allowed five minutes for the reproduction of learned syllables.

The score was taken as the number of words correctly reproduced.

The gross scores appear in the A and B columns of Table I. The mean gross scores from the verbal method are shown by *A* and those of the non-verbal by *B* in Fig. 1. The numerical differences between the scores made from the two methods of

learning are found to be larger for the higher than for the lower grades. The smaller differences in the lower grades are obviously due to their lower memorizing ability.

TABLE I

TWO 20-SYLLABLE LISTS LEARNED BY METHODS OF 'VERBALIZATION'
AND 'NON-VERBALIZATION'

A = average number syllables reproduced by verbalization method; *B* = the same with instruction against articulation; PE(diff) = probable error of the difference *A* - *B*; *D*/PE(diff) = PE(diff) units in the difference of the means *A* - *B*; *P* = chances in 100 that the real difference of means *A* and *B* exceeds 0; *Ri* = total number right syllables (*A* + *B*); *Wr* = total syllables wrong; *N* = number of cases.

Grade	<i>A</i>	<i>B</i>	PE(diff)	<i>D</i> /PE(diff)	<i>P</i>	<i>Ri</i>	<i>Wr</i>	<i>N</i>
2.....	2.27	2.00	.440	.61	66	4.27	6.82	22
3.....	5.04	4.03	.536	1.88	89	9.07	6.53	34
4.....	6.43	6.11	.648	.49	63	12.54	9.00	37
5.....	8.50	7.44	.624	1.54	85	15.94	8.62	40
6.....	8.42	7.39	.803	1.28	81	15.81	9.53	36
7.....	9.63	8.13	.686	2.18	93	17.76	10.06	37
8.....	10.90	9.58	.840	1.58	86	20.48	8.02	40
9.....	11.78	10.59	.880	1.35	82	22.37	6.72	32
College.....	15.34	12.42	.757	3.86	99.5	27.76	4.69	49
All groups...	9.37	8.16	.333	3.64	99	17.30	7.03	327

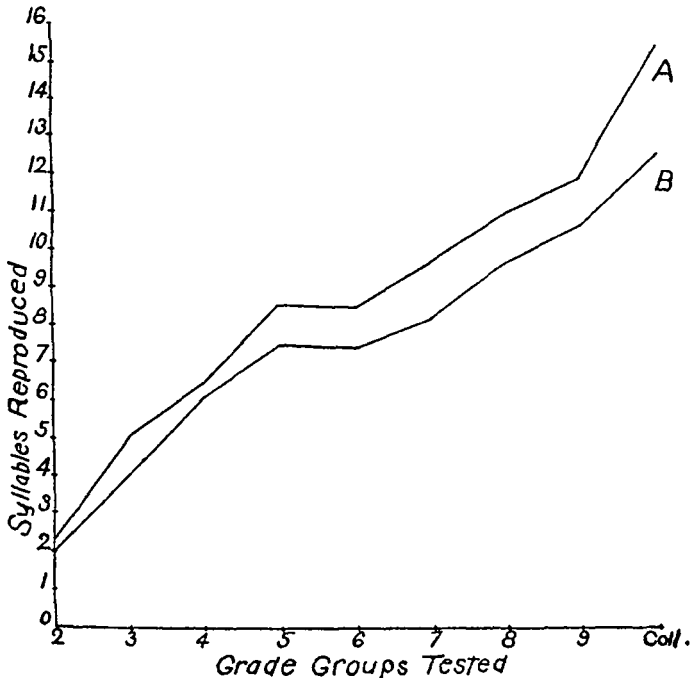


FIG. 1. *A* = number of syllables reproduced from 20-word lists learned with verbal responses. *B* = number of syllables reproduced with restricted articulation.

It is necessary to know the reliability of these differences. What are the chances that differences will continue to be found with an extension of the study to include more subjects? The probable error difference formula $PE(\text{diff}) = \sqrt{(PE_{M_1})^2 + (PE_{M_2})^2}$ serves our purpose here. With twenty-two cases in the Second Grade, the chances are 66 to 100 favoring superiority of the vocalization method of learning; 89 chances of 100 for the third grade; 63 for the fourth; 85 for the fifth; 81 for the sixth; 93 for the seventh; 86 for the eighth; 82 for the ninth; and 99.5 for the college group. Further, the chances are 99 out of 100 that the better scores made by the use of language in memorizing, taking the group as a whole, represent a true difference and not a difference due to chance conditions.

Sex differences are found to favor the girls. Girls excel the boys in memorizing. The mean number of syllables learned by 153 males is 8.79, the mean score of 173 girls is 9.73. The boys' scores have a wider range than the girls'. The sigma of the distribution is 4.73 for the boys and 4.39 for the girls. The $PE(\text{diff})$ of the mean scores is .695. There are 1.35 $PE(\text{diff})$ units in the difference of the mean score of girls and boys. This means that in 82 per cent. of the cases the girls excel the boys.

Again the girls excel the boys in memorizing with restricted articulation. For the above number of boys the mean number of syllables learned by the 'non-language' procedure is 7.55, with a sigma of the distribution of 4.18. The mean for the girls is 8.51 with a sigma of 4.18. The $PE(\text{diff})$ is .66. Hence the chances are that the girls will exceed the boys 84 times in a 100 for learning syllables by the 'non-language' method.

Individuals show wide differences in favor of one or the other method of learning. Of the 327 cases, 52 subjects reproduced the same number of syllables by both methods; 34 pupils reproduced one syllable more by Method A; 45, two syllables more; 35, three syllables; 29, four syllables; 13, five; 10, six; 12, seven; 3, eight; 2, nine; 1, eleven; and 1, twelve. There were 33 pupils who learned one syllable more by Method B; 30 cases learned two more by this method; 11, three more; 7, four; 2, five; 3, six; 3, seven; and 1, nine. 185 pupils learned more words by the former and 90 learned more words by the latter method. Although substantial differences are found in favor of the 'vocalization' method, there is no justification for claiming that all children should memorize material by this means. In the light of the large amount of overlapping of the scores obtained by the use of the two methods, it is probably safe to conclude that the best practical results in memorization can be secured by having the individual learners follow the method which yields best results. Experimental procedure appears to be the more satisfactory way of determining the preferred method of memorization, for the pupil is usually in no position to know beforehand which method is really better for him.

The number of wrong syllables produced is another difference factor for consideration. The greatest amount of overlapping from the two methods appears among the scores in grades five to eight, while in the second, third and fourth grades there is less of it. There is also less overlapping of errors made from the two methods as they apply to the ninth grade and also to the college group.

Fewer errors are made with restricted articulation. This fact seems to stand in favor of this method of learning as against the other. There are, however, qualifying factors which deserve to be considered. It has already been shown that because language is beneficial in learning its use results in the recall of a larger amount of learning material. In the lower grades, particularly the second, third and fourth, pupils who make more wrong responses also reproduce more right syllables.

In the upper grades the foregoing condition is reversed; *i.e.* high scores occur with a small number of errors. The small number of errors made by pupils of the higher grades is in all probability due to abridgments and abbreviations in the learning process.

Since more errors result from the non-articular method in the eighth grade and above, as is found in this study, it is quite fair to assume that for all groups above the eighth grade the errors will be fewer for the verbal method. Though there are no data here on the tenth, eleventh and twelfth grades, the relatively smaller number of errors for the grades we have used seems to justify the above statement.

These results suggest that, other things being equal, memorization is not only more accurate but also easier with articulation than without, for pupils in the primary as well as the upper grades. It is quite probable that intermediate grades also would yield similar results but for the influence of extensive training in silent reading in the primary grades. If the silent method is more natural, which seems not to be the case with our subjects, pupils that are once trained to read and think without articulation should go on using the same procedure more economically after the demands for silent reading have become less exacting.

The syllables produced by the second grade (Table I and Fig. 2, Wr) are more often wrong than right. From a knowledge of this condition it is not surprising that the reportability of children is very unreliable. It is also of interest to note that third grade children make more right than wrong responses. The total number of errors (Wr) shows a gradual increase up to the seventh grade, with a steady decline from here up.

The total number of right responses (Table I and Fig. 2, Ri) made by these groups presents a different picture. When the two variables are plotted, *i.e.* the total number of right responses for both lists and the successive grade groups, the graph is approximately linear. It is quite probable, however, that if the results from the ninth, tenth, and eleventh grades were included, the graph would show the region of diminishing returns so characteristic of learning curves.

Since we gave only one form of task, there are no scores from which to calculate reliability measures. There is, however, reason for imputing reliability to the scores when we consider their differences all together. In the nine groups there were over 300 subjects, and every group yielded scores favoring the same method of learning. Considerable claim to high reliability seems reasonable when a number of groups of subjects made scores with differences in the same direction, even where those differences are small.

A word concerning the possible objection that pencils held in the mouths of pupils are detrimental to non-language

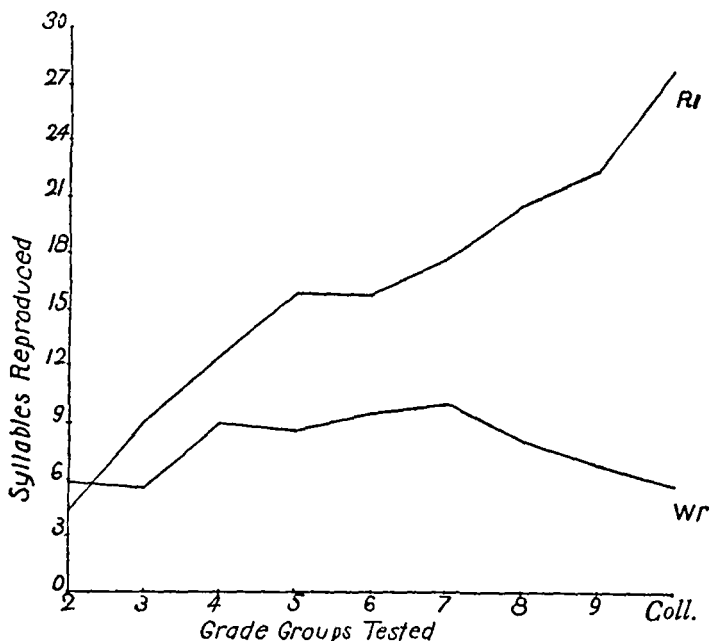


FIG. 2. R_i = average number of syllables correctly reproduced by various groups from two 20-syllable lists one learned with verbalization and the other with restricted articulation. W_r = average number of wrong responses from the same lists.

learning and beneficial to language learning. If this be true, it is possible that we have here a spurious factor not actually related to either method of learning. The writer observed few pupils whose behavior indicated that the pencils were real distractions. Some subjects manipulated the pencils while practicing. Others reported difficulty in learning because of these distractions. One pupil was heard to say that he repeated the words subvocally, with the pencil between

his teeth. Other reports indicated that the tendencies to vocalize were felt even with the silent learning. It is probably not far from the truth to say that the inhibitory influences caused by the pencils in the case of non-vocalization about equal the facilitating influences of vocalization in the case of the inarticulate procedure.¹

Our grade school subjects came from the University of Utah Training School where they are required to read silently, that is, without sub-vocalizing the words and without lip movement. It is quite likely that the previous training of any pupil exerts a measurable influence upon his ability to memorize by either of the foregoing methods. Since our subjects were practiced in silent reading, we should expect this kind of training to favor higher scores from silent than from verbal memorization, but the results are contrary to our expectations. We regard this as a tentative conclusion, only, pending the outcome of further experimentation with other controls of articulation than those already employed. These results indicate that the problem of linguistic responses is of considerable importance within the field of memorization.

How can we account, in terms of theory, for the advantage in memorization which is seemingly due to articulation? A plausible explanation appears to be in terms of the dynamic influence of articulation upon learning mechanisms. Each word, as it is exposed on the memory drum, is a stimulating condition which is antecedent to, and partially determinative of, the consequent language response. The stimulus may be said to evoke the response. In accordance with the theory of the reflex circuit, this language response now becomes a component part of a new stimulating situation in such a way as to constitute a dynamic factor in learning. Repetitions of the language-word act facilitate the fixation of right responses in the neuro-muscular equipment concerned with learning. Considered more broadly, it may be said that every explicit language response is a concrete fact of mental achievement within the experience of the individual. It is evident that more attention should be given to the study of our responses considered as stimuli to further responses.

It may be implied that memorization of meaningful material can be accomplished more economically through vocalization. To establish this point beyond question it is desirable to test the learning of meaningful material by a technique similar to that used in this experiment.

SUMMARY

(1) The average result from every one of our groups shows that the syllables were more economically learned with full than with restricted articulation. (2) The girls make better scores than the boys in both kinds of learning. (3) The pronounced individual differences in the relative number of syllables learned by the two methods point to a need of experimental determination for each pupil of the better

¹ *Editor's note.* The discriminating reader will distinguish between *non-verbalization* and *restricted articulation*. The presence or absence of verbal symbols is not controlled in the present study.

method for his use in memorization. (4) The errors made by the first-described method are slightly in excess of those made by the latter. They are about equally numerous in the lower and in the upper grades, and more numerous in the intermediate grades.

Further related problems of immediate interest include (1) The influence of verbalized learning upon retention of the memorized material; (2) The rôle of language in learning to spell, and (3) The relation between the degree of preference for either method of learning and general intelligence.

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