1947

Spaced learning versus unspaced learning in spelling

Oliver, Marjorie Armitage
Boston University

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Thesis

The writer wishes to extend appreciation to Dr. Helen B. Sullivan, Associate Professor of Education, School of Education, for assistance in planning and carrying out this study. She is also indebted to Dr. William C. Durrell, Professor of Education, School of Education, Boston University, for his help with the statistical analysis of data.

SPACED LEARNING VERSUS UNSPACED LEARNING IN SPELLING

Submitted by

Marjorie Armitage Oliver
(B.S. in Education, Massachusetts School of Art, 1937)

In Partial Fulfillment
of Requirements for the Degree of
Master of Education

1947

First Reader: Dr. Helen B. Sullivan, Professor of Education
Second Reader: Dr. Wm. C. Kvaraceus, Assistant Professor of Education
Third Reader: Dr. Donald D. Durrell, Professor of Education
Gift of M.A. Oliver
School of Education
June 6, 1947
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The writer wishes to express her appreciation to Dr. Helen B. Sullivan, Associate Professor of Education, School of Education, Boston University, for her assistance in planning and carrying out this study, and to Dr. William C. Kvaraceus, Professor of Education, School of Education, Boston University, for his help with the statistical analysis of data.
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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

I. THE PROBLEM

Statement of the problem. The aim of this study is twofold, namely: (1) to make a comparison of the growth in spelling achievement when using spaced learning versus the growth when using unspaced, or massed learning; (2) to find at what interval the most rapid growth seems to be found, at twenty minute intervals, three times a week, or at thirty minute intervals twice a week.

CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

Justification of the study. The results of the Stanford achievement Tests given in the eighth grades of the public schools of a city suburb of Boston for the year 1945 were definitely low in one subject, that of spelling. It was true not of just one grade nor of one building, but throughout the city to a noticeable degree in comparison with other subjects which were well above grade level. For that reason, a particular drive was made the following year to see what might be done to raise the spelling achievement. This study is based on the method of spelling carried out in the Junior High grades for the years 1945 and 1946.

II. DEFINITIONS OF TERMS USED

Spaced learning. Spaced learning is a distribution of
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I. THE PROBLEM

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1. To find out which method permits the most gain seems to be equally or slightly

more minutes in reverse than times a week or at thirty minutes in-

terminals twice a week.

II. DEFINITION OF THE TERMS USED

Spaced Learning. Spaced learning is a stratification of
practice. If a new poem is to be studied, as an example, it is believed by many investigators that a higher rate of learning may be accomplished by spacing the learning at different intervals. These intervals may be of varied length, perhaps a fifteen minute period every day or ten minutes twice a day.

**Unspaced learning.** Unspaced learning is a massing of practice. If this method was used the study of the poem mentioned above would be taught all at one sitting and for a much longer period of time.

### III. ORGANIZATION OF THE REMAINDER OF THE STUDY

**Organization.** This study covered a twelve week period using students selected from three groups. One group had spelling once a week, the second group twice a week, and the third group three times a week. Fourteen students with comparable mental ages and spelling abilities were selected from each group making a total of forty two. Although all students in the three groups, totalling 118, participated in the experiment only the findings of the matched forty two were studied. The scope of the study and method of investigation will be found in detail in Chapter III.

Many investigations have been made concerning the best methods of teaching spelling as well as on the subject of spaced and unspaced learning. These studies, reported in part, may be found in the following chapter.
I. Overtreatment and Under-treatment

Under-treatment. Under-treatment is a matter of degrees.

Overtreatment. If the treatment was neat the track of the bone

was longer than that of the

which longer periods of time.

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comparative material. These and comparing studies were selected

from each group, making a poster for each group. Administration in

the three groups, following the participation in

the examination only the limitations of the method for two

weeks existed. The scope of this study and method of research

planned will be taken in detail in Chapter III.

Many investigations have been made concentrating the deaf

methods of cochlear implanting as well as on the subject of

treatment and under-treatment. These articles reported in

may be found in the following sources.
CHAPTER II

REVIEW OF PREVIOUS RESEARCH

The first part of this chapter will be concerned with previous investigations of spelling as a social need, its importance as a tool subject, reasons believed causal in spelling disabilities, and various methods prescribed for spelling achievement. The second part deals with research conducted on spacing of practice (unspaced learning) versus distribution of practice (spaced learning). This study is concerned with the possible effect of spaced learning on spelling.

"Correct spelling is a condition of social approval as well as social respectability; it is a proof of custom, as much a mark of respectability as good manners,"¹ along the same lines of thinking Belling² states in his preface:

No person can be considered socially efficient, in all that these words imply, unless he is able skillfully to manipulate this tool. There are few elementary subjects in which insufficiency is more swiftly detected and more severely reprobated in later life than in spelling.

an increasing awareness of the importance of spelling in social living, often combined with a lack of success, has turned the attention of educators more and more to this field.


² JOHN B. BELLING, Spelling Efficiency in Relation to Age, Grade and Sex and the Question of Transfer (Educational Psychology Monographs. Baltimore: Warwick and York, Inc., 1911), preface.
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"Correct spelling is a condition of social approval as well as social efficiency. It is an approved custom, as much a mark of respectability as good manners."\(^1\) Along the same lines of thinking Wallin\(^2\) states in his preface:

No person can be considered socially efficient, in all that these words imply, unless he is able skillfully to manipulate this tool. There are few elementary subjects in which inefficiency is more swiftly detected and more severely reprobated in later life than in spelling.

An increasing awareness of the importance of spelling in social living, often combined with a lack of success, has turned the attention of educators more and more to this field.


\(^2\) John E. Wallin, Spelling Efficiency in Relation to Age, Grade and Sex and the Question of Transfer (Educational Psychology Monographs. Baltimore: Warwick and York, Inc., 1911), preface.
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prevention investigations of spelling: as a social need, the
importance as a tool subject, research preferred generally to spelling
the word stillness and various methods presented for spelling
prospective. The second part deals with research conducted on
meaning of practice (narrowing learning) versus acquisition of
practice (broad learning). The study is concerned with the

possibility effect of practice learning on spelling.

"Correct spellings is a condition of social approval." As
well as social advantage, it is by approving a concept as much
a mark of receptivity as good appearance. In short, the same
influence of thinking. Willing alters in the presence

No person can be considered socially intelligent to all
these words make it clear that these are the meaning English words.
spellers, and more than three are the spelling standard and more
several words, including in letters like plan in spelling.

An increasing awareness of the importance of spelling in social

living, often combined with a lack of success, is turned the

attention of researchers more and more to this field.
Spelling was originally considered a memorization and drill exercise rather than a thinking process. Long columns of words were assigned. Many of these were in neither the child's speaking nor writing vocabulary and hence were of no use to him socially. Little attention was paid to the fact that spelling like other subjects must be taught, and that the learner must develop many skills in order to conform to the standards of good spelling usage.

The standard for spelling should be a practical one based on the needs of the child in his daily life. It has been said that:

Spelling is taught to enable a person to write correctly and rapidly his thoughts and ideas. To do this he must develop many skills. Poor spelling is the result of bad habits, and also the lack of ability to see and hear similarities and differences in words. To remedy poor spelling, it is necessary to substitute new and correct habits for those which have already been established.3

In more recent years, many studies have been made of various methods of teaching spelling, and spelling lists have been compiled of more commonplace words. However, Miller4 still believes that spelling lists could be sifted even more to eliminate unnecessary words and lighten the primary spelling


4 Mary Margaret Miller, "Exercises in Auditory and Visual Training as a Means of Increasing Spelling Facility in Grade Three," (unpublished Master's service paper, Boston University School of Education, 1945).
Spelling was originally considered a memoriative skill. But in the modern world, spelling is often seen as a trivial skill, and little attention is paid to the fact that spelling is an important aspect of language learning. The need for spelling accuracy in order to communicate effectively is often overlooked.

The reason for spelling errors in the written language is that people have not been taught to spell correctly. In more recent times, many students have been taught to spell by rote, without understanding the underlying principles of spelling. However, Miller M. Miller, in his paper "The Effect of Spelling on Writing," and "Spelling and Reading," emphasizes the importance of spelling in the development of reading and writing skills.

"The Effect of Spelling on Writing," by Miller M. Miller, emphasizes the importance of spelling in the development of reading and writing skills. He argues that spelling is a means of understanding the structure of language, and that it is essential for effective communication.

"Spelling and Reading," by Miller M. Miller, further supports this view, stating that spelling is a critical component of literacy development. He argues that teaching spelling in isolation is not effective, and that it must be taught in conjunction with reading and writing.

In summary, spelling is an essential skill that should be taught as part of a comprehensive language arts curriculum. It is necessary for effective communication, and it is essential for the development of reading and writing skills.
load, listing only those words actually used by the children in writing.

At the other end of the pendulum, in direct contrast to the old "drill" method of teaching spelling, there developed the "incidental" method, whereby spelling was taught not as a subject, but only when the occasion demanded. Guile's study was made on the problem of which was more important in determining spelling accuracy, the learning that took place in the spelling period, or the learning that took place incidentally in connection with the child's other experiences. The tests were equated on the basis of average difficulty and, more important, on the basis of individual items. A parallel list of one hundred and fifty words that were in common usage was used versus the study list, one year after the words had been studied. Results showed that in each case the words studied were spelled with a higher percentage of accuracy, but the difference in no case was greater than 5 per cent. This is less than one fifth of the growth that took place over a two year period without formal instruction in spelling. Therefore the assumption that growth in spelling accuracy can be attributed solely to formal spelling instruction is not born out by the evidence in Guile's study. A special spelling

---

period devoted to the study of a basic list of words has only limited influence on spelling accuracy.

Wallin\(^6\) says, however:

\[
\begin{align*}
\text{while a skillful spelling drill is not an un} &\text{failing cure} \\
\text{all for the forgetfulness of word forms, it does } &\text{insure} \\
\text{a measure of habituation or organized stability that cannot } &\text{be reached by teaching spelling in a merely incidental way. . . .}
\end{align*}
\]

And in regards to transfer, Wallin\(^7\) also says:

\[
\begin{align*}
\text{We conclude, therefore, that column drills in spelling may } &\text{produce a positive increment of spelling efficiency in} \\
\text{dictated compositions or connected writing.}
\end{align*}
\]

The spelling proficiency developed in a drill situation does transfer to a dictation or composition situation.

It is felt by many that the "incidental" method of spelling is prone to set up bad habits which will have to be unlearned before successful independent study can be attained. Book\(^8\) believes that if spelling is directed in a way which will teach the learner, from the beginning, how to study correctly and how to test and check his accuracy of spelling responses, that very little individual help will be needed and there will be no wrong habits to eliminate. Wallin's\(^9\) theory

---

6 Wallin, \textit{op. cit.}, p. 69.

7 Ibid., pp. 66-67.


9 Wallin, \textit{op. cit.}, p. 13.
coincides saying that a child should never know the incorrect form and then there would be no occasion for wrong suggestions to arise. Instead of unteaching, instruction should be essentially a process of teaching.

Several investigations made by Williamson\textsuperscript{10} of the influence of psychological factors upon spelling abilities show that there are at least three important factors involved:

1. The ability to perceive the essential features of "word form."
2. The knowledge of the meaning of specific words.
3. The general intelligence of the child.

Many other factors also influence spelling efficiency. Investigators find that the time element, effort of the pupil, interest, proper motivation, visual and auditory perception, correct pronunciation, and handwriting all bear an important part. Tidyman\textsuperscript{11} concludes that one fifth of children's errors are due to the confusion of vowels having obscure or equivalent sounds, and over one half are due to the omission or insertion of silent letters.

Spache\textsuperscript{12} contends that research is conflicting which


\textsuperscript{11} Tidyman, op. cit., pp. 56-57.

\textsuperscript{12} George Spache, "Spelling Disability Correlates II - Factors that may be Related to Spelling Disability," \textit{Journal of Educational Research}, 35:119-37, October, 1941.
specifically a process of teaching.

General investigations show that spelling difficulties are the result of inexperience in spelling, which may cause a delay in spelling, while at the same time they show no connection for more unfortunate children who are not interested in spelling.

To write, interest in spelling, information, and experience of teaching.

The influence of psychological factors on spelling difficulties shows that there are at least three important factors involved:

1. The ability to perceive the essential features of the word.
2. The general intelligence of the child.
3. The accuracy of the child's perception of the word.

Many other factors also influence spelling ability.

Investigations find that the time element, interest, and sensory perception.

Interest, proper motivation, and ambitious goals can improve spelling, while haste, impatience, and lack of interest can hinder spelling.

The proper time of spelling is also an important factor. The child's ability to concentrate on spelling, as well as to avoid other activities, affects the spelling ability. The support and encouragement of the child are also important.

Special efforts are necessary to co-ordinate which

The Relation of Spelling to the \( \text{Spelling Ability} \)

Spelling Ability, April 1933

If "Spelling Ability" is related to "Spelling Ability",

October 1931

The Relation of Spelling to the \( \text{Spelling Ability} \)

Spelling Ability, April 1933

If "Spelling Ability" is related to "Spelling Ability",

October 1931
clearly demonstrates that a defect in the skill of visual perception may be a causal factor in spelling failure; but both Gates\textsuperscript{13} and Durrell\textsuperscript{14} believe that the inability to remember or visualize the word form is one of the most common causes of misspelling.

Much research conducted on the best methods of overcoming a lack of visual perception finds many supporters of the flash card method of word study. Durrell\textsuperscript{15} says that flash cards are the best method for conquering visual difficulties. Suzzalo,\textsuperscript{16} because of their emphasis on speed and accuracy in observing the visual form of words, states: "To enforce full attention 'flash card' work has been used to compel the child to visualize quickly and accurately." McCarthy,\textsuperscript{17} in a comparison of the flash card method with the study-test

\textsuperscript{13} Arthur I. Gates, Psychology of Reading and Spelling with Special Reference to Disability (Teachers College Contributions to Education, No. 129, New York: Teachers College, Columbia University, 1922), p. 86.

\textsuperscript{14} Donald D. Durrell, Improvement of Basic Reading Abilities (Yonkers-on-Hudson, New York: World Book Company, 1940), p. 268.

\textsuperscript{15} Loc. cit.


At the time of writing, a great deal of emphasis is being placed on the development of new methods for teaching reading. There is a general belief that the traditional methods of teaching reading are not effective, and that new methods are needed to improve reading skills.

In recent years, there has been a growing interest in the use of visual aids and technology in teaching reading. Some educators are experimenting with the use of computers and other electronic devices to help students improve their reading skills.

In addition to these new approaches, there is also a renewed interest in the classic methods of teaching reading. Some educators believe that the traditional methods of teaching reading are still the most effective, and that new methods are not necessary.

It is clear that the field of reading education is undergoing a significant transformation. As a result, there is a need for continuing education and professional development for teachers who are teaching reading.

Reference:

1. Addington, P. "Teaching Reading with the Brain in Mind," 2014.
method of teaching spelling in the second and third grades, finds that there is a statistically significant difference of 7.68 in favor of the flash card method in Grade Two, and of a statistically significant difference of 14.66 in Grade Three.

A diagnostic study of spelling readiness conducted by Russell\textsuperscript{18} concludes that phonetic training is important in spelling achievement. In this study one group of first graders was given early and direct instruction in reading, phonetic analysis and handwriting. The second group had later and less practice in these language skills. The first grade test, as measured by Gates primary reading tests, showed that a program of direct instruction in reading that included early instruction in handwriting and phonetic analysis, produced better achievement in English spelling than a more incidental one with little phonics.

Concerning interest, Gates\textsuperscript{19} has this to say:

That lack of interest or application is frequently responsible for the lag of real achievement in spelling behind possible achievement, cannot be doubted. While the causes of the lack of interest or application are probably many, it is quite likely that ineffective methods of learning to spell are among them.

Kay\textsuperscript{20} concluded in his investigation of the effect of


\textsuperscript{19} Gates, op. cit., p. 72.

A diagnostic study of auditory reception was made by K. Panerai, and the results were published in the "Journal of Experimental Research" in November, 1926. The study showed that the effect of noise on the ability to perceive speech sounds is not influenced by the presence of background noise. The results were confirmed by further experiments conducted in various conditions, including different levels of noise and varying types of speech sounds.
pronunciation upon spelling that an improvement in pronunciation was accompanied by an improvement in spelling, since training in pronunciation led to an increase of 23 per cent in the number of words correct in a spelling test.

Spelling is closely connected with reading ability, as poor readers are nearly always poor spellers, although the reverse may not be true. Acomb in his study says that it is very probable that spelling plays a definite roll in written recall, since disabilities along these lines would limit the recording of ideas assimilated from silent reading. He states in his conclusion that, "Spelling ability proved itself to be highly related to reading ability."22

Investigations carried out on the effect of improving spelling through reading, one by Thorndike and one by Gilbert, both have a common conclusion, namely, that the


22 Ibid., p. 89.


most gain is made by superior spellers. Thorndike\textsuperscript{25} states:

There is evidence to show that much of the learning and relearning or prevention of forgetting of spelling comes as a by-product of reading. Some individuals, including many of the better spellers, obtain during ordinary reading, impressions which leave after-effects adequate to aid in spelling. . . .

However, Gilbert\textsuperscript{26} also found that even the superior spellers failed to gain as much through reading as through direct study, and for the less able spellers he believed it probable that a gain in spelling would mean a loss in comprehension. The findings served to confirm the desirability of teaching spelling by a method stressing accurate speed of perception.

As a solution to the problem of the "best" method of teaching spelling, experimental researches on learning to spell, conducted by Winch,\textsuperscript{27} indicate that a combined method of both auditory and visual presentation of spelling words is likely to be superior. Even more strongly Tidyman\textsuperscript{28} has this to say, "An average of the results of three important investigations shows that the addition of speech and writing movements to visual and auditory presentation decreases the number of errors approximately one third."

\textsuperscript{25} Thorndike, op. cit., p. 191.
\textsuperscript{26} Gilbert, op. cit., pp. 458-63.
\textsuperscript{27} W. H. Winch, "Experimental Researches on Learning to Spell," \textit{Journal of Educational Psychology}, 4:525-37, November, 1913.
\textsuperscript{28} Tidyman, op. cit., p. 62.
However, differences also have been observed in other experiments. It is clear that a difference is significant when the results of an experiment show a larger effect than would be expected by chance.

The difference is considered significant when the results of an experiment show a larger effect than would be expected by chance.

A significant difference is observed when the results of an experiment show a larger effect than would be expected by chance.

References

The problem of spaced learning versus unspaced learning has been the subject of much research and investigation. Lorge\textsuperscript{29} used zero, one minute, and one day intervals between one-minute practice periods on the stabilimeter, and as a result of this study says, "Distribution of practice generally makes for economy. Under distribution of practice a fact is learned, or a skill acquired, with less work than if the practice were massed."

Dashiell\textsuperscript{30} has stated that in learning any kind of habit it has been found, from a great number of researches, that it is more economical to space the practice with time intervals rather than to try to form it completely in one sitting.

Murphy,\textsuperscript{31} from an experiment conducted on the effects of time intervals on javelin throwing, says that the learning periods can be distributed by giving alternate days practice without the loss of learning. The conclusion reached from this study, in relation to school subjects, is that better work


\textsuperscript{31} Herbert Murphy, "Distribution of Practice Periods in Learning," Journal of Educational Psychology, 7:150-162, March, 1916.
The problem of achieving increased efficiency and productivity
has been the subject of much research and experimentation.

In fact, we need more, not less, information on the effectiveness
of educational practices. The publication of practice examples
makes a study easy. Under Administration of practice the tact is
learned on a daily continuing, with base work plan of the
practice were measured.

Partially the studies that in learning any kind of
perfect it has been found, from a large number of experiments,
that it is more economical to observe the practice with time
intervals rather than to try to learn it completely in one
attitude.

We have, of course, experienced considerable on the efforts
of time intervals of a desirable magnitude, since for the learning
behavior may be affected by various stimuli during practice.

Without the loss of learning, the combination becoming from
this study in relation to school subjects, is that certain work

80. P. Dole, Influences of Retardation Interference of General Psychological
Interference upon Supervisor Learning (Teaching, College, Columbia) 4th.
New York: Teachers College, Columbia University, 1930.
81. P. Dole, Retardation Influence of General Psychological
Stresses on Retardation and Learning, 1935.
can be done through a distribution of three times a week than through a distribution of five times a week, for the amount of time consumed.

Boring (et al.)\textsuperscript{32} state, "The conclusion is well established that, over a wide range of conditions, some form of positive distribution is a more favorable condition of learning than a zero distribution or massed practice."

Lyons\textsuperscript{33} conducted a study using nonsense syllables and poetry at first. Digits and prose were then substituted. He concludes that it is obvious that \"\ldots the 'once-per-day' method is far more economical than the 'continuous' method, and gives also a far superior retention. This was found to be particularly true of nonsense syllables or digits.\"

Commins\textsuperscript{34} states:

It has been found in general that the spacing or distribution of practice periods over a considerable length of time is more saving of the total time and effort spent in memorizing than trying to learn all the material at one or a few sittings. The advantages of spaced learning are especially noticeable for long time retention.

\begin{itemize}
\item \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots 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\ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots 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\end{itemize}

\begin{itemize}
\item \textsuperscript{33} Darwin O. Lyon, "The Relation of Length of Material to Time Taken for Learning, and the Optimum Distribution of Time--Part II," \textit{Journal of Educational Psychology}, 5:85-91, January, 1914.
\item \textsuperscript{34} W. D. Commins, \textit{Principles of Educational Psychology} (New York: The Ronald Press Company, 1937), p. 411.
\end{itemize}
time consumed.

Hogging (or e.g. 40% of total time,

established fact, even a simple case of condition, some form

of positive identification is a mere tenuous condition to

insure from a case identification of message processing

These cases connected a study with unconscious syllables and

poetry of thrones. Poetry and prose were given supplementary

"one-on-one" contact. It is obvious that the "conditioned" method

method to test more extensively than the "conditioned" method

and given also a ten percent retention. This is shown to be

pertinently true of unconscious syllables of flight.

Commented after:

It can be seen today, in general that the operation of

publication of brochures permits over a communication faculty of

time is more sensitive of the total time and exact time of

memorization, and thinking of test of the material is a

substantially easier for your time retention.

28. R. F. Durrell, Principles of Experimental Psychology

An experiment conducted by Starch\textsuperscript{35} covered a six day period. The learning was divided into intervals of ten minutes, twice a day; twenty minutes, once a day; forty minutes, every other day; the entire task at one sitting. Within the limits of his experiment, the records show that the shorter and more numerous the periods of work are, the more rapid is the improvement. He says, however, that there would be a limit to how much the periods could be shortened and show benefits, as the advantages of shorter periods of work would be over balanced by the loss of adaptation at the beginning of each period. It is a well known fact that a period of rest after having studied something new gives it a chance to become settled and fixed. "There is, quite obviously, a point of diminishing returns, an optimal distribution and length of the period of work beyond which the expenditure of energy becomes less economical."\textsuperscript{36}

Of similar import is Boring's \textit{(et al.)}\textsuperscript{37} statement that, "Relatively short intervals are often more detrimental. Very long ones, particularly those which are longer than a few days, are almost always detrimental."


\textsuperscript{36} Ibid., pp. 212-13.

\textsuperscript{37} Boring, \textit{(et al.)}, loc. cit.
An expression commonly encountered when dealing with transient phenomena is the concept of a time constant. The time constant, often referred to as the constant time or time of one effective second, is defined as the time it takes for the response of a system to change by a certain percentage of the total change. It is a crucial parameter in understanding the behavior of systems over time.

In the context of the experiment, the time constant determines the rate at which the system approaches its steady-state condition. The shorter and more numerous the changes to work or the more slowly the system approaches steady-state conditions, the smaller the time constant and the more rapidly the system reaches a steady-state condition. If a system is well known to have a steady-state condition, it is often desirable to perform an experiment to verify if the system behaves as expected. This verification can help in validating the assumptions and models used in the analysis of the system.

The time constant is also important in minimizing the overall effect of the changes. By carefully choosing the time constant, the effects of the changes can be minimized, leading to improved system performance and reliability.

In practice, the time constant is often used to design filters, controllers, and other components that are required to operate in real-time systems. The time constant is a critical parameter in these designs, as it determines the speed at which the system can respond to changes.
Collins\textsuperscript{38} has this to say after conducting her experiment on spaced learning in word analysis:

It would appear from this study that statistically, skills of word analysis are not retained better by spaced than by unspaced learning on either immediate or delayed recall. However, in spite of no statistical significance being found, the progression of gain shown in the experiment points to significance in itself.

\ldots

The achievement under distribution of practice was generally superior to achievement under the massing of practice in this study.

Although Commins\textsuperscript{39} coincides with the statement that the advantages of spaced learning are especially noticeable for long time retention, he also says that a number of conditions are found which call for qualifications of that statement. The length of rest period, the type and difficulty of the material, and the method of memorizing are all influencing factors. The massing of effort seems to be relatively unfavorable to the whole method of learning, but it is much less so, however, if stress is placed on detail and immediate recall.

Conclusions drawn from this research seem to indicate that a study of spelling based on a combination of best methods and carried out through a comparison of spaced and unspaced learning achievement, might prove to be worthwhile, from the standpoint of the writer's particular problem.


\textsuperscript{39} Commins, loc. cit.
Collaboration was found to be a key component in successful performance.

We must appear from this study that collaboration

is effective in many situations. It was discovered that

the active involvement of all participants in the process.

However, it is quite clear that participation in the process

is not sufficient. In fact, the process of developing

suggestions for improvement is an essential part of the

process.

The role of collaboration in improving the process of

suggestion is essential. It is not enough to simply

suggest improvements. It is necessary to actively engage

all participants in the process.

Although collaboration was found to be a key component in

successful performance, it is also clear that a number of conditions

must be met for collaboration to be effective. These include:

- clear and defined roles and responsibilities
- open and honest communication
- mutual respect and trust
- shared goals and objectives
- willingness to listen and learn from others

In summary, collaboration is essential for successful performance.

"Since selection, "space learning" may prove

more effective in certain situations.

For example, the selection and training of

participants is crucial to the success of

the program. In addition, the use of

collaborative strategies, such as group

work, may enhance the learning process.

Finally, the program must be well-organized

and well-planned to ensure its success."
CHAPTER III

SCOPE OF THE STUDY AND PLAN OF CONDUCT

The purpose of this study, as previously mentioned, is to make a comparison of the growth in spelling achievement when using spaced learning versus the growth when using unspaced learning. The following points are to be kept in mind throughout:

1. Is more gain found when using spaced learning or unspaced learning?

2. At what interval does the most learning seem to be found, at twenty minutes, twice a day, three times a week, or at thirty minutes in five a week?

This study was set up within the framework of three groups totaling 160 pupils. The school program was set up arbitrarily, as the schedule following shows, and it was impossible to change pupils from one group to another. For this reason, although all 160 pupils participated in the experiment, only fourteen pupils from each group, or a total of forty-two, could be selected for the study.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 3</td>
<td>20 min.</td>
<td>20 min.</td>
<td>20 min.</td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>30 min.</td>
<td></td>
<td>30 min.</td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td></td>
<td>30 min.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Schedule of Weekly Program
CHAPTER III

SCOPE OF THE STUDY AND PLAN OF CONDUCT
CHAPTER III

SCOPE OF THE STUDY AND PLAN OF CONDUCT

The purpose of this study, as previously mentioned, is to make a comparison of the growth in spelling achievement when using spaced learning versus the growth when using unspaced learning. The following points are to be kept in mind throughout:

1. Is more gain found when using spaced learning or unspaced learning?

2. At what interval does the most learning seem to be found, at twenty minute intervals three times a week or at thirty minute intervals twice a week?

This study was set up within the framework of three groups totaling 180 pupils. The school program was set up arbitrarily, as the schedule following shows, and it was impossible to change pupils from one group to another. For this reason, although all 118 pupils participated in the experiment, only fourteen pupils from each group, or a total of forty-two, could be selected for the study.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 3</td>
<td>20 min.</td>
<td></td>
<td>20 min.</td>
<td></td>
<td>20 min.</td>
</tr>
<tr>
<td>Group 2</td>
<td>30 min.</td>
<td></td>
<td></td>
<td>30 min.</td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td></td>
<td></td>
<td>60 min.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Schedule of Weekly Program
CHAPTER III

SCOPE OF THE STUDY AND PLAN OF CONDUCT

The purpose of this study, as previously mentioned, was to make a comparison of the groups in spelling achievement when using speeded learning versus the groups with drill in word recognition. The following points are to be kept in mind:

1. To more easily teach with existing speeded learning or
   word recognition. Speeded learning seems to be
   more effective than drill in the mechanics of these
   groups consisting of 160 pupils. The spelling program was set up
   experimentally as the percentage following shows, and it was
   impossible to arrange within this study for all the pupils participating in the
   experiment. Only fourteen pupils from each grade of a total
   of forty-two could be selected for the study.

<table>
<thead>
<tr>
<th>Mon.</th>
<th>Tues.</th>
<th>Wed.</th>
<th>Fri.</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 min</td>
<td>60 min</td>
<td>60 min</td>
<td>60 min</td>
</tr>
<tr>
<td>60 min</td>
<td>60 min</td>
<td>60 min</td>
<td>60 min</td>
</tr>
<tr>
<td>60 min</td>
<td>60 min</td>
<td>60 min</td>
<td>60 min</td>
</tr>
</tbody>
</table>

Schedule of Weekly Program
The mental age of each child used for this study was obtained from the Terman-McNemar\textsuperscript{40} Group Intelligence Test. It was first considered desirable to find the Standard Error of the differences and Critical Ratios between the three groups on mental ages to see if the hypothesis that these groups were controlled might be assumed to be correct.

Mills\textsuperscript{41} has this to say:

If a given difference between hypothetical and observed values would occur as a result of chance only 1 time out of 100, or less frequently, we may say that the difference is significant. This means that the results are not consistent with the hypothesis we have set up. If the discrepancy between theory and observation might occur more frequently than 1 time out of 100 solely because of the play of chance, we may say that the difference is not clearly significant. The results are not inconsistent with the hypothesis. The value of T (the difference between the hypothetical value and the observed mean, in units of the Standard Error of the mean) corresponding to a probability of 1/100 is 2.576. One hundredth part of the area under the normal curve lies at a distance from the mean, on the x-axis, of 2.576 standard deviation, or more. Accordingly, tests of significance may be applied with direct reference to T, interpreted as a normal deviate (i.e., as a deviation from the mean of a normal distribution expressed in units of the standard deviation.) A value of T of 2.576 or more indicates a significant difference, while a value of less than 2.576 indicates that the results are not inconsistent with the hypothesis in question.

\textsuperscript{40} Lewis Terman and Quinn McNemar, Terman-McNemar Test of Mental Ability, Form C (Yonkers-on-Hudson, New York: World Book Company, Copyright, 1941).

The mental age of each child need for this study was obtained from the Terman-Merrill (G. O. A. H. Re—Test) Group Intelligence Test.

It was then considered advisable to find the standard error of the difference and critical ratio between the three groups on mental age to see if the hypotheses that these groups were controlled mentally be assumed to be correct.

If there is a given difference between the propounded...
In the light of the above information any group with a Critical Ratio of less than 2.576 was interpreted as not statistically significant. Tables I, II, III show the results of the group analysis of mental ages.

### TABLE I

**SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 1 AND 2 ON M.A.**

<table>
<thead>
<tr>
<th></th>
<th>$\mu_1$</th>
<th>$\sigma_1$</th>
<th>$\sigma_1$</th>
<th>N</th>
<th>Diff.$\mu_1$-$\mu_2$</th>
<th>$\sigma_{\text{Diff.}}$</th>
<th>C.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M_1$</td>
<td>13.76</td>
<td>.26</td>
<td>.96</td>
<td>14</td>
<td>.06</td>
<td>.37</td>
<td>.162</td>
</tr>
<tr>
<td>$M_2$</td>
<td>13.7</td>
<td>.26</td>
<td>.98</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE II

**SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 1 AND 3 ON M.A.**

<table>
<thead>
<tr>
<th></th>
<th>$\mu_1$</th>
<th>$\sigma_1$</th>
<th>$\sigma_1$</th>
<th>N</th>
<th>Diff.$\mu_1$-$\mu_2$</th>
<th>$\sigma_{\text{Diff.}}$</th>
<th>C.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M_1$</td>
<td>13.76</td>
<td>.26</td>
<td>.96</td>
<td>14</td>
<td>.04</td>
<td>.37</td>
<td>.108</td>
</tr>
<tr>
<td>$M_2$</td>
<td>13.8</td>
<td>.26</td>
<td>.96</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the light of the above information we found that

Critical Ratio of these sets were interpreted as not

statistically significant. Tables I. II. III show the results
on the ground exercises of men at sea.

| TABLE I |

<table>
<thead>
<tr>
<th>SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 1 AND 2</th>
<th>M</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEX</td>
<td>M</td>
<td>SE</td>
</tr>
<tr>
<td>AGE</td>
<td>M</td>
<td>SE</td>
</tr>
</tbody>
</table>

| TABLE II |

<table>
<thead>
<tr>
<th>SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 1 AND 2</th>
<th>M</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEX</td>
<td>M</td>
<td>SE</td>
</tr>
<tr>
<td>AGE</td>
<td>M</td>
<td>SE</td>
</tr>
</tbody>
</table>
TABLE III

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 2 AND 3 ON M.A.

<table>
<thead>
<tr>
<th>M_1</th>
<th>(\sigma_{M_1})</th>
<th>(\sigma_1)</th>
<th>N</th>
<th>Diff.(M_1-M_2)</th>
<th>(\sigma_{Diff.})</th>
<th>C.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.7</td>
<td>.26</td>
<td>.98</td>
<td>14</td>
<td>.1</td>
<td>.37</td>
<td>.027</td>
</tr>
<tr>
<td>M_2</td>
<td>(\sigma_{M_2})</td>
<td>(\sigma_2)</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.8</td>
<td>.26</td>
<td>.96</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tables I, II and III show the Critical Ratios between the three groups running so far below the standard of 2.576 for statistical significance that they may be considered equal in mental ages.

The Buffalo Spelling Scale, Grades 2-8, Form A,\(^42\) was administered at the beginning of the study and Form B at the end of the study. It was also considered desirable to find the Standard Error of Differences and Critical Ratios between the three groups on the results of Form A, to see if the hypothesis that the three groups were controlled as to spelling abilities might also be assumed to be correct. Tables IV, V and VI show the results of the group analysis of spelling abilities.

\(^{42}\)Allan J. Williams, compiler, Buffalo Spelling Scale, Form A and Form B Grades 2-8 (Bloomington, Illinois: Public School Publishing Company).
Table III

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 2 AND 3 ON W.A.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.2</td>
<td>4.5</td>
<td>4.7</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.2</td>
<td>4.5</td>
<td>4.7</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.2</td>
<td>4.5</td>
<td>4.7</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.2</td>
<td>4.5</td>
<td>4.7</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.2</td>
<td>4.5</td>
<td>4.7</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.2</td>
<td>4.5</td>
<td>4.7</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.2</td>
<td>4.5</td>
<td>4.7</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.2</td>
<td>4.5</td>
<td>4.7</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.2</td>
<td>4.5</td>
<td>4.7</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.2</td>
<td>4.5</td>
<td>4.7</td>
<td>5.0</td>
<td></td>
</tr>
</tbody>
</table>

Tables I, II and III show the effect of recta between

The three groups were similar in test results of the

For statistical significance tests may be considered, equally

in mental tests.

The Buffalo Spelling Scale’s Grade 2-8, Form A, was

abnormality at the beginning of the study and does not show the

and at the study. It was also correlated negatively to find the

standard error of differences and critical ratio between the

three groups on the results of Form A, to see if the hypothesis

that the three groups were controlling as to spelling abilities

might also be assumed to be correct. Table IV, V and VI show

the results of the groups’ ability on spelling abilities.
TABLE IV

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 1 AND 2 ON BUFFALO SPELLING SCALE, FORM A

<table>
<thead>
<tr>
<th></th>
<th>$M_1$</th>
<th>$\sigma_{M_1}$</th>
<th>$\sigma_1$</th>
<th>N</th>
<th>Diff.$M_1$ - $M_2$</th>
<th>$\sigma_{\text{Diff.}}$</th>
<th>C.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>7.5</td>
<td>.24</td>
<td>.91</td>
<td>14</td>
<td>.5</td>
<td>.33</td>
<td>1.52</td>
</tr>
<tr>
<td>M2</td>
<td>8.0</td>
<td>.23</td>
<td>.88</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE V

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 1 AND 3 ON BUFFALO SPELLING SCALE, FORM A

<table>
<thead>
<tr>
<th></th>
<th>$M_1$</th>
<th>$\sigma_{M_1}$</th>
<th>$\sigma_1$</th>
<th>N</th>
<th>Diff.$M_1$ - $M_2$</th>
<th>$\sigma_{\text{Diff.}}$</th>
<th>C.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>7.5</td>
<td>.24</td>
<td>.91</td>
<td>14</td>
<td>.4</td>
<td>.31</td>
<td>1.29</td>
</tr>
<tr>
<td>M2</td>
<td>7.9</td>
<td>.20</td>
<td>.76</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TABLE VI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significance of Differences Between Control Groups 1 and 2, on Bison Spitting Scale Form A

<table>
<thead>
<tr>
<th></th>
<th>D1</th>
<th>D2</th>
<th>M1</th>
<th>M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR.</td>
<td>38</td>
<td>32</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>1.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| TABLE V |

Significance of Differences Between Control Groups 1 and 2, on Bison Spitting Scale Form A

<table>
<thead>
<tr>
<th></th>
<th>D1</th>
<th>D2</th>
<th>M1</th>
<th>M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR.</td>
<td>38</td>
<td>32</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>1.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE VI

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 2 AND 3 ON BUFFALO SPELLING SCALE, FORM A

<table>
<thead>
<tr>
<th></th>
<th>$M_1$</th>
<th>$\sigma_{M_1}$</th>
<th>$\sigma_1$</th>
<th>N</th>
<th>Diff.$M_1$-$M_2$</th>
<th>$\sigma_{\text{Diff.}}$</th>
<th>C.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M_1$</td>
<td>8.0</td>
<td>.23</td>
<td>.88</td>
<td>14</td>
<td></td>
<td>.1</td>
<td>.30</td>
</tr>
<tr>
<td>$M_2$</td>
<td>7.9</td>
<td>.20</td>
<td>.76</td>
<td>14</td>
<td></td>
<td>.33</td>
<td></td>
</tr>
</tbody>
</table>

Tables IV, V and VI show the Critical Ratios between the three groups running higher than for the mental ages, particularly for Groups 1 and 2 and Groups 1 and 3, but still far below the standard of 2.576 for statistical significance. It can thus be assumed that the three groups are equal as to spelling abilities.

The study covered a twelve week period. The city used for the experiment was a residential one close to Boston and composed of better than average homes for the most part. The children from these homes have all the comforts and advantages to be expected from such circumstances. There is, however, a small group of children from definitely underprivileged homes where both parents may be working and the children left to take care of themselves, or of general poverty and unsanitary living conditions. There is practically no foreign element and therefore the problem of a language difficulty is eliminated. The school system is considered a progressive one with dillematic and extra-curricular activities.
Table I

Comparison of Differences Between Control Groups

<table>
<thead>
<tr>
<th>Control (A)</th>
<th>Control (B)</th>
<th>Control (C)</th>
<th>Control (D)</th>
<th>Control (E)</th>
<th>Control (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>88</td>
<td>73</td>
<td>67</td>
<td>80</td>
<td>76</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>9</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>

Table II

Comparison of Differences Between Experimental Groups

<table>
<thead>
<tr>
<th>Experimental (G)</th>
<th>Experimental (H)</th>
<th>Experimental (I)</th>
<th>Experimental (J)</th>
<th>Experimental (K)</th>
<th>Experimental (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>90</td>
<td>85</td>
<td>78</td>
<td>92</td>
<td>88</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>10</td>
<td>8</td>
<td>9</td>
<td>11</td>
<td>9</td>
</tr>
</tbody>
</table>

These groups were randomly assigned to the control and experimental conditions. The results indicate that Group A shows the least variance, while Group C has the highest variance. This suggests that the experimental conditions may have had a significant impact on the outcomes.
conditions. There is practically no foreign element and therefore the problem of a language difficulty is eliminated. The school system is considered a progressive one with itinerant teachers for the physically handicapped, posture classes, and extra-curricular activities.

Ninety words from the required spelling list for seventh and eighth grades were taught during the first six weeks of the testing period. At the end of that time the same sentence test composed of the ninety words taught was given to all three groups to test retention. Ninety more words were taught during the next six weeks and another sentence retention test given. The results of this test were compared with the previous sentence retention test.

Fifteen new words and five review words were assigned each week. The following method was used for each of the three groups. A presentation of the new words for the week was made. Each word was pronounced distinctly by the teacher and written on the board as she said it. Similarities to known words were pointed out, attention was called to double letters, difficult parts were stressed, small words were found within the main word, endings and the number of syllables were noted. The class then tried to visualize the word without looking at it, saying it softly or writing it, and then comparing it with the printed form. Meanings were discussed, and those not known were looked up in the dictionary. Each new word was used in a sentence, sometimes orally and sometimes written. The words
were then dictated and corrected to find those needing further study. Specific directions for independent study were given. A record was kept of the words failed most often and these words were given the most attention. Thus, if the word "recommended" was misspelled twelve times, and the word "information" only three times, the former word might be written and compared eight times, and the latter only twice. Stress was laid on the fact that mere writing of the word was of no value unless a thoughtful attempt was made to visualize its form and then make a comparison with the printed form after writing the word.

Each new list of words was tested and graded once a week with each child keeping an individual spelling book with his work and score listed. The back of the spelling book was arranged in alphabetical order and each word misspelled in the weekly test was written correctly under the proper letter. These words were studied independently and as time allowed, an individual test was given each child on his own particular spelling demons. A red line was then drawn through those he had learned leaving those not cancelled for still further study. A table of weekly scores was kept for motivation.

As previously mentioned, at the end of six weeks the same test composed of sentences using the ninety words studied during that period was given to all three groups to measure retention. The test follows:
1. Do you consider that science will benefit a considerable amount by the construction of ten new buildings?

2. The prosperous merchant carried a diamond concealed in an unusual envelope everywhere he went in Europe.

3. His appearance was especially against him when he applied for the job of reading the gas meter.

4. She was a mere child when I last saw her.

5. A thorough study was made of the increasing lack of convenient passenger trains.

6. He did not behave as he always had formerly when making out his application for provisions.

7. The fog will envelop the countryside this forenoon.

8. He is going to undertake to develop an independent study of the habits of reindeer.

9. The severe storm gave me a great fright, particularly when the very foundation of the house simply trembled.

10. Did it occur to you to ask his pardon, rather than to offend him by going into further detail over a difficult matter?

11. No provision was made for an expression of public opinion.

12. He did not indicate that there would be any prospect of a job in the orchestra.
I THINK INFORMATION

Do you consider that science will occupy a central position in the reconstruction of our new philosophy? I am convinced that science is the key to understanding the universe. The progress of science cannot be held back by any amount of smugness or arrogance. The appearance of new and unexpected phenomena is a source of excitement and joy.

Supposing for a moment that we found the key to life. Would we be able to control the processes of living? Would we be able to bring about a world where there is no suffering and no death? It is a question that has always fascinated me, but one that remains unanswered.

The problem of life is one that has plagued scientists for centuries. It is a problem that has been tackled from many different perspectives. Some have sought to understand the nature of life through the study of biology and genetics. Others have approached the problem from a more philosophical perspective, seeking to understand the essence of life through the study of ethics and metaphysics.

In any event, it is clear that the study of life is a field that has much to offer. It is a field that has much to teach us about ourselves and our place in the universe. It is a field that has much to contribute to our understanding of the world and our place in it.

To allow him at once into further secret over a difficult material, if no provision was made for an expression of opinion.

He did not imagine that there was any prospect of a job in the profession.

Opinion.
13. Will you relate your explanation of your entry into his house?

14. The minister said that a sense of believing in good will influence one's purpose in life.

15. The seasons slip by so quickly that it is with difficulty that we can separate the approach of one from another.

16. We can appreciate the opera more perfectly if we consult the program first.

17. I was uneasy until the first three sections of the freight train loaded with a mixture of gasoline and explosives had passed.

18. The little orphan was careful to remedy his mistake before the patience of the carpenter was exhausted.

19. What rule can you apply to this problem?

20. Even though he was a capable man he could not establish an urge to attend the convention.

21. It is easy to misspell the word "disappear."

22. Did he inquire whether the bill for goods purchased was payable, or if he should remit the same?

23. The falling of the trees in the orchard was likely to both frighten and injure the child.

24. The people of the republic were not united.

25. Oil now sells at twenty cents a gallon.

26. The house was thirty ft. by twenty ft.
16. Will you receive your explanation or your survey info
the home?
15. The minister said that a sense of belonging in your
will influence one's behavior in life.
14. The reason why go to a doctor if it is with
illness that we can express to the approach of one from
more satisfaction.
13. We can appreciate the degree more satisfaction if we
consult the program itself.
12. I am happy with the idea that these sections of the
material train together with a mixture of Nescafe and espresso
had prepared.
11. The little article was certainly to remember the mistake
before the beginning of the conversation was expedient.
10. What time can you supply to this program?
9. I can supply a copy of this program in the psychology
satisfied with a desire to attend the convention.
8. If it is easy to misplace the word "thirstless"
7. Did the incident happen the day for coffee breathing?
6. The feeling of the process in the original was likely
to catch people and influence the onlookers.
5. The people of the republic were not much.
4. If you settle at twenty cents a gallon.
3. The house was straight if you wanted it.
Six weeks later the second retention test composed of the ninety words taught during that period was given to all three groups. The results from this test were compared with those from the first test. The test follows:

**SENTENCE RETENTION TEST II**

1. The governor did wonderfully well on his new trolley transportation system in the neighborhood.

2. The tobacco company will advertise its new source of supply in the near future.

3. "That is a peculiar instrument!" exclaimed the gracious patron of the music club.

4. I don't quite know whether I should make an exception of the text submitted to the council.

5. The wireless tower was not a usual type seen at such a distance.

6. We'll govern the traffic problem as exactly as possible.

7. Can you possibly substitute one assignment for the other as a personal favor?

8. Did the disappearance of the queer visitor convince you that he was not a ghost?

9. The examiner can instantly distinguish between pleasant and stormy weather reports.

10. He was forced to resign his position solely because of an incomplete report.
Six weeks later the second report of the company
of the mixed work team and that report was given to
three companies. The reports from these teams were compared with
space from the first lead. The lead follows:

STATEMENT ELEVEN

If the company and workable well on the new
project transportation strategy in the neighborhood
The company company will achieve the new scheme
of supply in the near future
The lead is less important! the management
Regarding vision of the work stop
If you could know without I could\n
An opinion of the lead supplied to the company
The adjacency power was not a major type need of
such a location
We'll remove the partial problem as exactly as
possible
Can you possibly substitute one assuagement for the
other as a temporary repair?
Did the disappearance of the chain available continue
you find peace was not a surprise?
Do the element can internally distinguish between
pressure any strong weather reports
We were forced to remove the position safety because
of an incomplete report.
11. Can you gradually stretch the twine to meet the requirements of the measurements assigned?

12. Upon his arrival at his new residence he began at once to dispose of quantities of valuable furniture.

13. Water is the natural home of the muskrat.

14. We've had an invitation to join the new society being formed on domestic relations.

15. Whoever can hit the ball with one stroke will win a splendid prize for the strength and quality of his performance.

16. The widow left for a tour of Spain and Asia.

17. We can't tell the exact amount of moisture unless we examine the stalk we now possess.

18. There is no instance of a disease which will correspond with this one.

19. The moral of this story is to be generous.

20. I'd like some instruction in the mixing of cement.

21. The celebration of the republican party will cease at midnight.

22. The package marked "pd." weighed less than one oz.

Form B of the Buffalo Spelling Scale was administered at the end of the twelve weeks.

Significance of differences was found on the following points:

1. Sentence Test I results with Sentence Test II results on Controlled Group 1.

2. Sentence Test I results with Sentence Test II results on Controlled Group 2.
If you file stays in the new building please go to the appropriate of the performance.

The window is a part of the building and is

The window tells the exact amount of sunlight these.

There is no instance of a glass which will

correspond with this one.

The money of the storm is to be received.

So, I've given some instruction in the mixing of cement.

The celebration of the centennial party will cease

at midnight.

The house is named "by" Welling Less than one at.

Form 8 of the building draught shown may be administered

at the end of the centurial week.

Significance of Residence was wrong on the following:

I. Sentence Test I chapter with sentence Test II to

either on Contrasting Group I.

2. Sentence Test I repeats with Sentence Test II re-

either on Contrasting Group II.
3. Sentence Test I results with Sentence Test II results on Controlled Group 3.

4. The Buffalo Spelling Scale, Form A with the Buffalo Spelling Scale, Form B on Controlled Group 1.

5. The Buffalo Spelling Scale, Form A with the Buffalo Spelling Scale, Form B on Controlled Group 2.

6. The Buffalo Spelling Scale, Form A with the Buffalo Spelling Scale, Form B on Controlled Group 3.

The following chapter deals with the analysis of data taken during the experiment.
The following chapter deals with the application of force.

The Buffalo Spelling Scale form a with the Buffalo.

The Buffalo Spelling Scale form a with the Buffalo.

The Buffalo Spelling Scale form a with the Buffalo.

The Buffalo Spelling Scale form a with the Buffalo.

The Buffalo Spelling Scale form a with the Buffalo.

The Buffalo Spelling Scale form a with the Buffalo.

The Buffalo Spelling Scale form a with the Buffalo.

The Buffalo Spelling Scale form a with the Buffalo.

The Buffalo Spelling Scale form a with the Buffalo.

The Buffalo Spelling Scale form a with the Buffalo.

The Buffalo Spelling Scale form a with the Buffalo.
CHAPTER IV

THE ANALYSIS OF DATA

As the mental ages and spelling abilities of the three groups may be considered to be equal as shown by the data obtained in Chapter III, the analysis of data will center around the achievement in spelling when using spaced learning versus the achievement when using massed, or unspaced learning.

The Standard Error of the differences and the Critical Ratio was found on the raw scores of Sentence Retention Tests I and II with the same standard of 2.078 as a Critical Ratio, and also on the Buffalo Spelling Tests, Form A with Form B.

The tables follow THE ANALYSIS OF DATA of these tests by the three groups.

TABLE VII

SIGNIFICANCE OF DIFFERENCES BETWEEN SENTENCE RETENTION TESTS I AND IV ON CONTROLLED GROUP I

<table>
<thead>
<tr>
<th>W₁</th>
<th>W₂</th>
<th>p₁</th>
<th>p₂</th>
<th>3</th>
<th>39.52</th>
<th>60.65</th>
<th>d.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>65.79</td>
<td>2.41</td>
<td>0.03</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>W₃</th>
<th>W₄</th>
<th>p₂</th>
<th>p₃</th>
<th>3</th>
<th>7.48</th>
<th>60.65</th>
<th>d.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>86.06</td>
<td>1.46</td>
<td>6.52</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The analysis of data for the other tests follows.
CHAPTER VI

THE ANALYSIS OF DATA
CHAPTER IV

THE ANALYSIS OF DATA

As the mental ages and spelling abilities of the three groups may be considered to be equal as shown by the data obtained in Chapter III, the analysis of data will center around the achievement in spelling when using spaced learning versus the achievement when using massed, or unspaced learning.

The Standard Error of the differences and the Critical Ratio was found on the raw scores of Sentence Retention Tests I and II with the same standard of 2.576 as a Critical Ratio, and also on the Buffalo Spelling Scale, Form A with Form B. The tables following show the results of these tests on the three groups.

TABLE VII

SIGNIFICANCE OF DIFFERENCES BETWEEN SENTENCE RETENTION TESTS I AND II ON CONTROLLED GROUP 1

<table>
<thead>
<tr>
<th></th>
<th>M1</th>
<th>M1</th>
<th>M1</th>
<th>N</th>
<th>Diff. M1-M2</th>
<th>Diff.</th>
<th>C.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>84.79</td>
<td>2.41</td>
<td>9.03</td>
<td>14</td>
<td>1.29</td>
<td>2.82</td>
<td>.46</td>
</tr>
<tr>
<td>M2</td>
<td>86.08</td>
<td>1.48</td>
<td>5.52</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER VI

THE ANALYSIS OF DATA

As the results were and are still applicable to the state

Where may be considered to be equal to those of this study

Opposition in Chapter III, the analysis of data with samples

Among the relationships in analyzing mean values especially sample

The standard error of the differences and the critical

Ratio was found on the two scores of sentence recognition Tests

I and II with the same standard of 2.96 as a critical ratio

and also on the British spelling scores. For A with Form B

The tables following show the results of these tests on this

<table>
<thead>
<tr>
<th>Tests</th>
<th>I and II on Controlled Group I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill A</td>
<td>Drill B</td>
</tr>
<tr>
<td>60.2</td>
<td>65.2</td>
</tr>
</tbody>
</table>
### Table VIII

**Significance of Differences between Sentence Retention Tests I and II on Controlled Group 2**

<table>
<thead>
<tr>
<th></th>
<th>$\sigma M_1$</th>
<th>$\sigma_1$</th>
<th>N</th>
<th>Diff.$M_1$-$M_2$</th>
<th>$\sigma$Diff.</th>
<th>C.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>80.08</td>
<td>3.77</td>
<td>14</td>
<td>5.13</td>
<td>4.65</td>
<td>1.10</td>
</tr>
<tr>
<td>M2</td>
<td>85.21</td>
<td>2.72</td>
<td>14</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

The Critical Ratios on Tables VII, VIII and IX all run far below the criterion of 2.576 and are not statistically significant.
## Table VII

Significance of Differences Between Estimates of Tests I and II on Controlled Group S

<table>
<thead>
<tr>
<th>Test</th>
<th>C.O.</th>
<th>C.O. - M.</th>
<th>M.</th>
<th>F.</th>
<th>M.</th>
<th>M.</th>
<th>M.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.10</td>
<td>5.72</td>
<td>4.86</td>
<td>4.16</td>
<td>0.80</td>
</tr>
</tbody>
</table>

## Table IX

Significance of Differences Between Estimates of Tests I and II on Controlled Group S

<table>
<thead>
<tr>
<th>Test</th>
<th>C.O.</th>
<th>C.O. - M.</th>
<th>M.</th>
<th>F.</th>
<th>M.</th>
<th>M.</th>
<th>M.</th>
</tr>
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---

The critical ratio of Tables VII, VIII, and IX are given confident
### Table X

**Significance of Differences Between Buffalo Spelling Scale, Form A with Form B, on Controlled Group 1**

<p>| | | | | | | |</p>
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### Table XI

**Significance of Differences Between Buffalo Spelling Scale, Form A with Form B, on Controlled Group 2**

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TABLE X

Significance of Differences Between Buffalo Splicing Scars, Form A With Form B, on Control Group I

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<th>C.R.</th>
<th>Diff.</th>
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<th>M^2</th>
<th>M^3</th>
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<thead>
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<th>M^1</th>
<th>M^2</th>
<th>M^3</th>
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<td>78</td>
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TABLE XI

Significance of Differences Between Buffalo Splicing Scars, Form A With Form B, on Control Group II

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<th>M^3</th>
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S.E. = 0.3
The Critical Ratios on Tables X, XI and XII, although running somewhat higher than on Tables VII, VIII and IX, are below the criterion set and are not statistically significant.
TABLE XIII

SIGNIFICANCE OF DIFFERENCES BETWEEN BUFFALO SHIELD SCALE, FORM A WITH FORM B ON CONTROLLED GROUP 2

<table>
<thead>
<tr>
<th>CITY</th>
<th>DIFF. M - MS</th>
<th>DIFF. C - MS</th>
<th>T</th>
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<th>SO</th>
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<th>T1</th>
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</table>

The critical regions on Table XI and XII, and on Tables VIII and XI, are

imposing somewhat higher tests on Tables IV, VIII and XI, the

former are constructed on the coefficient set.
CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this investigation was to answer the following questions:

1. Is more gain found when using spaced learning in spelling or when using unspaced learning in spelling?

2. At what interval does the most learning seem to be found, at twenty minute intervals three times a week, or at thirty minute intervals twice a week?

CHAPTER V

SUMMARY AND CONCLUSIONS

The data obtained from the Sentence Retention Tests and the Buffalo Spelling Scale, Forms A and B, were analyzed statistically with the conclusions which follow:

1. There was no more statistically significant gain to be found in spelling achievement when using spaced learning than when using unspaced learning.

2. There was no more statistically significant gain to be found in learning at intervals of three times a week than at intervals of twice a week.

However, it is interesting to note in examining the data the following points:

1. Although there were no statistically significant differences on the Sentence Retention Test
CHAPTER V

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However, it is interesting to note in examining the data the following points:

1. Although there were no statistically significant differences on the Sentence Retention Test
CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of the investigation was to answer the following questions:

1. Is the more a day taken when using spaced learning
   in spelling more within wordspace learning?

2. At what interval does the most learning seem
   to occur in a week or at sixty minutes intervals?

The differences obtained from the sentence repetition tests and
the spelling spelling scale, form a part of the general finding
that there was no more statistically significant gain
in doing any in spelling improvement when using
spaced learning than when using wordspace learning.

If there was no more statistically significant gain
in doing any in learning at intervals of three
times a week at intervals of twice a week.

However, it is interesting to note in examining the
cave the following points:

1. Although there were no statistically significant
   differences on the sentence repetition test
results on the three groups, Groups 2 and 3 showed considerably higher Critical Ratios of 1.10 and 1.08 as compared with .46 for Group 1. This seems to indicate a slight trend toward higher Critical Ratios for the spaced learning groups than for the unspaced learning group. It is readily acknowledged that these were raw scores obtained from test results in which the words to be tested were not equated for difficulty and so cannot be considered valid tests. This trend is mentioned, however, because it follows the same general pattern to be found in the point following.

2. Again no statistically significant differences were found on the Buffalo Spelling Scale, Form A with Form B, on the three groups, but the same trend toward higher Critical Ratios for the spaced learning groups than for the unspaced learning group may be seen. Groups I and 3 showed Critical Ratios of 1.46 and 1.19 as compared with 1.11 for the unspaced learning Group 1.

3. A slight trend was shown toward more learning for the thirty minute interval twice a week group than for the twenty minute interval three times a week group, with higher Critical Ratios on both tests, though not statistically significant.
There seems to indicate a slight trend toward higher critical factors for the space-learning group. It is possible to speculate that those were more or less at the point of having just learned some new information. I do not think it is possible to compare the two groups, however, because of the following reasons:

1. The two groups were comparable on the general intelligence test.
2. The space-learning group may be seen Group I and the speech-learning group may be seen Group II. Group I showed critical factors of 1.4 and I.19 as compared with I.11 for the speech-learning group.
3. A slight trend was shown toward more learning for the speech group, while the space group was steady. These three groups with higher critical factors showed a large trend toward learning.
It is realized that twelve weeks is a short time to measure any learning process. Had this experiment been carried over an entire school year it is possible that these trends toward more gain in spelling achievement when using spaced learning than when using unspaced learning might have become statistically significant.
CHAPTER VI

SUGGESTIONS FOR FURTHER RESEARCH

1. The words to be taught in the first period of the study should be equated for difficulty with those to be taught in the second period of the study.

2. A study of spaced learning in spelling versus unspaced learning in spelling should be made with larger groups of children chosen from other areas than the one used in this study.

3. A study of this sort might be carried over a much longer period of time, as an entire school year, to see if Chapter V would show statistically significant gains in spelling achievement when using spaced learning.

4. It might be of interest to discover differences of boys and girls in spaced and unspaced learning in spelling.

5. A comparison might be made of the Intermediate grade level with the Junior High level using spaced and unspaced learning to see if the same conclusions hold true for both levels in spelling achievement.
CHAPTER IV

SUGGESTIONS FOR FURTHER RESEARCH
CHAPTER VI

SUGGESTIONS FOR FURTHER RESEARCH

1. The words to be taught in the first period of the study should be equated for difficulty with those to be taught in the second period of the study.

2. A study of spaced learning in spelling versus unspaced learning in spelling should be made with larger groups of children chosen from other areas than the one used in this study.

3. A study of this sort might be carried over a much longer period of time, as an entire school year, to see if the trends indicated in Chapter V would show statistically significant gains in spelling achievement when using spaced learning.

4. It might be of interest to discover differences of boys and girls in spaced and unspaced learning in spelling.

5. A comparison might be made of the Intermediate grade level with the Junior High level using spaced and unspaced learning to see if the same conclusions hold true for both levels in spelling achievement.
CHAPTER IV

SUGGESTIONS FOR FURTHER RESEARCH

The work to be continued in the final period of the study should not be expected to differ greatly from those a study of speech learning in spelling versus

a study of spelling learning in spelling versus

further research of children chosen from other areas

than the one used in this study.

It is evident that some sort of writing over a napkin together part of time as an entirely separate activity to see if the results indicated in Chapter 4 are

shown statistically significant enough in spelling

spelling with and without speech learning

of data and graphs to support the hypothesis of

in spelling.

A comparison might be made of the improvement made with the speech and non-speech

and speech learning to see if the same con-

suggestion hold true for both learners in spelling.

development
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D. TESTS


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University of California, Berkeley, 1943.


University of California, Berkeley, 1943.


University of California, Berkeley, 1943.


### Words Taught During the Study

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Review:

- appearance
- thorough
- science
- occur
- increasing
- considerable
- formerly
- develop
- indicate
- prosperous
APPENDIX

WORDS TAUGHT DURING THE STUDY
### WORDS TAUGHT DURING THE STUDY

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**Review**
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- thorough
- science
- occur
- increasing
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| experience | freight | separate |
| actual | patience | unusual |
| independent | sense | patience |</p>
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**Review**
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- gradually
- exactly
- residence
- council

- distinguish
- source
- text
- solely
- disappear
- society