A Study of the Effect of Meaningfulness of Materials Under Conditions of Practice on Learning and Retention

Le-Thi-Que, Le-Thi-Que

Loyola University Chicago

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A STUDY OF THE EFFECT OF MEANINGFULNESS OF MATERIALS UNDER CONDITIONS OF PRACTICE ON LEARNING AND RETENTION

by

Lê-Thị-Quê

A Thesis Submitted to the Faculty of the Graduate School of Loyola University in Partial Fulfillment of the Requirements for the Degree of Master of Arts

February

1961
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CHAPTER I

STATEMENTS OF THE PROBLEM

The purpose of this study is twofold; to test the hypothesis that the influence of massed and distributed practice upon learning and retention is a function of the meaningfulness of material; and second, that the more meaningful the material the better the retention (1, 2, 3). However, Underwood's and Archer's findings indicated that meaningfulness was directly related to learning but not to retention. One of the factors which appears to be responsible for this contradiction is the definition of meaningfulness. In their experiments, Underwood and Archer used high associative nonsense syllables rather than meaningful words. Thus, the second purpose of this study is to test the hypothesis that is meaningful words are used rather than high associative nonsense syllables, meaningfulness is related to retention.

Mc Geoch states: "In the psychology of learning the definition of concepts has not always been accomplished with proper care, and defined concepts


4 Ibid.
have not always retained their proper meaning." This is shown in the definition of conditions of practice. Conditions of practice are described in terms of the presentation rate of materials, the inter-item interval, the intra-list interval and the activity of the experimental groups during the rest intervals. However, these rest intervals and the activities assigned to subjects vary according to individual investigators and the purpose of the study. There are few studies reported in the literature that used the same rate of presentation and rest intervals.

The term "meaning" has a low uniform use among experimenters. Noble\(^5\), in a recent study, has formally defined meaning as the relationship between the stimulus word and the response word. Accordingly, a word is meaningful to the extent that it elicits many response words. Noble has arrived at what he calls an index of meaning:

An index of stimulus meaning (m) was operationally defined in terms of the mean frequency of continued written associations made by subjects within a 60 second time interval.

This definition of the term "meaning" has been challenged by other authors. Cagood, Suci, Tannenbaum\(^7\) reject Noble's interpretation that the associations may be thought of as word meaning. However, they accept m as a measure of the associative value of a stimulus word. They state that a basic distinction exists between the meaning of a sign and its association. They


\[6\] Ibid.

wrote as follows:

This point needs to be labored because our recent writer (Noble, 1952) at least, has seriously proposed that the meaning of a sign is nothing more than the number of different associations between it as a stimulus and other signs as responses. According to Noble "the Index of meaning (m) of a particular stimulus was defined as the grand mean number of (acceptable) written responses given by all subjects within a 60 second period... It is this basic notion - that meaning and association can be equated - which is wrong. Does BLACK means WHITE because this is the most common associate? Does NEEDLE means SEW? BREAD means BUTTER? MAN means WOMAN? Noble's m may be identified as meaningfulness rather than meaning, or better, simply the association value of the stimulus since, this is actually what he is measuring.

On the other hand, Staats described word meaning as a conditioned mediating response, part of the response elicited by the object denoted by the word. A word gains its meaning because it has been systematically paired with aspects of the environment. While Underwood states that "meaningfulness... is the same characteristics as implied by the term familiarity."

Hollingworth has presented the concept more clearly when he wrote:

Intellectual or cognitive meaning is the presence of an appropriate context of concepts, images, references, relations, notions, ideas, associative tendencies, and in many cases of appropriate naming responses and of varied secondary meaning.

Following Webster's definition of meaning as "the sense, significance or import of words", the present study defines meaning or meaningfulness as the sense which words are intended to convey to the understanding. A word is

8 Ibid.


meaningful to the extent that the speaker or the listener understands what it signifies, what it stands for. It follows that an English word is meaningful to a person speaking English but it will be meaningless to those foreigners who have never been exposed to the English language.

The reason why the present study uses meaningful words rather than high associative nonsense syllables is to be certain that we are studying meaningfulness; secondly, it is the belief of the author that the use of meaningful words will give the study greater significance than would the use of nonsense syllables.
CHAPTER II

REVIEW OF RELATED LITERATURE

Experiments on learning have taken great steps since Ebbinghaus' and Jost's days. Animals have been used as well as human beings. Material ranges from motor performance to digits and verbal learning. Ingenious mathematical equations have been devised to take into account data obtained. Very few reported studies were done with one subject and if they were done, the data were not taken seriously. Ruch in a paper has summarized the effect of various conditions of learning on the relative economy of different degrees of distribution as follows:

The following factors have received experimental consideration and are of major importance: first, the general characteristics of the distribution of practice (number and length of periods, intervals between periods, degree of learning being considered etc.); second, the type of material being learned; third, the age of subjects; fourth, criterion or aim of the learning (immediate or delayed recall, speed, accuracy and amount of recall, improvement, etc.); fifth, the order of repetitions within a practice period (whole vs. part order); sixth, manner of studying; seventh, the stage of learning (whether the distribution is equally effective at the initial and final stages of learning and in the exercise of a well learned habit.)

An exhaustive survey of the literature on the relative efficacy of distributed practice over massed practice would have to include motor learning.


2 Ibid.
However, this present study was concerned only with verbal materials. Henceforth, the following report will be restricted to that field.

C. I. Hovland has done a series of studies on rote learning theory and has consistently found that distributed practice produced faster learning and better retention than massed practice. Two of Hovland's studies will be reported here.

In the first study, Hovland⁴ compared the influence of distribution of practice on serial and paired-associate learning. The subjects were thirty-two college students who had been served in Hovland's previous memory experimentation. Subjects were required to learn on successive days eight lists. Four lists consisted of eighteen syllables of paired associates. The other four lists were serial nonsense lists of eleven syllables. The tasks were equated in difficulty. Subjects learned under both conditions of practice—six seconds between trials for massed practice and two minutes for distributed practice. The rate of presentation was two seconds for each item. During the rest interval subjects named automatically presented colors. The criterion was one errorless trial.

Hovland found that distributed practice produced faster learning than massed practice in serial learning. The saving was 23 per cent of the number of trials required to attain mastery. However, the results failed to demonstrate the efficacy of distributed practice over massed practice in paired associate learning. The saving was only 2 per cent and lacked statistical

significance. According to Hovland, this result might be attributed to the difference in the rate of responding under the two methods. On serial learning, subjects responded every two seconds while in paired-associated learning each response occurred every four seconds.

The second study was concerned with the comparison of retention following learning to the same criterion by massed and distributed practice. In this study, thirty-two college students served as subjects, some of whom had served in Hovland's previous memory experiment. Subjects were required to learn sixteen lists of nonsense syllables, eight lists under massed practice (six seconds between trials). Eight lists under distributed practice (two minutes between trials). During the rest interval subjects named automatically presented colors. The criterion was one perfect trial. The test of retention was taken at four different intervals: six seconds, two minutes and twenty-four hours after the completion of learning.

Hovland found that distributed practice gave better recall scores at every time interval of testing despite the fact that fewer trials had been spent in learning by distributed practice. Besides, it took fewer trials to relearn the material when the original learning had been done by distributed practice. Also, retention of materials by distributed practice was superior to massed practice.

An examination of Hovland's design shows that: Hovland's subjects

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learned eight lists in his first study and sixteen lists in his second one. Since the number of letters to be used were limited, intra-list interference must be great. The results obtained might not be due to the conditions of practice as such. Furthermore, some of Hovland's subjects in his second study and all the subjects in his first study had served in Hovland's previous experiment on learning. There is no doubt that the subjects knew the purpose of these experiments and knew exactly what was expected of them. This knowledge of the purpose of the experiment might influence the course of learning. Moreover, all subjects served under all conditions; this, too, might create an interference between conditions.

Pattern studied the retention of sixteen item lists of nonsense syllables following massed and distributed practice. In the distributed practice group, a two minutes rest was introduced following each trial. Ten minutes after the end of practice the lists were relearned. In the original learning, Pattern found that the distributed practice group learned in significantly fewer trials than did the massed practice. Following the ten minutes rest interval, the distributed practice group recalled significantly more syllables on the first relearning trial than did the massed practice group. There was also a tendency for more anticipatory errors to occur in recall following massed than following distributed practice.

Wilson in another study has found that the learning of sixteen


item serial lists of two syllable adjectives will be facilitated by using
either a thirty seconds or one minute rest between trials.

Mc Geoch\(^7\), after an exhaustive survey of the literature, wrote:

The generalization that some form of positive distribution yields faster
learning than does massed practice holds over so wide a range of condi-
tions that it stands as one of our most general conclusions.

However, there are exceptions to the above generalization. In a
study by Sandahl\(^8\) in which serial lists of adjectives were used, no such
facilitation was found in several conditions. In this study each list consist-
ed of six pairs of highly synonymous adjectives. The purpose in using lists
with high intra-list similarity was to increase the number of errors made
during learning, since evidence has tended to suggest that distributed practice
will most facilitate learning when interference within a list is high.\(^9\)

Sandahl had twenty one subjects served under all conditions which
consisted of one-two-and four minute rest after each block of two trials;
one-two-and four minute rest after each block of four trials and massed
practice. Sandahl's results showed that whereas there was considerable inter-
ference within the list, there was little difference in the speed of learning
among the results of any of the above seven conditions. This is one of the
few known instances in which distribution has failed to facilitate learning
of serial verbal material.

\(^7\) Ibid., 119.

\(^8\) R. Sandahl, *The Effect of Distribution of Learning on Lists of

New Haven: Yale University Press, 1940.
However, when conditions of practice are combined with meaningful material the result obtained is somewhat different.

Tsao\textsuperscript{10} required twenty four subjects to learn four nonsense syllable lists taken from Glaze\textsuperscript{11}. Two of them have high association values, the other two have low association values. The syllables were exposed by an ordinary memory apparatus. The exposure time for each syllable was two seconds with one half second intervals between successive syllables. In spaced practice, a one minute interval was interpolated between every two successive trials, during which the experimenter talked with the subjects on current events or other general topics. All subjects served under all conditions. The learning score for each trial was the number of correct anticipations.

Tsao's findings indicated that learning was faster for high association value lists under either conditions of practice. Also, spaced practice was more efficient than massed practice in learning the high association value lists as well as the low association value lists. However, the difference was not significant in the case of the high association value lists.

Braun and Heymann\textsuperscript{12} in studying the effect of meaningfulness of material and distribution of practice on serial position curves, reported the following:


1- For both high and low meaningful lists, distribution of practice was associated with fewer trials to learn.
2- With low meaningful lists the longer the inter-trial intervals the faster the learning.

Dowling and Braun\textsuperscript{13}, in a study on retention and meaningfulness of material, reported that meaningfulness of material was directly related to learning and relearning. Besides, they also found that meaningfulness of material and retention interval were significant only when retention was measured by the methods of unaided recall and aided recall.

It is well to know that the lists used in the above two experiments consisted of meaningful words taken from Noble's scale. They were not nonsense syllables like those used in Tsao's experiment.

Archer\textsuperscript{14} had seventy two subjects serving for five consecutive days. Subjects were divided into six groups, three of the six groups learned the high association value lists, the other three learned the low association value lists. One rest interval was four seconds and was sued as the control "no rest", the other intervals were two minutes, five minutes and ten minutes. During the rest intervals subjects were supposed to read aloud a certain number and were told that their reaction times to the numbers recorded. Archer's findings are the following:

1- Recall is not related to meaningfulness of materials.
2- The more meaningful the materials the easier to learn.


\textsuperscript{14} E. J. Archer, "Retention of Serial Nonsense Syllables as a Function of Rest Interval Responding Rate and Meaningfulness", J. Exp. Psych., 45, 1953.
3- As the rest interval increased, recall decreased.

4. Archer's findings are confirmed by that of Underwood and Richardson. Underwood and Richardson found that distributed practice produced faster learning than massed practice for all lists\(^{15}\) and meaningfulness was directly related to learning but not to recall.\(^{16}\)

Archer and Underwood equated meaningfulness of material with association value. The lists used in their studies consisted of nonsense syllables. These nonsense syllables differ from one another on the basis of the number of the associated words each of them could evoke in the mind of the subjects.

Thus, it seems that one explanation for high association value lists to produce faster learning is a combination of the following:

1- Syllables that have high association value are easier to pronounce. They sound much more like meaningful words which subjects already knew.

2- The warming-up phenomena during the learning process. The high association value syllables get more reinforcements at very trial.

The reasons for the failure to show that high association value syllables are related to retention are:

1- During the learning process the associated words were learned as well as the nonsense syllables, since the very reason these nonsense syllables are easier to learn is that they are associated with meaningful words.

2- As time goes on the associated words are better retained because they are meaningful and have higher association value than any nonsense syllables.

3- A nonsense syllable has many associated words, each of these words has a different meaning and they in turn have many associated words. The original
syllable is dropped in favor of another nonsense syllable, one that sounds much more like the associated word just before recall. In this case, high association value is a hindrance rather than a help to retention.

By using meaningful materials rather than nonsense syllables in their experiments, McGeoch and various investigators were able to show that the more meaningful the material the better the retention.

By the method of complete presentation McGeoch required ninety-eight subjects to learn four lists of ten items each. One list was made up of three-letter words, another of 100 per cent association value syllables, another of 53 per cent, and a fourth, of 0.0 per cent association value syllables. Each subject learned all four lists, a form of systematic randomization being used to balance practice effects. Rather than learning to a criterion, each subject was asked to recall as many of the words of a given list as possible after having studied the list for a given interval of time. The results show that with 0.0 per cent association value syllables, the mean number items correctly recalled after a constant study period is 5.09, 6.41 for 53 per cent association value syllables, and 7.35 for 100 per cent association value syllables. For the three-letter words, the mean number of items correctly recalled


is 9.11. There is a direct relationship between meaningfulness and amount learned and recalled.

Also, Reed\textsuperscript{18}, in the study of concept formation, compared his results on retention with Ebbinghaus's results for nonsense syllables. Reed showed that in a great many respects his procedure was quite similar to that of Ebbinghaus. After six weeks Reed found that only a 10 per cent loss in the retention of concepts. This compares with almost 80 per cent loss in the case of Ebbinghaus's nonsense syllables.

The curve of retention of poetry shows a form which is similar to the nonsense syllables retention curve, but it never falls as fast or as far over comparable time intervals\textsuperscript{19}. Retention curves of factual material show about the same relationship\textsuperscript{20}. The retention of substance material (ideas which cannot be derived from a single sentence) shows only slight loss over a period of eighty days\textsuperscript{21}.

This contradiction may be due to the fact that Archer and Underwood used high association value syllables while other authors used meaningful materials in their studies.

\textsuperscript{18} H. B. Reed, "Factors Influencing the Learning and Retention of Concepts: I. The Influence of Set", \textit{J. Exp. Psych.}, 36, 1946, 71-78.


Subjects: One hundred college students, ninety three males and seven females, were subjects for this experiment. Seventy three of these students were taking the first course in psychology. The remaining twenty seven have had more than one course in psychology.

Out of one hundred subjects, eighty were serving for the first time in a psychological experiment. The remaining twenty had served more than twice in psychological experiments. Three subjects claimed they had had a learning experiment before but the procedure was different.

This heterogeneity did not influence the course of the experiment. All subjects had one practice period. This control was imposed to assure a similar degree of learning ability between groups.

Materials: The materials used in the present experiment consisted of two lists of nonsense syllables and one list of three-letter words. Each list contained ten items. The lists of nonsense syllables were taken from Glaze. They are reproduced on the next page.

The first list of nonsense syllables has from 93 per cent to 100 per cent value of association. The second list of nonsense syllables has from 0.0 per cent to 20 per cent value of association. In both lists the vowels are used twice, the consonants once. The letter J is not included in the first list.
The letter R is not included in the second list.

<table>
<thead>
<tr>
<th>The First List Of Nonsense Syllables</th>
<th>The Second List Of Nonsense Syllables</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOZ</td>
<td>CEF</td>
</tr>
<tr>
<td>SOC</td>
<td>DAX</td>
</tr>
<tr>
<td>QIL</td>
<td>GAH</td>
</tr>
<tr>
<td>MEK</td>
<td>MEQ</td>
</tr>
<tr>
<td>FEV</td>
<td>SIJ</td>
</tr>
<tr>
<td>HIN</td>
<td>TOV</td>
</tr>
<tr>
<td>PUR</td>
<td>NUB</td>
</tr>
<tr>
<td>YUT</td>
<td>YIL</td>
</tr>
<tr>
<td>GAB</td>
<td>ZOK</td>
</tr>
<tr>
<td>WAK</td>
<td>WUP</td>
</tr>
</tbody>
</table>

The list of meaningful words is made upmostly with letters taken from the second list of nonsense syllables. In this list the vowels are used twice and their positions are the same as in the nonsense syllables list. The letters Q, Z, V, C are not included in the list of meaningful words. The reason is the inability to form meaningful words with these letters. The list of meaningful words is reproduced on the next page.

The nonsense syllables as well as words are spelled out on separate slides two millimeters wide and five centimeters large. The presentation of the materials was done by a semi-automatic projector upon a screen.

Lists of simple multiplications were provided to the distributed

1 Ibid.
practice groups. These multiplications were used to prevent rehearsal during the interpolated rest and were not considered as data in the experiment. A sample of these problems is reproduced in Appendix V.

**Instructions to subjects:** Subjects were told exactly what to do in each session. These instructions were given orally by the author's adviser to secure better understanding from the subjects. A complete reproduction of these instructions will be found in Appendix IV.

**Procedure:** The experiment was conducted in three different sessions for all subjects during the regular classroom-time. This was arranged in advance by the author's adviser and the concerned professors.

On the first session all subjects learned the first list of nonsense syllables under massed practice. The exposure time for each syllable was two seconds with two seconds interval between successive syllables and six seconds
between trials. The criterion was two errorless trials. This was the practice session.

On the experimental day subjects were divided into four groups of twenty five each on the basis of the results obtained on the practice session. Each group served under one condition.

- Group I learned the second list of nonsense syllables under massed practice.
- Group II learned the second list of nonsense syllables under distributed practice.
- Group III learned the list of meaningful words under massed practice.
- Group IV learned the list of meaningful words under distributed practice.

The rate of presentation of each item was two seconds with two second interval between successive syllables for all groups throughout the experiment. For the massed practice groups, the interval between trials was six seconds. For the distributed practice groups, the interval between trials was two seconds. The criterion for all groups was two errorless trials. During the interpolated rests between trials, subjects in the distributed practice groups were provided with simple multiplications and were instructed to solve them as fast and as accurately as possible.

Group presentation was used to assure uniform atmosphere for all subjects. Furthermore, it assures the presence of subjects at the desired time.

Twenty four hours later, each group was tested for retention and a list of questions was provided for each subjects at the same time.

The questionnaire: The questionnaire was composed of eleven questions. The
first three questions dealt with the subjects' familiarity with psychology. The fourth question dealt with the subjects' interest in the experiment. Question five, six and seven dealt with the inner activity of the subjects who learned the nonsense syllables lists during the learning process. Questions eight and nine dealt with the inner activity of subjects who learned the meaningful words list during the learning process. Questions ten and eleven were intended to check whether the subjects did follow the instructions of not discussing the experiment with anybody and not rehearsing the list during the time interval between the original learning and the retention test.

A sample of these questions can be found in Appendix VI.
CHAPTER IV

ANALYSIS OF DATA

Three general types of data were gathered from the experiment: practice data, learning data and retention data obtained twenty-four hours after the completion of learning. The practice data will be considered first.

A. Practice data:

The practice data were obtained from four groups of subjects learning under the same experimental conditions. A subject's score is the number of trials each subject needed to reach the criterion. These scores appear in Table VI, Appendix I.

To make an over-all analysis of these scores the analysis of variance technique was used. The formula for this computation can be found in Edwards1. Table I summarizes the analysis just mentioned.

On the assumption that the groups making up the total series of measurements are random samples from a homogeneous population, the two estimates of variance can be expected to differ only within the limits of chance

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fluctuations. The null hypothesis if tested by dividing the variance between the groups by the variance within the groups, a value of \( F = .865 \) is found. The result of this variance is such that the null hypothesis of no significant difference in the learning ability between groups cannot be rejected. In another words, the hypothesis of random sampling from a common population would be regarded as tenable.

### TABLE I

**ANALYSIS OF VARIANCE OF THE NUMBER OF TRIALS FOR ONE HUNDRED SUBJECTS TESTED UNDER THE SAME EXPERIMENTAL CONDITIONS**

| Source of Variation | Sum of Squares | Degrees of Freedom | Estimate of Variance | \( F \)  
|---------------------|----------------|-------------------|----------------------|--------|
| Between Groups      | 3.87           | 3                 | 1.29                 | .865*  
| Within Groups       | 143.04         | 96                | 1.49                 |        
| Total               | 146.91         | 99                |                      |        |

**Note:**

* not significant at the 5 per cent level of confidence.
*** significant at the 5 per cent level of confidence.
**** significant at the 1 per cent level of confidence.

**B. Learning data:**

The learning data were also obtained from four groups of subjects.

---

2 In the present study, a test of significant which yields a probability of .05 to .01 will be regarded as significant and the hypothesis being tested will be rejected.
mentioned above. However, this time each group learned under different experimental conditions. A subject's score is the number of trials that subject needed to reach two errorless recall. These scores appear in Table VII, Appendix II.

To make an over-all analysis of these scores the analysis of variance technique was used. The formula for this computation can be found in Edwards³.

Table II below summarizes the analysis just mentioned.

### TABLE II

**ANALYSIS OF VARIANCE OF LEARNING SCORES OF FOUR GROUPS OF SUBJECTS TESTED UNDER FOUR DIFFERENT EXPERIMENTAL CONDITIONS**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Estimate of Variance</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>307.07</td>
<td>3</td>
<td>102.36</td>
<td>51.77 ***</td>
</tr>
<tr>
<td>Within Groups</td>
<td>189.92</td>
<td>96</td>
<td>1.977</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>496.99</td>
<td>99</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The significance of this variance ratio is such that the null hypothesis must be rejected. The significantly greater variance between groups than within groups excludes the likelihood of chance, and is explained in terms of the experimental conditions.

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³ Ibid. 183.
There are three sources of variance in the experimental procedure. The first source of variation is the nature of the materials learned; that is, whether the learned materials are meaningful words or nonsense syllables. The second source of variance is the mode of presentation; that is, whether the material was learned under conditions of massed or distributed practice. The third source of variance is the result of the joint effect of these two conditions. This is ordinarily referred to as interaction.

By analyzing the sum of squares between groups, the variation caused by these three conditions can be determined. The formula for this computation can be found in Edwards.\(^4\) Table III summarizes the computation mentioned above.

**TABLE III**

**COMPLETE ANALYSIS OF VARIANCE OF THE LEARNING SCORES**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Estimate of Variance</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>289.89</td>
<td>1</td>
<td>289.89</td>
<td>151.13**</td>
</tr>
<tr>
<td>Mode of Presentation</td>
<td>.49</td>
<td>1</td>
<td>.49</td>
<td>.247%</td>
</tr>
<tr>
<td>Interaction</td>
<td>7.69</td>
<td>1</td>
<td>7.69</td>
<td>3.889*</td>
</tr>
<tr>
<td>Within Groups</td>
<td>189.92</td>
<td>96</td>
<td>1.977</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>496.99</td>
<td>99</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^4\) ibid., 212.
Since the analysis of variance yields no significant result in the case of the mode of presentation and interaction, comparison between individual groups is not needed.

However, from these data, it can be noted that meaningful words were learned with significantly greater ease than nonsense syllables under either conditions of practice. This finding is in accord with those of other authors such as Archer, Underwood and Richardson. Furthermore, distributed practice was not superior to massed practice in learning. This result was thought to be related to the rest interval between trials of the distributed practice groups. It was felt that if one minute rest between each trial for the distributed practice groups were used instead of two minutes as used in the present study, the usual distribution effect of learning might be found. Also, Underwood has suggested that distributed practice was superior to massed practice when the interference within the list was high. Since the lists used in the present study were short - the vowels being used twice and the consonants once - thus, have very little intra-list similarity, this too, might be a factor in producing the above result.

C. Retention data:

The retention data were obtained twenty four hours after the completion of learning. A subject's score is the number of syllables correctly recalled without any reference to the correct position of each syllable in the original learning. These scores appear in Table VIII, Appendix III.

The analysis of variance technique was used to make an over-all analysis of these scores. The formula for this computation can be found in
Edwards. Table IV summarizes the computation just mentioned.

**TABLE IV**

ANALYSIS OF VARIANCE OF RETENTION SCORES OBTAINED TWENTY FOUR HOURS AFTER THE COMPLETION OF LEARNING

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Estimate of Variance</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>105.96</td>
<td>3</td>
<td>35.32</td>
<td>1074 ***</td>
</tr>
<tr>
<td>Within Groups</td>
<td>315.68</td>
<td>96</td>
<td>3.288</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>421.64</td>
<td>99</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The significance of this variance is such that the null hypothesis must be rejected. The significantly greater variance between groups than within groups excludes the likelihood of chance, and is explained in terms of the experimental conditions.

There were three sources of variance in the experimental procedure. The first source of variation was the nature of the materials learned and then recalled twenty four hours later. The second source of variation was the mode of presentation; that is, whether the materials were learned under massed practice or distributed practice. The third source of variation was the result of the joint effect of these two conditions. This is ordinarily referred to as interaction.

---

5 Ibid., 183.
By analyzing the sum of squares between groups, the variation caused by these three conditions can be determined. The summary of this computation is given in Table V. The formula for this computation can be found in Edwards.

**TABLE V**

COMPLETE ANALYSIS OF VARIANCE OF THE RETENTION SCORES

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Estimate of Variance</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>1.96</td>
<td>1</td>
<td>1.96</td>
<td>.596*</td>
</tr>
<tr>
<td>Mode of Presentation</td>
<td>46.24</td>
<td>1</td>
<td>46.24</td>
<td>14.24***</td>
</tr>
<tr>
<td>Interaction</td>
<td>57.76</td>
<td>1</td>
<td>57.76</td>
<td>17.57***</td>
</tr>
<tr>
<td>Within Groups</td>
<td>315.68</td>
<td>96</td>
<td>3.288</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>421.64</td>
<td>99</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These results reveal that there is no significant difference between the retention scores of subjects learning meaningful words and that of those who learned nonsense syllables. Furthermore, the difference in the conditions of practice was a source of significant variance between groups as indicated by the analysis of variance summarized in Table V. Lastly, the joint effect of materials and mode of presentation did cause groups to differ significantly in the number of syllables recalled or retained.

---

Ibid., 212.
Since the analysis of variance yields significant results from mode of presentation and interaction, comparison between individual groups can be computed.

A t test was performed between groups I and II, which yields a value of \( t = 2.9 \). This value is not significant. This means that conditions of practice did not relate to the retention of nonsense syllables. In another words, there was no significant difference in the retention of nonsense syllables whether they had been originally learned under massed practice or distributed practice.

A \( t = 2.664 \) was obtained between groups III and IV. This value is significant beyond the five percent level of confidence. This statistical result indicates that the retention of meaningful words is best when they were learned under the distributed practice.
CHAPTER V

SUMMARY AND CONCLUSION

The purpose of this study was twofold; to test the hypothesis that the influence of massed and distributed practice upon learning and retention is a function of the meaningfulness of material; and second, that the more meaningful the material the better the retention.

A review of the literature showed that there existed a contradiction between the findings of different investigators. Some authors have found that distributed practice was superior to massed practice not only in learning but also in recall. Others contended that distributed practice was superior to massed practice in learning but massed practice was found to be superior to distributed practice in retention. Meaningfulness was found to relate to learning. However, not all authors agreed as to the effect of meaningfulness upon retention.

It was also noted that most investigators used high association value lists of nonsense syllables rather than words in their studies about the effect of meaningfulness.

In the present study, one hundred college students served as subjects under four different conditions. The experiment was conducted in three sessions. The first session was the practice day. On that day all subjects were asked to
learn one list of nonsense syllables taken from Glaze, having from 93 per cent to 100 per cent value of association. All subjects learned the list under the conditions of massed practice.

On the basis of the results obtained from the practice day, subjects were divided into four groups of twenty five, Group I and group II learned a list of nonsense syllables having association values ranging from 0.0 per cent to 20 per cent. Group I learned the list under massed practice; group II learned the list under distributed practice. Group III and group IV learned a list of meaningful words. Group III learned the list under massed practice; groups IV learned the list under distributed practice.

The syllables as well as words were all spelled out and projected on a screen by an automatic projector. The rate of presentation of each item was two seconds and the interval between successive items was two seconds for all groups throughout the experiment. For the massed practice groups, the interval between trials was six seconds. For the distributed practice groups, the interval between trials was two minutes. During the two minutes intervals the distributed practice groups were asked to do simple multiplications as fast and accurately as possible.

The retention test was given twenty four hours after the completion of learning. Each subject was then given a list of questions to answer.

The analysis of the learning data indicated that meaningfulness of materials was directly related to learning. This finding is in accord with others reported in the literature and confirms to some extent the hypothesis of the present study. Meaningfulness, as a determinant of the rate of learning is probably due to the subject's familiarity with the items learned and the
meaning of the words. Since meaningful words have great numbers of associations, the subjects were enabled to use the vast store of existing associations to facilitate learning. Furthermore, it is commonly believed that pleasant things are easier to learn than unpleasant things. Another reason for the meaningfulness of materials to relate to learning could be that meaningful words are more pleasant than nonsense syllables.

Distributed practice was not found to be superior to massed practice in learning. It was thought that the result could be different if the lists were longer, and if one minute rest between each trial for the distributed practice groups were used instead of two minutes as used in the present study, the usual distribution effect of learning might be found.

The analysis of the retention data revealed that meaningfulness was not related to retention. This finding was in accord with those of Underwood, Richardson and Archer. It was felt that this result could be due to the fact that those subjects who learned the nonsense syllables got more practice than those who learned the list of meaningful words. In another words, it took more trials to learn the nonsense list which implies that the nonsense syllables were looked at longer and were recalled more often which might make it easier to retain them.

It was also noted that meaningfulness and distributed practice combined yielded the greatest amount of retention. Whereas, meaningfulness and massed practice combined gave the least amount of retention. Conditions of practice had practically no effect upon the retention of nonsense syllables.

In conclusion it may be said that meaningfulness seems to related to
learning under either conditions of practice. The more meaningful the material, the greater the amount of time saved in learning. And, meaningfulness is most beneficial for retention when combined with distributed practice.

A questionnaire of eleven items were given to all subjects in all groups after the test of retention. It was intended to deal with each subject's inner activities during the learning process. The results showed that there was no significant difference in the activities of different groups. However, the investigators feels that since this group testing, the results might have been different had there been individual interviewing of subjects.

Nevertheless, it should be noted that in response to question ten "Did you rehearse the list?", forty six subjects out of one hundred answered yes to the question. A t test was performed between the retention data of those who answered yes and those who answered no in the same group. No significant different was found for any group. That 46 per cent of the subject did practice during the rest interval between the completion of learning and the retention test suggests that in the learning experiments, there are more rehearsals than it is generally reported in literature.
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APPENDIX I

TABLE VI

DISTRIBUTION OF PRACTICE SCORES FOR ONE HUNDRED SUBJECTS TESTED UNDER THE SAME EXPERIMENTAL CONDITIONS

<table>
<thead>
<tr>
<th>Number of Trials to Reach Criterion</th>
<th>Number of Subjects in Each Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group I</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
</tr>
</tbody>
</table>
APPENDIX II

TABLE VII

LEARNING SCORES OF ONE HUNDRED SUBJECTS TESTED UNDER FOUR DIFFERENT EXPERIMENTAL CONDITIONS

<table>
<thead>
<tr>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Group IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 8</td>
<td>10 7</td>
<td>5 4</td>
<td>7 4</td>
</tr>
<tr>
<td>10 8</td>
<td>10 7</td>
<td>5 4</td>
<td>6 4</td>
</tr>
<tr>
<td>9 8</td>
<td>10 7</td>
<td>5 4</td>
<td>6 4</td>
</tr>
<tr>
<td>9 8</td>
<td>10 6</td>
<td>5 4</td>
<td>6 4</td>
</tr>
<tr>
<td>9 7</td>
<td>10 6</td>
<td>5 4</td>
<td>5 4</td>
</tr>
<tr>
<td>9 7</td>
<td>9 6</td>
<td>5 4</td>
<td>5 4</td>
</tr>
<tr>
<td>9 7</td>
<td>9 6</td>
<td>4 4</td>
<td>5 4</td>
</tr>
<tr>
<td>9 7</td>
<td>9 5</td>
<td>4 3</td>
<td>5 3</td>
</tr>
<tr>
<td>9 7</td>
<td>9 5</td>
<td>4 3</td>
<td>5 3</td>
</tr>
<tr>
<td>9 7</td>
<td>8 5</td>
<td>4 3</td>
<td>5 3</td>
</tr>
<tr>
<td>9 6</td>
<td>8 4</td>
<td>4 3</td>
<td>4 3</td>
</tr>
<tr>
<td>8 5</td>
<td>8 3</td>
<td>4 3</td>
<td>4 3</td>
</tr>
<tr>
<td>8 8</td>
<td>8 4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>
APPENDIX III

TABLE VIII

RETENTION SCORES OF ONE HUNDRED SUBJECTS OBTAINED TWENTY FOUR HOURS AFTER THE COMPLETION OF LEARNING

<table>
<thead>
<tr>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Group IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>9</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
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<td>10</td>
<td>6</td>
</tr>
<tr>
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<td>7</td>
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<td>6</td>
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<td>10</td>
<td>5</td>
</tr>
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<td>10</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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APPENDIX IV

INSTRUCTIONS FOR THE SUBJECTS

Instructions Given to Subjects on the Practice Day

This is an experiment in learning. You are asked to put down your name on the sheet of paper in front of you. Number the sheets of paper as you go along. You can use your real name or any other name you like but be consistent i.e. use the same name throughout the experiment. I am going to show you a list of ten nonsense syllables and I want you to do the following:

When the list is shown for the first time, try to remember as many syllables as you can. Then the list will be shown again in the same order. This time when you see a blank on the screen put down the first nonsense syllable if you remember it, if you do not remember it, guess, if you cannot guess leave it blank. When the first nonsense syllable is shown, write down the second syllable. Then the second syllable will be shown, you write down the third one and so on... When all ten syllables are shown to you, this constitutes a trial. Turn the sheet of paper you are using upside down and take a blank sheet of paper for the next trial.

When you think you have them all right remain for one more trial to make sure you have. Then you can leave the room. Any questions?

The slides were then projected on the screen in the manner indicated above.

Instructions Given to the Distributed Practice Groups on the Second Session.

This is an experiment in learning. You are asked to put your name or the name you used in the previous session on the sheet of paper in front of you. You belong to group II (or group IV). I am going to show you a list of nonsense syllables (for group II and meaningful syllables for group IV) and I want you to do as follow: when the list is shown for the first time try to remember as many syllables as you can. The list will be shown again in the same order. This time when you see a blank on the screen, put down the first syllable if you remember it, if you do not remember it, guess, if you cannot guess leave it blank. When the first syllable is shown, write down the second syllable. Then the second syllable will be shown. You write down the third one and so on... When ten syllables are shown to you, this constitutes a trial. Turn the sheet
of paper you are using down. Take the sheet of paper with the multiplications and start doing the multiplications as fast and accurately as possible. When you hear a tap on the desk, turn the sheet of paper upside down and take a blank sheet of paper for the next trial.

When you think you have them all right, remain for one more trial to make sure you have. Then you can leave the room. Do not discuss the experiment with anyone especially among yourselves. Do not try to rehearse the list. The success of the experiment depends on your observance of these recommendations and your presence here to-morrow.

Instructions Given to the Massed Practice Groups on the Second Session.

This is an experiment in learning. You are asked to put your name on a sheet of paper in front of you, or the name you used on the previous session. You belong to group I (or group III, as the case may be). I am going to show a list of nonsense syllables (for group I and meaningful syllables for group III). I want you to do as follow: when the list is shown for the first time try to remember as many syllables as you can. The list will be shown again in the same order. This time when you see a blank on the screen put down the first syllable if you remember it, if you do not remember it, guess, if you cannot guess leave it blank. When the first syllable is shown, write down the second syllable. Then the second syllable will be shown, you write down the third one and so on... When all ten syllables are shown to you, this constitutes a trial. Turn the sheet of paper upside down and take a blank sheet of paper for the next trial.

When you think you have them all right remain for one more trial to make sure you have. Then you can leave the room. Do not discuss the experiment with anyone especially among yourselves. Do not try to rehearse the list. The success of the experiment depends on your observance of these recommendations and your presence here to-morrow.

Instructions Given to all Subjects Before the Retention Test.

You are asked to write your name or the name you used in the previous sessions. Write also the group you belong to. Write down whatever you remember from the list you learned yesterday. Try to write the syllables in the order you learned them. If you cannot remember them guess. After you have finished, answer the questions provided for you on these sheets of paper. After you have finished answering these questions we will discuss briefly the purpose of this experiment with you. Thank you for your cooperation.
<table>
<thead>
<tr>
<th>86</th>
<th>75</th>
<th>72</th>
<th>51</th>
<th>89</th>
<th>36</th>
<th>28</th>
<th>14</th>
<th>49</th>
<th>27</th>
<th>34</th>
</tr>
</thead>
<tbody>
<tr>
<td>47</td>
<td>26</td>
<td>92</td>
<td>37</td>
<td>43</td>
<td>35</td>
<td>72</td>
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<td>26</td>
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<td>15</td>
<td>53</td>
<td>37</td>
<td>74</td>
<td>49</td>
<td>92</td>
<td>28</td>
<td>81</td>
</tr>
</tbody>
</table>

**APPENDIX V**
APPENDIX VI

Date

Group

Name

Answer briefly to these questions. If you do not know, guess.

1- How many courses in psychology have you had?

2- Have you ever served in a psychological experiment?
   How many times?

3- What do you suppose the purpose of this experiment could be? Answer briefly.

4- Are you interested in this experiment? Circle one
   a- Not interested
   b- Indifferent
   c- Very much

If you belong to group I and II please answer the following questions by putting a check mark.

5- When the nonsense syllables were flashed on the screen, you
   a- Read the letters one by one to yourself?
   b- Read the whole syllable first?
   c- Which way did you do first? a or b?

If none of these answers are suitable, describe briefly in your own words.

6- When you tried to memorize these syllables, you
   a- Just read the syllables to yourself?
   b- Tried to connect the first syllable with the second, the second with
      the third and so on...
   c- Tried to associate the syllable with something you already knew?
   d- Tried to put some meaning into these syllables?

If none of these answers are suitable, then describe briefly in your own words.
7- When you tried to anticipate the syllable that was coming next, you used
   a- The syllable before as the signal for the next to come?
   b- Something you associated with the syllable while you tried to memorize
       it as the signal for the next?
   c- The meaning you put into the syllables?

If none of these answers are suitable, describe in your own words.

If you belong to group III and IV please answer these following questions.

8- When you tried to learn the words, you
   a- Read them to yourself when you saw them on the screen?
   b- Connect the first word with the second and the second with the third
       and so on...?
   c- Made a sentence with the word included in it?

If none of these answers are suitable describe briefly in your own words.

9- When you anticipated the word that was coming next, you
   a- Used the first words as the signal for the second and so on?
   b- Not the word itself but the meaning of the word?
   c- The sentence you made up with the word included in it when you tried
       to learn?

If none of these answers are true, describe in your own words.

The following questions are for all.

10- Did you discuss the experiment with anybody?

11- Did you try to rehearse the list to yourself?
    How many times?

Please be truthful and do no feel offended for we are interested in facts alone.
Thank you.
The thesis submitted by Le-Thi-Que has been read and approved by a board of three members of the Department of Psychology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Arts.

Jan. 10, 1961

Date

Signature of Adviser