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FOREWORD

This research represents a portion of the technical development program of the Technical Training Branch, Training Research Division, Behavioral Sciences Laboratory, Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio. The research was documented under Project 1710, "Training, Personnel and Psychological Stress Aspects of Bioastronautics," Task 171007, "Automated Training and Programed Instruction." The research was conducted by the University of Pittsburgh under Contract AF33(616)-7175. The research was also supported in part by the Cooperative Research Branch, U. S. Office of Education under Contract OE-2-10-057. Dr. Robert Glaser was the principal investigator. Air Force personnel associated with the research were changed several times during the effort. Dr. Gordon A. Eckstrand was the project scientist throughout the entire period. Dr. Felix Kopstein was the initial Air Force technical monitor. He was succeeded by Dr. Theodore E. Cotterman and Dr. Ross L. Morgan. Likewise, task scientists were Dr. Marty R. Rockway, Dr. Theodore E. Cotterman, and Dr. Ross L. Morgan. The authors acknowledge the various contributions of the above Air Force personnel to the planning, execution, and reporting of the research. The present version of this report was adapted for Air Force publication by Dr. John S. Abma. This research began in October 1961 and was completed in October 1963.

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This technical report has been reviewed and is approved.

WALTER F. GRETHER, PhD
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ABSTRACT

Programing methods and response modes were investigated to determine effective training methods. The identification and pronunciation of phonetic symbols were taught by two different programing methods and two different response modes. The programing method featured either prompting or confirmation,and the response mode was either overt or covert. Achievement was measured on both a multiple choice test and a test requiring overt oral responses. Considerable variation occurred among the test scores for each learning condition. Differences among the conditions, tending to indicate the superiority of overt responding and of confirmation, were significant on only one case.Overt responding was superior for retention when measured by tests requiring overt oral responses. The prompting method coupled with the covert response mode tended to produce poorer learning and retention than the other conditions, but it required only 30 to 50 percent as much learning time as the other conditions.

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SECTION I

INTRODUCTION

In a linear program, each frame consists of (a) an initial stimulus, (b) the learner's response to the stimulus, and (c) confirmation or feedback immediately following the response. Generally, the confirmation or feedback portion of the frame serves as a reinforcer, strengthening the correct response that is made to the initial frame stimulus. This immediate reinforcement is often considered to be the characteristic of programed instruction which most clearly distinguishes it from other learning materials, such as textbooks or audio-visual devices.

There are, however, additional features about a programed sequence which are also unique to programing as an instructional method (Glaser, ref 1). One such feature is the use of prompting. The prompting technique consists of providing a hint, in the initial stimulus part of a frame, about what response the learner should make. After assisting the learner to make the correct response by this method, the prompt is gradually eliminated from the initial stimulus portion of subsequent frames, so that on later frames the learner must make responses to frame stimuli without receiving any hints. In this procedure, the learner first learns through the prompt to make the correct response, then in later frames makes the response without any prompting aids.

Despite the wide use of prompting in program construction, theoretical explanations of programed learning have focused primarily on reinforcement. Because the program sequence of "stimulus – response – confirmation" is analogous to the operant conditioning paradigm of "stimulus – response – reinforcing stimulus," the learning that takes place in a program often is described in terms of operant conditioning, and attributed primarily to the reinforcing effect of confirmation. Skinner (ref 2) has described this analogy in detail.

An alternative analogy may be made, however, between the operations that define prompting and the paradigm for classical conditioning. The classical conditioning paradigm is that an unconditioned stimulus is paired with a new stimulus to which a response must be attached. The unconditioned stimulus elicits the desired response in the presence of the new stimulus (conditioned stimulus), resulting in an increased probability that presentation of the conditioned stimulus alone will elicit the response. This sequence of events is very similar to the prompting procedures used in programing. Essentially, a prompt is a part of the initial stimulus in a frame that forces a given response to occur. The remaining part of the initial stimulus is the new stimulus, to which the response is to be associated. In this sense, the pairing of the prompt and the new stimulus in the same initial stimulus frame is analogous to the pairing of the unconditioned and conditioned stimuli in the classical paradigm. When the prompt, analogous to the unconditioned stimulus, is removed, the learner then responds to the new stimulus alone. Thus the prompted response is attached to a new frame stimulus in much the same way that a response is conditioned to a new stimulus in the classical paradigm.

Some previous research has attempted to determine the relative contribution of prompting and confirmation in programed learning. Investigations by Evans, Glaser, and Homme (ref 3), Scharf (ref 4), and Hessert (ref 5) have demonstrated that subjects presented with programed sequences containing highly prompted frames and no confirmation at all learned as well as others who received the usual combined prompt-and-confirmation frames. In the study by Hessert, an additional group received a programed sequence containing confirmation frames but no prompting. The confirmation-no prompt subjects made more errors than either the prompt-no confirmation subjects or the subjects receiving combined prompting and confirmation. Also, the three groups showed equivalent degrees of learning on a criterion test given at the end of the learning period.

These investigations consistently demonstrated that learning took place in the absence of confirmation. Also, a recent study by Sidowski, Kopstein and Shillestad (ref 6) indicates that, under some conditions, prompting techniques are more effective than confirmation techniques. These studies suggest that a theoretical explanation of programed learning strictly in terms of the usual operant conditioning paradigm is incomplete. However, the amount of evidence currently available is not yet sufficient to warrant a revision of the current theoretical explanation for programed learning, nor does existing evidence readily suggest a reliable alternative explanation. Therefore, one of the objectives of the present investigation was to supplement existing data on the effects of prompting by comparing the learning effectiveness of prompting methods and confirmation methods with different learning materials than those used previously in making such comparisons.

A second objective of the present study was to compare the effects of different modes of responding upon the learning that takes place in programed instruction. Some form of response necessarily occurs in a program, whether the programing procedures used are prompting, confirmation, or a combination of the two methods. Although the response required in most existing programs is written, other response modes, such as vocal, subvocal (implicit), choice-selecting, etc, may be used. An active area of programing research has been the study of the effect of these types of responses upon learning. Results of such investigations have been quite consistent. In a review of programing research, Silberman (ref 7) lists at least five studies which have demonstrated no differences among overt and covert response modes when a test following the program was used as the learning criterion. In singular contrast, an investigation by Krumboltz and Weisman (ref 8) has shown that an overt response group was superior to a covert group on a criterion test delayed 2 weeks.

An important consideration to be made in comparing the effects of response mode upon criterion test performance is the kind of response required on the criterion test itself. If the test requires oral responses, then oral responding during training would be considered a direct response mode, and other types of responses would constitute indirect response training of the specific terminal behavior desired. When response training is of the latter, indirect type, the terminal behavior requires that the learner generalize certain stimuli to elicit new kinds of responses. The generalization requirement implies that any indirect response, whether written, oral, or other, would be less effective in a program than a response mode that is the same as that required on a criterion test. This distinction between direct and indirect response modes during training and their possible effects upon terminal performance, raises a pertinent question for the programer; namely, can programs which use indirect response modes teach specific terminal responses effectively or should responses made during learning be identical to those required as terminal behavior?

Two investigations which employ programed learning can be cited as examples of the effects of direct and indirect response modes upon learning. One was by Evans (ref 9), who administered a program of numbers to small children. The response mode required in the program was to choose the correct stimulus from a set of alternatives and draw a circle around it. At no time during the program did the children actually write numbers. When a test requiring the learners to write numbers was given at the end of the program, however, the numbers written were superior to those written during the pretest given before instruction began. Thus instruction aimed at teaching one response (writing numbers) was successful when another indirect response mode (circling choices) was used during the learning trials.

In another study, Fry (ref 10) taught Spanish vocabulary to groups using either constructed or multiple-choice responses during training. When immediate and delayed criterion tests consisting of items requiring both response modes were given, the groups were found to be equivalent in performance on the multiple-choice test items, but the constructed-response group had consistently higher scores on the constructed-response test items than did the group that made multiple-choice responses during learning. The latter finding suggests that, when unfamiliar written responses are the terminal behavior desired, direct-response training is superior to training which uses an indirect response mode.

These two studies will not support a definite conclusion regarding the effect of indirect response practice. Moreover, both investigations of direct and indirect response modes required some form of written responding as the terminal behavior; either writing numbers, writing words, or making checks with a pencil. In many instructional situations, the terminal behavior desired is some form of oral response, eg, learning to speak a foreign language. The relative effectiveness of teaching an oral response by direct (oral) or indirect (nonoral) training modes has received little attention to date, although the question has important practical implications for language instruction as well as posing a further test of response generalization. The present study, in addition to investigating the relative effects of prompting and confirmation methods of programing, also varied response modes in an attempt to determine the effect of direct and indirect response training upon learning oral responses to the stimulus characters used in the International Phonetic System.

SECTION II

METHOD

Materials. Four experimental variations of a program designed to teach pronunciation of 12 phonetic symbols, taken from the International Phonetic System, were used. Seven symbols represented vocoid (vowel) sounds, and five represented contoid (consonant) sounds. Figure 1 presents the 12 symbols taught, and indicates the sounds associated with them.

1) /a/, a symbol that stands for the sound of A in FATHER
2) /e/, standing for the sound of A in ALE
3) /ae/, standing for the sound of A in CAT
4) /ay/, standing for the sound of I in ICE
5) /u/, standing for the sound of OO in MOON
6) /U/, standing for the sound of OO in BOOK
7) /Σ/, standing for the sound of E in MET
8) /ʃ/, standing for the sound of SH in SHIP
9) /tʃ/, standing for the sound of CH in CHIRP
10) /θ/, standing for the sound of TH in THIRST
11) /ð/, standing for the sound of TH in THEN
12) /dʒ/, standing for the sound of J in JOB

Figure 1. Phonetic Symbols Taught in Each of the Four Experimental Programs.

All program versions were presented though Min Max II teaching machines in a language laboratory room containing individual semisoundproof booths. Each of the four program sequences used was composed of 480 frames, and all four experimental variations contained the same number of stimulus and response repetitions. One experimental version presented the material by prompted frames that required an oral response, but gave no confirmation. This version was designated as the PO program, since the presentation mode was prompting (P), and an overt oral response (O) was required on each frame. A second version ($P\bar{O}$) also used prompting frames for presentation; but implicit responding ($\bar{O}$), rather than overt oral responding, was required. The third and fourth versions contained no prompting, but offered response confirmation (C) on each frame. One of these versions (CO) required overt oral responding, and the other ($C\bar{O}$) required the implicit, nonoral response mode. The oral response mode was accomplished by instructing the learner to say out loud the sound of the symbol designated as the response frame, while the learners taking the nonoral versions were instructed to read all frames silently and not say any of the responses aloud.

A sample frame from the PO version is presented in figure 2. In this frame, the underlined letter A in FATHER is the prompt stimulus which elicits the response "ah" from any subject who can read English. By pairing the A in FATHER with the phonetic symbol /a/, the response "ah" is attached to that symbol, so that at a later time the symbol /a/ alone without the prompt FATHER should elicit the sound "ah." Subjects receiving the $P\bar{O}$ program were presented with identical frames, except that the instructions "Read Out Loud" and "Pronounce Out Loud" were replaced with instructions to "Read Silently."

Figure 3 contains a sample frame from the CO program. Each C frame was presented in two parts. First, the subject was shown the portion that is printed above the dotted line in figure 3. In this portion, a response to the phonetic symbol was required, but no prompting aids were given. After making the response (oral or nonoral, depending upon the directions given for the CO and $C\bar{O}$ versions), the subject was presented with the multiple-choice situation illustrated below the dotted line in figure 3. Here the subject matched the response he had made to one of the choices (A, B, C, D, or E). After matching, READ OUT LOUD: THE PHONETIC SYMBOL /a/

Is pronounced the same way as the underlined portion of the word F A T H E R

PRONOUNCE OUT LOUD THE PHONETIC SYMBOL /a/

Figure 2. Structure of Frames Used in the Prompting-No Confirmation (P) Program Method. Oral Responding (O) is Required for the Sample Shown.

NUMBER 1 Pronounce out loud the following phonetic symbol: /a/

Check your pronunciation by matching it with A, B, C, D, or E below:

DID IT SOUND LIKE				
A	B	C	D	E
A in AT	A in NAME	E in MET	A in FATHER	None of these

To see whether your pronunciation was correct or not, punch a hole for the matching choice (A, B, C, D, or E) at Number 1.

Figure 3. Structure of Frames Used in the Confirmation-No Prompting (C) Method. Oral Responding (O) is required for the Sample Shown.

he punched his choice in a specially prepared punch-card device, which confirmed or disconfirmed his original response. Through this procedure, then, an unprompted response was made in each frame, followed by feedback which indicated its correctness.

The punch-card device used for the CO and $\overline{CO}$ versions, similar in design to the punchboard described by Sakoda and Greenwood (ref 11), was constructed of eight IBM code cards stapled together. On the top card was printed a list of numbers corresponding to the frame numbers in the program. Beside each number were five holes, labeled A, B, C, D, and E, corresponding to the response choices given in the frame. The subject was instructed to press a pencil into the hole corresponding to his choice. If by applying pressure the pencil could be forced down through the card stack, the choice was correct; if not, the choice was incorrect.

The Phonetic Script Test (PST), a subtest of the Modern Language Test (Carroll and Sapon, 1959), and the California Short Form Test of Mental Maturity, 1957, S-Form (CTMM), were used to assess individual differences among subjects. Two learning criterion measures were administered at time, T1, immediately after completion of the program: 1) a T1 Oral Test, consisting of 47 single words and six complete sentences, all written in phonetic script, which the subject was required to read aloud, and 2) a T1 Multiple-Choice Test of 47 items requiring the subject to match phonetic symbols and words with their English counterparts.

One week after the program was completed (time T2), a T2 Oral Test and a T2 Multiple-Choice Test were administered to measure retention. These retention tests had the same format as the T1 Oral and T1 Multiple-Choice Tests, but were rearranged so that items on the initial T1 Multiple-Choice Test were used as T2 Oral Test items on the retention measure, and vice-versa. The other change made was the use of six new phonetic sentences to replace those used in the initial T1 Oral Test.

<u>Subjects</u>. Groups of junior high school students, matched on PST scores, were used as subjects. Prior to the experiment, the PST was administered to 50 students in a summer reading improvement course. The highest forty scores were assigned to four experimental groups (N=10 per group) according to the randomized block design described by Edwards (ref 12). The 13 male and 27 female subjects were randomly distributed within each of 10 blocks. The CTMM was also administered to determine if the matched PST groups were also equivalent in intelligence.

<u>Procedure</u>. On the first day of the actual experiment subjects were given extensive in-group instructions regarding the nature of the experiment and the details of the experimental procedure. Also, individual instructions were given regarding the use of the apparatus by which the programs were displayed.

Two groups of ten subjects were run at a time, with the Oral groups proceeding in the first period (from 9-9:50 a.m.) and the Nonoral groups working the second period (10-10:50 a.m.). Individual subjects were allowed to proceed at their own paces, but time-sheets were used to record individual working times for subsequent analysis.

As each subject finished the program, he was given the criterion tests (T_1), composed of the T1 Oral Test and the T1 Multiple-Choice Test. One week later the T2 Oral Test and the T2 Multiple-Choice Test were given to measure retention. In the oral test, there were two subtests, a 47-item word test in which phonetically spelled words were given to the subject and he had to pronounce them aloud, and a second test consisting of phonetically spelled sentences. The subject's responses were recorded on tape and the experimenter judged whether the correct word was said. This was not a difficult discrimination for the experimenter. On the words subtest, one point was given for each word pronounced correctly (total possible score of 47). On the second subtest there were five sentences which contained 28 words in all. This subtest was scored by giving a point for each word pronounced correctly and five additional points for each additional sentence pronounced correctly, a total of 53 possible points. The sentences test was in this way given more weight because the phonetic words in sentences was a more difficult task. All tests were given individually by one experimenter, who recorded the oral responses on tape.

SECTION III

RESULTS

The prelearning means and standard deviations of each experimental group on the PST and IQ measures are shown in table I. An analysis of variance performed on the CTMM scores indicated that the four groups, matched on PST scores, also did not differ significantly in intelligence ($F < 1.00$; df/3,27; $P > .05$).

__Learning and Retention.__ The means and standard deviations of all criterion (T_1) and retention (T_2) tests for each group are presented in table II. The nature of the task was such that there were wide variations in performance among the subjects, ie, the standard deviations obtained on the various tests were large. This variability was consistent within each of the experimental conditions. Since the assumption of homogeneity of variance was met for all tests, all statistical analyses of the data were performed with parametric techniques (Boneau, ref 13).

The groups were compared on each of the tests in a series of 2 x 2 factorial analyses of variance, using the randomized blocks technique described by Edwards (ref 12, Ch. 11). Table III summarizes the analyses made for the T1 Oral and T1 Multiple-Choice Tests. None of the comparisons was significant. The lack of significance found between O and $\bar{O}$ groups on the T1 Oral Test is somewhat surprising, in view of the large and consistent differences in O and $\bar{O}$ means shown in table II. It is possible that the combination of small N's and the nature of the task, the latter resulting in large within-group variability for all groups, decreased the power of the statistical analysis made for this test. Nevertheless, results showed that the experimental learning treatments had no statistically reliable differential effects upon either oral responses or multiple-choice responses immediately following the learning trials.

The retention (T_2) tests consisted of Oral and Multiple-Choice Tests containing different arrangements of the items used at T_1. Table IV presents the results

TABLE I

MEANS AND STANDARD DEVIATIONS OF ALL GROUPS ON THE PHONETIC SCRIPT TEST AND THE CALIFORNIA TEST OF MENTAL MATURITY

Pretests		Groups			
		PO	CO	$P\bar{O}$	$C\bar{O}$
PST	M	19.6	19.6	18.9	20.1
	SD	3.9	3.4	3.6	3.6
IQ*	M	108.5	108.2	110.6	111.2
	SD	8.5	5.9	12.9	7.2

*Total IQ score on CTMM

TABLE II

MEANS AND STANDARD DEVIATIONS OF ALL GROUPS ON THE ORAL AND MULTIPLE-CHOICE TESTS GIVEN T1 and T2

		Groups			
		PO	CO	$P\bar{O}$	$C\bar{O}$
Oral Test (100 points)					
T1	M	46.3	46.5	34.1	37.1
	SD	27.25	30.04	25.10	25.37
T2	M	51.5	55.3	30.4	45.2
	SD	29.40	31.07	31.17	28.59
Multiple-Choice Test (47 points)					
T1	M	30.8	29.7	22.4	28.9
	SD	11.9	13.4	12.2	12.8
T2	M	31.0	31.6	22.3	29.6
	SD	14.1	12.7	12.1	13.4

TABLE III

ANALYSIS OF VARIANCE RESULTS FOR THE
T1 ORAL TEST AND T1 MULTIPLE-CHOICE TEST

Test	Source	df	MS	F
T1 Oral Test	Program Method	1	25.60	-
	Response Mode	1	1166.40	2.81 (n.s.)
	P X R	1	19.60	-
	Blocks	9		
	Error	27	414.55	
	Total	39		
T1 Multiple-Choice Test	Program Method	1	211.60	2.22 (n.s.)
	Response Mode	1	72.90	-
	P X R	1	144.40	1.52 (n.s.)
	Blocks	9		
	Error	27	95.40	
	Total	39		

TABLE IV

ANALYSIS OF VARIANCE RESULTS FOR THE
T2 ORAL TEST AND T2 MULTIPLE-CHOICE TEST

Test	Source	df	MS	F
T2 Oral Test	Program Method	1	864.90	1.65 (n.s.)
	Response Mode	1	2433.60	4.64 ($p < .05$)
	P X R	1	302.50	-
	Blocks	9		
	Error	27	524.61	
	Total	39		
T2 Multiple-Choice Test	Program Method	1	156.03	1.66 (n.s.)
	Response Mode	1	286.22	3.04 (n.s.)
	P X R	1	112.23	1.19 (n.s.)
	Blocks	9		
	Error	27	94.05	
	Total	39		

of the variance analyses made for each T_2 measure. Again, no significant differences between the P and C treatments were found on either test, and the interaction terms were not significant. Differences between response modes were within chance limits on the 12 Multiple-Choice Tests. On the T_2 Oral Test, however, a significant difference was found between the O and $\bar{O}$ groups. The subjects who were required to make oral responses during the learning trials showed significantly better oral performance on the retention test than did subjects who made nonoral responses during learning.

Learning Time. The mean number of minutes taken by each group to complete the learning task is presented in table V. A 2 x 2 factorial analysis of variance indicated that differences in learning time between response groups and between program methods were both significant beyond the .005 level of probability (F=152.94 and 27.87, respectively; df/1, 27), and that the interaction between response mode and program method was significant also (F=7.75; df/1, 27; $P < .01$). The P method and the $\bar{O}$ response mode required less time than the C and the O conditions, respectively, and hence the various combinations of the four conditions accordingly required different amounts of learning time.

TABLE V

MEANS AND STANDARD DEVIATIONS OF NUMBER OF MINUTES TAKEN BY PO, CO, $P\bar{O}$, AND $C\bar{O}$ GROUPS TO COMPLETE THE LEARNING TASK

	PO	CO	$P\bar{O}$	$C\bar{O}$
M	87.1	140.1	42.5	126.3
SD	13.6	20.3	14.8	17.1

Reminiscence. Table II indicates that the T2 Oral Test means of the PO, CO, and $C\bar{O}$ groups were consistently higher than their mean performance on the T1 tests. The same tendency is evident in the differences between the T1 and T2 Multiple-Choice Tests also, but only to a slight degree. Although the T1 and T2 tests were not identical they probably were of equivalent difficulty, therefore the superiority of T2 over T1 probably represents an improvement in performance from T1 to T2. This increase in performance during an interval in which no further learning trials were administered is sometimes called reminiscence. The $P\bar{O}$ group showed a drop in mean scores between T1 and T2 on both tests. On the Multiple-Choice Test, the mean drop between T1 and T2 was too slight for the $P\bar{O}$ group to be of any consequence. On the Oral Tests, however, the mean changes between T1 and T2 for the four groups were large, ranging from $\bar{D} = -3.7$ for the $P\bar{O}$ group to $\bar{D} = +8.8$ for the CO group. On this test, the different direction of change made by the $P\bar{O}$ group relative to the other groups resulted in a T2 mean for $P\bar{O}$ group that was considerably lower than the T2 means of the other three groups. The $P\bar{O}$ treatment seemed to be a less effective learning situation than the other three treatments, yielding generally lower test means on all measures, and not permitting reminiscence in a situation that yielded reminiscence effects in varying degrees for all of the other learning conditions used.

SECTION IV

DISCUSSION

Although no response mode differences were found on either of the criterion T1 measures, the significant difference between O and $\bar{O}$ groups on the T2 Oral Test indicates that retention of oral responses was facilitated by direct oral responding during the programed learning trials. These results differ in part from those reported by Fry (ref 10), who showed that direct response practice was superior to indirect response training not only on a retention measure but on an immediate criterion test as well. Both investigations, however, demonstrated that direct response practice has a significant effect upon response availability at a later time, and consequently should be considered a relevant factor in the construction of programs designed to teach specific kinds of responding.

The absence of significant differences between the prompting and confirmation programing methods on all tests given at T1 and T2 supports earlier findings (ref 5) that program frames of the prompt-no confirmation type are as effective in producing learning as are frames which give confirmation but no prompting. Taken alone, the results indicate that the confirmation or operant conditioning paradigm is a sufficient, but not necessary, requirement for construction of an effective programed sequence. Two qualifications of the implication seem appropriate. First, there is some support for the contention that the $P\bar{O}$ group was inferior to all other groups, ie, perhaps in some cases confirmation is superior to prompting. The $P\bar{O}$ group obtained the lowest mean of the four groups on all post-learning measures. If low means were entirely a function of the $\bar{O}$ response mode the lowest mean value would be expected to be shared by $P\bar{O}$ and $C\bar{O}$ randomly. That $P\bar{O}$ was consistently lowest of all means, however, suggests that mean scores may have been influenced to some extent by the P treatment as well as by the $\bar{O}$ treatment. Also, the $P\bar{O}$ group was the only one of the four groups which did not demonstrate reminiscence on the T2 Oral Test. The second qualification to any general conclusion about prompting and confirmation is that the error rate in the present confirmation conditions probably was considerably higher than in most programs that involve both prompting and confirmation. Confirmation, of course, was provided only for correct responses. Therefore, the relative frequency of confirmation probably was less in the present experiment than in most linear programs.

In judging the relative efficiency of the conditions of the present experiment, one must consider that the PO group took significantly less time than the other groups. Using only 30 to 50% as much time, as the other groups, they achieved a level of performance that was not statistically different from the level achieved by the other groups. However, the large standard deviations obtained on the various tests make it reasonable to suspect that either the task or the tests that were used were of limited sensitivity in showing real differences between groups — ie, the power of the statistical tests made was reduced because of the wide individual differences on the materials employed. This suspicion, while it cannot justify a conclusion that the $P\bar{O}$ group did in fact differ significantly from the other groups, nevertheless imposes reservations on the conclusion that the $P\bar{O}$ treatment was as effective as the other treatments. Further investigation, using a less difficult task, a more effective program, and/or larger samples, must be made to determine if this interpretation about the present results is accurate. Until such investigation is made, the question of whether the prompting method of programing is as effective as the confirmation method under both oral and nonoral response mode conditions must remain unanswered.

The apparent reminiscence found for the PO, CO, and $C\bar{O}$ groups was not anticipated, but seems consistent with another investigation of programed instruction variables (ref 14). These independent observations of an apparent reminiscence effect are of interest, in that they imply a method by which retention may be improved, or at least by which forgetting can be eliminated, over a period of time. The exact cause of the reminiscence observed in the two investigations cannot be determined from existing data. It seems reasonable to hypothesize, however, that the effect is a consequence of giving an immediate post-test. Ammons and Irion (ref 15), using a short poem as learning material, have demonstrated under laboratory conditions that an immediate posttest is a learning trial which facilitates retention. Future investigation of the reminiscence effect, using a long programed sequence rather than the short learning sequence ordinarily used in the laboratory, may contribute further support to the hypothesis that immediate testing is an important factor of the total instruction process.

SECTION V

CONCLUSIONS

The effects of using two different programing methods and two different response modes in a programed instruction sequence were compared. Four groups, matched on a measure of language aptitude, received programed sequences designed to teach oral responses to standard phonetic symbols. Two of the groups used programs constructed according to a prompting method, and two used programs of a confirmation type. Within each of these programing methods, one group was required to make oral responses and the second was instructed to respond nonorally. Criterion and retention tests were analyzed in a series of factorial variance analyses, with the following results:

1. There were no significant differences in achievement between the prompting and the confirmation programing methods on either the criterion or the retention tests.

2. No significant differences in achievement between the oral and nonoral response modes were found on the criterion tests. On the retention tests, however, the oral response groups were superior to the nonoral groups on those items which required overt oral responding.

3. Learning time for programs using the prompting method and nonoral response mode was only 30 to 50% of the learning time for those using either the confirmation method or the oral response mode.

4. Three of the four groups demonstrated higher performance on the retention tests than on the criterion tests, indicating an apparent reminiscence effect.

In the discussion, it was pointed out that the performance of one group, receiving a prompting sequence with nonoral responding, was consistently lower than that of the other three groups. This deviant performance was not evident in the statistical tests made, possibly because the large within-group variabilities of all of the groups rendered the statistical tests insensitive to small but consistent performance differences. In view of these statistical problems associated with the variability of the particular task used, conclusions concerning the relative effectiveness of the programing methods and response modes under investigation were withheld until further evidence is available.

SECTION VI

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Programing methods and response modes were investigated to determine effective training methods. The identification and pronunciation of phonetic symbols were taught by two different programing methods and two different response modes. The programing method featured either prompting or confirmation, and the response mode was either overt or covert. Achievement was measured on both a multiple choice test and a test requiring overt oral responses. Considerable variation occurred among the test scores for each learning condition. Differences among the conditions, tending to indicate the superiority of overt responding and of confirmation, were significant on only one case. Overt responding was superior for retention when measured by tests requiring overt oral responses. The prompting method coupled with the covert response mode tended to produce poorer learning and retention than the other conditions, but it required only 30 to 50 percent as much learning time as the other conditions.

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