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LITERATURE MEMORIZATION IN THE LIGHT OF EXPERIMENTAL PEDAGOGY

By MAXWELL F. LITWIN, A. M.

I. INTRODUCTION

The subject of literature memorization has received little, if any, methodical treatment in our schools. Scant consideration has been given to the important results derived from scientific research in this field, and the average teacher pursues his course in this subject in a more or less haphazard way, sometimes striking the right procedure, but more often working in the dark. This is a situation that requires remedying. When we consider that the aim of learning "memory gems" is to foster a love for the good things in literature, and to store the mind with noble thoughts expressed in beautiful language, we must conclude that greater attention ought to be paid to the theory and practice of successful memorization. Both teachers and pupils must be made thoroughly acquainted with the most economical ways of teaching and of learning the memorization material. With this object in view the writer wishes in this article: (1) to present a brief and critical-pedagogical account of the investigation of literature memorization in the elementary schools; (2) to indicate the main conclusions which have been established by previous experimentation in this field; and (3) to raise the questions which ought to be considered in the further experimental-didactical study of this subject.

2. "ECONOMY" AND "HYGIENE" IN MEMORIZATION

It will be well, before proceeding further, to define the terms "economy" and "hygiene" as applied to the memorization of literature, in order that we may use them as touchstones by which to determine the value of prior experimentation in this field.

We usually employ the words "economy" and "hygiene" to mean the saving of time and energy which follows from the use of a particular mode of learning for the achievement of a particular result. The application of these terms to memorization gives us the following definition, quoted from Meumann (10, p. 373):

"That method of learning is most economical which secures a particular memorial effect or attains a particular memorial purpose in the shortest time, with the least number of repetitions, and with the minimum degree of fatigue; and this method may be regarded as the most economical only with reference to this memorial effect and this memorial purpose. Of these three determinations, the learning-time measures the economy of time; while the economy of energy is measured by the number of repetitions, and, in less precise form, by the amount of fatigue. No other accurate means of measurement is at our disposal."

In addition to the above criteria for the evaluation of method, we must consider the question: What purpose actuates our memorization? If our object is merely the temporary retention of the material learned, we may be satisfied with a method which will prove ineffective when the aim is permanent retention. Likewise, if we desire complete instead of merely partial recall of the material, our appraisement of a method will be correspondingly modified.

Since we are here concerned with the memorization of literature in the elementary schools, literature that consists mainly of poetry, we must decide that our purpose is permanent and complete retention; for the primary value of literature memorization lies in the fact that the mind is filled with noble thoughts and feelings expressed in artistic language.

Bearing in mind the criteria above indicated, we conclude that method to be the most desirable which:

- a—Gives more quickly and with fewer repetitions a first perfect reproduction;
- b—Results in more correct and uniform associations; and
- c—Leads to more confident reproduction, and more accurate and permanent retention.

A further preliminary word is necessary as to the conditions of scientific experimentation, in order that we may be able to criticize intelligently the investigations which have been conducted in the field of memorization. These conditions may be briefly characterized as external and internal; the former being concerned with the experimenter, the material employed, the *modus operandi*, atmospheric and barometric conditions, the time of day when the experiment is performed, and the like; while the latter deal with those upon whom the experiment is performed, with their psycho-physical nature, their bodily and mental vigor, their emotional state, their attention, and their interest in the experiment. If an experiment is to consider the influence of a certain factor, it is absolutely essential that all the factors, external and internal, except the

one in question, should remain, as far as possible, constant, and under the control of the experimenter; otherwise, the conclusions of the experiment will be vitiated. Particularly in the investigation of memorial activity is it necessary to have the material a constant factor, and it was for this reason that Ebbinghaus (5), the pioneer in this line of experimentation, suggested the use of "nonsense syllables." This gave him a material (a) that could be so manufactured as to be of equal difficulty throughout; (b) that could be manufactured in sufficient quantities to extend the experiment over a long time; (c) that was capable of accurate quantitative gradation; (d) that permitted of a systematic, mathematical treatment of the errors made in reproducing it; (e) that, on account of its meaningless character, permitted of no appeal to the learner's apperceptive intelligence.

It is from experimentation with this medium, therefore, that most of the laws of memorial activity have been deduced; and, in this discussion we shall first consider experimentation with such non-significant material. Following this, we shall examine the experiments with significant material, indicating here the additional factors that must be taken into account.

The first problems with which memorization study dealt were in the field of the Mode of Presentation. This includes within itself the following elements:

- a—The Kind of Material;
- b—The Ideational Types;
- c—The Method of Presentation itself (10, p. 144).

3. KINDS OF MEMORIZATION MATERIAL

The memorization material may be either meaningless or meaningful. The former has been sufficiently explained above; the latter requires further elucidation. Meaningful material may be relatively coherent,—such as names, dates; or coherent. The coherent material may be further sub-divided into prose and poetry,—and again into relatively abstract matter, dealing with theories, speculations; and relatively concrete matter, dealing with description, narration, etc.

Presenting this in outline, we have:

4. THE "IDEATIONAL TYPE" AND THE MODE OF PRESENTATION

In the "Ideational Types" we find a very important item for consideration. It had been formerly supposed that the method of presentation determined the method used by the learner in his perception and understanding of the material. Investigation has shown that this is only partly true, and that the learner's method is a joint product of the mode of presentation and of his ideational type (10, p. 149).

A preliminary word about these "types." Experiments in the learning process have demonstrated that different individuals recall verbal images to consciousness in different forms. There is the "auditory" individual who hears the auditory images of words; the "motor" individual who mentally experiences the muscular sensations arising from the adjustment of his vocal apparatus; and the "visual" type who sees before him the visual images of printed or written words. Besides these, there are various combination types, known as "mixed" types (11).

In the process of imprinting, these types present radical differences. "In the auditory and motor types, the process of imprinting consists in the formation of a series of successive auditory or vocal images of spoken words, or series of successive innervations of the vocal muscles, which, in turn, are accompanied by sensations or images of movements; or he makes a mental note of the 'melody' of what is spoken to him, and he remembers the sounds and the rhythmic sequence of the words and syllables which he memorizes. And in this melody the various sounds then assume their proper auditory and rhythmic positions. Now, in the act of reproduction, the auditory or motor individual is unable to present the whole series simultaneously to his consciousness; his only alternative is to allow the successively learned items to run their course again in successive order, in the form of either concrete or verbal images. The individual who remembers visually proceeds in a wholly different fashion. The syllables or letters which are to be remembered, he arranges side by side in the form of visual images: and the result of this internal vision, namely, his visually ideated series of letters, he can see before him either simultaneously or in successive sections" (10, p. 182; also 11).

Besides the above differences in the learning types we have differences in the type of attention, some pupils being characterized by intensive attention, while the attention of others may be called distributive. We have also the rapid learner who learns quickly, but forgets quickly, and the slow learner

who learns more slowly but whose retention is more trustworthy.

A. Pohlmann attempted to investigate the relation of method of presentation to ideational type in school children. His experiments are set forth in Meumann (10, pp. 151-154). His subjects: Sixty school children, from nine to fourteen years of age (ten of each age). His Material: (1) familiar significant material; (2) two-syllable names of concrete objects; (3) concrete objects themselves. His *Modus Operandi*: (1) He presented the objects visually; (2) he presented the objects visually and at the same time pronounced their names; (3) he pronounced the names alone; (4) he presented the names visually; (5) he combined the visual and auditory presentation of the names; (6) he combined the visual presentation of the names with pronunciation by the observer. The stimuli were presented only once, and were immediately reproduced in writing.

Results: (1) The retention of objects was better than that of words; (2) Auditory presentation, on the average, produced better results than visual presentation; (3) The combination of auditory-visual-motor presentation gave the poorest results of all.

Commenting on the above experiments Meumann observes (10, p. 152):

"These results show, however, that the superiority of auditory presentation holds only in the lower classes of the schools; beyond the intermediate classes visual presentation gradually gains the ascendancy, and in the upper classes the relations are reversed, visual presentation being more advantageous here. This state of affairs is undoubtedly a product of the prevailing methods of teaching, because instruction is addressed more to the ear in the case of younger pupils, while in the case of older pupils, the visual sense is more concerned."

The above conclusions have been verified also by Miss Conway (8), who found that when children enter school their auditory memory is best; but that when they have been in school for some time their visual memory is superior.

When Pohlmann also investigated the comparative retention of words and of concrete objects, for intervals of twenty-four hours, and of three days, he found that: (1) the best results were furnished by presenting the objects; (2) the visual-auditory-motor mode of presentation was the worst; (3) the purely auditory mode of presentation was better; (4) while the auditory-visual presentation was the best.

In an experiment with unfamiliar and non-significant material Pohlmann found that visual presentation gave the best results, a conclusion that Meumann agrees with.

Pohlmann's work has great pedagogical value, in that it shows the importance of methods of presentation for different sorts of material. It shows also that in presenting material to pupils their ideational types must be taken into account; that the auditory-visual method of presentation is the best; and that concrete presentation leads to more permanent retention.

Pohlmann's experiments "do not, however, furnish a final verdict concerning our problem, because they fail to provide for a complete separation of the component processes which constitute apprehension" (10, p. 154). In class-room experiments it is impossible to isolate the mental effect of the various methods of sensory presentation in any definite fashion. Where auditory presentation is used, we have no guarantee that the pupils will not use motor or visual imprinting. If now we take each individual separately and use such methods as will enable us to isolate each sense, we are met with the objection that the experiment is of no practical value for the school-room. The most trustworthy method is a combination of both of the above, and this Pohlmann did not employ.

A question that must now be answered is: Are the ideational types capable of modification? Radosavljevich answered this question in the affirmative. He investigated the memory of eleven school children from seven to thirteen years of age. The learning was done solely by a method of reading and sotto voce pronunciation. He found that his observers gradually approached more and more closely to the auditory type of memory. From this he concluded that the ideational types of children are modified by long continued learning (10, p. 185).

Meumann also mentions an experiment of Ziehen, who found that a boy, to whom words were presented orally, always made use of visual images of written words, because he had been taught to spell by the visual method (10, p. 226).

From the above investigations we are able to appreciate the significance of the ideational type in class-room memorization. If the teacher is aware of the relation of method of presentation to ideational type, he will choose the mode of presentation which will reinforce the ideational type of the pupil instead of hindering it. The question of visual or auditory presentation thus becomes a question of discovering the pupil's ideational type.

It is also important for teacher and pupil to know whether the learner should use only those memory aids suited to his peculiar type of learning or whether he should employ as many aids as possible. At first glance it would appear that

the latter is the better course to follow,—that the greater the number and variety of the associations the more permanent will be the impression. Meumann's experiments, however, demonstrated that unpracticed individuals succeed better when working only with those helps customary to their memory type; and he concludes that at first children should be taught to use properly their innate memory aids, and only when they have acquired some degree of skill should they attempt to improve their memory performance, by gradually remedying the deficiencies of their memorial faculty (10 and 11).

If it is imperative for the teacher to take into account the ideational type of his pupils, it becomes necessary for him to have methods of determining such types. For this, many suggestions have been offered, although they are rather ingenious devices than accurate and systematic methods. Meyerhardt (11) indicated the following:

(a) Take twenty-five letters or numbers divided into five lines of five each; arrange them uniformly in a square; then divide into twenty-five equal squares, and tell pupil to memorize these in the general way from the left to the right. When pupil is able to recite these without error, ask him to recite those letters or numbers which form a diagonal line from the left to the right,—or those numbers contained within a vertical line of squares. The visualiser will find this task easy, but the auditory type will experience much difficulty.

(b) A number of phrases, words, or syllables are presented first to the visual, and then to the auditory memory. In the first series, during one hundred seconds, fifty words, one every two seconds, are exposed to the eye of the pupil. In the second series, fifty words of similar nature, one every two seconds, are spoken with a loud voice. If a pupil retains more words of the first series than of the second his visual memory is the stronger, whereas if the second series results in the retention of a greater number of words, his auditory memory is superior. This device is of course open to the same objections, made above, in connection with Pohlmann's experiments.

The visualiser can also be determined because he confuses words that look alike, although they may have entirely different sounds. He spells long words backwards almost as readily as forwards; while the auditory and motor individuals find this difficult.

Another scheme suggested by Meumann (10, p. 338) is to ask children to record all of the visual, auditory, and motor ideas which occur to them in a given period; or to ask them

to report the first idea which comes to them when a word is pronounced in their presence.

With the foregoing brief exposition of method of presentation in relation to ideational type, we can now proceed to the method of presentation in its other aspects, keeping in mind that the value of a method should be determined by (1) the time required for learning; (2) the expenditure of energy; and (3) the permanency and accuracy of retention.

5. THE "PART-PROCEDURE," THE "WHOLE-PROCEDURE" AND THE "MEDIATING PROCEDURE"

First let us answer the question whether memorial material should be learned as wholes or in parts.

In order to determine the method of memorizing used by unpracticed learners, Lottie Steffens (11), a student of Professor G. E. Müller at Göttingen, performed several experiments, with six adults and one nine year old boy. To the former she assigned for study two verses from Byron,—to the latter, two six-line parts of a German poem. Her subjects were given no directions as to how they should work. Their procedure was usually as follows: 1—Each learner divided the verse into parts; 2—Each repeated parts already learned by going back, or occasionally while learning other parts; 3—Each repeated the first lines oftener than the last ones; 4—Difficult parts or words were learned by special, separate repetitions; 5—The end of one part and the beginning of the next were connected by special reciting; 6—The adults showed a tendency to learn by attempting to recite what had been half memorized, looking back at the original for purposes of checking; the boy learned entirely by means of reading; 7—The boy learned most erratically, wasting twenty-one repetitions on the first two lines, while using only six for the last two. Upon test his recall was irregular and hesitating, the retention superficial.

Notwithstanding certain individual differences in methods of learning, it will be found that most unpracticed learners adopt a procedure similar to the above. Their learning proceeds in three stages: First, there is the stage of adaptation and orientation, during which the learner "sets himself" for the task in hand. Second comes the stage of passively receptive learning, when the impressions are being repeated to the end that recall may be possible. Third is the stage of tentative recitation, checked and controlled by the learner. Finally follows the fixing and strengthening of uncertain parts.

What strikes the investigator with peculiar significance is the inevitable tendency to divide the material into parts; and

yet this method of learning has been found by experiment to be the most uneconomical from the points of view of economy of time, of expenditure of energy, and of permanence and accuracy of retention.

There are in general two methods by which the learner may memorize his material:

1—He may divide it into sections, and learn each section as a whole. This is called the part-procedure.

2—He may read his material through from beginning to end during the entire process of learning. This is the whole-procedure.

Many experiments have been performed to determine the values of these two modes of learning. Miss Steffens (10, p. 238) used stanzas of poetry of as nearly equal difficulty as possible. These stanzas were learned by several persons first by the part-procedure, and then by the whole-procedure. She found that, on the average, the learning of a verse by the whole-procedure required 167 seconds, while by the part-procedure the time taken was 183 seconds. She performed similar experiments, using nonsense syllables, and found that here too there was a slight difference in favor of the whole-procedure. The children's results were on the whole the same as those of the adults.

Her explanation of her results was as follows:

a—In the part-procedure many false and useless associations are formed. For example, two lines are repeated several times, and at each repetition an association is formed between the end of the second line and the beginning of the first. Then the third and fourth lines are learned in the same way. When the two pairs are connected we have a new association between the second and third, and the fourth and first lines. These new associations compete with associations already formed. Watt (14, p. 50), commenting on the same point says: "If one hundred lines of verse were learned in this way, in twos and fours,—say, verses from Pope—there would be formed between the lines 198 or 148 associations, of which only 100 would be ultimately required. Every second one of these would be blocked by two useless associations, and in order to be safe from their power would have to be raised to a much greater strength than would otherwise have been necessary. In time the strength of all the associations formed would decrease, and those necessary to correct repetition of the verses, being in many cases formed later than the false associations, would lose strength more rapidly than these. Thus, in the end, many of the false associations would be the more powerful and therefore effective."

b—In learning by the whole-method we have the advan-

tages of mediate association, association between parts widely removed from one another, and of "absolute position," the position of the parts in the whole. These advantages are lacking in the part-method.

c—In using the whole-procedure, our learning is uniformly distributed over all parts of the material, and if all the parts are equally difficult, we avoid the error of devoting too many repetitions to certain parts and too few to others.

The investigations of Miss Steffens, while instructive in many particulars, are defective for the reason that the only criterion used by her was the saving in time. She omitted consideration of the factors of expenditure of energy and of accuracy and permanency of retention.

It is for this reason that we must turn to Meumann's experiments at Zurich in 1901 (10, p. 240), before we can truly determine which method is the most "economical."

Meumann's aim was to find:

a—Which method of learning leads to faultless recitation from memory in the shortest time and with the least number of repetitions.

b—Which method of learning secures the best distribution of attention over the material, and the best formation of associations between its parts.

c—Which method gives the most accurate reproduction and the most permanent retention.

d—In what way the meaningless or meaningful nature of the material influences the efficiency of the various methods.

In his experiments Meumann employed both adults and school-children.

He found that: (1) Learning by parts becomes more and more disadvantageous the more the material is subdivided; and the more closely part-learning approximates to whole-learning, the more rapidly and certainly is the work done; (2) The whole-procedure is even more advantageous with significant than with non-significant material, the reason being that here the learner's apprehension of the meaning, and of the logical coherence of the material is much more vivid and certain.

One of his observers, Kl., learned two stanzas from Schiller's "Dido" on each of two consecutive days; on alternate days she used the part-procedure, each stanza constituting a part, and on intervening days, the whole-procedure. As to the factor of time, Meumann found that the whole-procedure showed an average saving of 14.5 minutes per stanza, over the part-procedure. As to the factor of energy, he found that the part-procedure required thirty-three repetitions for the memorization of each pair of stanzas, while the

whole-procedure required only fourteen repetitions. As to the factor of retention, it was discovered that the stanzas learned by the whole-method were recited from memory with greater certainty. Later, when the stanzas had been partly forgotten, they were re-learned, those which had originally been learned as wholes being re-learned most rapidly.

Another observer, who memorized five eight-line stanzas of poetry each day for several days,—employing the whole and part methods alternately,—required 32 minutes and 45 repetitions for each stanza, with the part-method; while he needed only 12 repetitions, but approximately the same amount of time, with the whole-method. This shows that the gain is not so much a gain in time as a gain in saving of repetitions, and in accuracy and permanency of retention.

Meumann's explanation of the advantages of the whole-method is as follows:

a—The uniform distribution of repetitions results in more stable and uniform associations.

b—The associations are all formed in the direction in which they are to operate in reproduction. There are no backward associations.

c—The position of each section in the whole is formed correctly at the outset, and is reinforced by each successive repetition.

d—The meaning of the material is better understood, and thus our learning is more strongly reinforced.

e—The better apprehension of the meaning prevents a relaxing of concentration.

When the experiments were extended to children Meumann obtained somewhat different results (10, p. 248). Here he found that at first the advantage in the saving of time lay with the part-procedure. He explains that this is due to the fact that the child is at first discouraged by the whole-procedure; he does not perceive his progress, becomes depressed, and this dejection of mood exercises an unfavorable effect upon his learning. When, however, the child was "let into the secret," was explained the advantages of the whole-method, and had used it for a time, the results were very different; and after a little practice even the child learned nonsense material more economically by memorizing it as wholes, than by dividing it into parts.

With significant material the whole-procedure was as advantageous for children as for older persons. An eight-year old boy learned a verse of Goethe's "Erlkönig" in seventeen repetitions by the part-method,—in eleven repetitions by the whole-method. Subsequent re-learning was also much easier

where the latter method had been employed. Meumann found this true of all the other children, provided the material was not long enough to fatigue them.

The above experiments seem to establish that: "For adults and children it is more advantageous, and it is psychologically and pedagogically more appropriate to learn every sort of material as a whole than to break it up into parts." (10, p. 249.) Yet there are two important limitations to this principle:

a—It is extremely hard to find material for school memorization that is equally difficult in all its parts. Each piece of literature often contains parts of special difficulty. If we use the whole-procedure throughout, we shall have to waste many repetitions on account of such troublesome parts, even though the greater part of the material is already well learned.

b—Again, experiments show that our concentration of attention, during the act of learning, is not entirely uniform; that it proceeds in a curve, showing a maximum intensity at the beginning and end, but weakening at the center. If the whole-method is used we find that the beginning and the conclusion of the material are much better learned than the center portion.

The foregoing disadvantages of the whole-method of learning are overcome by the "mediating-procedure," which combines the advantages of the whole-method and of the part-method. In this procedure the material is divided into parts according to the degree of difficulty of context, and the parts are marked off by a stroke. In reading, the learner pauses for a short time at the end of each section, but he does not return to the beginning; instead, he continues to read through to the end. The pauses enable the attention to return to the task with increased vigor,—while, at the same time, retrogressive, inhibitory associations are prevented. The parts of special difficulty are learned by themselves, and then the whole series is read again, until the entire context is uniformly memorized.

Ebert and Meumann (11) in an extended series of experiments with nonsense syllables compared the relative values of the whole-, the part-, and the mediating-procedures. They came to the following conclusions:

a—Each one of the old methods has its characteristic strong and weak points:

(1) The whole-method is bad because it permits a weakening of attention at the center of the material; it is good because it forms associations only in the direction in which they will be needed in reproduction.

(2) The weakness of the part-method lies in the fact that it allows the formation of irrelevant associations; its strength is found in the fact that the attention is renewed and invigorated at the beginning of each part.

b—The mediating-method combines the advantages of the whole and the part methods and avoids their respective disadvantages.

6. THE DISTRIBUTIONS OF REPETITIONS IN MEMORIZING— "JOST'S LAW"

Another important factor in economical learning is that of the distribution or concentration of the repetitions. Is it more advantageous to learn the whole material at one sitting or to spread the repetitions over several sittings? In an attempt to answer this question several interesting experiments have been performed.

Ebbinghaus (5) used series of nonsense syllables, and found that when the repetitions were distributed over three days, each series was learned in thirty-eight repetitions, while learning a series at a single sitting required sixty-eight repetitions. It does not appear from this experiment, however, what the effect was upon the factor of retention.

A. Jost (3) investigated this problem more in detail. His primary object was to determine the influence of the distribution of repetitions upon the permanence and accuracy of retention. In one case he employed thirty consecutive repetitions in the learning of a series of syllables; in another case, upon a similar series, he employed ten repetitions on each of three successive days. The accuracy of retention was tested within twenty-four hours after the completion of the learning. The results demonstrated that the syllables learned with distributed repetitions were retained better than those learned with the same number of accumulated repetitions.

After several other experiments which gave similar results, he enunciated his famous "Law of the Age of Associations," known since as "Jost's Law." This states (3, p. 157): "When two associations are of like strength, but of unlike age, repetition increases the strength of the older more than of the younger associations. When two associations are of equal strength, but unlike age, the younger fades more rapidly than the older." Stating this more concretely: If I have learned two poems equally well, one having been learned some time before the other, a given number of repetitions will fix the first poem in my mind more firmly than the second. Also a month from now I shall be better able to recall the poem learned first (3).

Meumann (10, p. 267) repeated Jost's experiments, and found his conclusions generally correct. With smaller and easier material, however, he found it was better to accumulate the repetitions until memorization was complete.

D. O. Lyon (9) also performed several experiments in this connection. His subject was himself, and his material was nonsense-syllables, poetry, digits, and prose. His experiments extended over a period of fifteen months. He used two methods of learning: the "continuous" method by which all the material was learned at one sitting; and the "once-per-day" method by which he repeated his learning once every day. For example, on May 1, 1908, he memorized eight nonsense syllables, keeping a record of the time spent. On the evening of the same day he memorized a four-line stanza of poetry. On May 4th a similar set of nonsense-syllables was read once, and then laid aside for re-reading the next morning. On the evening of May 4th a four-line stanza of poetry, similar to the one learned on May 1st, was read through once. Later he increased the length of the series and the number of the stanzas. He guarded his experiment from error by performing no other memory work during this period, by reading no other nonsense syllables or poetry.

After an excellent graphic presentation of his results, he concludes: 1—by the "once-per-day" method a long passage or set of nonsense syllables is learned in nearly the same number of days as a short passage or set of syllables. 2—In so far as poetry and prose are concerned, one method is as economical as the other if we consider only the time spent; if we consider the tenacity of the impression the "once-per-day" method is far superior. 3—In the case of nonsense material and digits there is considerable saving of time by the "once-per-day" method.

Jost's Law is of great pedagogical significance. When the learner has extensive material to learn, he must not attempt to master it by accumulating the repetitions at one sitting. The repetitions must be distributed as widely as possible. It may be objected that distributing the repetitions results in a wasting of time and energy, because the "warming-up" process, necessary at the beginning of a task must be often repeated. While we must admit this shortcoming, we must remember that economy of time and energy are not the sole factors in economical memorization. What we desire above all is accuracy and permanence of retention, and this can be obtained only by distributing the repetitions. The fact that the learner can reproduce a certain amount of material immediately after learning is no guarantee that he will be able to retain it permanently and accurately. Experiments have

proved just the contrary. It is only when the learning has been extended over a considerable time, and the associations have had an opportunity to become fixed, that we may expect reliability in retention (3, p. 158). An additional advantage of distributed learning lies in the fact that it lessens fatigue.

7. THE RELATION BETWEEN LENGTH OF MATERIAL AND DIFFICULTY IN MEMORIZATION

We come now to the discussion of the relation that exists between length of material and difficulty in memorization.

In this field also, Ebbinghaus (5) was a pioneer. He performed many experiments with nonsense syllables and then formulated the following law: "Difficulty in memorization does not increase in direct proportion with increase in the amount of material, but larger groups or greater masses of material require a disproportionately greater number of repetitions" (10, p. 275).

This conclusion has been disputed by Meumann, Radosavljevich, and others. In an excellent article by D. O. Lyon (9) the data of several experiments on this point are presented.

RELATION BETWEEN LENGTH OF MATERIAL AND DIFFICULTY IN MEMORIZATION

TABLE C		TABLE D		TABLE E		TABLE F		TABLE G	
Meumann and Radosavljevich		Ebbinghaus		Henmon		Henmon		D. O. Lyon	
Self as subject		Self as subject		Self as subject		Average of 3 expt's on 1 subject		Average of 1 expt. on 14 subjects	
No. of Syl.	No. of Rep.	No. of Syl.	No. of Rep.	No. of Syl.	No. of Rep.	No. of Syl.	No. of Rep.	No. of Syl.	No. of Rep.
8	5	7	1	..	..	..	..	..	...
..	..	..	..	10	7	10	13	10	144
12	10	12	17	12	8	12	14	20	138
..	..	..	..	14	8	14	15	..	...
16	17	16	30	16	9	16	15	..	...
18	21	..	..	18	11	18	16	..	...
..	..	..	..	20	14	20	19	..	...
24	30	24	44	24	13	24	16	..	...
..	..	36	55	30	20	30	26	40	174

According to this table, we see that in the experiments of Ebbinghaus there is a relative increase in number of repetitions with the increase in number of syllables. According to Meumann there is a relative decrease, a conclusion borne out by the other experiments.

Henmon also experimented with meaningful material, using stanzas of "In Memoriam." He used three subjects. His results follow:

Stanzas	Words	Number of Repetitions		
		<i>H</i>	<i>D</i>	<i>P</i>
1	28	3	3	4
2	56	5	6	7
3	84	6	9	10
4	112	7	11	12
5	140	9	14	14

D. O. Lyon likewise experimented with poetry of the kind of "The Ancient Mariner," obtaining the following results:

Stanzas	Words	Number of Repetitions	
		<i>G</i>	<i>M</i>
2	60	7	5
5	150	17	14
10	300	19	16
25	750	22	16
50	1500	30	23

Henmon also performed an experiment, using prose from the essays of Huxley and of Matthew Arnold. The following were his results:

No. of Words	No. of Repetitions	Approximate Time
100	6.4	3.2 min.
200	7.3	7.3 min.
300	7.0	10.5 min.

The foregoing experiments demonstrate that the conclusion of Ebbinghaus is not sound, and that, on the contrary, we find a relative decrease in expenditure of energy with increase in the amount of learning material. With unpracticed learners Ebbinghaus' conclusion has more validity (10, p. 275), but with practiced learners it is found that a little more work added to a task does not demand the same expenditure of energy as if the added work had to be done by itself. Meumann's explanation (10, p. 275) is that proper orientation and adaptation is already established and the additional material benefits thereby.

8. THE INFLUENCE OF RE-LEARNING UPON FORGETTING

In our investigation of retention as one of the factors in economical learning, the question naturally arises: What is the relation between permanent retention and re-learning; in other words, What influence does re-learning exert upon the process of forgetting?

We again find in Ebbinghaus (5) an attempt to solve this problem. His subject was himself; his material was nonsense syllables. His procedure follows: He memorized many series of nonsense syllables, thirteen in each series. He usually learned eight series in succession. Each series was learned until one perfect recitation was possible. Then it was re-learned after intervals of twenty minutes, one hour, and thirty-one days. At each re-learning he recorded the time expended and the time saved, and employed these as the measure of forgetting up to that point.

His results indicated that forgetting is rapid at first, and then proceeds more and more slowly. The loss at the end of one hour was one-half; at the end of nine hours about two-thirds; at the end of six days it was three-fourths; and at the end of one month it was four-fifths. From his results Ebbinghaus plotted his famous Curve of Forgetting: "Forgetting progresses not in direct proportion to the time, but in proportion to the logarithm of the time."

Several objections may be made to the validity of the above investigation. In the first place, the only subject was himself, and, therefore, his range was too narrow to give him a foundation for accurate judgment. Secondly, he recorded only the time expended and the time saved. He omitted to take into account the factors of number of repetitions and tenacity of retention.

These objections would in themselves be sufficient to cast doubt upon the significance of Ebbinghaus' "curve," were his conclusions not further disturbed by the results of succeeding experimentation.

Radosavljevich repeated the experiments of Ebbinghaus, using twenty-seven subjects. He found that forgetting by no means proceeds as rapidly at the beginning as Ebbinghaus claimed. A comparison between their results taken from Meumann (10, p. 333) reveals this very clearly:

	Number of experiments performed by		Length of interval between learning and re-learning	Per cent forgotten		Difference in favor of Rados.
	Rados.	Ebb.		Rados.	Ebb.	
1	24	..	5 min.	2.5		
2	24	12	20 min. (Ebb. 19)	11.4	41.8	—30.4
3	24	16	60 min. (Ebb. 63)	29.3	55.8	—26.5
4	24	12	480 min. (Ebb. 525)	52.6	64.2	—11.6
5	47	26	1 day	32.2	66.3	—34.1
6	26	26	2 days	39.1	72.2	—33.1
7	20	26	6 days	50.7	74.6	—13.9
8	13	..	14 days	59.0		
9	8	..	21 days	62.0		
10	18	45	30 days	79.8	78.9	9
11	12	..	120 days	97.2		
Total	240	163				

In connection with the same problem Radosavljevich made the following investigation (13, p. 328): Two series of eight lines of poetry, comprising about ninety syllables, were learned to the point of two perfect recitations. One series was re-learned after an interval of twenty minutes, the saving of time being 96 per cent. After an interval of sixty minutes the other series was re-learned, the saving here being 81 per cent.

From his experiments Radosavljevich concludes that the amount of forgetting which occurs for a time after the learner has given a first perfect recitation is almost directly proportional to the length of the elapsed interval; and that not until some time later is there a more rapid progress of forgetting; this again being followed by a gradually decreasing rate.

The deductions of Radosavljevich have been borne out by subsequent investigation, and are in accord with our everyday experience. If our memory behaved as Ebbinghaus explained, it would be very untrustworthy indeed.

9. SIGNIFICANT LEARNING—"MEMORIAL AIDS"

We are now prepared to take up the investigations in the field of significant learning, and here we must take cognizance of certain factors not present in purely mechanical memorization.

It will be readily seen that an important element in significant learning is the kind of material. This as was pointed out above may be relatively incoherent (such as synonyms, dates), or wholly coherent. In the latter case we must again subdivide into prose and poetry, and consider also whether the context is relatively abstract or concrete, and if the latter, whether it deals with description, narration, etc.

Another new element in significant learning is the "types

of memorization," by which is meant that in studying extensive material some learners remember chiefly by means of the sensory elements in the context, others by means of the logical elements.

These problems present opportunities for interesting exploration in the field of significant memorization. Yet the investigations here, perhaps on account of the complexity of the conditions, have been few and far between.

The work of Ebert, of Meumann, and of Kraemer is alone important in this field. First these investigators discovered the "types of memorization." They found that learners choose "corner-stones" of retention; that for the logical learner these consist of those portions of the context from which the rest logically depend, while for the verbal learner these "corner-stones" are chiefly the visual and auditory elements of the text, the length of words and sentences, the sounds of words, the recurrence of the same sounds, the position of the words, and the like. With the first class it was found that the logical elements were of primary importance, the verbal elements playing an auxiliary rôle, whereas with the second class the conditions were reversed, the sensory elements taking the prominent place, while the significance of the context was only of secondary importance.

In investigating this problem Ebert and Meumann used stanzas from Schiller's "Zerstörung von Orleans," and selected portions from a translation of Locke's "Essay concerning Human Understanding." Kraemer's material covered a wider field, embracing excerpts from Locke, and from Hume, passages from a narrative poem by Kleist, and selections from Mau, Schmeil, and Hertwig.

The learners in each case were asked to describe their ways of beginning to learn, and their introspective reports were supplemented by objective determinations.

The above investigations and others along the same line have led to several pedagogically significant conclusions (IO, p. 297):

a—For coherent, meaningful, material the chief "memorial aid" is the understanding of the logical context. Since this is so, the teacher must use every means possible to enable the pupils to understand the material.

b—The ideas and modes of expression with which the pupil is already familiar should be the "corner-stones" upon which to erect the memory process. Therefore, the teacher should help the pupil to discover the familiar elements in the context.

c—The factors which serve as chief supports of the process

of learning are of three sorts: (a) When the material is a description of tangible objects or of concrete situations, the learner's chief aid is picturing them as concretely as possible. To this end pictures, objects, and the like are of great service. (b) When the memory material is of a narrative character, the learner's chief aid is in the temporal relations,—the sequence of events, their duration, etc. (c) When the context is of an expository or of an argumentative nature, the learner's chief aid is in the logical relations.

Besides these primary "aids," there are secondary supports to learning, such as sentence-structure, rhythm, rime, tempo; as well as certain hindrances, such as extremely long sentences, a succession of short sentences, interpolated words, fatigue, and the like. Rhythm has been found to be of great importance in the memorizing of poetry. It exercises an exhilarating effect upon the learner, and thus produces an emotional state favorable to effective learning (10, p. 309).

Kraemer was also instrumental in discovering learners' "attitudes" or modes of distributing the attention, and the influence of these "attitudes" upon the memory process and product. He found that some learners adjust themselves to the content as such, others to the form as such, and still others to both form and content together.

It was found to be disadvantageous to distribute the attention over both form and content at the same time,—because such distribution resulted in a purposeless expenditure of energy, now centering upon one thing, now upon the other, in the end producing a feeling of irritation in the learner. It is, therefore, important that the teacher should call to the pupil's attention the significance of his "attitude" and warn him against attending to form and content at the same time.

10. THE INFLUENCE OF THE EMOTIONAL ATTITUDE UPON MEMORIAL ACTIVITY

The conditions of economical learning which we have above indicated are mainly objective. There are, of course, many subjective conditions of learning which ought to be considered; but the scope of this presentation will not permit such consideration at length. We cannot, however, dismiss this subject without taking up the question of the influence of the learner's emotional attitude or will upon memorial activity.

It is an undisputed fact that the mind attends best to that which pleases it. If the learner is presented with material which is directly or indirectly pleasant to him, his memorial activity will be favorably stimulated; while, conversely, if the material offered has no appeal, the memory process will

be retarded. From this follows, as a corollary, the necessity of eliminating, during the learning period, all factors that will have a depressing effect upon the learner, such as lack of understanding, fear of not making progress, and the like. The teacher's duty here is to explain to the pupil the conditions of learning, the difficulties that he will have to encounter, and the means of overcoming those difficulties. This procedure will interest the pupil and induce him to exert his will to tide him over the periods of depression. In this way the efficiency of his learning will be greatly increased.

II. FORMAL MEMORY TRAINING—ITS PLACE IN THE CURRICULUM

In the pedagogical study of memorization the question will naturally be asked: Can memory, in general, be trained or improved, and, if it can, shall we incorporate into the school curriculum such formal memory training?

It must be borne in mind, at the outset, that the memory of school-children is very poor. Bolton (2) experimented with children under fourteen years of age and found that their memory ability was very low, and that while it improved as they grew older, this improvement depended upon age rather than upon intelligence.

In order to determine whether general memory training is possible, we must examine the work of Dearborn, Winch, Sleight, James, and Ebert and Meumann.

Dearborn (13), after experimenting with learning the English meanings of French and German words, and with stanzas of poetry, concluded that memory for all sorts of material can be markedly improved in the case of all except considerably practiced learners.

Winch (15), who tested the ability of thirty-six school-children to hold in regular order in their minds twelve consonants, found that this ability improved very rapidly with practice. He also showed, in an experiment with groups of girls averaging thirteen years of age, that practice in the learning of poetry transfers to the learning of history, and that memory for geography was also greatly improved by practice in poetry. Experimenting with boys and girls from ten to twelve years old, he found that practice in mechanical learning improved rational learning. As a result of his experiments Winch concluded (10, p. 356): "Training which is acquired through the memorizing of one sort of subject-matter may be transferred to the memorizing of other sorts of subject-matter whose nature is certainly diverse from the first."

Sleight (12) who experimented with adults and used as his material dates, nonsense syllables, prose, and poetry, found the following improvements, expressed each as a percentage of the variability of the function in question in the group in question: Dates 3; Nonsense Syllables 66; Poetry 14; Prose (literal) 35; Prose (substance) 16.

James (13), also found improvement when he measured the ability to memorize one kind of verse before and after a fixed amount of training with a different kind of verse.

Ebert and Meumann (10, p. 358), tried to measure the influence of "training series" of nonsense syllables upon the memorization of series of numbers, series of letters, other series of nonsense syllables, series of unrelated words, series of visual forms, German—Italian word-pairs, stanzas of poetry, and paragraphs of prose.

Some of their results follow:

Observers	Repetitions before practice	Repetitions after practice
(For the learning of ten nonsense syllables)		
Ba.	28	3
F.	23	2
Br.	25	4
M.	31	4
(For the learning of sixteen nonsense syllables)		
Ba.	31	5
F.	19	5
Br.	23	8
M.	34	3
(For the learning of prose)		
Ba.	36	14
Br.	26	11
F.	17	5
S.	38	10
(For visual impressions of geometric forms)		
Ba.	25	7
Br.	26	6
F.	24	7
S.	43	6

Meumann concludes (10, p. 359): "There can be no doubt that so great an amount of transferred training cannot be explained from a mere acquisition of mechanical devices which aid in memorizing; we are compelled to assume that a concomitant training of related functions of memory took place."

Since the above investigations are unanimous in demonstrating that formal memory training is possible, the question arises: Shall we introduce it into the class-room?

We are met at the outset with the objection that the school curriculum of to-day is already greatly overcrowded, and therefore any further additions are impossible. We may overcome this objection by introducing formal memory training under the following limitations: (a) the "training" material should be closely related to the work of the class-room; (b) It should be adapted to the age and the intellectual capacity of the learner.

12. SUMMARY OF CHIEF PEDAGOGICAL CONCLUSIONS IN MEMORIZATION

With the above brief survey of the field of memorial investigation we are prepared to summarize some of the conclusions which are of significance for the teacher.

a—We have first of all seen that the general practice of leaving actual memorization to the unguided efforts of the child results in a useless expenditure of time and energy. Children are not conscious of the steps in systematic study, and, as a consequence, their efforts are often misdirected, and lead to no useful end (4). The teacher's province is then, to let the pupil into the secret; to give him an efficient technique of learning. In this way not only will there result a saving of time and energy but the emotional and volitional state of the pupil, an important consideration in all learning, will be very favorably affected.

b—We have also determined that the method of presentation depends to a great extent upon the ideational type of the learner. Therefore the teacher should discover the "types" of his pupils, and indicate to each the peculiar behavior of his type, its advantages and shortcomings, how to use the one and overcome the other.

c—In the matter of actual presentation for memorial purposes it has been shown that the "whole-method" of learning is most advantageous, if we consider the factors of time, energy, and retention; that in cases where the material is particularly difficult the "mediating-procedure" should be employed. In the same connection it has been shown that it is unwise for the learner to attempt recall until his material is thoroughly learned, because such premature testing causes confused and inaccurate associations.

d—Further we have demonstrated the necessity of distributing our memorial activity, explaining that one reproduction without error is not a guarantee of permanent reten-

tion, but that in order to obtain such retention we must allow mechanical, distributed, repetition.

e—As part of the technique of memorization with which every pupil should be endowed, we have indicated the use of memorial “aids,” conducive to speedy apprehension and accurate retention; showing that with significant material these “aids” consist primarily in a logical apprehension of the context (4). This apprehension can be indirectly effected if the teacher, while questioning the pupils in regard to a passage, should require answers in the exact words of the context (6). Pupils should also be shown the importance of their “attitudes,” should be warned against distributing their attention over both form and content at once, and should be instructed to learn slowly and accurately at first, then gradually to increase the rapidity of reading and learning.

f—It has also been made clear that formal memory training is possible, and that its introduction, with certain limitations, into the school curriculum will prove of great value.

13. PROBLEMS FOR FUTURE INVESTIGATION

So much for the chief pedagogical conclusions which have been derived from previous experimentation. We do not, however, believe that this field has been entirely exploited. There are to our way of thinking several important problems which are still open to investigation. These problems may be divided into primary problems and secondary problems.

Chief among the former is the question of the suitability of the school memorization material to the nature of the child. How do the so-called “memory-gems” appeal to the pupil; which does he like and which does he dislike?

In this connection it would be essential to investigate children’s tastes in literature. According to Gardner (7) who took up this matter, children’s literary tastes are, from literary, moral, and aesthetic points of view, very poor. Yet he showed that they are capable of improvement and modification.

In discussing the suitability of memory material to the child, we must again remember the psychological law that the mind attends with best results to that which gives it pleasure. If, therefore, we offer the child a content that appeals to him, his memorial process will be favorably affected, while if we present content that has no appeal we introduce a retarding influence.

The question now presents itself: What factors can aid us to determine the appropriateness of memorial material to the child? Two that may be suggested are: the child’s age, and the child’s intelligence.

Bagley (1) has determined that there are three stages in the child's apprehension of material: (a) During the transition stage, from six to eight years, the mental characteristics are not strictly rational. In this stage words have little meaning unless they are definitely associated with concrete images. (b) During the formative stage, from eight to twelve, children's interests still center largely in the objective rather than in the subjective. Concrete imagery is still essential. There is no understanding of the symbolical. (c) During the adolescent stage, there is a decided improvement in the logical faculty. The new social interests, the strong emotions and high aspirations that characterize this period make necessary an appeal to the symbolic and the ideal.

It is clear, if we admit the above characteristics in the various stages of the child's mental development, that we must carefully choose memorial material that will appeal to the child in whatever period of development he happens to be. "Memory Gems" for children in the first stage must differ materially in content and in method of presentation from those offered to children in the second and third stages. Where the content has no appeal to the child he becomes indifferent to the end in view, because it has no relation to his aptitudes and motives (16).

In this relation we must also consider the question, sometimes overlooked, as to what our aim is in having children memorize literature. Is it to stimulate their intelligence, or arouse the feelings? If our aim is to arouse the feelings and this is the primary aim of literature (6), we must choose material that abounds in vivid mental imagery; and we must so present this material that it will exercise an intense emotional appeal. To choose memory matter for the young elementary-school child because it has moral or ethical significance is to err in two directions: 1—by appealing to rational faculties which are not present; 2—by failing to recognize the true function of poetry, namely, to stimulate the imagination, and arouse the feelings.

Among the secondary problems which still require solution is the matter of class-learning versus individual learning. It is usually contended that in class-learning there is a certain social incentive, an esprit de corps, which is beneficial to the learning process. It would be interesting and instructive to determine just what relation exists between these two methods.

Again, future investigation should discover the connection between learning in school and learning at home, discussing the aiding and hindering influences in each case.

The question of visual as against auditory presentation has not yet been fully decided. Meumann (10, p. 270) suggests that some further experimentation is necessary to clear up this matter.

In conclusion, it must be admitted that the practice in literature memorization in our elementary schools is too often at variance with the conclusions which have been derived from the experimental study of memorization. A closer acquaintance on the part of teachers with the important work that has been done in this field is to be earnestly recommended.

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