TRAINING LETTER DISCRIMINATION IN FOUR-YEAR-OLD CHILDREN¹

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Four-year-old children were tested on letter discrimination. Subjects in two experimental groups went through an experimental training program on a match-to-sample apparatus. Subjects in the experimental-critical group were given reinforcers for responding to features of the stimuli thought critical for discriminating letters while subjects in the experimental-noncritical group were given reinforcers for responding to non-critical features. Subjects went through the training program daily until they reached criterion; then they were posttested on letters. Subjects in a control group received no training but were posttested. Subjects in all groups made fewer errors on the posttest. Subjects in the experimental-critical group made significantly fewer posttest errors than subjects in the experimental-noncritical group, lending support to the hypothesis that reinforcement of discriminative responding to critical features of letter-like stimuli results in greater improvement in letter discrimination than reinforcement of discriminative responding to noncritical features of stimuli. Analysis of confusion matrices provided tentative indications of the nature of letter confusions in 4-year-old children.

It is generally supposed that visual perception in first-grade children is sufficiently developed to enable the child to succeed in beginning reading. That many children nevertheless do not readily succeed is no secret, and has been of concern to educators of normal and of exceptional children. This failure to learn to read is often ascribed to some impairment or delay in visual perceptual development. Once identified, children with "perceptual" problems may be subjected to any of an amazing variety of techniques to overcome this perceptual deficit. Money (1966) questioned the relevance of such techniques: "... current fashions in perceptual training and visual motor coordination . . . have not yet been proved to have any direct effect on the learning of reading (p.v.)."

Perceptual training programs designed to remedy an inferred dysfunction or delay in perceptual development appear to be based on the following assumptions: it is necessary to fill in perceptual deficits of children who are not "perceptually ready" to read; training on non-specific stimuli transfers to skills necessary for acquisition of reading; the training of "processes" is superior to the training of specific tasks; such procedures are useful for a broad spectrum of children who exhibit a "perceptual deficit". The validity of these assumptions is open to question.

A behavioral approach to teaching children with reading problems offers an alternative to "perceptual training". Reading is treated as a complex behavior that can be broken into component parts, each of which must be learned. Execution of a "remediation" program requires task analysis of reading skills and development of programs to train each skill. This study is concerned with the task analysis and training of a "pre-reading" skill, letter discrimination.

Little attention has been given to the development of the perception of complex figures, including letters (Gibson and Olum, 1960; Wohlwill, 1960). Gibson, Gibson, Pick, and Osser

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(1963) noted that it is generally assumed that when a child begins to read, he can discriminate the letters of the alphabet. This undoubtedly accounts for the fact that only a few studies have focused on the phenomenon of reversals and rotations (Davidson 1934, 1935; Kennedy, 1954). Gibson *et al.*, (1963) examined the development of letter discrimination in 4- to 8-yr-old children. They analyzed the letters of the alphabet to determine which features are critical for discrimination and constructed letter-like forms based on rules that determine letter construction. They presented subjects with a sample letter-like figure and a comparison array and instructed them to pick out from the array those stimuli exactly like the sample. They found that children learn to attend to distinctive critical features of stimuli. Those that are critical, such as rotation and reversal, are learned. Those that are not critical for letter discrimination, *e.g.*, perspective transformations, are not discriminated even at older age levels.

Gibson, Osser, Schiff, and Smith (1963) quantified the critical feature reported in the Gibson *et al.*, (1963) study. They developed a confusion matrix, based on successive presentations of letters to subjects in a match-to-sample design. This 26 by 26 matrix showed which letters of the alphabet were most often confused with each other. The stimuli from the Gibsons' experiments and information obtained by their confusion matrix analysis have been used in the development of the present study.

Jeffrey (1958), Bijou and Baer (1963), Moore and Goldiamond (1964), Sidman and Stoddard (1966), and Bijou (1968), reported attempts to teach complex visual discriminations to normal and retarded individuals. While the nature of the discriminations has varied, it has generally been found that, when sufficient attention is given to programming, very complex discriminations can be established. These studies suggest a methodology for training letter discrimination and, eventually, higher-order skills.

The purpose of the present study was to compare the effect of two training procedures on

subsequent letter discrimination. It was hypothesized that reinforcement of discriminative responding to critical features of stimuli will produce significantly better performance on a test of letter discrimination than reinforcement of discriminative responding to noncritical features of stimuli. Letter-like forms were used in training to avoid confounding with early or concurrent exposure to letters and to have stimuli that would "accept" the additions or distortions planned in the training programs.

METHOD AND MATERIALS

Subjects

The subjects for this study were drawn from the population of 4-yr-old children enrolled in the Champaign-Urbana, Illinois, summer Head Start program. They came from predominately Negro, low-income homes in the community.

A pretest of letter discrimination was given to 73 of the 85 children listed at the attendance centers. The children not tested were enrolled but absent while pretesting was in progress. The 30 children who made the greatest number of errors on the test of letter discrimination were assigned to experimental-critical, experimental-noncritical, or control groups in the following manner. The subject who made the highest number of errors was assigned to the experimental-critical group, the next highest to the experimental-noncritical group, the third highest to the control group, the fourth highest to the experimental-critical group, and so on. There were 10 subjects in each group, with 13 males and seven females distributed between the two experimental groups. Chronological ages of all subjects ranged from 4-0 to 4-9, with means of 4-5 for the experimental-critical and experimental-noncritical groups, and a mean of 4-3 for the control group. Three subjects in the experimental-critical group and four in the experimental-noncritical group were replaced during the experiment. Two went on vacation, three failed to meet the initial pretraining criterion, and two exhibited behavior problems. Replace-

ments were drawn in random order from the remainder of the subjects in the Head Start population. Pre- and posttest data were obtained on all subjects originally assigned to the control group.

Materials

A test of letter discrimination and stimuli for use during the training program were constructed.

Test of letter discrimination. Data from the Gibson, Osser, Schiff, and Smith (1963) study were utilized to develop the test of letter discrimination for this study. Capital letters were typed on a 3 by 4.25 in. page, in IBM Prestige Elite type, in a match-to-sample arrangement. Five letters appeared below the sample. The comparison letters were chosen on the following basis: (1) the match; (2) letters with which the sample was highly confused (highly confused defined as five or more errors in the Gibson matrix); (3) letters that showed somewhat lesser degrees of confusion in the Gibson matrix or that had the same configuration. The last category was necessary

because most letters were highly confused with only one or two other letters. Since this was so, it was necessary to choose the five comparison letters on additional bases. The aim was that each match would be made under the most "confusing" conditions. Although they were not highly confused with other letters, B-I-S-Z were included in the test, in order that each letter appear at least one time.

When the Gibson matrix indicated that a letter was highly confused with more than one other letter, it appeared as a sample more than one time. This was done so that if, for example, the letter C was confused with the letters O, G, J, and U, the subject would have an opportunity to make each confusion error. The letter C appeared as a sample five times in the test of letter discrimination. Thus, it was possible for the subjects to make one correct C-C match along with C-O, C-G, C-J, and C-U confusions (or up to five confusions of any type).

Table 1 illustrates the 42 items that made up the test. The position of each item within the test booklet was randomly assigned.

Table 1

Match and Comparison Stimuli for Each Item on the Test of Letter Discrimination

Page No.	Sample Stimulus	Comparison Stimuli	Page No.	Sample Stimulus	Comparison Stimuli
1	C	OCUGJ	22	Y	RVYXK
2	M	MNHWZ	23	C	GJCOU
3	O	GDCQO	24	K	NXFKH
4	M	HWMNZ	25	O	QGCDO
5	I	LITFP	26	N	MNFKW
6	Q	GOQCD	27	G	BGQCR
7	R	RBGHP	28	X	VXKWZ
8	N	FWNMK	29	F	EHKFL
9	B	PREGB	30	W	EW MNX
10	A	AVNHX	31	S	GZJBS
11	V	KYAVX	32	W	XMWNE
12	V	KXYVA	33	C	JCOUG
13	U	VUCJY	34	C	GJOUC
14	Y	XYVKR	35	C	UGJCO
15	O	DQCOG	36	P	DEF RP
16	M	MHNWZ	37	L	TELFZ
17	D	DOHQN	38	T	LTIEF
18	V	AXVYK	39	E	BEFHR
19	N	NWMFK	40	K	HNFXK
20	H	PEHMR	41	Z	ZSMLJ
21	X	WZVXK	42	J	QUCZJ

Familiarization stimuli. A series of 31 slides was used in familiarizing subjects with the laboratory setting and the apparatus. The stimuli were slides of cartoon characters shown in a match-to-sample apparatus. The sample stimulus appeared in the top window and the comparison stimuli appeared in any of five windows positioned below the sample.

Training stimuli. A set of 156 slides trained subjects to respond to specific features of letter-like stimuli. These stimuli resembled those used in the Gibson, Gibson, Pick, and Osser (1963) experiments and are represented in Figure 1.

Features critical for letter discrimination were determined by searching the Gibson, Osser, Schiff, and Smith (1963) confusion matrix for highly confused pairs of letters, grouping together those letter-pairs with common structural characteristics and comparing each letter in a group with each of the others. For each letter-pair comparison, a set of operations was stated that would transform one letter into the other. Generalized transformation rules were then extracted by grouping similar sets of operations. In the end, there were 19 changes of basic figure and three changes of orientation in the set of critical features. Figure 2 illustrates transformations of the

four basic stimuli used in the set of training slides.

The features assumed to be noncritical to letter discrimination were size of figure, width of line, and addition of an irrelevant shape to the basic figure. In constructing the set of training stimuli, the three noncritical features were used repeatedly, with variations: size was faded from a 12/16 in. to a 2/16 in. difference between stimuli. Width of line was faded from thick (0.25 in.) to thin (just appreciably larger than the width of line in the standard figure).

Each training slide contained a sample letter-like stimulus and either two or three comparison letter-like stimuli. Both critical and noncritical features appeared on the sample. The matching critical feature appeared on one comparison stimulus (correct for the experimental-critical group), and the matching noncritical feature on a different comparison stimulus (correct for the experimental-noncritical group). An exception was test slides, where matching critical and noncritical features appeared on the same comparison stim-

Fig. 1. Stimuli used in the training program.

Fig. 2. The four sample stimuli and the changes in those stimuli that represent the set of critical differences abstracted from the rules derived by analyzing specific letter-pair combinations.

Fig. 3. Stimuli showing alternatives for experimental-critical and experimental-noncritical groups on one segment of the training series.

ulus, and the responses of subjects in both experimental groups to the same stimulus were reinforced. Responses to test slides indicated whether the experimental-critical group, for example, matched by responding to the critical feature and not simply by avoiding the non-critical feature. (A correct match on a test slide could not occur if the subject avoided the non-critical feature.) Figure 3 illustrates the layout of training slides.

The set of 156 training slides was arranged into a series of 23 increasingly difficult programs, with a varying number of slides in each program. Within each program, discriminations progressed from easy to difficult. The training series was not designed to produce errorless learning. Each program, however, was built on preceding programs.

Apparatus

Two subjects were run simultaneously in separate experimental rooms, approximately 5 by 7 ft, which contained identical response panels. The controlling and recording apparatus for both rooms was identical in function and was located in a passageway behind the rooms. To

balance the effects of any differences between the two sets of equipment, subjects alternated between rooms on successive days. The experimenter could observe the subject through a one-way window and could communicate with the subject through an intercom system.

The response panel, described by Bijou (1968), consisted of one long sample window and, directly below it, five comparison windows. The windows were made of translucent plastic and were hinged so that pressing them closed microswitches mounted behind the panel. A bead dispenser was mounted above the response panel. Reinforcers were collected in a transparent plastic container attached to the dispenser. A red light was situated below the row of five comparison windows. A chime and buzzer were located directly behind the response panel.

The subject was required to press the top window, in which the sample stimulus was present. This press caused the comparison stimuli to appear in the lower windows so that both the sample stimulus and comparison stimuli were present. If the subject pressed the correct comparison window, a chime rang, a red light flashed, and a bead was dispensed into the transparent box. If an incorrect comparison window was pressed, a buzzer sounded, and the comparison windows went dark. The subject had to press again the sample window, which still contained the same sample stimulus, to re-illuminate the same stimulus array in the comparison windows. A correct response after an incorrect response resulted in the chime and flashing light, but no bead reinforcer. Under this correction procedure, the slide tray advanced to the next slide only after a correct response.

Reinforcement

A reinforcement system similar to one described by Staats *et al.*, (1964) was used. A heavy board, drilled to hold five transparent tubes, was clamped to a small table. Plexiglas tubes of different heights and diameters were placed in the holes. Back-up reinforcers were attached to a 3 by 4 ft board situated behind the

plastic tubes, and were obtained when the subject had filled one of the tubes with beads.

A variety of back-up reinforcers was available at all times. Reinforcers were changed periodically to maintain the subject's interest in the selection. Reinforcers included small boxes of raisins, five-cent bags of M & M's, five-cent candy bars, and a variety of small toys worth 10, 15, 20, and 50 cents.

Procedures

Pretesting. Children were pretested at Head Start attendance centers approximately three weeks after the beginning of the summer Head Start program.

The examiner first presented each child with a set of colored blocks, in a match-to-sample arrangement, to test the concept of matching. Then, subjects were presented with the test of letter discrimination. The examiner pointed to the sample, then said: "See this? Now find one here", while pointing to the row containing the comparison letters.

Familiarization. With parent permission, subjects assigned to experimental and control groups were transported by car from Head Start attendance centers to the laboratory. Each subject was brought into the room by the examiner and seated on a chair in front of the response panel. The set of cartoon slides was used. The examiner said: "Watch me", then proceeded to press the top window, in which the sample was already present. The examiner then pressed the comparison window containing the match and obtained the bead reinforcers. This sequence was repeated three times, then an incorrect (blank) window was pressed to illustrate the consequence of an incorrect response. After the buzzer sounded and the bottom windows went dark, the top window was pressed again and a correct matching response was made. The examiner said: "Now, you do it." After the subject made four matching responses, the examiner stopped him and helped him place the beads in a plastic tube. Then he said: "When this is full you get one of these", and pointed to the array of toys

and candy. The subject was returned to the response panel with the directions: "Get as many beads as you can. When you are done, you can get some of these."

At this point, the examiner said: "Now, do more. Get as many as you can", and left the room. The subject completed the remainder of the 31 slides in the cartoon series. If the subject reached criterion (five or fewer errors in the set of 31 slides) early in a session, he was immediately placed on the training series of letter-like stimuli. If the subject failed to reach the criterion he repeated the familiarization series. If he reached criterion on the familiarization series too late in the session to begin the training that day, he was given one additional presentation of the familiarization series the following day, then started on the training series. Each time the subject completed the set of slides, the examiner returned to the experimental room and helped the subject transfer the beads to a reinforcer tube. At the end of the 20-min experimental session, the beads were traded for a back-up reinforcer. Three subjects failed to meet the criterion after 15 presentations of the familiarization series and were dropped from the experiment and replaced by other children.

Training. When a subject started on the set of 156 slides in the training series, the examiner pointed to the letter-like stimulus that was present in the sample window and said: "See this? Do what you did before."

The examiner waited until the subject began responding appropriately, then left the room. After the subject finished each tray of 48 to 57 slides, the examiner said, over the intercom: "Good, I'll be right there", then went to the experimental room to help the subject place his beads in the reinforcer tubes. The examiner then returned to the area containing the recording and controlling equipment, recorded the data, reset the apparatus, put in the next tray of slides, turned on the intercom, then said: "Begin now". The time necessary to reset the apparatus introduced a short wait for the subject after each tray was completed. At the end of each daily

session, the bead reinforcers were traded for a toy or candy.

Each subject went through the complete training series once daily until he reached the criterion of 16 or fewer slides with errors (10% error rate) or until he had completed 20 training sessions.

Posttesting. The test of letter discrimination was administered the day after each subject in the experimental groups reached criterion on the training series. Testing was done by assistants in a small room adjacent to the experimental rooms. Subjects in the control group were posttested at Head Start Centers during the last week of the summer Head Start program, at a time when most experimental subjects were completing the training series.

RESULTS

Difficulty Level of the Training Program

One criterion guiding the development of the training series was that the training programs for the experimental-critical and experimental-noncritical groups be of equal difficulty. The subjects were run through the series to criterion (10% errors) or to termination (20 sessions). A *t*-test was computed on trials to criterion between experimental groups. The obtained *t* (0.28) was non-significant, indicating that the assumption that the programs were not different in difficulty need not be rejected.

Pre- and Posttest Analysis

The subjects' performance on the pretest is shown in Table 2. Since the letters did not ap-

pear an equal number of times, the types of confusions were scored instead of the total number of errors; *e.g.*, the subject might make a C-G error three times and a C-U error once. This would be scored as two error types: C-G, C-U, rather than four errors. An analysis of variance of number of error types in each group was computed on the pretest scores. The obtained *F* was less than 1.0, indicating no significant differences among groups in how many types of errors were made on the pretest.

The analysis of variance that was computed on the posttest error scores is shown in Table 3. With *df* (2, 27) an *F* of 3.35 is required for significance at the 0.05 level and an *F* of 5.49 for significance at the 0.01 level. The obtained *F* (4.79) falls between these figures. Comparison of the pre- and posttest scores indicates that all groups made fewer errors on the posttest. Figure 4 illustrates the within- and between-group differences on the pretest and posttest.

To test the experimental hypothesis, a *t*-test was calculated on the difference between the posttest error scores for experimental-critical and experimental-noncritical groups.

Because one effect of the treatments was heterogeneous variance in the posttest error scores of the two experimental groups, which violates one assumption underlying the *t*-test, a correction suggested by Edwards (1950) was used. This procedure accounts for heterogeneity of variance by halving the degrees of freedom. With *df* = 9, the obtained *t* of 2.13 > 1.833 (one-tailed) required for significance at the 0.05 level, lending support to the hypothesis that reinforcement of

Table 2
Test of Letter Discrimination

Groups (<i>N</i> = 10)	Number of Types of Confusion Error					
	Range		Mean		SD	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Experimental-Critical	7-29	0-6	13.0	3.4	6.29	2.20
Experimental-Noncritical	7-27	3-17	12.7	7.0	6.39	4.56
Control	9-27	2-20	15.5	9.9	5.39	5.84

Table 3

Posttest Error Scores Analysis of Variance				
	Source	Df	Ms	F
Between	212.07	2	106.035	4.79
Within	597.30	27	22.12	
Total	809.37	29

Fig. 4. Scatter diagram of experimental and control groups pre- and posttest raw scores on the test of letter discrimination.

discriminative responding to features of stimuli critical to letter discrimination results in better letter discrimination than reinforcement of discriminative responding to noncritical features of the same stimuli.

Error Analysis

The qualitative differences between groups were examined by constructing confusion matrices based on pre- and posttest scores for the experimental and control groups. The number of different letter-pair confusions that was possible with the test of letter discrimination used in this experiment was 104. Of these 104 pairs, 37 are of major interest, based on the findings of Gibson, Osser, Schiff, and Smith (1963). This num-

ber represents the most highly confused letter-pair combinations.

Table 4 shows the total number of different letter-pair confusions (total number of matrix cells with non-zero entries) over all subjects. All groups made similar confusion errors on the pretest. Approximately the same number of cells was filled on the pretest error-matrix for each group, and the total number of pretest errors was similar for the groups. When the pretest and posttest matrices were compared, a number of interesting results emerged. First, the similarities noted among the pretest matrices did not exist in the posttest matrices. The training program reduced the number of cells filled in the experimental-critical matrix to approximately half the number filled in the experimental-noncritical and control matrices. Further, the numbers within the cells were somewhat lower for the experimental-critical than for the other groups, indicating a more specific effect for the experimental-critical group.

Table 4

Number of different letter-pairs which were erroneously "matched" by at least one subject.

(Total possible = 104)

Group	Pretest	Posttest
Experimental-Critical	56	19
Experimental-Noncritical	58	32
Control	59	44

There were certain frequent errors in the posttest matrices that appeared consistently over groups. This was partially a function of the number of times items appeared on the test of letter discrimination. The opportunity for error for some items was higher than for others; the number of times a letter appeared as a sample in the test ranged from one to five. Still, each time the sample appeared, five comparison stimuli appeared, so it was possible for a different confusion to occur on each appearance of the sample item. Nevertheless, while C, for example, was confused with O, G, J, and U (with differ-

ent frequencies) in the pretest, only the C-G error appeared in the experimental-critical group in the posttest, and only C-G and C-O confusions appeared in the other two groups in the posttest.² Thus, certain confusions persisted from pretest to posttest in all groups, even the one (experimental-critical) that was presented with a program designed to extinguish confusions.

DISCUSSION

The results indicate that reinforcement of discriminative responding to critical features of letter-like stimuli produced greater improvement in letter discrimination than reinforcement of discriminative responding to noncritical features of the same stimuli. While all groups made fewer errors on the posttest, mean error scores for the experimental-critical group were significantly lower than those for the experimental-noncritical group. Although mean error scores on the posttest for the experimental-noncritical group were lower than scores for the control group, Table 2 indicates that the pre-posttest drop in raw scores was equivalent for these groups. This suggests that the training program had no demonstrable effect on the subjects in the experimental-noncritical group. However, Table 4 indicates that the number of cells filled in the posttest confusion matrix for the experimental-noncritical group was much lower than for the control group, indicating some effect of training in the experimental-noncritical group. To account for this discrepancy it must be noted that when several subjects each make one of a variety of confusion errors, the number of cells filled in a confusion matrix is large. If the subjects all make the same confusion error, the number of errors on the posttest remains the same, but the number of cells filled in the confusion matrix decreases. Inspection of the experimental-noncritical and control groups'

pre- and posttest matrices substantiated that the effect of the noncritical training program was to reduce the number of cells filled, but not necessarily the number within a given cell.

The effect of the training program can be summarized as follows:

- (1) The training program for the experimental-critical group reduced the frequency of the most-common letter confusions. It also eliminated altogether many less-common confusions.
- (2) The training program for the experimental-noncritical group had little effect on the frequency of the most-common letter confusions, but it did eliminate many of the less-common confusions. Taken together, the results for the two experimental groups suggest that increased experience with letter-like stimuli, possibly acting to increase the subjects' attending behavior, is sufficient to eliminate easy (infrequent) letter confusions. However, specific discriminative training on features critical to letter discrimination is necessary to reduce difficult (frequent) letter confusions.
- (3) The control group posttest matrix showed a reduction in the total number of cells filled. This is probably a function of experience in rather structured situations.

Further matrix analyses suggest that the effect of the training program for the experimental-critical group was to reduce both the total number of errors and the kinds of letter confusions. When all posttest matrices were compared, the more specific effect of the experimental-critical training program was apparent. The errors that remained in the experimental-critical matrix were confined to particular letter pairs. Failure to eliminate these errors may mean that in letter discrimination there are specific kinds of confusion that require more extensive programming. It is worthwhile to look at the M-W/W-M, and A-V/V-A confusions. In both cases, a difference in orientation is involved. This type of error appears to be common and persistent in young children. In this study, three of the 10 subjects in the experimental-critical group showed difficulty with the orientation difference in the training program. Each of the three subjects who did

²Matrices depicting all pretest and posttest letter-pair confusions for all groups may be obtained from the author.

not meet the 10% error rate criterion failed because of errors made on the orientation segment of the program. These errors, especially the 180° orientation difference, persisted even though the subjects were responding without error on all other segments of the training program. It is more difficult to explain the failure of the training program to reduce the C-G, G-C confusion to a greater extent. Evidently, the training series was not adequately programmed to reduce this confusion.

Certain conclusions can be drawn on the nature of letter discrimination in 4-yr-olds. Subjects' performance on the pretest was quite variable. Many of the subjects made few confusion errors on the pretest while others made many errors. Based on the change in performance for the experimental groups, it appears that letter discrimination can be trained quickly, and that the change in performance can be attributed to specific features of training. Certain types of errors (M-W, A-V, C-G) appear to be more persistent than others. Finally, 4-yr-old children do not perform consistently. With the opportunity to confuse a certain letter-pair, C-O for example, more than one time, it was found that the child might show that confusion only once or twice. He might show other confusions, such as C-U, C-G, or might show no other errors. It appears, then, that persistent confusions between particular letter pairs at this age level are not widespread and that with training techniques such as those developed in this study, discrimination can be established quickly, with some specific exceptions.

This approach, derived from an experimental analysis of behavior, appears to have direct application to the classroom. Subsequent activities might include:

(1) Redesigning those segments of the training program that were not successful. Basically, this includes "fading-in" orientation changes and the open-closed critical feature, using letter-like stimuli.

(2) Further refinement of the critical features.

(3) Further improvement of the training program by identifying the subjects who make specific confusions and giving them special programs designed to eliminate those specific confusions.

(4) Devising programs utilizing actual letter stimuli (not letter-like stimuli) and enhancing the cue properties of the critical features that distinguish a letter-pair confusion such as A-V, M-W, etc.

(5) Transferring the program to worksheets for use in the classroom.

This experiment confirmed the utility of a behavioral approach to the problem of letter (visual/perceptual) confusion. When a task is analyzed, critical features identified, and immediate reinforcement provided, young children can be trained to discriminate among stimuli that they had previously confused. Further, this approach proved more successful than reinforcing responses to features of stimuli that are "simple" but not critical to letter discrimination.

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