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The Effects of Cumulative Review in an Interspersal Procedure on the Acquisition and Retention of Sight Words

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THE EFFECTS OF CUMULATIVE REVIEW IN AN INTERSPERSAI PROCEDURE
ON THE ACQUISITION AND RETENTION OF SIGHT WORDS

by

Kathleen M. Wright

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Master of Arts
Department of Psychology

Western Michigan University
Kalamazoo, Michigan
December 1980
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INTRODUCTION

This study was designed to determine whether cumulative review improves acquisition and retention of sight words with beginning readers when an interspersal procedure is used. The most important set of skills for a beginning reader are: being able to produce the correct sound in the presence of letters; blending; and telescoping (going from saying a word slowly to saying it quickly). A well-established phonics background enables the beginning reader to attack unfamiliar words. These skills provide the learner with a generative set (Alessi, unpublished). Problems arise, however, when an irregular word is presented. Because irregular words cannot be sounded out correctly and context clues are often insufficient to help in identifying the word, beginning readers must receive whole word training on irregular words; especially those that occur frequently in basal reading series.

Several methods have been proposed for teaching students sight words. Many traditional educators advocate using the word being taught in a meaningful sentence, showing pictures, and/or discussing the meaning of the word with the children (Heilman, 1972; Mazurkiewicz, 1976). Carnine and Silbert (1979), who advocate a strong phonics approach to reading, say that when introducing the child's first 10 to 15 irregular words, the child should be required to sound out the word and then pronounce the word as it is normally pronounced. The child is told that the word is one that must be remembered. The purpose of this procedure is to show the child that these "funny words"
have individual letters that must be carefully attended to just as regular words have and that they must be memorized (the teacher tells the child that the word is inconsistent with the decoding strategy being taught). After the first 10 to 15 words have been taught, others are taught one at a time through a discrimination format in which the teacher adds known words one at a time. The teacher alternates between the new word and previously mastered words. For example, the sequence would be: Her (new word), was, her, about, man, her, about, city, was, her, etc. The rationale for gradually adding words is to progressively increase the difficulty of the task. Engelmann (1969) agrees with this general strategy, but does not specify how many words should be introduced in the sound-out format.

Carnine (1977) compared the phonics approach to the look-say approach to teaching regular words in terms of generalization to novel regular and irregular words with 26 preschool students as subjects. The results demonstrated that the phonics group did significantly better than the sight word group on regular test words, but only did slightly better on irregular test words. The necessity of further research on sight words was suggested, particularly as to whether maximally or minimally different words should be trained in close succession.

Alessi (unpublished) has described a "word bank" procedure that peers and cross-age tutors can use to teach irregular words. The tutor starts with a stack of high-frequency words printed on index cards and presents them, one at a time, to the student.
Words correctly identified are put in a "known" pile and others are put in an "unknown" pile. Two or three maximally different words are selected from the unknown pile for training. The training begins by the tutor telling the child each word being taught and then alternating between them until the child responds correctly 10 consecutive times. Next, words that are very similar (minimally different) to the training words are selected from the known pile, all the word cards are spread out on a table and the child points to the correct word upon request. Finally, 10 different cards are randomly selected from the known pile, mixed with the training words, and the pupil is asked to read these words. Newly trained words (the last 5 to 10 taught) are reviewed daily before each training session.

Several studies have been conducted on various methods of sight word training. Monteiro (unpublished) compared two procedures to teach pairs of irregular words to remedial readers. The procedures consisted of an "errorless" procedure and a "trial and error" procedure. The main differences between the two procedures were that in the errorless procedure (1) the subjects were provided with an echoic prime (model) at the beginning of the training session (Skinner, 1968), (2) three previously mastered words were interspersed one at a time among the training words, and (3) cumulative review was provided for words taught. The trial and error procedure presented the subjects with repeated trials on the training words. The results showed that the errorless procedure led to faster acquisition and better retention than the trial and error procedure.
In a related study, Neef, Iwata, and Page (1977) used a multiple baseline design to investigate the effects of interspersing known items during training of new spelling and sight words. Six mentally retarded adults served as the subjects. During interspersal training sessions, 10 words known on the pretest were alternately presented with 10 unknown words. One spelling and one sight word session was conducted daily. The interspersal condition was compared with a high density reinforcement condition in which subjects were reinforced upon task-related behaviors (not on correct versus incorrect responding). The results showed that for all subjects, acquisition and retention of spelling and sight words were better under the interspersal condition than under the high density reinforcement or baseline conditions. The percentage of words retained was below 70% for all conditions. The authors suggested that this problem may have been due to the large number of words trained per day (40). The authors concluded that the interspersal of known items during training may facilitate closer attention to the training words and that reinforcement contingent on correct responding results in better performance than reinforcement contingent on attending behavior. This study did not, however, provide information as to why the interspersal of known items was superior.

Another important research question in sight word training is whether the training words should be very similar to one another. Halverson (unpublished), using two elementary students as subjects, investigated the effects of training maximally versus minimally different sight words. In Part I of the study, 30 irregular words
were selected from a pretest and were divided into 6 maximally different subsets of 5 words each. Words were considered maximally different if each initial, middle, and final letter cluster was different. Five words were taught at one time, and training sessions were terminated when the subject read all five words correctly in a row, or 15 minutes had passed. In Part II, 30 words were selected from the pretest and were divided into 6 minimally different subsets. Words were considered minimally different if the initial, middle, and final letter clusters were similar to at least one other member of the subset. Both conditions resulted in an increase in acquisition and retention of the words trained, 85-100% word mastery. A major flaw in this study, however, was that words known on the pretest were included in the study; thus making the data difficult to interpret.

Another independent variable that has been studied in the sight word literature is the delivery of tokens contingent upon correct responses. The effect of this variable on the acquisition and retention of sight words was studied by Lahey and Drabman (1974). Acquisition was more rapid in the token group, but retention was only slightly better than in the no-token group. Neither interspersal of known items nor cumulative review of words learned were included in the procedures.

In addition to delivering reinforcement contingent upon correct responding, it seems important that a mastery criterion be used to determine whether additional training should be given on particular sight words. Among others, Kibby (1979) investigated this variable through comparison of three instructional conditions to teach sight
words to first grade students. The conditions consisted of (1) correction (reinforced correct responding and corrected incorrect responses), (2) criterion learning (continued practice on words not mastered in the allotted time), and (3) regular (no correction or added trials). The results revealed that no difference existed between the first two conditions in terms of number of words learned or retained, but that acquisition was most rapid for the correction group. Kibby concluded that additional trials to criterion were not beneficial to the acquisition or retention of sight words. This conclusion would be much more strongly supported if there had been a correction only group and correction plus added trials group. It seems imperative that errors be systematically corrected in any training program in addition to providing further practice on more difficult words.

In keeping with basic literature on errorless learning of discrimination tasks (Stoddard & Sidman, 1967; Terrace, 1963a; Touchette, 1968), McDowell, Nunn, and McCutcheon (1969) compared a stimulus-fading procedure to teach sight words with the look-say method. One group of subjects was taught 20 words from a story using echoic, intraverbal, textual, and pictorial supplementary stimuli to "overdetermine" correct responding. These supplementary stimuli were gradually faded until only the textual stimuli remained. A second group was taught the same 20 words by the look-say method. The subjects learned the list of 20 in the same order as did Group 1. All errors were corrected and subjects received preliminary echoic training. In echoic training, subjects were presented with a series
of pictures that illustrated the story. The pictures were presented in correspondence to a tape-recording of the story. Subjects were required to echo a sentence immediately after each picture was presented; no textual stimuli were shown. A third group, which received echoic training but no reading instruction, served as the control group. Retention was good for both experimental groups, but the stimulus-fading group made significantly fewer errors than the look-say group during training. The authors considered this to be an advantage for the stimulus-fading group as the subjects had a lessened opportunity to practice incorrect responses, and thus develop error patterns. Corey and Shamow (1972) also studied the effects of stimulus-fading on the acquisition and retention of sight words. They found that fading resulted in improved reading, while requiring the subjects to made overt observing responses (pointing—Skinner, 1968) had no effect on performance.

In addition to research on sight words, a number of authors have written about and a number of studies have been conducted to investigate the essential components of discrimination training in general. The following components will be discussed: (1) cumulative versus simultaneous introduction of items; (2) introduction of minimally versus maximally different stimuli in the beginning of training; (3) evoking the first instance of the behavior; (4) interspersal of known items; and (5) cumulative review of trained items.

Carnine (1978) studied the effects of simultaneous versus cumulative introduction of addition facts to preschool students. Six facts were taught under each condition. For the cumulative introduction
group, a new fact was introduced when the subject had mastered previously trained facts. For the simultaneous group, all six facts were introduced at once. The cumulative introduction group required significantly fewer trials to meet criterion than the simultaneous introduction group. These results suggest that it is better to introduce items a few at a time and that new items should be added only when previously introduced items have been mastered. The present study followed this suggestion.

The question of whether minimally or maximally different stimuli should be used in the initial portion of a teaching sequence has been addressed by several researchers (Corey & Shamow, 1972; Engelmann & Carnine, unpublished; Halverson, unpublished; McDowell, et al., 1969; Stoddard & Sidman, 1967; Terrace, 1963a; Touchette, 1968; Williams, Granzin, Engelmann, & Becker, 1979). Engelmann and Carnine (unpublished) are the only authors who advocate showing minimum differences in initial training of discriminations. They argue that the learner is given much more information about what feature(s) is (are) the basis for a correct response when minimum differences are shown, than if maximum differences are shown in the initial part of a teaching sequence. In a study in which college students were taught to "hear" through tactual stimuli, Williams, et al. (1979) found that presenting minimally different stimuli resulted in better performance than maximally different stimuli when a low criterion of performance was used. When a high criterion of performance was used, the maximally different stimuli yielded better results; although the minimally different, low criterion group had the best performance overall.
They suggest that when dealing with very naive learners, it is best to use maximally different stimuli in initial teaching because such learners: (1) lack an extensive history in making fine discriminations, (2) have trouble "remembering" these features, and (3) have no framework for organizing these features. In the present study maximally different word pairs were taught because of the difficulty involved in selecting minimally different words and because this was not the dependent variable of interest.

A third special problem arises in discrimination training when shaping the response of interest is either impractical or impossible. In such cases, Skinner (1968) recommends using a prime to evoke the first instance of the behavior so that it can be reinforced. When working with vocal behavior, an echoic prime is used (a type of product duplication). Several studies have used echoic primes to evoke the first instance of a behavior (Halverson, unpublished; McDowell, 1969; Monteiro, unpublished). These studies did not evaluate echoic primes as an independent variable, but used them as a component in a complex procedure.

A fourth component of discrimination training is the question of whether known tasks should be interspersed with training tasks. Studies have used a known item interspersed without isolating it as an independent variable to teach imitative behavior (Brigham & Sherman, 1968; Lovaas, Berberich, Perloff, & Schaeffer, 1966; Peterson, 1968; Schumaker & Sherman, 1970), picture-naming (Kircher, Pear, & Martin, 1971), and language (Carr, Binkoff, Kologinsky, & Eddy, 1978; Frisch, Schumaker, 1974). Studies that have isolated interspersal as an
independent variable have not provided a component analysis (Monteiro, unpublished; Neef, et al., 1977; Neef, Iwata, & Page, 1980).

Neef, et al. (1980) compared interspersal training with high density reinforcement in teaching spelling to three mentally retarded adults. This study provided a more thorough investigation of the two procedures than the Neef, et al. (1977) study. A major difference between the interspersal procedure used in this study and the previous one was that words trained during the study were cumulatively reviewed, thus improving retention. In addition, a more stringent mastery criterion was used (a correct response for five consecutive sessions rather than three). The experiment did not, however, parcel out the features responsible for the improved performance under the interspersal condition. The authors speculated that (1) the inclusion of the interspersal items may have made the subjects more likely to attend to critical features of the words, and/or (2) the emotional responses brought about by making more consecutive errors under the high density reinforcement condition interfered with attending behavior to critical features.

The interspersal of known items has been described in a theoretical paper by Engelmann (1977). He refers to it as a "memory sequence". He states that we must "turn the learner on" to reinforcement. This means that we should arrange the learning situation such that the learner will respond correctly at least 70% of the time (which is between a variable ratio of two and a continuous schedule of reinforcement). The memory sequence can help the teacher achieve this high level of reinforcement by presenting a newly trained task in
alternation with increasingly more familiar tasks. He specifies four levels of "memory" difficulty. The sequence is given below. The letter "A" stands for the new item and the letters "B, C, D" represent known items. The letters "b, c, d, e, f" in level 4 represent types of responses other than the type being trained.

<table>
<thead>
<tr>
<th>Level</th>
<th>Sequence</th>
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<tbody>
<tr>
<td>1</td>
<td>A----(pause)----A</td>
</tr>
<tr>
<td>2</td>
<td>A----B--------A</td>
</tr>
<tr>
<td>3</td>
<td>A----B----C----D----A</td>
</tr>
<tr>
<td>4</td>
<td>b--c--d--e--f--A</td>
</tr>
</tbody>
</table>

Thus, by gradually interspersing more and more familiar tasks between presentations of the new task, the learner is trained to "remember" the new tasks. Carnine and Silbert (1979) recommend this procedure in teaching sight words.

Level 4 of the memory sequence represents the cumulative review of recently trained items (the fifth component of discrimination training). The student leaves the training session and after a time lapse in which many other behaviors are evoked, the student is asked to "recall" the item. Alessi (unpublished) has stressed the importance of cumulative review in skill retention. No research has been conducted to isolate whether interspersal is beneficial due to cumulative review or discrimination of critical features, or both. The present study was designed to investigate these components.

This study is a systematic replication of the Monteiro (unpublished) study. Two conditions were compared: An interspersal only condition and an interspersal with cumulative review condition (which will be referred to in this paper as the cumulative review condition). These
conditions were identical to the "errorless" condition in the Monteiro (unpublished) study except that for the interspersal only condition, all interspersal words were selected from the pretest. The independent variable was the method for choosing the interspersal words (from pretest versus cumulative review of newly trained words). The dependent variables assessed were the rate of acquisition, the absolute number of words mastered, and short- and long-term retention of words. A multi-element design (Uhlman & Sulzer-Azaroff, 1975) within a modified multiple-probe design (Horner & Baer, 1978) was used to compare the two conditions.
METHOD

Subjects

Three male 7-year-old students, enrolled for a 5½ week semester in Project Help (a tutoring program affiliated with Western Michigan University), participated in this study. Two subjects (Andy and Johnny) were receiving reading instruction in the beginning (Lessons 1-20) of the Distar Reading II Fast Cycle Program (Engelmann & Bruner, 1975) and one subject (Larry) was being tutored in the latter half (Lessons 38-51) of the Decoding A Program (Engelmann, Carnine, & Johnson, 1978) of the Corrective Reading Series. Both programs are phonics-based. Andy and Johnny were tutored together in a small group (five children with one tutor), and Larry was receiving individual instruction.

Enrolled subjects were selected on the basis of their performance on a pretest. Out of the 110 words on the pretest, they read an average of 38 words (range: 31-44). All were in their eighth month of the first grade in the public school system and had the Houghton-Mifflin program as their basal reading series (a meaning-emphasis program). They were referred by school personnel to Project Help for work on reading. All subjects had been given the Woodcock Reading Mastery Test prior to their enrollment in the program. On the Word Identification subtest, Larry and Andy received scores in the mid-first grade range (1.6 and 1.5, respectively). Johnny did not meet the basal level (5 times correct) necessary to get a meaningful grade score.
Prior to the start of this study, the parents signed informed consent forms and the research was approved by a departmental and a university Human Subjects Committee. A copy of this form is included in Appendix A of this report.

Setting

Sessions were conducted twice daily in two university classrooms in which the subjects were tutored from 4:00-6:00 p.m., four days a week. The subjects received points at Project Help for "working hard" and were able to exchange their points for items in the program's "store" (sugarless gum and mints, small toys, etc.). For the first four of the five-and-one-half weeks of the study, the subjects were attending public school.

Because Johnny and Andy were likely to be distracted by the other three children in their group, the experimenter placed a portable blackboard between them and the other children to block their view. Also, they were seated with their backs to the group. Two groups of children were working concurrently in each room. The noise level in each room was moderate (the typical level of their regular classroom in school). The subjects rarely were distracted by others in the room. Pica-typed words were presented on 3" x 5" cards; a wristwatch was used to time the sessions.
Procedure

Pretest

The 110 words on the pretest were sorted into stacks of 10 words each, all of which differed in their initial letter. The experimenter ran through each stack, one word at a time, asking the subject, "What word?". Each response was recorded as correct, incorrect, or no response. The subjects were praised for "working hard", but no differential consequence was delivered for correct versus incorrect responding. They were not told what the word was, nor were they told "correct" when they correctly identified a word. Each stack was recycled through three times. If the subject answered correctly on all three trials or on each of the last two, the word was considered known. All other words were considered unknown and were candidates for training if all three subjects did not know them. This was done so as to control for the possibility that one word would be more "difficult" than another. No more than three stacks (30 words) were presented during a session. Since sessions were conducted twice daily, a maximum of 60 words was presented each day. The pretest required two days to complete.

The 110 word pretest was derived from a paper by Alessi (unpublished) which integrated the Dolch, Johnson, and Hauserman irregular word lists. This list contains 335 of the most common irregular words that occur in basal reading series for grades 1-3.

Interspersal Only condition

One session per day was conducted and approximately one-half of the words were taught under this condition. The first session began
with the recording of the time started and a preview word probe in which the words to be trained that session were presented alternately three times each to insure that the subject had not learned the words since the pretest. A word was considered known if it met the same criterion as in the pretest. A preview sentence probe was also conducted. These were short sentences (three to five words) made up of words the subject knew on the pretest and the words being probed. They contained unpredictable syntax so that it would be impossible for the subject to guess the word from context. There was one sentence for each probe word and only one probe word was included in each. No prompts or corrections were made on any probe.

Two new words were taught at one time. These were referred to as word "sets". These sets were made up of words that were as different as possible. They began with different letters and the letter clusters did not resemble each other. Training on a word set began with the experimenter placing one word card on the table, providing an echoic prime, and then asking the subject to echo the response (i.e., "My turn. What word? '_____'. Your turn. What word? '_____'."). Care was taken during all steps in training to insure that the subject was looking at the words when asked to respond. The word was removed for three seconds, replaced, and the subjects was again asked, "What word?". Second, the other member of the word set was placed next to the first card and the sequence was repeated. In the third step, both cards were removed for three seconds and replaced (in the same order). The experimenter again provided an echoic prime for one word at a time and asked the subject
to read it immediately after each prime. Fourth, the cards were again removed for three seconds and replaced in the opposite order, whereupon the subject was asked to identify each word. If an error occurred, the experimenter told the subject the correct word, asked him to repeat it, and returned to Step 1. Fifth, the cards were presented randomly until the subject responded correctly for five consecutive trials (a trial consisted of a presentation of both words). The intertrial interval was three seconds. Errors were corrected during this and subsequent steps by the experimenter saying the correct word and asking the subject to repeat it. Responses were recorded throughout training as correct, incorrect, or no response. The subject had to respond within five seconds in order for a response to be scored as correct. Self-correcting was not considered to be an error. Subjects were reinforced for "working hard" and almost all responses were confirmed [i.e., "Yes, ____" (correct word)].

In Step 6, the interspersal of known words was begun. For each subject, the experimenter had a stack of cards which contained words the subject knew on the pretest. Word cards were chosen randomly from the subject's known stack one at a time. Step 6 was conducted exactly like Step 5 except for (1) a trial now consisted of three words (the words being trained and the known word) and (2) only five trials were presented regardless of the number of errors made. If an error was made on a "known" word, the subject was corrected as in Step 3 above. Steps 7 and 8 were conducted in the same manner as Step 6, with the inclusion of one more word from the subject's known stack (thus a trial in Steps 7 and 8 included 4 and 5 words, respectively). The experimenter recorded the time the session stopped after Step 8 was completed.
After the session was complete, the subject was given 10 points for working on the words (which was the amount the children normally received for that much work in their regular sessions) and was returned to his group. The points were given noncontingently on performance.

On the second day of the study (and on every day thereafter), the subjects were given retention probes to determine whether or not they had learned the word set taught on the previous day(s). These probes were conducted in the same manner as the preview probes (the word cards were alternated until the subject had responded to each three times). A word set was considered learned if the subject correctly identified both words in that set (that is, the subject responded correctly to each word on all three attempts or on the last two attempts). If, on the other hand, the subject had learned only one word, then that word set was not considered known and the subject was given a score of one on the retention probe. Thus, a score of two (the subject identified both words in the set), one or zero (the subject did not identify either word in the set) words was possible for each word set probed. Sentence retention probes were also conducted, but were not used to determine whether the word sets had been learned; they were included to test for generalization. The sentences were changed daily to control for practice effects. If the subject "passed" the word retention probe, training was not conducted on that word set for that day and new words were immediately probed until two still unknown words were arrived at (in a few instance, a subject had "learned" a word he had not known on the pretest). Each word set trained was probed until
the subject met the mastery criterion of correctly identifying both words in that word set on the word retention probes for three consecutive sessions. If the subject failed on more than one word set on the retention probes, the word set that had been taught first was retrained (as many as three previously trained word sets were probed during a given session). For example, if the subject met criterion on word set #1 during session #3, a new word set was trained (#2) that day. If during session #3, he did not meet criterion on either sets #1 or #2, then word set #1 was retrained in that session. If a subject knew both words of every word set on every probe, a new word set would have been taught during every session. A given word set was trained for a maximum of four sessions and was dropped from the study if the subject did not meet the mastery criterion given this stipulation.

**Cumulative Review condition**

As with the interspersal only condition, one session per day was conducted and approximately one-half of the words were taught under this condition. The sessions were conducted in the same manner as the interspersal only condition except for the way in which the interspersal words were selected. When the first word set of this condition was trained, the two words that comprised the first word set and one word taken from the pretest were used for interspersal. It was not until the third set was trained that all of the interspersal words were words that had been learned during the study. A record was kept as to when each word had been trained and when it had been
reviewed. As more word sets were trained, each of the three review (interspersal) words for each session was selected if (1) that word had not been reviewed in a while, (2) it had been difficult for that subject, and/or (3) it had been recently trained. The maximum number of sessions that occurred between reviews for a given word was six.

Final Day and Retention probes

In addition to the daily word and sentence retention probes, an overall retention probe was conducted on the last day of the study. In addition, follow-up retention probes were administered to measure long-term retention of words mastered during the study. These were conducted after 5 weeks and 14 weeks had elapsed since the cessation of the study. All retention probes were given in the same manner as the pretest.

Experimental Design

The design of the experiment was a multi-element design (Uhlman & Sulzer-Azaroff, 1975) with a modified multiple probe design (Horner & Baer, 1978). The multi-element component was used to compare the interspersal only and the cumulative review conditions. Different word sets were taught under each condition. As previously stated, both conditions were presented daily, but in random order. Two daily sessions were conducted 4 days each week for 5½ weeks (with a range of 16-18 sessions). Word sets comprised of two words were probed and trained under each condition.
The multiple probe component was included to demonstrate that non-study learning did not account for the improvement in performance that was attained. This was accomplished by probing each word set once just before training was begun on that set.

**Data Collection and Reliability**

**Dependent measures**

The dependent variables recorded for each subject were (a) number of training sessions necessary to reach the mastery criterion for each word set, (b) rate of words introduced and mastered each day throughout the study, (c) number correct on each word retention probe, (d) number and percent correct on each of the final retention probes, and (e) number correct on sentence retention probes. These variables were evaluated with the following data that were collected: (a) data from the daily training sessions, (b) daily word and sentence retention probes, and (c) final retention probes.

**Independent measures**

The independent variable was the type of procedure (cumulative review versus interspersal of known words) used to select words to intersperse with the training words as described in the previous sections. Reliability data were recorded on the degree to which the experimenter ran the procedure as stated. The data form used to record this information is included in Appendix B.
Reliability

On a minimum of 22% of the sessions per condition, word-by-word reliability data were taken on each subject on all aspects of the session. Reliability samples were distributed throughout the sessions. Reliability was calculated by adding the number of agreements and dividing by the number of agreements plus the number of disagreements, multiplied by 100. The following formula was used.

\[
\text{Percent Reliability} = \frac{\text{Agreements}}{\text{Agreements} + \text{Disagreements}} \times 100
\]
RESULTS

Reliability

Reliability data were taken on 23% of all sessions for all subjects (12 sessions of each condition). Mean reliability was 99% for the interspersal only condition (range 88-100%), and 100% for the cumulative review condition. Reliability was taken on each subject during 10 sessions staggered throughout the study. On the final day retention prove, the mean reliability score was 99% (range 98-100%) on all subjects.

Training Sessions

Figure 1 presents the mean number of training sessions conducted to meet the mastery criterion of three consecutive proves with both words correct on word retention proves for each subject under each condition. Andy took an average of 2.8 and 2.3 training sessions to meet criterion with the interspersal only condition and the cumulative review condition, respectively (18% less time). It took Johnny an average of 3.0 and 2.2 sessions (27% less time) to meet criterion, while Larry required an average of 3.3 and 1.75 sessions (47% less time). Thus, for all subjects, fewer training sessions were required per word set with the cumulative review condition than with the interspersal only condition.
Number of Word Sets Introduced and Mastered

The number of word sets introduced, mastered, and dropped under each condition for each subject is presented in Figure 2. For all subjects more word sets were introduced and mastered under the cumulative review condition than under the interspersal only condition. There was no difference between the two conditions in number of word sets dropped (a word set was dropped from the study if more than four training sessions would have been required to meet the mastery criterion).

Rate of Words Introduced and Mastered

For both conditions, the daily rate of words introduced and mastered was compared. The data in Table 1 show that for each subject the cumulative review condition was superior on these two variables. The percent difference in the rate of words introduced was similar across all subjects (range 25-38%). The percent difference in rate of words mastered, however, was more variable across subjects (range 18-51%).

Performance on Daily Word Retention Probes

Number correct on the daily word retention probes under each condition for each subject is shown in Figures 3–5. Each pair of axes from the top to the bottom of each figure includes word sets taught under each condition as they were introduced throughout the study. The legend at the right of each axis indicates which word
TABLE 1

Daily Rate of Words Introduced and Mastered

| Subjects | Words Introduced per Day | | | | | Words Mastered per Day | | | |
|----------|--------------------------|------------------|------------------|--------------------------|------------------|------------------|------------------|------------------|
| Andy     | 0.67         | 0.89         | +25%             | 0.55         | 0.67         | +18%             |
| Johnny   | 0.62         | 1.00         | +38%             | 0.37         | 0.75         | +51%             |
| Larry    | 0.55         | 0.89         | +38%             | 0.33         | 0.44         | +25%             |
sets were taught under each condition. Circles represent the cumulative review condition and triangles represent the interspersal only condition probe results. Closed data points indicate that training did not occur during that session for that word set. All data points indicate the number correct on the word retention probes for each word set except for the first point for each condition on the axis. These data points indicate the number correct on the preview probe for each word set trained. Of all words preview probed throughout the study, Andy never knew any words he had not known on the pretest, while Johnny and Larry knew 12% (4 out of 31 words probed). These data indicate that few words were being learned outside of the study. Any changes in performance can be attributed to the procedure and not to non-study learning. A score of zero (the subject did not identify either word in the set), one (the subject identified one of the two words in the set), or two (the subject identified both words in the set) was possible on a given word retention probe.

Figure 3 shows Andy's daily progress. On the first day of the study, a cumulative review session was conducted first (between 4:00 and 5:00 p.m.). At the beginning of the session, a preview probe was given to insure that the two words to be trained that day had not been learned since the pretest. Andy knew neither word (see the first circle on the first pair of axes) and, therefore, these words were training ("those" and "many"). Between 5:00 and 6:00 p.m. on that day, an interspersal only session was conducted. The probed words were "new" and "again"; as Andy did not correctly identify either of them, training was conducted on these two words (see the first triangle on the first pair of axes).
ANDY

- CUMULATIVE REVIEW, TRAINING
- CUMULATIVE REVIEW, NO TRAINING
- INTERSPERSAL ONLY, TRAINING
- INTERSPERSAL ONLY, NO TRAINING

○ ◆ THOSE, MANY
△ NEW, AGAIN

○ ◆ DIDN'T, CAME
△ TAKE, ONLY

○ ◆ OUR, MADE
△ KIND, WHO

○ ◆ SAW, LIKE
△ DOES, TELL

○ ◆ HER, FIND
△ USE, KNOW

○ ◆ MUCH, FAR
△ EVERY, ANY

○ ◆ NEVER, OVER
△ N.A.

○ ◆ SMALL, TOO
△ N.A.
On the second day of the study, an interspersal only session was conducted first. Andy correctly identified the word "again" but, did not know the word "new". Because he could not identify both words in the set, that set was retrained during Session 2 (see the second triangle on the first pair of axes). During the cumulative review session (conducted between 5:00 and 6:00 on that day), he did not know either word on the retention probe for "those" and "many"; consequently, retraining was conducted on this word set (see the second circle on the first pair of axes).

On the third day, the first session conducted was again under the interspersal only condition. Andy knew both words on the retention probe for the first set (see the third triangle on the first pair of axes), making it possible to preview probe and train a new word set. This set included "take" and "only" (see the first triangle on the second pair of axes). The second session conducted that day was under the cumulative review condition. Andy knew both words on the retention probe for "those" and "many" (see the third circle on the first pair of axes); therefore, a new set was preview probed and trained ("didn't" and "came"; see the first circle on the second pair of axes).

On Day 4, Andy again knew both words of the first set (see the fourth circle on the first pair of axes). He could only identify "didn't" of the second set of that condition and, thus, this set was retrained (see the second circle on the second pair of axes). During the second session on Day 4 (an interspersal only condition), Andy knew both words on the first set (see the fourth triangle on the
first pair of axes), but did not know either word in the second set and, thus, this set was trained (see the second triangle on the second pair of axes).

On Day 5, the first session was conducted under the cumulative review condition. Andy knew both words of the first set (see the fifth circle on the second pair of axes) and of the second set (see the third circle on the second pair of axes), thus making it possible to preview probe and train on a third set: "our" and "made" (see the first circle on the third pair of axes). During the second session on that day (an interspersal only session), Andy knew both words in the first set (see the fifth triangle on the first pair of axes), but only knew "take" in the second set (see the third triangle on the second pair of axes). Retraining was therefore conducted for the third time on "take" and "only". After Day 5, it was no longer necessary to probe on the first set of each condition because the mastery criterion of three consecutive days of knowing both words in a set was met for each. By following the figures in the preceding manner, one can determine exactly which word sets were probed and trained on a given day for each condition and what the results of the daily word retention probes were.

Figure 3 shows that the data for the two conditions begin to separate with the introduction of the third word set for each condition. This is exactly the point at which all three of the interspersal words in the cumulative review condition included only words trained during the study (when the second word set was trained, it was still necessary to draw one word from the words known on the
pretest). Andy was trained on eight sets under this condition. As can be seen from Figure 3, the rate of acquisition for the cumulative review condition was faster than for the interspersal only condition. Andy met the mastery criterion on all word sets introduced and trained with the exception of the last few sets for which time ran out at the end of the Project Help semester, and thus for the study. In every case, once Andy could identify both words on a given retention probe, his performance maintained at that level until mastery criterion was met. The number of opportunities to drop from this level was 10 under the interspersal only condition and 12 under the cumulative review condition.

Figure 4 shows Johnny's daily progress. For Johnny, the separation of the data points between the two conditions occurs with the first word set. At this point, the two conditions were identical (both drew words from the pretest for interspersal). Johnny had trouble with the word "again" in the first set of the interspersal only condition, and had equal difficulty with both words of the second set of that condition. One word set was dropped from the study for Johnny (the second one of the interspersal only condition). He also had trouble with the word "our" (he often called it "or") in the third set of the cumulative review condition. This difficulty accounted for two cases in which he only knew one word in the set. Once Johnny could identify both words on a given word retention probe, his performance maintained at that level until the mastery criterion was met, except in one case under each condition (see Session 9 on the second pair of axes and Session 8 on the third pair...
of axes). The number of opportunities to drop from this level was 7 under the interspersal only condition and 13 under the cumulative review condition. As was the case for Andy, acquisition for the cumulative review condition was more rapid than for the interspersal only condition. Johnny was trained on eight sets under the cumulative review condition and on five sets under the interspersal only condition. He was absent from Project Help between Sessions 12 and 13, and between Sessions 13 and 14. These absences do not appear to have affected his performance on the subsequent probes.

Larry's retention probe data are shown in Figure 5. The separation of the data points between the two conditions appears most clearly with the third word set of each condition. Thus, the data are more similar to those in Figure 3 (Andy's) than to the data in Figure 4 (Johnny's). Larry had trouble with the word "new" in the first set trained under the interspersal only condition (he often called it "now"). Whenever he missed one word in this set, it was "new". Because of this difficulty, training on the second set of that condition had to be postponed (see the fifth and sixth data points for that set). If these two points are ignored, the rate of acquisition for this set would appear very similar to the second set of the cumulative review condition.

Three sets were dropped from the study for Larry. They were: the first set of the interspersal only condition and the fifth and sixth sets of the cumulative review condition. As with the first set of the interspersal only condition, Larry often had trouble with one particular word of the other sets that were dropped (he often called
"far" "fair" and "small" "some-all"). He also had trouble with "kind" of the third set of the interspersal only condition and with "does" of the fourth set of that condition. Once Larry could identify both words on a given retention probe, his performance maintained at that level until the mastery criterion was met except in two cases. Both of these were under the interspersal only condition (see Session 5 on the first pair of axes and Session 13 on the third pair of axes). The number of opportunities to drop from this level was eight under each condition. As was true with the other two subjects, the rate of acquisition was more rapid under the cumulative review condition than under the interspersal only condition. Larry was trained on eight sets under the cumulative condition and on five sets under the interspersal only condition.

**Final Day Probes and Retention Probes**

Tables 2 and 3 show the results of the final day and retention probes. The data in Table 2 exclude words that were dropped from the study, but include words for which the mastery criterion was not met due to the lack of time. Also included are words that met the mastery criterion.

The number of words known on each probe and the number trained (introduced) are shown in Table 2, along with the percent correct on each probe for each condition. For every subject on each probe, the percent correct and the absolute number of words known for the cumulative review condition is greater than for the interspersal only condition. Johnny's and Larry's data on each probe are highly similar.
<table>
<thead>
<tr>
<th>Subjects</th>
<th>Final Day Probe</th>
<th>5-Week Retention Probe</th>
<th>14-Week Retention Probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andy</td>
<td># Introduced</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td># Known</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>% Known</td>
<td>58</td>
<td>100</td>
</tr>
<tr>
<td>Johnny</td>
<td># Introduced</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td># Known</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>% Known</td>
<td>88</td>
<td>94</td>
</tr>
<tr>
<td>Larry</td>
<td># Introduced</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td># Known</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>% Known</td>
<td>75</td>
<td>83</td>
</tr>
</tbody>
</table>

Data excludes words dropped from the study, but includes words for which the mastery criterion was not met due to lack of time and word that met the mastery criterion.
### TABLE 3

Number Introduced, Number and Percent Known on Final Day and Retention Probes

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Final Day Probe</th>
<th>5-Week Retention Probe</th>
<th>14-Week Retention Probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Introduced</td>
<td>10</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td># Known</td>
<td>6</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>% Known</td>
<td>60</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>Johnny</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Introduced</td>
<td>6</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td># Known</td>
<td>6</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>% Known</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Larry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Introduced</td>
<td>6</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td># Known</td>
<td>6</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>% Known</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

^Data include only those words that met the mastery criterion (correctly identified both words in a set for three consecutive sessions on word retention probes). Data exclude words dropped from the study and words for which the mastery criterion was not met due to lack of time.
in percent correct. Johnny was generally the highest performer of the three subjects. Andy's 5-week and 14-week results were considerably lower than the other two subjects' results.

Table 3 displays the final day and retention probe data in the same manner as Table 2. In this table, however, the data only include those words for which the mastery criterion was met. The data exclude words dropped from the study and words for which the mastery criterion was not met due to the lack of time. In every comparison, the absolute number of words known was greater in the cumulative review condition than in the interspersal only condition. Cumulative review was greater in percent correct than interspersal only in four out of nine cases. In four comparisons (the final day and 5-week probes for Johnny and Larry), the percent correct was identical between the two conditions. In one case (Larry's 14-week probe results), the percent correct for the interspersal only condition was greater than for the cumulative review condition.

The data also show that when the mastery criterion on words trained was met, two of the subjects generally knew all of these words on each probe. Andy's data were discrepant in this respect, except for the cumulative review final day probe.

Retention Sentence Probes

Of the 304 sentence retention probes conducted throughout the study, the results of the word retention and sentence probes were in agreement in 291 cases, or 96% of the time.
In four comparisons (the final day and 5-week probes for Johnny and Larry), the percent correct was identical between the two conditions. In one case (Larry's 14-week probe results), the percent correct for the interspersal only condition was greater than for the cumulative review condition.

The data also show that when the mastery criterion on words trained was met, two of the subjects generally knew all of these words on each probe. Andy's data were discrepant in this respect, except for the cumulative review final day probe.

**Retention Sentence Probes**

Of the 304 sentence retention probes conducted throughout the study, the results of the word retention and sentence probes were in agreement in 291 cases or 96% of the time.
DISCUSSION

This study was designed to determine whether cumulative review of recently trained items in an interspersal procedure facilitates acquisition and retention of sight words. The results showed that, for all subjects, cumulative review of sight words led to more rapid acquisition than interspersal only (a range of 18-51% more words were mastered per day under the cumulative review condition than under the interspersal only condition). In terms of short- and long-term retention, however, the two conditions appear to be identical in percent of words retained; although, the absolute number of words recalled was generally superior under the cumulative review condition. For two of the three subjects, there was little or no decrement in percent of words recalled on the 5- and 14-week retention probes for both conditions. For one subject, the decrease in percentage of words recalled was approximately the same under both conditions. The percentage of words known on each retention probe under both conditions in this study was higher than that reported by Monteiro (unpublished). This was probably due to the fact that almost all responses in this study were confirmed, which provided further pairing of the auditory stimulus with the written stimulus. It is believed that doing so made the reading response even stronger in the subject's repertoire.

It may be that, under the review condition, the subjects attended more closely to the letters in each word because the interspersal words were relatively new to them, thus making acquisition more rapid. Under the interspersal only condition, they may have been able to identify words just by looking at a few of the letters and/or the size of the
words. None of the subjects knew very many words at the beginning of the study and, thus, it was possible for them to look at only one, or a few, features of the words and still be able to identify them. This is often seen with beginning readers. They frequently look at the first letter of a word and say a word they know. An alternative explanation for superiority of the cumulative review condition is that the additional number of trials provided in training words may have made it "easier" to learn new words. It would be interesting to see the results of a longer intervention program. At some point, the subjects may begin to confuse the words as a much greater chance of training words being similar to some other words being trained exists with a larger set.

An aspect of the results that was unexpected consisted of the within study retention appearing to be similar between conditions. It seems logical that if a word set was not reviewed from day to day, performance would be like to continuously decline. This was not the case however. Once the subjects were able to identify both words in a particular set, they generally continued at this level of performance until the mastery criterion of three consecutive sessions with both words correctly identified was met. This was not found to be the case in the study by Monteiro (unpublished).

Another consistency in the results was the fact that when subjects had trouble with a word set, the difficulty was generally due to one particular word in that set (the subject would frequently misidentify one of the words). Also, when the subjects misidentified one of the training words, the response made was generally very close to the correct answer. For example, Larry would call "far" "fair" and "new" "now."
This fact suggests that choosing minimally different words to train and/or intersperse may alleviate the problem. If the words are very similar in size and have many letters in common, then the child would have to carefully inspect the individual letters in each word to respond correctly. A problem may arise, however, in that the child may make more errors in the beginning of training. These errors may be undesirable because the child would be practicing incorrect responses. This question of whether minimally or maximally different stimuli should be used in initial teaching of a discrimination task warrants further research.

Williams, et al. (1979) have suggested that the decision as to whether minimally or maximally different stimuli should be used may depend on the sophistication of the learner. An advanced learner is one who has a long history of making fine discriminations and is able to "remember" these discriminations. The errorless learning studies in which fading from maximally versus minimally different stimuli were compared have used preschool children, pigeons, and mentally retarded adults as subjects (Stoddard & Sidman, 1967; Terrace, 1963a; Touchette, 1968). Thus, there is a need to conduct research in this area with more advanced learners. This question could be answered for different age groups of children by replicating the cumulative review procedure of this study and teaching one group of words with all training and interspersal words minimally different and one group of words with all training and interspersal words maximally different.

Another question that should be addressed is whether there is a minimum number of items which should be interspersed to achieve good
performance. Could the same results be obtained with only two interspersal words or would four words be better? Also, should the interspersal words be successively or simultaneously added to the training words? Intuitively, one would think that the successive approach would be better, because it builds the child's "memory" of the word.

This procedure seemed to be very effective for teaching irregular words to beginning readers (at a rate of about one every two days). Training is brief (about nine minutes per session) and can be easily conducted by teachers while other students are doing seat work, by classroom paraprofessionals, or peer tutors. Also, by having students develop word "banks" (Alessi, unpublished), the reinforcing value of the sessions can be increased. The interspersal of known items seems critical to short- and long-term retention and cumulative review seems critical to rapid acquisition of words. The question of whether the children are able to identify the words in other contexts (sentences) was answered definitively and positively in this study (there was a 96% agreement between isolated word and word-in-sentence probes). For those children who are receiving instruction in a reading series that presents many irregular words, the interspersal with cumulative review procedure would be maximally beneficial if training words were selected from stories in the reader they are currently using.

One final issue that should be addressed by future research in the area of sight word training is the question of how often irregular words should be introduced so as not to disrupt progress in a phonics program such as the Decoding A program of The Corrective Reading Series (Engelmann, et al., 1978). Carnine and Silbert (1979) have argued that
if irregular words are introduced too soon, the children may be led to believe that their strategy for attacking words does not work very often and consequently may resort to a guessing strategy.
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APPENDIX A

Informed Consent Form
Dear ____________________

is enrolled in the Project Help reading program for the Spring session 1980. ____________ is in the Decoding A program of the Corrective Reading Series.

The A program teaches a good background in phonics to improve your child's reading ability. However, only a limited number of words which do not follow the phonics rules are taught. To improve the Project Help reading program, I have developed two procedures to systematically teach such words to the children in the A program. Each procedure requires 10 minutes of instruction time each day your child attends Project Help this session. One of the procedures intersperses words your child already knew in the training words. The other procedure is one which is designed to help your child learn new words while reviewed recently learned words. The procedure which best teaches the words will be used again at Project Help in future semesters.

I would like permission to teach your child extra words this semester with these two methods. The number of words taught will be adjusted to fit your child's learning progress. The words have been selected since they are frequently found in the classroom reading books for grades 1-3. I will teach the words as part of the daily lesson and keep daily records regarding how long it took to teach each new word. These records will be kept on my desk. If you wish to see these records or observe a session at any given time, you are welcome to do so.

A weekly report will be sent to you listing the words you child learned during the week. At the conclusion of the Spring term, a final report will be sent to your, summarizing the progress made in this part of the program. If you wish to withdraw your child from this part of the program at any time, you may do so by contacting me.

This project was developed with the help of two psychologists: Drs. Marilyn Monteiro and Galen Alessi. As the person responsible for the project, I am the Program Director of Project Help. I hold a bachelor's degree in psychology. This project is part of my degree requirement for a master's degree in psychology. The results of this project will be written in a report form, and all participants will remain anonymous. At no time will your child's name or any other identifying information be associated with the project. If you would like a copy of my final report, I will be happy to furnish you with a copy.

Sincerely,
I have read the attached description and agree to have my child participate in the extra word reading program. It is my understanding that I will receive weekly reports regarding the words taught, as well as a final report. I may withdraw my child from this part of the program at any time I so wish.

Signature ___________________________ Date ____________
APPENDIX B

Session Checklist for Each Condition
Session Checklist

Checklist completed by: ____________________________
Date: __________________ Condition: __________________
Subject: __________________

1. E presents words for retention probe (one word at a time; no corrections or prompts provided; 5 sec for each word; 3 trials for each word)

2. E presents sentence retention probes (points to each word; corrects errors on non-sight words; provides no corrections or prompts for sight words; 5 sec for each word)

3. E places 1st word on the table, provides echoic prime and requests echoic response from S

4. E removes the card for 3 sec; replaces it requesting response from S (errors are corrected)

5. E adds 2nd word, provides echoic prime and requests echoic response from S (1st word card present, but no response required)

6. E removes the cards for 3 sec; replaces them requesting a response to the 2nd word only

7. E provides echoic prime for both words, requesting response from S

8. E removes cards for 3 sec; replaces them requesting response to both words from S (reversed order)

9. E removes and replaces both cards in an unpredictable order for 5 trials, asking S to read each word within 5 sec. E records all responses and corrects all errors

10. E adds one word (interspersal for 5 trials). E places cards in an unpredictable order for each trial, asks S to read each word within 5 sec; records all responses and corrects all errors

11. E adds 2nd interspersal word for 5 trials

12. E adds 3rd interspersal word for 5 trials

13. E gives 15 points to S at the end of the session
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