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The Effects of Two Training Procedures on the Acquisition and Retention of a Sight-Word Vocabulary in Remedial Readers

Marilyn Monteiro

Western Michigan University

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THE EFFECTS OF TWO TRAINING PROCEDURES ON THE ACQUISITION AND RETENTION OF A SIGHT-WORD VOCABULARY IN REMEDIAL READERS

by

Marilyn Monteiro

A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Doctor of Philosophy
Department of Psychology

Western Michigan University
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April 1980

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Marilyn Monteiro
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Western Michigan University

Ph.D. 1980

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INTRODUCTION

This study investigated the effects of two training procedures on the acquisition and retention of a sight-word vocabulary in remedial readers. The two procedures compared were a Trial and Error procedure and an Errorless procedure designed to minimize subject errors during word acquisition and retention sessions. The Trial and Error procedure was designed to approximate training strategies used by classroom teachers while the Errorless procedure was designed to incorporate relevant stimulus control techniques outlined in the errorless discrimination training literature.

The role of errors in the acquisition and retention of discrimination tasks has been examined by many behavior analysts. Several procedures have been designed to minimize the number of errors a subject will make as the relevant stimulus gains control over the correct response (Terrace, 1963a; Stoddard and Sidman, 1967).

Terrace (1963a), with pigeons as subjects, manipulated the variables of when and how the negative stimulus (S-) was introduced during training. The positive stimulus (S+) was a red key light and the negative stimulus (S-) was a green key light. The four conditions examined were: early-progressive, early-constant, late-progressive, and late-constant. The early versus late variable determined when the S- was introduced in the course of the training sessions. The constant versus progressive variable determined whether the S- was introduced at the full intensity and duration of the S-.

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The results indicated that very few errors occurred during training when the S− was introduced in the early-progressive condition. Terrace (1963a) concluded that presenting the S− early in training, and gradually increasing its intensity and duration to match those of the S+ will result in fewer errors than the other ways when a new discrimination is being mastered.

By manipulating the intensity and duration dimensions of the S−, Terrace (1963a) introduced a stimulus fading procedure which could potentially be used to teach discrimination tasks while minimizing the number of errors a subject would make. Stoddard and Sidman (1967) applied this technology to a more complex discrimination task than Terrace (1963a), and employed children as subjects. The discrimination task to which Stoddard and Sidman (1967) exposed two groups of subjects consisted of establishing a discrimination between a circle (S+) and an ellipse (S−). A continuous progression of ellipse series slides was presented, with each progression more clearly approximating a circle. When errors were made, Stoddard and Sidman (1967) presented the stimuli from slightly earlier in the series until each step was mastered. With this continuous progression series, the number of errors made by each subject as well as the threshold for discrimination were assessed. After the experimental group was exposed to the initial program, it was exposed to the end of the threshold series, and the slides were presented in an order of decreasing difficulty until subjects could discriminate between the circle and the ellipse. Following this procedure, the experimental subjects advanced progressively.
through the threshold series in the same manner as the control group.

Stoddard and Sidman (1967) found that all subjects exhibited a much higher threshold for discrimination in the ascending than descending series. Performance deteriorated for the experimental subjects who were exposed to the backward procedure several times. Stoddard and Sidman (1967) concluded that the backward progression created conditions in which repeated errors occurred. The authors reported that responding was difficult to maintain during the backward progression series of stimulus presentations. Due to the number of consecutive errors made during the series, few opportunities existed for obtaining a reinforcer. This study provided a dramatic demonstration of the detrimental effects which errors can have upon the acquisition of a discrimination task. Their data lend support to the notion of minimizing the occurrence of errors to maximize acquisition of stimulus control.

Touchette (1968) utilized a graduated stimulus change procedure to train severely-retarded boys in a simple discrimination task. He effectively taught a simple discrimination to severely-retarded youths who had previously demonstrated no learning under differential reinforcement conditions with a trial and error procedure. The results Touchette (1968) obtained showed that the subjects who participated in the trial and error procedure did not acquire correct responding to the $S^+$ while the subjects who participated in the errorless procedure did acquire correct responding to the $S^+$. Touchette (1968) concluded that a history of trial and error learning may interfere with the acquisition and retention of a discrimination task.
Furthermore, individuals who appear to be untrainable may be victims of training techniques which generate persistent error patterns.

Several more recent studies have examined additional variables related to the occurrence of errors during the acquisition of stimulus control. Schilmoeller and Etzel (1977) examined the variable of cues provided during a stimulus fading procedure. They conducted two studies in which a series of matching-to-sample tasks were taught to preschool children. One task involved matching color configurations while the other involved matching Japanese characters to the sample. The procedures and results were equivalent for the two tasks. In both tasks, Schilmoeller and Etzel (1977) compared the number of errors and task retention when the stimulus cues provided during training were criterion-related and noncriterion-related. The criterion-related cues involved fading the density of the S- to equal that of the S+. The noncriterion-related cues involved the fading of an irrelevant cue, i.e., a red rectangle surrounding the S+. The subjects exposed to the criterion-related cues training procedure retained the discrimination at a much higher percent correct than the noncriterion-related group (96% acquisition, 100% retention after four weeks versus 36% acquisition and 61% retention after four weeks). Schilmoeller and Etzel (1977) concluded that the addition of unnecessary stimuli interferes with the subject's observation of the critical cues for stimulus control. They recommend that the cues selected for stimulus control tasks insure correct responding throughout training as well as allow for a ready shift in stimulus control from the cue to the final task.
Soviet psychologists have also examined the role of irrelevant cues in teaching mathematics (Hooten, 1975). Kabanova-Meller (Hooten, 1975) concluded after a series of experiments that for children to learn a discrimination or concept, it is critical that they be able to identify not only the relevant features, but also the irrelevant features. In teaching formation of correct generalizations, the irrelevant features should be varied, while keeping the relevant features constant. These suggestions are supported in the American literature by the recommendation of Carnine and Engelmann (unpublished) in their text which outlines basic sequences to teach operations and concepts to learners, as well as by Engelmann, Becker and Thomas (1975) and Markle and Tiemann (1974).

In terms of the role of errors in teaching math operations, Hooten (1975) summarizes the Soviet position that errors can be prevented in the acquisition and later retention of tasks by utilizing "heterogeneous" versus "homogeneous" exercises. In other words, training repeatedly on the same task will encourage errors and the acquisition of misrules, while training on several different tasks will provide stimulus change cues, thereby minimizing the opportunities for certain types of errors to occur.

Teaching phonically-irregular words would be enhanced by minimizing errors as well. Providing training on several words during training sessions, with trials including the interspersal of review words would provide "heterogeneous" training while minimizing errors.

The errorless discrimination training literature has implications for the area of reading instruction. In terms of teaching

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basic reading to children in the primary grades, errorless procedures may be more beneficial than standard trial and error procedures. In the primary grades, some students fail to read at the same level as their peers, and these readers have had ample opportunities to make reading errors. Terrace (1963a) and Touchette (1968) point out that a history of errors might interfere with learning new stimulus-response relations and in retaining a discrimination once it has been mastered. One way in which a history of errors might interfere with learning is in the production of detrimental emotional by-products (Terrace, 1963a). In the case of reading, a history of errors might result in associating reading with the lack of opportunities to obtain reinforcers. The errorless discrimination training literature may have particular implications for teaching difficult words to readers in the primary grades, i.e., words which are phonically irregular.

A major controversy in the field of reading instruction is the extent to which sight-word training versus phonics training should be emphasized (Chall, 1967). The controversy is one which has been debated by reading experts since 1878. It is generally agreed that some sight-word training is essential to enable students to master words which cannot be attacked phonically. For words which do not fall into the irregular category, i.e., phonically-regular words, phonic strategies are recommended to teach the pronunciation rules which apply to regular words (Chall, 1967). Irregular words, or sight words, must be taught as whole units. They cannot be attacked phonically since a phonic pronunciation would be
incorrect. An errorless stimulus fading procedure may be an effective way of teaching irregular words. Teaching irregular words as well as regular words is particularly important for those primary grade readers who have been categorized as remedial, i.e., who perform at a reading level below their peers. Such children have a history of making errors with regard to word reading in the classroom environment. Supplementary work for them in the reading area should combine teaching phonics and sight words while minimizing the opportunities for making additional errors.

The Project Help tutorial program at Western Michigan University utilizes a phonics training program for remedial readers. The program used is the Corrective Reading Series, developed by Engelmann, Carnine and Johnson (1978) and published by Science Research Associates. The Corrective Reading Series is designed to teach reading strategies, and is divided into three levels. The Decoding A level (Word Attack Basics) is the most basic level, and the emphasis is on teaching letter sounds and on sounding out and reading words that are spelled regularly (Engelmann et al., 1978). Many remedial readers placed in the Decoding A program at Project Help are in first through third grade in elementary school. It would be a significant addition to remedial instruction for such students to receive systematic sight-word training on words frequently encountered in their basal readers to accompany the extensive phonics training in the Corrective Reading Series.¹ In the Decoding A program, which

¹L. Carnine, personal communication, October, 1978.
consists of 60 lessons, many novel regular words are introduced in each lesson. By Lesson Nine, the following sounds are taught: m, a, s, e, t, r, d, i, f, h, c, and th. By Lesson 57, 36 sounds are taught. The regular words taught in these lessons are formed from the sounds listed above. After Lesson 4, students read over 10 regular words per lesson (between 10 and 30 words per lesson).

In contrast, a total of only seven irregular words are taught (was, to, said, do, of, you, what) in the entire A program. The procedure used in the A program to teach irregular words consists of having students sound out the irregular word phonically. Once the students does so, the instructor briefly states that the word is said differently from the way it is sounded out, and that the student must remember the word. The instructor then says the word and asks the student to repeat it while looking at the written word. This procedure demonstrates to students that they are using their decoding strategies correctly, but that those strategies are not effective with all words. It also provides the learner with an opportunity to make an incorrect response repeatedly before the correct response is required, thus building in a history of errors with irregular words.

A major problem with the sight-word training in the A program is the limited number of words taught. Since the student is required to remember the special word, it is essentially a trial and error procedure. The A program takes approximately five months of instruction to complete, if instruction occurs for 45 minutes a day, five days a week, and the student is able to cover approximately one
lesson per day. For a student to increase his or her sight-word vocabulary by seven words in five months is not a significant gain, since approximately 335 irregular words commonly appear in basal readers used in the first through third grade (Alessi, unpublished). It is of experimental interest to examine how many sight words could be taught to students in the Decoding A program using a trial and error procedure not unlike the techniques used in the regular classroom, i.e., errors corrected, limited practice. This procedure is of interest rather than the procedure used in the A program because pilot data collected for the present sight-word study indicated that subjects had difficulty in the Decoding A program sounding out irregular words correctly. In the context of the present study, a trial and error and an errorless procedure will be compared to assess which technique will result in teaching the most words. Both acquisition and retention will be examined. Additional sight-word training in the A program would directly enable the student to perform at a higher level in the classroom reader.

As the typical reader referred to Project Help for tutorial services is one to three years below grade level in reading, performing better in the classroom is a critical goal. The Corrective Reading Series provides students with intensive, accelerated training in basic reading skills, and pretest/posttest measures on clients in the program indicate accelerated grade level gains on standardized reading tests (Monteiro and Wright, unpublished). Accelerated sight-word training added to an effective phonics program would be highly desirable for this population. The findings of the United States
Select Committee on Equal Educational Opportunity (1970) support this position.

"... as early as the third grade, the average disadvantaged child will have to learn at twice the rate of the average child in order to catch up ... But what is distressing to note is the disadvantaged-norm child achieving at two-thirds the rate of the average child cannot hope to close the gap unless he achieves at a rate well above the average student, that is, much faster than the national norm rate of one month or one year for every month or year of instruction." (p. 160)

An effective alternative sight-word training program to the one included in the Decoding A program would have to be compatible with that phonics program. To increase the number of sight words taught to students in the A program, the words would have to be introduced in a manner which would not interfere with the phonics training. Teaching a few words at a time and providing ample opportunities for review would accomplish this objective. Careful monitoring of each student's mastery of the Decoding A lessons would provide a measure of progress in that program.

Several variables are of interest in developing an alternative sight-word training program. It is of experimental interest to determine whether an errorless training program for sight-word acquisition and retention would be more effective than a trial and error procedure. An effective procedure which is relatively easy to implement would be of interest as well. Finally, it is of interest to determine how well students are able to transfer the correct reading of sight words from the training situation to reading words in grade level sentences.

One study from the experimental literature provides a model for
developing an errorless sight-word training program. Touchette (1971) developed an errorless procedure for establishing stimulus control which employed a delayed-prompt procedure. His subjects were three severely-retarded adolescent boys. A trial procedure was used with a 5 sec intertrial interval and with reinforcement following each correct response. Stimuli were presented on two response keys. The S+ consisted of the symbol \[ \mathbb{1} \], while the S- consisted of the symbol \[ \mathbb{1} \]. A stimulus control baseline condition preceded the delayed-prompt procedure, in which a red key (S+) had the appropriate symbol superimposed on the center of the key, as did the white key (S-). Touchette's (1971) delayed-prompt procedure consisted of progressively delaying the superimposed red stimulus by 0.5 sec each time the subject responded correctly. If an incorrect response occurred, the delay would be reduced by 0.5 sec on the subsequent trial. However, significant number of errors did not occur and consequently, the delays were seldom reduced.

The results clearly demonstrated that for all subjects, the transition from responding after the prompt to before the prompt occurred in an abrupt manner. The shift was a stable one in that once subjects began to respond before the prompt, they continued to do so throughout the study. Touchette (1971) added a control procedure in which he reversed the S+ and S- stimuli. He found no differences in the results during the control condition. Howard (unpublished) replicated Touchette's (1971) procedure to examine the role of reinforcement density in the transfer of stimulus control. She found that the number of trials to criterion and response latency
were considerably less during the reinforcement condition which most heavily favored anticipatory responses (responses before the delayed prompt occurred).

Delaying the onset of stimuli in a delayed-prompt fashion has an advantage over fading out a stimulus [in the case of Touchette's (1971) study, the red key]. In a stimulus fading procedure, subjects may come under the control of the dimension which is being removed rather than the desired dimension. For example, if the size of the irregular word being taught were faded to equal the size of the S- word, size might control responding rather than the stimulus of the word as a unit. If a red rectangle surrounded the S+ word, as in the Schilmoeller and Etzel (1977) study, the stimulus might interfere with the subject's observation of the relevant stimulus cues for correct responding. A delayed-prompt procedure would be highly desirable in terms of sight-word training in that the emphasis would be on the desired dimension (the word as a whole unit). A fading procedure involving two words, with the size of the relevant word (S+) gradually faded to equal the size of the S- word, would introduce several irrelevant dimensions which could be detrimental to the training procedure: letter size and attending to different letters in the S+ and S- words. The delayed-prompt procedure utilizing an auditory prompt is one which could readily be applied to training subjects to respond to a word unit with the correct verbal response without involving a second stimulus configuration. With only one word present during training, the transfer which would have to occur would be from the auditory stimulus paired with the visual stimulus.
to the visual stimulus alone. To insure that the subject attends to the relevant features, only one word should be presented at a time. A delayed-prompt procedure would minimize the availability of irrelevant stimulus features in the process of a printed word gaining stimulus control over the appropriate verbal response.

The auditory stimulus paired with the visual stimulus is what Skinner (1968) referred to as an echoic prime. With the retarded subjects in Touchette's (1971) study, a progression of delays was necessary to successfully train subjects to respond correctly, and with minimal errors. Pilot data for the present sight-word training project, in which a series of auditory stimuli or echoic prime delays were used, confirmed the notion that such fine gradations of stimulus pairing were not needed with normal subjects. Once subjects were presented with the first echoic prime, they matched the visual stimulus with the correct response within 1 sec each subsequent time the word was presented. Thus, the notion of a delay was nonfunctional while the notion of an echoic prime was critical in eliminating initial errors.

To test for appropriate stimulus control, each word would need to be tested in the context of other words. A transfer test would confirm whether or not the subject was attending to the word as a whole unit. With only one word introduced at a time during training, it is possible that subjects will attend to only one letter in the word. Presenting each word separately minimizes this possibility but does not eliminate it. One solution is to introduce one word with an echoic prime before requiring a response, followed by the
introduction of a second word, thus allowing the subject to compare and contrast the visual displays. A subsequent transfer test could be accomplished, for example, by having the subject read a set of sentences which would contain the target sight words in the context of phonically-regular words.

Alessi (unpublished) described a "word bank" trial and error procedure to teach sight words. During each training session, the child is presented with three words to be learned. The instructor points to each of the three words in a random order and asks the child to say each word. If an error is made, the instructor says the correct word and asks the child to repeat it several times while touching the word card. The words are trained to a criterion level (ten correct consecutive responses) and reviewed at a later date.

This procedure incorporates a great deal of review over the sight words trained but contains a potential problem. When multiple words are presented, more irrelevant features exist to weaken the effectiveness of the procedure. Given the data presented by Schilmoeller and Etzel (1977), it may be advisable to eliminate as many irrelevant cues as possible when teaching sight words to beginning readers. A modification of the procedure described above would consist of presenting each word initially on separate trials, with daily reviews of words previously mastered, and frequent sentence reading probes to determine if the words would be read correctly in the context of other grade level words. It would be important to program for the review of words previously taught and mastered as well as for the transfer of correct sight-word reading during.
training trials to correct reading in the context of sentences. To accomplish these objectives, each training session would include trials in which words were reviewed once they had been mastered, along with words which were being taught.

Carnine (1978) conducted a study in which he compared simultaneous and cumulative introduction of addition facts with preschool children. The simultaneous introduction consisted of training a group of six problems during each session until the established mastery criteria had been met with a three-problem set, then a four-problem and finally a five-problem set. He found that the cumulative group reached the mastery criteria on the set of six problems with fewer overall trials required. However, when a follow-up retention test was administered one week after training, retention on the problems was identical for the two methods of problem introduction. In terms of sight-word training, cumulative introduction of words may result in fewer training trials to criteria.

Studies which specifically focused on sight words have been reported in the literature. Carnine (1977) examined the role of irregular words in the transfer of training on regular words to new words. Twenty-six preschool children were exposed to either a sounds training procedure or a word training procedure. The sounds training procedure consisted of mastering sound-symbol correspondence and blending before reading regular words was attempted. The word training group received trial and error training on a set of phonically-regular words and six phonically-irregular words from the Dolch Word List. The results showed that the sounds training group
had higher scores on the phonically-regular transfer test words than the word training group. Neither group scored well on the transfer test irregular words, but the sounds group scored higher than the word training group. Carnine (1977) suggested that further research was needed in the area of training irregular words. He proposed that training diverse sight words would lead to better transfer to new irregular words.

Lahey and Drabman (1974) compared the use of tokens and no tokens in training 30 sight words to 16 second-grade children. The sight words taught consisted of both irregular words and service words (regular words which are frequently used). Their procedure consisted of three sessions with 10 words taught in each session. The sight words were taught by holding up a sight word card, waiting 1 sec, giving the correct answer, and repeating trials until the subjects could read the words correctly. Two retention tests were administered: one immediately following the last session, and one two days later. A group design was used, and the results showed that the no-token group took twice as many trials to reach criteria as the token group. Retention for both groups was equal during the first test, but the token group recalled more words during the second test. From this study, it appears that providing reinforcement after each correct response is an important variable. Lahey and Drabman's (1974) study supports the notion of teaching irregular words as units to complement word-attack or phonics instruction.

An additional study confirms the relevance of presenting tokens or praise after correct responses. McLaughlin and Lane (1975), in
a brief report, indicated that the use of praise following each correct response increased the sight-word vocabulary of a third-grade child by 25 words. No retention test data were presented.

Kibby (1979) compared three procedures in teaching a small set of regular and irregular words to first-grade students. The conditions he compared were: 1) correct responses reinforced and incorrect responses corrected; 2) criterion learning, i.e., words were taught for additional trials; and 3) no corrections or extended instruction. His results showed that acquisition was highest for the correction group, but no difference was found between groups in terms of the number of words initially learned or retained. Kibby (1979) concluded that additional trials to criterion were not beneficial in the initial learning nor in the retention of basic words. However, the extra trials were equivalent to what Hooten (1975) referred to as "homogeneous" exercises, and thus may have encouraged the development of persistent error patterns or misrules.

Halvorsen (unpublished) conducted a two-part study in which he examined the role of minimally- and maximally-different sight words in the acquisition and retention of irregular words. With teachers serving as the experimenters, Halvorsen (unpublished) taught students enrolled in a special education language-arts course to read phonically-irregular word sets containing five words each. The study was conducted for 10 weeks. Each session consisted of training trials in which each of the five words was modeled, i.e., an echoic prime was provided, and tested for four trials. A new word set was introduced and taught after all the words in a set were read 100%
correctly for three consecutive sessions, i.e., on review word probes. The only difference between the two sections of the study was the nature of the difference between words in each word set. The definition Halvorsen (unpublished) used for minimally-different words required that only two of the five words in each set have the same initial letter and similar configurations.

His results showed that 85% to 100% of the 40 words taught to each subject were mastered. No differences were found between the minimally- and maximally-different word conditions. A serious problem in interpreting these data arises from the fact that words which were known on the pretest before training were included in the training sets rather than omitted. Thus, it is impossible to determine how well subjects would have done with word sets of unknown words during the training sessions.

Neef, Iwata and Page (1977) utilized a multielement design to determine whether acquisition and retention of sight words would be facilitated by interspersing trials in which new words were presented with review trials (words previously mastered). Their results confirmed that interspersal improved retention and resulted in the acquisition of more words for six mentally-retarded subjects. The percent of words mastered on the retention tests given five days after the subjects had met the mastery criterion was below 70% for all conditions (mean of 68.4% for the interspersal condition and a mean of 55% for the baseline and high density reinforcement conditions).

Neef et al. (1977) concluded that the increase in reinforcement
during training when known words are interspersed with words to be taught accounted for the improved retention. In the present study, words which have been mastered in previous sessions will be reviewed during training sessions for the Errorless procedure, providing subjects with opportunities to make correct responses, as well as providing cumulative review over those words. Furthermore, fewer words will be presented during each session. Neef et al. (1977) presented 60 words during each session, 40 of which were test words.

Schilmoeller and Etzel (unpublished), in a review of errorless training procedures they have used, recommend that cumulative review of concepts previously mastered be included in any errorless program to improve retention. They suggest that more research is needed to empirically determine the importance of this variable.

The present study will compare two procedures to teach a sight-word vocabulary to remedial readers. An Errorless training procedure utilizing cumulative review of words previously mastered and an echoic prime (Touchette, 1971) will be compared to a Trial and Error procedure which will contain features of the procedure described by Alessi (unpublished).

There are two major differences between the two procedures. One is the use of an echoic prime in the Errorless procedure when words are introduced. The other is the cumulative review provided in the Errorless procedure, when words previously mastered are interspersed with training words during review trials. The use of the echoic prime and cumulative review trials is expected to minimize the number of acquisition sessions required as new words are mastered, as
well as to improve retention.

The present study had four major goals: 1) to compare an Errorless and a Trial and Error procedure in terms of acquisition and retention of sight words; 2) to develop procedures which are easy to implement in terms of the time involved and teacher effort; 3) to assess the transfer of words taught to sentences; and 4) to increase the number of sight words mastered by remedial readers in the Corrective Reading Series without interfering with the phonics instruction.

The major variables to be assessed were: 1) the number of sessions to criterion needed during the acquisition of sight words; 2) the retention of sight words; and 3) the transfer of sight words taught to a different set of stimulus conditions. Subjects were remedial readers enrolled in the Project Help tutorial program. A multielement design (Uhlman and Sulzer-Azaroff, 1975) within a multiple baseline design (Baer, Wolf and Risley, 1968) was used to compare the two procedures.
METHOD

Subjects

The six subjects in this study were students enrolled in the Decoding A program of the Corrective Reading Series at Project Help, a tutorial service offered through the Psychology Department at Western Michigan University. All subjects were referred to Project Help because of poor reading skills. Four subjects had completed the first grade in public school, and two others had completed the second grade. Two subjects were seven years old and four were eight years old. All scored below the second grade level on one of two standardized tests: the Woodcock Reading Mastery Test or the Peabody Individual Achievement Test. Three subjects were given the Woodcock Reading Mastery Test. Their overall grade level scores ranged from 1.2 to 1.6, with a mean grade level score of 1.4. Individual overall grade level scores were: 1.2, 1.4, and 1.6. Three subjects were given the Peabody Individual Achievement Test and the range of overall grade level scores was 1.1 to 1.7, with a mean score of 1.4. Individual overall grade level scores were: 1.1, 1.4, and 1.7. Four subjects were male and two were female. One subject, Julie, participated in a pilot project for five weeks. None of the words trained in the pilot project were retrained for this subject in the present study.

Prior to implementation of the study, each parent signed an informed-consent form allowing their child to participate. This
form is presented in Appendix A. The project was approved by both a departmental and a university-wide Human Subjects Review Committee.

Setting

Sessions took place daily from 9 am to 12 noon on Monday through Friday at Project Help as part of the regular tutoring program. Subjects attended Project Help for the summer session, and thus were not concurrently enrolled in public school. All clients attending Project Help were tutored in groups of two or three clients for two daily 50-minute sessions of Corrective Reading. Subjects in the study received between 5 and 10 minutes of sight-word instruction at the beginning of each 50-minute session. All instruction took place in university classrooms. For five of the six subjects, other clients were present and working in different areas of the room during the sight-word training sessions.

Procedure

Pretest. A pretest was administered to determine basic sight words needing instruction. The words on the pretest were 110 phonically-irregular words taken from a list compiled by Alessi (unpublished). This list contains the words found on the separate Dolch, Johnson and Hauserman irregular word lists, for a total of 335 common irregular words found in basal readers in grades 1 through 3. The words selected for use in the pretest were ones which could be found on all three lists or on at least two of the three lists. Of the 110 words selected for use on the pretest, 66
are found on the Dolch, Johnson and Hauserman lists, and 44 others appear on two of the three lists. The pretest list was sorted into groups of 10 words which differed from one another in the initial letter. The 110 words were types on 4" x 5" blank index cards in pica style type and small case letters. Each card displayed one word.

During the pretest sessions, the experimenter presented the cards in each group one at a time, pointing to the word and asking the subject, "What word?". The experimenter recorded the subject's response on the data sheet as correct, incorrect, or no response, and proceeded to the next word. When each of the 10 cards had been presented once, the experimenter recycled through the series two additional times. A word was considered known if the subject read it correctly on each of the three trials, or on the last two of the three trials. The experimenter presented up to 30 words during each pretest session. Subjects were matched on words to be trained from the pretest results for as many words as possible. The matching controlled for variability due to differences in the difficulty of words taught.

**Trial and Error procedure.** Half of the sight words were taught using the Trial and Error procedure. Two new words were taught at a time. Each pair of words comprised a word set. The words were selected to appear maximally difference within a set, i.e., beginning with different letters and containing different letter clusters. The same word set was taught for at least one session. Mastery criteria for the set were defined as 100% correct reading during the
word retention probes and sentence retention probes for three consecutive sessions. Word retention probes measured pupil mastery of words taught in the previous session. Retention probes were conducted at the beginning of each daily session. Training for each word set was discontinued once the words were read correctly during the word retention probe for one session. Retention probes for each set were discontinued once the mastery criteria had been met. Since the mastery criteria was 100% correct on three consecutive probe sessions, word sets were retrained whenever a pupil scored less than 100% correct on a retention probe. When retraining sessions occurred for a word set, the alternative new word set was not trained. Thus, only one word set was taught during any given session. For example, Word Set A would be taught until the subject read 100% of the words in that set correctly on the word retention probe. At that point, Word Set B would be taught, while Word Set A would continue to be probed until the subject read 100% of the words correctly for three consecutive probes. If the subject responded at less than 100% correctly on one of the Word Set A probes, that word set would be retaught until 100% correct responding was reached again on the word retention probe. When the Word Set A was retaught, Word Set B would be probed but not taught.

During each Trial and Error session, the experimenter placed the unknown word cards on the table and asked the subject, "What word?" while pointing to each of the cards. No corrections or prompts were given during this portion of the session, e.g., telling the subject the word or indicating whether or not the word had been said
correctly. After two consecutive attempts to read the sight words without experimenter assistance, the experimenter corrected the subject by pointing to each card and saying, "This word is _______. What word?" and required a correct response from the subject. For each trial, the word cards were presented in an unpredictable order to control for order effects. Trials continued until the words had been learned to the session criterion of five consecutive trials in which each of the two words were correctly read. During the acquisition (trials to criteria) portion of the session, any errors were corrected by the experimenter. The experimenter pointed to the misread word and said, "(correct word.) What word?". Each session ended after five consecutive trials of correct word reading without experimenter assistance or corrections.

At the conclusion of each session, subjects were awarded points on their point cards. Points awarded ranged from 10 to 15 per session. Subjects received points for performance during their regular tutoring sessions as well, and could exchange the points for items in the Project Help "store" during the daily break. "Store" items included sugarless gum and mints, coupons for bowling, rollerskating, and hamburgers, models, and toys.

**Errorless procedure.** Half of the words were taught by this procedure. Two new words were taught at a time, comprising one word set. A word set was taught for at least one session to meet the criterion of 100% correct reading on three consecutive word retention probes. Retraining sessions occurred when necessary, as in the Trial and Error procedure. Also, words were selected to appear maximally different,
as in the Trial and Error procedure.

During each session, the experimenter presented the first word to be taught two times. First, the experimenter provided an echoic prime and tested the subject by saying, "My turn. What word? (Correct word). Your turn. What word?". Then, the experimenter removed the card from the table for three seconds, place the card back on the table and pointed to it, asking the subject, "What word?". If the subject read the word correctly, the experimenter presented the second word to be taught, juxtaposed with the first word card on the table. The subject was able to see the first word and compare it to the second word, but was not requested to read the first word during training on the new word. The experimenter taught the second word in the same way as the first word.

After obtaining correct reading for the second word, the experimenter pointed to each of the words in succession while providing an echoic prime for both correct responses. Immediately after each prime, the subject was asked to read the word card pointed to by the experimenter. The experimenter then removed the two cards from the table, waited three seconds, and replaced them in reverse order. As each card was pointed to, the experimenter asked the subject to read each word. If errors were made, the echoic prime step was repeated. If errors were not made, training trials to criterion began. During the acquisition (trials to criterion) portion of the session, any errors were corrected by the experimenter. This portion of the session ended after five consecutive trials of correct word reading without experimenter assistance or correction.
After the criterion of five correct reading responses was met, an additional set of trials was presented. These consisted of the interspersal of the new words with sight words previously mastered, i.e., review words. Interspersal with three review words was used to firm up reading responses to the new words. The three words used for interspersal in each session were drawn from a pool of words mastered during the study, thus providing a form of cumulative review over words previously mastered. The interspersal condition began after each subject had accumulated at least two mastered word sets with the Errorless procedure. Prior to that time, the interspersal words were selected from those the subject read correctly on the pretest. As additional word sets were learned, they were used in the interspersal condition, displacing the previously mastered word sets. One subject, Tom, was the exception. He never mastered more than one word set with the Errorless procedure, and thus his interspersal words were drawn from his pretest list throughout the study.

During the interspersal condition, the experimenter placed the two new word cards and one review card on the table. While pointing to each card, the experimenter asked the subject to read each word. Any errors were corrected. The three words were presented for five trials. In between each trial, the cards were removed or shifted, and their placements were switched to avoid a position effect. After the five trials, a second review was added for five more trials. Then, a third review word card was added for a final five trials. The session concluded after presentation of the last trial containing all five words. Points were awarded as in the Trial and Error...
condition.

**Word probes.** Two types of word probes were conducted in the study: preview word probes and retention word probes. Each preview word probe contained one word set. The preview word probe was given the day before or on the same day the word set was taught. This probe controlled for the possibility that the word set had been learned outside of the study between the time of the initial pretest and the point of introduction in the study. If a word was correctly read during the preview probe, that word was dropped from the study list. Another unknown word from the pretest was substituted. Thus, only words incorrectly read both on the pretest and the preview probe were used in the study. Preview probes were conducted in the same way as the pretest.

Retention word probes were given at the start of the next session, i.e., following the session in which the words were introduced. The retention probe data indicated whether or not the words were recalled on days after training. Each word set was probed for retention at least three consecutive days to determine whether the mastered criteria had been met.

At the conclusion of the study, a comprehensive word retention probe was administered to measure long-term retention. A follow-up retention probe was conducted six, seven or eight weeks after the conclusion of the study, depending on the subject and when the school visits could be scheduled. The probe measured long-term retention after training had concluded.

**Sentence probes.** Two types of sentence probes were used in the
study: preview sentence probes and retention sentence probes. Each sentence probe contained one word set. Preview sentence probes were conducted either during the session prior to the training session for those words, or during the same session immediately prior to training. The preview probe provided the same control as the preview word probe. Subjects were asked to read each sentence without any prompts or corrections by the experimenter. The retention sentence probes were given during the sessions after the training session to determine whether or not the words could be correctly read in sentences. At least three retention sentence probes were given to each subject for each word set, to measure when the mastery criteria had been met, i.e., 100% correct reading for three consecutive sessions.

Sentences for all probe conditions were constructed in a special manner. All sentences were short (five or fewer words) and all words were ones each subject could already read, with the exception of the target sight word. Only one new sight word appeared in each sentence. Sentences were constructed so that the words would not likely be guessed from the context of the sentence. Standard sentence formats were used for each part of speech, to control for possible syntax cues. Slightly different sentences were presented for each word on each of the different probes to control for practice effects. Sentences were constructed according to parts of speech, i.e., nouns, verbs, adjectives. For example, two noun frames would be: a) It is a city., and b) See the city. Two adjective frames would be: a) See the little cat., and b) Look at the little cat.

Experimental design. The overall design used was a multielement
design (Uhlman and Sulzer-Azaroff, 1975) within a multiple-baseline design (Baer, Wolf and Risley, 1968). A multielement design was used to compare the two procedures. The comparison elements in the design were the Trial and Error and the Errorless procedures. Both procedures were presented daily, but in an alternating order. Two daily sessions took place for five days a week for five weeks (a range of 19 to 22 days during the tutoring term). Within each condition, words were taught and tested as word sets containing two words each.

The multiple baseline design was used to demonstrate experimental control of each procedure over reading responses. The design consisted of word sets which were introduced in a staggered fashion across time. This introduction of words sets controlled for possible external variables which might have been acting coincidentally with the manipulated procedures in the study.

Data collection and reliability. 1. Dependent measures. The dependent measures recorded for each subject were: a) average duration of session for each procedure, b) number of initial training sessions required to reach criterion for introducing a new word set, c) number of retraining sessions needed to reach the mastery criterion, d) rate of words introduced and mastered per procedure, e) percent accuracy on the daily word retention probes, and f) percent correct on the final retention probes. The above variables were evaluated with data collected by means of: a) training procedures data for the daily word sets, b) preview word and sentence probes, and c) retention word and sentence probes.

2. Independent measures. The independent variables were the
Trial and Error and the Errorless training procedures described in the previous sections. Measures were made of the degree to which the training sessions were implemented, using the two checklists which are presented in Appendices B and C.

3. Reliability. On at least 10% of the sessions per condition, word-by-word reliability was conducted for each subject during the preview, review and training trials. Reliability was calculated by counting the number of agreements and dividing by the number of agreements plus disagreements multiplied by 100, using the formula:

\[ \frac{a}{a + d} \times 100. \]
RESULTS

Reliability

Reliability data were collected during 19 Errorless and 19 Trial and Error sessions, for a total of 15.6% of the combined retention probes and training sessions. The range of percent agreement for the Errorless procedure across all subjects was 91.6% - 100%, with a mean of 99.23%. The range of percent agreement for the Trial and Error procedure across all subjects was 87.5% - 100%, with a mean of 98.6%. Reliability was taken for each subject for at least four sessions and for no more than nine sessions. Reliability checks were distributed throughout the study. At the conclusion of the study, final day probe data were collected for five out of six subjects. Reliability was taken on 4 out of 10 final day probe sessions. Percent agreement ranged from 96% - 100%, with a mean of 98.25%.

Average duration of sessions for each procedure

To determine the duration of the Errorless and Trial and Error sessions, a sample of times was collected across 32 sessions (16 Errorless and 16 Trial and Error). The word retention probes, sentence probes, and the actual teaching session were timed for each session. The duration of the Errorless sessions ranged from 5 minutes to 9 minutes, with a mean time of 7 minutes. The duration of the Trial and Error sessions ranged from 2 minutes to 5 minutes, with a mean of 3 minutes. Thus, the Errorless procedure required
Training and retraining sessions

For both procedures, the number of training sessions needed to reach 100% correct reading and the number of further training sessions needed to reach the criterion of three consecutive sessions of 100% correct reading were compared. Words were taught in sets of two, and the data in Table I are reported in terms of word sets. Only the word sets trained to the mastery criterion were used to tabulate the training and retraining session data. In the cases where words were probed beyond the established criterion of three consecutive sessions of 100% correct reading (e.g., the Errorless word set gave and found for Allen in Figure 1) those additional data points are not included in the Table I data.

The summary data shown in Table I indicate that the Trial and Error procedure took 33% more sessions to reach 100% correct reading per word meeting the mastery criterion. The Trial and Error procedure required 133% more retraining sessions, as well as 166% more total sessions per word meeting the mastery criterion. The total number of training and retraining sessions is shown per word as well as per set in Table I.

Rate of words introduced and mastered

The daily rate of words introduced and mastered for each subject in the two procedures is represented in Table II. For all subjects, the rate of words introduced is higher than the rate of words
Table I. Number of training sessions to 100% correct responding and number of retraining sessions needed to reach criterion of three consecutive sessions of 100% correct responding. Figures are reported in terms of word sets.
<table>
<thead>
<tr>
<th>Subject</th>
<th>Errorless</th>
<th>Trial and Error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># sessions to 100%/# sets</td>
<td># sessions retrain/# sets</td>
</tr>
<tr>
<td>Allen</td>
<td>7/3</td>
<td>2/3</td>
</tr>
<tr>
<td>Bob</td>
<td>17/5</td>
<td>3/5</td>
</tr>
<tr>
<td>Sally</td>
<td>16/5</td>
<td>2/5</td>
</tr>
<tr>
<td>Sam</td>
<td>6/3</td>
<td>2/3</td>
</tr>
<tr>
<td>Julie</td>
<td>10/3</td>
<td>0/3</td>
</tr>
<tr>
<td>Tom</td>
<td>5/1</td>
<td>0/1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>61/20 (3.05)</td>
<td>9/20 (.45)</td>
</tr>
<tr>
<td>TOTAL PER WORD</td>
<td>(1.52)</td>
<td>(.22)</td>
</tr>
</tbody>
</table>
Table II. Rate of words introduced and mastered.
TABLE II

<table>
<thead>
<tr>
<th>Subject</th>
<th>Errorless Daily Rate of Words</th>
<th>Trial and Error Daily Rate of Words</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Introduced</td>
<td>Mastered</td>
</tr>
<tr>
<td>Allen</td>
<td>.769</td>
<td>.333</td>
</tr>
<tr>
<td>Bob</td>
<td>.706</td>
<td>.435</td>
</tr>
<tr>
<td>Sally</td>
<td>.666</td>
<td>.571</td>
</tr>
<tr>
<td>Sam</td>
<td>1.000</td>
<td>.400</td>
</tr>
<tr>
<td>Julie</td>
<td>.526</td>
<td>.421</td>
</tr>
<tr>
<td>Tom</td>
<td>.353</td>
<td>.105</td>
</tr>
<tr>
<td>Mean Rate</td>
<td>.670</td>
<td>.377</td>
</tr>
</tbody>
</table>
mastered. With the exception of Tom, the daily rate of words introduced and mastered was higher in the Errorless procedure. The rate of words introduced in the Errorless procedure ranged from 0.353 to 1.0 per session, with a mean rate of 0.670, while the range of words introduced in the Trial and Error procedure was 0.50 to 0.833 per session, with a mean rate of 0.629. The rate of words mastered in the Errorless procedure ranged from 0.105 to 0.571, with a mean rate of 0.377. The rate of words mastered in the Trial and Error procedure ranged from 0.20 to 0.381 per session, with a mean of 0.324.

**Final day word retention probe**

Following the last day of training, five of the six subjects were given a final word retention probe over all words trained during the study in the Errorless and Trial and Error procedures. The final day retention probe was identical to the daily word retention probes, except more words were included. Julie was not probed due to illness.

The percent of words read correctly on the final day retention probes is presented for each subject in Table III. The first four subjects retained a higher percentage of words in the Errorless procedure. Tom retained a lower percentage of the Errorless words taught. For Allen, Bob, Sally, and Sam, the range of words retained in the Errorless procedure was 71% to 100%, with a mean of 81.5%, and in the Trial and Error procedure, 20% to 66%, with a mean of 46.5%. A comparison of the total data on the final day retention probe indicates that subjects scored 30% higher in the Errorless
Table III. Final day word retention probe.
Overall word retention probe for all subjects conducted one day after the last day of training. Julie was not probed due to illness.
procedure. This difference represents a 70% gain in performance of the Errorless procedure over the Trial and Error procedure.

Follow-up word retention probe

A follow-up retention probe session was conducted for each subject. Allen and Sally were probed six weeks after the completion of the study. Bob and Sam were probed after seven weeks, and Julie and Tom were probed after eight weeks. These data are presented in Table IV.

All subjects showed a decrease in the percent of words retained since the final day word retention probe except Sally, who showed an increase in the percent of words retained in the Trial and Error procedure. All other subjects except Tom showed greater long-term retention in the Errorless procedure. Tom showed no difference between the two procedures. However, retention data for Tom in the Errorless procedure is identical for both the final day retention probe and the follow-up retention probe, whereas in the Trial and Error procedure probes, retention dropped sharply (41.6% to 16.6%).

A comparison of the total data on follow-up retention indicates that subjects scored 9% higher with the Errorless procedure. This difference represents a 25% gain in performance for the Errorless over the Trial and Error procedure.

Daily word retention probes

For each subject, word retention probe data were collected across word sets for both the Errorless and the Trial and Error
Table IV. Follow-up word retention probe.
## TABLE IV

<table>
<thead>
<tr>
<th>Subject</th>
<th>Errorless Percent Words Mastered</th>
<th>Trial and Error Percent Words Mastered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen</td>
<td>60%</td>
<td>50%</td>
</tr>
<tr>
<td>Bob</td>
<td>33.3%</td>
<td>30%</td>
</tr>
<tr>
<td>Sally</td>
<td>57.14%</td>
<td>50%</td>
</tr>
<tr>
<td>Sam</td>
<td>60%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Julie</td>
<td>60%</td>
<td>50%</td>
</tr>
<tr>
<td>Tom</td>
<td>16.6%</td>
<td>16.6%</td>
</tr>
<tr>
<td>Mean Total</td>
<td>47.84%</td>
<td>38.32%</td>
</tr>
</tbody>
</table>

Overall word retention probe for all subjects, conducted six weeks (Allen and Sally), seven weeks (Bob and Sam), and eight weeks (Julie and Tom) following the last training session.
procedures. Figures 1 through 6 show the percent correct on the word retention probes for each of the six subjects for both the Errorless and the Trial and Error procedures.

Word sets are presented in a multiple-baseline fashion, with the first word set taught depicted in the first panel at the top of each figure, and the last word set taught depicted in the bottom panel of each figure. Figures 1 through 6 graphically represent: a) the number of sessions required to reach 100% correct reading for each word set, b) the number of retraining sessions required before the mastery criterion of 100% correct reading for three consecutive probe sessions was reached, and c) the rate of words introduced and mastered for each subject. Preview probe data for each condition are indicated by the separate initial data point for each word set presented.

All figures graphically depict the information presented in Tables I and II. The figures also portray the time sequence in which word sets were introduced and mastered for the Errorless and Trial and Error procedures, thus demonstrating experimental control of those procedures. Effectiveness of each procedure can be estimated by comparing the retention probe data with the preview probe data for each panel. In all cases, both the Trial and Error and Errorless procedures were effective. The fact that the treatment showed an immediate effect over preview probes at the time of introduction, regardless of when probes occurred during the study support the notion that the observed effects were coincidental with the treatment and not due to extraneous variables.
Figure 1 shows the effect of the two procedures on word retention data for Allen. The actual word sets taught are depicted in the right side of each panel. Errorless word sets are portrayed by the circles and Trial and Error word sets by the triangles. With the exception of the top panel, the first data point is separate and represents the preview word probe data. The preview probe data for the top panel was taken from the pretest data and thus are not depicted in the figure. The remaining data points represent word retention probe data. The solid circle and triangle data points indicate sessions in which either retraining or no training occurred, but in which retention probe data were collected.

Five Errorless and three Trial and Error word sets were introduced. Three Errorless and two Trial and Error word sets reached the mastery criterion. For both procedures, several no training and retraining sessions are depicted in Figure 1. In the top panel for the Errorless procedure, no training occurred on Sessions 2, 3, 5, 6, or 7, due to the 100% correct responding on the word retention probes. On Session 4, in the Errorless procedure, the first word set (may, friend) was retrained because the retention probe data indicated only 50% correct reading. For that session, the second Errorless word set (about, city) was probed but not trained, as is indicated by the solid data point on Session 4 for that Errorless word set in the second panel. In the top panel, the Trial and Error sessions in which no training occurred are Sessions 6, 7, and 8.

The solid and broken lines below each panel indicate the sessions between introduction and mastery of each word set. The pattern
Figure 1. Percent correct on daily word retention probes across sessions for Allen.
of introduction of word sets can be compared for the Errorless and Trial and Error sets by scanning down the page of panels and across the sessions. Word sets in the Errorless procedure (Panels 1, 2, 3, 4, and 5) were introduced on Sessions 1, 2, 3, 7, and 13. The first three word sets were mastered on Sessions 7, 5, and 9. Trial and Error word sets (Panels 1, 2, and 3) were introduced on Sessions 1, 6, and 14, and the first two word sets were mastered on Sessions 8 and 16. The rate of words introduced in the Errorless procedure was higher than in the Trial and Error procedure, and fewer retraining sessions were needed in the Errorless procedure.

The mastery criterion was extended in the Errorless procedure for the third word set, depicted in Panel 3 (gave, found). The subject reached the mastery criterion of three consecutive sessions of 100% reading, but was probed for an additional session. Since the probe data for the additional session indicated reading at 50% rather than 100% correct reading, the word set was probed for three additional sessions until the mastery criteria was reached once again. One retraining session occurred, and during that session, training was delayed for the next word set (Panel 4).

Figure 2 shows word retention probe data for Bob. Six Errorless and five Trial and Error sets were introduced. Five Errorless and four Trial and Error word sets reached the mastery criterion. Fewer trials to 100% correct responding and fewer retraining sessions per word set were needed in the Errorless procedure.

One additional retention probe was made beyond the mastery criterion for the third word set in the Errorless procedure (little,
Figure 2. Percent correct on daily word retention probes across sessions for Bob.
FIGURE 2

Subject Bob
- - Errorless
•-• Trial and Error

<table>
<thead>
<tr>
<th>PERCENT CORRECT ON VOCAB RETENTION TESTS</th>
<th>SESSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay, Friend</td>
<td>5 10 15 20</td>
</tr>
<tr>
<td>Didn't, Wash</td>
<td></td>
</tr>
<tr>
<td>About, City</td>
<td></td>
</tr>
<tr>
<td>Other, Work</td>
<td></td>
</tr>
<tr>
<td>Little, Make</td>
<td></td>
</tr>
<tr>
<td>Have, Back</td>
<td></td>
</tr>
<tr>
<td>Her, Gave</td>
<td></td>
</tr>
<tr>
<td>Why, Across</td>
<td></td>
</tr>
<tr>
<td>Want, Show</td>
<td></td>
</tr>
<tr>
<td>People, Ride</td>
<td></td>
</tr>
<tr>
<td>Every, Door</td>
<td></td>
</tr>
</tbody>
</table>

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make), and responding remained at 100% correct reading.

Sally received training on seven Errorless and five Trial and Error word sets, as is shown in Figure 3. The rate of words introduced was higher for the Trial and Error condition for panels 2, 3, 4, and 5. Five Errorless and four Trial and Error word sets were mastered to the criterion of three consecutive probes with 100% correct reading.

The number of trials to 100% correct reading was lower for the Trial and Error condition, although the number of retraining sessions required was equal for the two procedures.

Figure 4 shows the word retention data for Sam. Five Errorless and three Trial and Error word sets were introduced for this subject. The rate of word set introduction was equal across procedures for the first two sets (top panel), but Sam had many retraining sessions for the second Trial and Error word set (a total of seven retraining sessions). The number of retraining sessions for the second Trial and Error word set substantially lowered the rate of word set introduction for that procedure.

Four Errorless and two Trial and Error word sets were mastered by Sam. The Errorless condition required fewer sessions to 100% correct reading and fewer retraining sessions per word set.

Figure 5 shows the data on word retention probes for Julie. Five Errorless and four Trial and Error word sets were trained for this subject. Three Errorless and three Trial and Error word sets were trained to the mastery criterion. More training sessions were needed to reach 100% correct reading in the Errorless procedure, but more
Figure 3. Percent correct on daily word retention probes across sessions for Sally.
Subject Sally

- Errorless
- Trial and Error

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Figure 4. Percent correct on daily word retention probes across sessions for Sam.
Subject Sam

-○ Errorless
Δ---Δ Trial and Error

○ May, Friend
△ Didn't, Wash

○ About, City
△ Other, Warm

○ Gave, Found
△ When, Are

○ Then, Show

○ Every, Much

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Figure 5. Percent correct on daily word retention probes across sessions for Julie.
FIGURE 5

Subject Julie
- Errorless
- Trial and Error

- May, Friend
- Didn't, Wash

- City, Want
- Other, Warm

- New, Gone
- Find, Show

- Some, Give
- Much, Light

- Across, Why

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Figure 6. Percent correct on daily word retention probes across sessions for Tom.
Table V. Average number of sentence probes needed to reach the mastery criterion per word set for each subject.
<table>
<thead>
<tr>
<th>Subject</th>
<th>Errorless</th>
<th>Trial and Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen</td>
<td>16/3 (5.33)</td>
<td>16/2 (8.00)</td>
</tr>
<tr>
<td>Bob</td>
<td>40/6 (6.66)</td>
<td>25/4 (6.25)</td>
</tr>
<tr>
<td>Sally</td>
<td>32/5 (6.40)</td>
<td>17/4 (4.25)</td>
</tr>
<tr>
<td>Sam</td>
<td>22/4 (5.50)</td>
<td>21/2 (10/5)</td>
</tr>
<tr>
<td>Julie</td>
<td>18/3 (6.00)</td>
<td>19/3 (6.33)</td>
</tr>
<tr>
<td>Tom</td>
<td>7/1 (7.00)</td>
<td>26/4 (6.50)</td>
</tr>
<tr>
<td><strong>OVERALL TOTAL</strong></td>
<td><strong>135/22 (6.14)</strong></td>
<td><strong>124/19 (6.52)</strong></td>
</tr>
</tbody>
</table>
retraining sessions were required in the Trial and Error procedure. Julie was probed for one session beyond the mastery criterion in the second Errorless word set (city, want), but reading remained at 100% correct responding.

Word probe data for Tom are presented in Figure 6. Three Errorless and six Trial and Error word sets were introduced for this subject. Four Trial and Error word sets were mastered while only one Errorless word set reached the mastery criterion. Tom never mastered the word "about" in the second Errorless word set (Panel 2). After 12 training sessions, the second Errorless word set was abandoned and a third Errorless word set was introduced. For the word sets mastered, more trials to 100% correct reading and retraining sessions were required in the Trial and Error condition, which is partly a function of the larger number of word sets introduced in the Trial and Error procedure.

In addition to the daily word retention probes, data were collected on daily probes of the sight words in sentences. The sentence probe data paralleled the word probe data in terms of the errors made. The sentence probe data for each subject are presented in Table V. The average number of sentence probes needed to reach the mastery criterion per word set for each subject, i.e., 100% for three consecutive sessions, is presented for both conditions. In the Errorless condition, the range of necessary probes was 5.33 to 7.00, with a mean of 6.15. The range for the Trial and Error probes was 4.25 to 10.5, with a mean of 6.97. The overall total difference between the two conditions was very small (6.14 versus 6.52 average probes per word set).
DISCUSSION

Results of this study indicate that phonically-irregular words can be taught to remedial readers utilizing either a Trial and Error or an Errorless procedure. The number of sight words taught to each subject exceeded the number of sight words included for instruction in the Decoding A program of the Corrective Reading Series. In terms of overall retention, the Errorless procedure was superior, as subjects retained 41% more words on the final day retention probe in the Errorless condition. Follow-up probe data indicated a smaller difference between the two procedures, although subjects still scored 9% higher with the Errorless procedure words.

Although either procedure can be used to teach irregular words, a comparison of the two procedures in terms of training time required is critical. The Errorless procedure required 133% more time per training session. Thus, if teachers used the Errorless procedure, they would have to spend between five and nine minutes per session, as opposed to the two to five minutes required for the Trial and Error procedure. However, the Trial and Error procedure required 133% more retraining sessions per word meeting the mastery criterion. Thus, although less time was needed per Trial and Error session, more retraining sessions were required. With the Trial and Error procedure, more time was spent in remedial activities.

In terms of teaching a discrimination task, the Errorless procedure would be preferable, as time was spent in the critical acquisition
of the task rather than in remediating errors. The Errorless procedure may have circumvented the problem of developing persistent error patterns by minimizing the number of retraining sessions necessary. Touchette (1968) suggested that persistent error patterns may develop due to Trial and Error training techniques.

Minimizing the number of retraining sessions decreased the number of corrections needed as well. Stoddard and Sidman (1967) suggested that one detrimental effect of increased errors is the decrease in the number of opportunities for obtaining a reinforcer. Thus, by decreasing the number of retraining sessions needed, the Errorless procedure provided more opportunities for subjects to obtain reinforcers, particularly at the start of each session.

In terms of practical applications of the two procedures, the Errorless procedure is clearly preferable. Although teachers would be required to spend more time with a student per session, the amount of time required is brief (five to nine minutes). Since remediation is not needed very frequently, teachers can be assured that few retraining sessions will be required over the word sets taught. It is less likely that teachers would spend repeated sessions in remediation activities, even if those sessions were brief.

The daily word retention probe data (Figures 1 through 6) indicate that for five out of six subjects, more word sets were mastered with the Errorless procedure. The data for the sixth subject, Tom, are difficult to interpret. Not enough data are available in the Errorless procedure to determine whether or not the difficulties Tom had in that procedure were due to specific properties of the irregular
word being taught (about). Tom's Trial and Error procedure performance was comparable to Bob's (Figure 2), indicating no difficulties with that procedure. Thus, the Errorless procedure would be recommended over the Trial and Error procedure. The Trial and Error procedure took 33% more sessions to reach 100% correct responding per word meeting the mastery criterion, and required 166% more total sessions per word meeting the mastery criterion.

The daily probe results are supported by the final day and follow-up retention probe data, as subjects retained more words with the Errorless procedure. The follow-up data indicate that for both procedures, less than 50% of the words introduced during the study were retained after six, seven or eight weeks. Clearly, further research is needed to investigate methods to improve long-term retention. One possible method would be to program more extensively for generalization. Once sight words were mastered on word cards and in controlled sentences, they could be probed in the context of grade-level basal reader passages. Also, continued review of words after training has been completed is a variable which might affect long-term retention.

The Errorless procedure differed from the Trial and Error procedure in several ways. Three critical features of the Errorless procedure are outlined below. The first feature was the echoic prime provided as each word was introduced. Thus, each visual stimulus was paired with the appropriate auditory stimulus without an opportunity for initial error. The prime served the same function as the delayed prompt outlined by Touchette (1971), and provided initial opportunities
to obtain social praise which could be important (Stoddard and Sidman, 1967; Neef, Iwata and Page, 1977).

A second feature was the presentation of two maximally-different words in each training session. Data collected by Halvorsen (unpublished) suggest that there is no difference between training minimally- or maximally-different sight words. Maximally-different words are much easier to select and program than minimally-different words. The data collected in this study on sentence reading indicates that subjects did attend to the relevant features of the target words, as the errors made in the sentences paralleled the errors made on the word retention probes.

A third feature was the use of interspersal trials during training. The addition of 15 interspersal trials per session allowed for additional "heterogeneous" trials (Hooten, 1975), as well as cumulative review of words previously taught and mastered. Subjects had to discriminate between an increasingly larger group of sight words (two to five words) within each training session. The interspersal of words minimized the possibility of errors occurring due to task "homogeneity" or repetitiveness, as a new word was added after each five trials.

Since the Errorless procedure contained three major components, a component analysis would be useful. One important question is to sort out the importance of the cumulative review of words previously mastered from the interspersal element in terms of overall word retention. In other words, were the additional discrimination trials the critical feature, or the continual review of target words? This
question could be addressed by comparing an Errorless procedure utilizing interspersal of words known on the pretest and an Errorless procedure utilizing interspersal of words mastered during training.

Another practical area of interest is the transfer of reading sight words in the training sessions to reading those words in the basal reader. Teachers utilizing the Errorless drill procedure for sight words in the classroom could select target words directly from the basal reader stories, thus insuring additional opportunities for students to contact and practice the target words.

One additional practical advantage of the Errorless procedure is the ease with which it can be implemented. A classroom aide could readily learn to conduct the drill sessions with low performers in the classroom. By incorporating elements of Alessi's (unpublished) word bank, students would have an incentive system for mastering words, i.e., increasing the size of the word bank. Because of the minimum time involved per session, aides could provide low performers with a sight word drill session in an area of the classroom during reading or some other convenient time.

The stimulus control literature outlining errorless acquisition and retention of tasks clearly has applied relevance in the area of teaching basic reading to remedial readers. In particular, phonically-irregular words can be taught to remedial readers utilizing the errorless technology. Providing an echoic prime, eliminating irrelevant cues and providing cumulative review over words previously taught are all components of the Errorless procedure outlined in this study. Further research in this area, particularly focusing
on methods to improve long-term retention, would provide a significant contribution to the applied literature. Clearly, the range of application of techniques to improve stimulus control has yet to be determined.


Terrace, H. S. Discrimination learning with and without "errors". *Journal of the Experimental Analysis of Behavior*, 1963(a), 6, 1-27.


Uhlman, J. D. and Sulzer, Azaroff, B. Multielement baseline design in educational research. In E. Ramp and G. Semb (Eds.), *Behavior Analysis: Areas of research and application*, 1975.

APPENDIX A

Client Informed-Consent Form Distributed to Parents

Dear ____________:

________ is enrolled in the Project Help reading program for the Summer session 1979. ________ 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 ten minutes of instruction time each day your child attends Project Help this session. One of the procedures is very similar to the one which is included in the regular A program. The other procedure is one which is designed to help your child learn new words while making fewer mistakes. 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 because they are frequently found in the classroom reading books for grades 1-3. The tutor working with your child will teach the words as part of the daily lesson. He or she will keep daily records regarding how long it took to teach each new word. These records will be kept with the tutor's regular tutoring materials on a special shelf. If you wish to see these records or observe a session at any given time, you are welcomed to do so.

A weekly report will be sent to you listing the words your child learned during the week. At the conclusion of the summer term, a final report will be sent to you, 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 school psychologists: Dr. Cheryl Poche and Dr. Galen Alessi. As the person responsible for the project, I am the Program Director of Project Help. I hold a master's degree in Psychology and an elementary education certificate. This project is part of my degree requirements for the Ph.D. 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 above 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 if I so wish.

Signed: ____________________________ Date: ____________
Session Checklist for Errorless Procedure

Session Checklist: Errorless condition
Checklist filled out by: ________________
Date: __________________
Subject: ________________

1. E presents words for retention probes (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 probe (points to each word; corrects errors on nonsight 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, then 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, then replaces them, requesting a response to the 2nd word only from the S.  

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

8. E removes cards for 3 sec, then replaces them, requesting response to both words from S.  

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.  

+ done correctly  
o done incorrectly  
or not done
11. E adds 2nd interspersal word for 5 trials.
12. E adds 3rd interspersal word for 5 trials.
Session Checklist for Trial and Error Procedure

Session Checklist: Trial and Error Condition

Checklist filled out by: ________________________
Date: _____________________
Subject: ____________________

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

2. E presents sentence retention probes (points to each word; corrects errors on nonsight words; provides no corrections or prompts for sight words; 5 sec for each word; scores data sheet) ___

3. E places both cards on the table and asks S to read each word without corrections or prompts once. ___

4. E shifts cards and replaces them after 3 sec, asks the S to read each word and corrects errors. ___

5. E shifts cards and replaces them in an unpredictable order, asks S to read each word within 5 sec, records all responses, corrects all errors. Each trial consists of placing the 2 cards on the table. ___

6. E ends session after 5 consecutive correct trials. ___

7. E gives 10-15 points to S at the end of the session. ___