

THE EFFECTS OF FADING ON THE ACQUISITION  
AND RETENTION OF ORAL READING<sup>1</sup>

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Comparisons were made between reading programs that involved superimposition of correlated pictorial and printed stimuli, fading of the pictorial stimuli, and overt observing (touching) responses. Nursery school children aged 4 to 5.8 yr learned and retained oral reading behavior better when fading was used; observing responses had no effect.

Reading may be defined as a discrimination in which "... a vocal response is under the control of a non-auditory printed stimulus." (Skinner, 1957, p. 66). Thus, the goal of any program to teach oral reading should be to facilitate the acquisition of that discrimination. Procedures for the rapid acquisition of a complex discrimination by transferring control from one stimulus dimension to another have been demonstrated in pigeons (Terrace, 1963*a, b*), normal children (Moore and Goldiamond, 1964; Gollin and Savoy, 1965) and retardates (Sidman and Stoddard, 1969; Touchette, 1968). The procedure in each case consisted of superimposing the new stimulus dimension upon a stimulus dimension under which responding was already controlled and gradually fading out the original stimulus dimension.

Reese (1965) used a fading procedure to train pigeons to respond appropriately to two printed words, "Turn" and "Peck", while McDowell (1968) gradually eliminated echoic, pictorial, and textual stimuli while kindergarten children were reading "Goldilocks". A later

study (McDowell, Nunn, and McCutchen, 1969) involved a comparison between fading and a program in which children guessed the same words and received feedback from the experimenter. Both groups did better on retention tests than a non-treated control group, but both instructional methods were equally effective. However, this comparison did not involve a direct test of the relative effectiveness of fading, since there were no initial controlling stimuli for the "feedback-only" group. In addition, the reinforcement contingencies and the method used to fade the complex and redundant controlling stimuli were not precisely specified.

In light of the general use of the "sight" method of teaching reading (Heilman, 1961), and since the "sight" method usually involves superimposition of printed and verbal or pictorial stimuli without a systematic program for the transfer of the response to printed stimuli alone, the present study was undertaken as a direct comparison of fading and superimposition in the acquisition and retention of oral reading. A further purpose was to study the role of overt observing responses in the transfer of stimulus control in the reading situation.

## EXPERIMENT I

### METHOD

#### *Subjects*

Twelve non-reading normal nursery school children, six male, six female, aged 48 to 66

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months, were randomly assigned to one of two groups: fading (F) and superimposition (S).<sup>3</sup> Pilot observations established that children designated as non-reading by the nursery school instructors could not read the words later used in the study.

### Apparatus

Stimuli were constructed from six Milton Bradley "Picture flash cards words for beginners" (apple, ball, horse, dog, elephant, and book). Photographic negatives were mounted in Kinderman slide holders with varying amounts of translucent material (combinations of typing and tracing paper) covering the pictures. There were six steps for each picture-word combination to be used in the fading procedure. In Step 1, both the picture and the word had a light transmittance of approximately 40%, while the background transmitted approximately 0.16%. The word and background remained constant for the rest of the steps, while the picture transmitted as follows: Step 2, 7.1%; Step 3, 3.5%; Step 4, 2.2%; Step 5, 1.6%; Step 6, background and word only. Measurements were obtained on a Macbeth Quantilog Densitometer, model TD102.

The slides were projected on an 7.25 by 9.5 in. (18.3 by 23.7 cm) rear projection screen mounted in the front of a plywood box that enclosed a Kodak Carousel 850 projector and a candy dispenser. In the lower center of the screen was a three-dimensional clown face with a red pilot light for a nose. The chute for the candy dispenser exited below the clown. The projector lamp, forward and reverse slide change mechanism, and delivery of the light and candy were remotely controlled.

### Procedure

Subjects were seated before the apparatus and instructed that they would see pictures and words on the screen, and that they were to tell

<sup>3</sup>The authors wish to thank Mrs. William Hollander for the use of the facilities of the Busy Bee Nursery School, Amityville, New York.

"Happy the Clown" what the words were. If they were correct, "Happy" would light up and sometimes give them candy. Appropriate verbal responses were followed every time by the illumination of the clown's nose and on an average of once every three times by the delivery of Hersheyettes. Slides were arbitrarily divided into three sets of two picture-word combinations and the stimuli in each set were presented in a scrambled order. In the superimposition (S) group, each set of two picture-word combinations was presented at full strength (Step 1) five times, followed by the presentation of the word alone (Step 6). This last step constituted the initial test; thus, there were three such tests during acquisition, one for each pair of words.

The fading (F) procedure was similar, but for Steps 2 through 5, each picture became progressively darker while the word remained at full strength. Step 6 again constituted the initial test with only the word visible. The order of presentation of individual words was the same for both groups. After the last initial test, Subjects were tested on all six words alone in a scrambled order; this constituted the cumulative test. Inappropriate behaviors (*i.e.*, looking at Experimenter, talking) were controlled through the use of a timeout procedure, in which the screen was briefly darkened until inappropriate responding stopped. In neither group were any verbal prompts employed, other than initial instructions. All children could name the pictures, and the responses of the subjects to the printed or pictorial stimuli were unambiguous. The detection, reinforcement, and recording of correct responses were all carried out by the second author.

### RESULTS

The mean number of correct words out of a possible six were as follows: group F, initial test = 5.67, cumulative = 3.00; group S, initial test = 0.33, cumulative test = 0.83. These data are shown in Figure 1. An analysis of variance yielded an *F* for the method of presentation

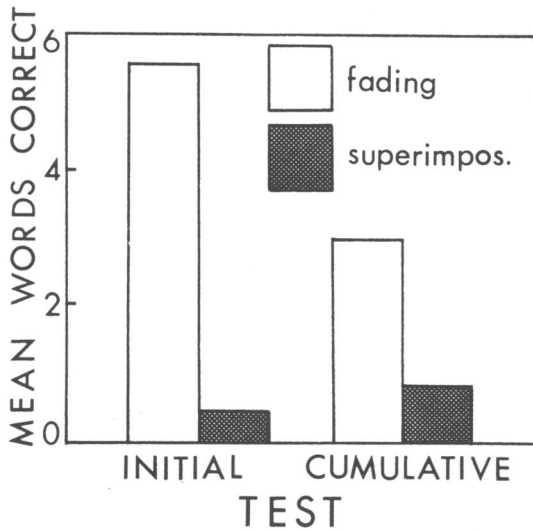


Fig. 1. Mean words read correctly as a function of teaching procedure and test time.

(fading *vs.* superimposition) of 76.13 ( $df = 1, 10, p < 0.005$ ). The effect of test time (initial *vs.* cumulative) was non-significant ( $F = 0.46$ ). The interaction between method of presentation and test time was significant at  $p < 0.005$  ( $F = 34.02, df = 1, 10$ ), reflecting a decrement in performance from the initial test to the cumulative test for the fading group. A *post hoc t*-test between groups on the cumulative test yielded a  $t$  of 3.61 ( $df = 10, p < 0.005$ ) in favor of the fading group.

## EXPERIMENT II

Experiment I demonstrated that fading facilitated the acquisition of reading more efficiently than did a superimposition procedure. Experiment II had as its purpose a direct replication of Experiment I with the additional requirement of an overt observing response for half of the subjects. It may be hypothesized (Terrace, 1963*b*) that fading is effective because it forces the subject to shift "attention" from the old stimulus dimension to the new dimension early in acquisition. An alternative way of forcing this attentional shift might be to require that the subject attend to the new dimension throughout a simple superimposition procedure by performing a

chain of responses, *i.e.*, touch the printed word with a finger before naming the word. If this relatively simple procedure produced results comparable to fading, then the technical problems of programming a sequence of faded stimuli in the classroom could be avoided.

An additional purpose of Experiment II was to test the longterm retention of reading responses after different training procedures, since a procedure that produced only transitory effects would be of limited practical value.

## METHOD

### Subjects

Forty normal, non-reading nursery school children, 17 male, 23 female, aged 48 to 70 months, served.<sup>4</sup>

### Apparatus

The apparatus was the same as that in Experiment I, with the addition of a bell that rang when the clown's nose was illuminated.

### Procedure

The following groups of 10 Subjects each were randomly assigned to cells in a  $2 \times 2$  factorial design: fading (F), superimposition (S), fading with observation (FO) and superimposition with observation (SO). Groups F and S allowed a direct replication of Experiment I. The procedure for groups FO and SO was identical to groups F and S, respectively, except that the child was instructed to touch the word before naming the stimulus, and the light, bell, and candy were withheld until the child performed this chain. Few prompts were necessary to maintain the chain. The presentation of stimuli, schedule of reinforcement, and the administration of the initial and cumulative tests were the same as in Experiment I, with the addition of a retention test administered at a mean interval of

<sup>4</sup>The authors wish to thank Mrs. Paula Roberts for the use of the facilities of the Robin Hood Country Day School, Brookville, New York.

44 days (range: 26 to 69) following the cumulative test.

### RESULTS

An analysis of variance of correct responses (out of six) as a function of group and retention interval yielded a significant effect of method of presentation ( $F = 14.01$ ,  $df = 1, 3$ ;  $p < 0.005$ ) and retention interval ( $F = 34.4$ ,  $df = 2, 72$ ,  $p < 0.005$ , while the effect of observing responses was not significant ( $F = 0.05$ ). In addition, none of the interactions approached significance. The fading groups achieved better retention scores than the superimposition groups; the mean scores for the individual groups as a function of retention interval were as follows: Initial test, S = 2.8, SO = 2.2, F = 3.4, FO = 4.1, cumulative test S = 1.9, SO = 1.5, F = 2.6, FO = 3.1; retention test, S = .9, SO = 1.4, F = 1.8, FO = 2.0. The pooled fading (F and FO) and superimposition (S and SO) means for all three tests appears in Figure 2.

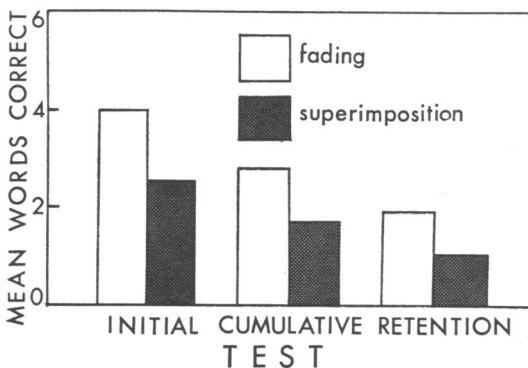


Fig. 2. Mean words read correctly as a function of teaching procedure and retention interval.

### DISCUSSION

The general finding of this study was that a fading procedure may be profitably applied to the reading situation, in that it produces fewer errors than a superimposition procedure over a wide range of testing intervals. The difference in magnitude of the main effect in Experiment I and II may have been due to population differences or other factors, but the general finding

that fading was more efficient than superimposition was clearly replicated. It must be noted, however, that the present fading procedure was rigidly predetermined in order to equate the number of exposures and reinforcements received by the fading and superimposition groups. More typically, fading is continued until the subject makes an error, at which point the controlling stimulus is re-introduced at a higher intensity. This titration procedure would be more likely to result in nearly errorless acquisition than the present procedure, and is more appropriate when dealing with children who differ greatly in their rates of acquisition of the discrimination.

The implications of the ineffectiveness of chaining an overt observing response are somewhat ambiguous. It may be either that the primary function of fading does not involve an attentional shift or that the manipulation in the present study was not effective in shifting attention. In either case, the present results would seem to indicate that it may be valueless to instruct a child to point at a word during the acquisition of oral reading, and the reader is cautioned against drawing any inferences from the slight, nonsignificant effects of the observing contingencies in Experiment II.

Given the general use of the "sight-reading" (superimposition) procedure, either alone or in combination with a phonetic approach in teaching reading (Heilman, 1961), it would appear that the reduction of early reading errors through a fading procedure would be desirable. Even if a superimposition procedure were not to be eventually used, a child might profit from the high density of reinforcement associated with "errorless" performance at the very beginning of training or in a remedial program, since Hively (1962) has shown that success on early, simple discriminations facilitates later performance on complex discriminations.

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