AMRL-TR-67-225

# EFFECT OF CONFIRMATION PEEKING AND RESPONSE MODE ON PROGRAMMED INSTRUCTION

*HORACE H. VALVERDE*

# Foreword

This research represents a portion of the technical development program of the Operator Training Branch, Training Research Division of the Behavioral Sciences Laboratory. The research is documented under Project 1710, "Human Factors in the Design of Training Systems," Task 171003, "Human Factors in the Design of Systems for Operator Training and Evaluation." Dr. Gordon A. Eckstrand, Chief of the Training Research Division, was Project Scientist. Dr. Donald E. Meyer, Chief of the Operator Training Branch, was Task Scientist.

The reported experiment was conducted by the author while a member of the Training Materials and Evaluation Division, 3500th Pilot Training Wing, Air Training Command, Reese Air Force Base, Texas. Colonel Dudley S. Faver was the Wing Commander during this effort. The project was approved by Colonel Victor Mahr, Deputy Chief of Operations. The experiment was conducted during the period April 1965 through January 1966.

This report was presented by the author at the National Society for Programmed Instruction Convention, San Antonio, Texas, 18 April 1968.

The author acknowledges the review of the manuscript and the suggested improvements by Dr. Ross L. Morgan, Dr. Alan Neiberg, and Dr. John P. Foley, Jr. of Aerospace Medical Research Laboratories. Special recognition is due Mr. Arnold Hanson, Instructional Systems Development Team, Lowry Air Force Base, Colorado, for technical advice in the preparation of the programmed text. Also, the assistance of Captain George Nolde and the instructional staff of the Academics Section, Reese Air Force Base, Texas is appreciated.

This technical report has been reviewed and is approved.

C. H. KRATOCHVIL, Colonel, USAF, MC
Commander
Aerospace Medical Research Laboratories

# Abstract

An experiment was conducted to determine the effect of peeking on programmed instruction. The study tested the following hypotheses: (1) the requirement for overt responses does not increase learning in programmed instruction, (2) devices or formats to preclude confirmation peeking do not increase the effectiveness of programmed instruction, and (3) time can be saved by eliminating the requirement for overt responses. Two groups of 39 subjects each were used. The subjects were commissioned officer Air Force pilot trainees and Air Force Reserve Officer Training Corps (AFROTC), junior and senior college students matched on the basis of scores obtained on the Officer Quality Composite of the Air Force Officer Qualifying Test (AFOQT). The stimulus material was a radar orientation programmed text. Results of the study were: (1) peeking did not reduce the effectiveness of programmed instruction; (2) students who responded covertly learned as efficiently as students who responded overtly; and (3) covert responding did not save instructional time.

# Table of Contents

# Section I

## INTRODUCTION

Since reinforcement has been a principal characteristic of programmed materials, much effort has been expended to develop programs which elicit overt responses before the student is permitted to progress to the next frame. Thus, most programs are designed to discourage "peeking" (observing the response confirmation before responding). This study was conducted to determine what effect peeking has on programmed instruction.

Skinner (1960) has stated that programmed learning is most effective when students are required to construct responses for programmed text frames. As a result, the Skinnerian format requires the learner to first write an answer to a question presented in the program frames. He then checks the accuracy of his response by moving a slider (mask) which reveals the confirmation. As overt activity became an important aspect of programmed instruction, great concern was evidenced as to whether or not the student had the opportunity to peek at the confirmation and thus cheat the program by merely copying the answer rather than first responding to the stimuli in the various frames (Gray, 1963). Programmers became interested in providing cheatproof vehicles for their programmed materials. Ingenious means were devised to preclude peeking, of which an interesting example appears in the linear constructed response text by Holland and Skinner (1961) and Cartier's (1965) format for concealing confirmations without a mask.

In contrast to the Skinnerian approach, the instructional technology curriculum of the Instructional Programmer Course at Lackland Air Force Base, Texas, uses an approach whereby overt responding is not greatly emphasized. Teaching frames are based upon terminal behavior specifications which are, in turn, derived from behavioral analyses. This systems approach utilizes the optimum operant span for the target population, discrimination training, and various concepts conceived by Gilbert (1958a, 1958b). Although the discrimination frame technique rejects the use of constructed responses, it does not depart from the overt response mode completely. The student must make a checkmark, circle a letter, label a diagram, or make some other visible sign of response selection. Often the programmer, when preparing discrimination frames, uses only one operant span frame per page, and the confirmation is placed alone on the back of the page to discourage peeking.* The assumption is made that checking an alternative is an important factor in the learning process and that peeking should be prohibited. There is some information to support this notion. Brown (1965) found that students performed 14% to 16% better if the confirmation was not exposed. Unfortunately, no experimental details were given.

Proponents of teaching machines have been critical of the inability of programmed texts to prevent peeking or cheating. Wayne and Klein (1963) observed that students may misuse a programmed text as a result of curiosity, laziness, or cheating, while with most machines, cheating is eliminated. For example, Pressey (1926, 1927, 1960) developed several devices with built-in correction procedures which required that the student make a correct response before proceeding until the right response was selected, but unlike Pressey, Skinner required the student to construct the response rather than recognize it from a group of alternatives.

Some studies have presented evidence that refutes the assumption that overt responding produces greater learning than covert responding. Evans, Glaser, and Homme (1959) found no signif-

*This technique was used in the development of The Staff Report-A Programmed Text. Squadron Officer School, Air University, Maxwell Air Force Base, Alabama, March 1965.

icant differences between subjects instructed to make overt written responses to each learning sequence and those subjects instructed not to make written responses. Silverman and Alter (1961) reported three experiments which indicated that programmed learning is not facilitated by the overt response.

Goldbeck (1960) investigated the effects on learning of three response modes: (1) overt, (2) covert, and (3) implicit response (reading underlined material). He found that, for difficult materials, learning-efficiency scores showed that the implicit response condition produced more efficient learning than the overt response treatment with the covert response condition between the other two treatments. The overt response group performed poorer than did the covert response groups when the material was of lower difficulty level. However, the performance of the overt group at the intermediate difficulty level exceeded all other groups. Thus, it is doubtful that easy items and written constructed responses constitute the best learning. Rather, Goldbeck's work suggests that the need for overt response depends, in part, upon program difficulty.

Goldbeck, Campbell, and Llewellyn (1960) reported the effects on learning of four response modes: (1) overt response, (2) covert response, (3) reading response, and (4) option response (the subject could either construct a written response or omit it). No significant differences were found among the four response mode conditions, but the obtained mean of achievement for the reading mode was slightly higher than the mean for the overt mode, with the option mode and covert mode means ranking third and fourth. When considering learning time differences, the authors found that the overt condition required the longest learning time, followed by the option mode, covert mode, and reading mode, respectively.

In the area of immediate achievement in programmed instruction, Ashbaugh (1964) found that the covert response mode was at least as effective as the overt response mode. In the same study, students who responded overtly spent significantly less time in attaining the same level of achievement. An additional sidelight derived is that overt responses are frustrating to some personality types, but may lend security to others. This indicates that perhaps the response mode (overt or covert) should be optional to the student.

# Section II

## PROBLEM

The problem was to determine the effect of confirmation peeking and response modes on programmed instruction. For this purpose, achievement on two response modes was compared: (1) covert which encouraged peeking and (2) overt which did not permit peeking.

The following hypotheses were tested:

1. Devices or formats designed to prevent peeking do not increase the effectiveness of programmed instruction.

2. The requirement for overt responding does not increase the effectiveness of programmed instruction.

3. Covert responding saves time.

# Section III

## METHOD

**Instructional Material.** A programmed text on radar orientation, written and group and field tested by the author, was taken by all subjects. The instructional material provided a radar orientation block for students in under-graduate pilot training programs at nine Air Force flying training bases. The text was designed so that students could complete it during regularly scheduled classroom periods. The program was self-paced, i.e., each student progressed at his own rate. Completion times, carefully recorded during the field test involving over 1000 students, showed that students of the target population could complete the program in 2 hours or less. An eclectic technique was used in the development of the teaching frames. Employed are discrimination frame writing, branching, and constructed response frames. A sample of the program is contained in Appendix I.

**Subjects:** The subjects were Air Force pilot trainees and Air Force Reserve Officer Training Corps (AFROTC) juniors and seniors. The pilot trainees were commissioned officers and members of class 66-G and class 66-H in the Air Training Command Undergraduate Pilot Training Program at Reese Air Force Base, Texas. They were college graduates who had completed a college AFROTC program or the course of instruction at the Officer Training School (OTS), Lackland Air Force Base, Texas. The AFROTC subjects were juniors and seniors enrolled in the AFROTC program at Texas Technological College, Lubbock, Texas and they aspired to enter pilot training after graduation. The radar orientation programmed instruction was required for all pilot trainees, but it was voluntary for the AFROTC students. The subjects (N=78) were divided into six groups (three overt and three covert) as shown in Figure 1.

| *Overt* | | | *Covert* | | |
|---|---|---|---|---|---|
| *Group I* | *Group II* | *Group III* | *Group I* | *Group II* | *Group III* |
| 66-G | 66-H | AFROTC | 66-G | 66-H | AFROTC |
| (A) | (A) | (A) | (B) | (B) | (B) |
| N=13 | N=13 | N=13 | N=13 | N=13 | N=13 |

**Fig. 1. Overt-Covert Groups**

Matching of the groups was based on the subjects' scores on the Officer Quality Composite of the Air Force Officer Qualifying Test (AFOQT). The AFOQT is a device used to evaluate attitudes and aptitudes considered to be important for commissioned officer performance and success. The Officer Quality Composite of the AFOQT is primarily a measure of general learning ability and officer quality. It measures verbal and quantitative aptitude and reasoning ability background knowledge relevant to world events, and an inventory of biographical material found to be predictive of officer leadership. Individuals with high Officer Quality Composite scores may be expected to do well in any technical training having appreciable academic content. Since the radar programmed text was intended to teach an orientation block of instruction of medium difficulty, the Officer Quality Composite was considered to be suitable for the experiment. Henceforth, the composite will be denoted as AFOQT in this report.

# Section IV

## PROCEDURE

**Design.** The 35-item, multiple-choice, master validation examination based on the terminal behavior specification for the programmed instruction served as a pre-test and post-test. The treatment procedure in diagramatic form is shown in Figure 2.


**Fig. 2. Treatment Procedure**

**Program Administration.** The program was administered by the author to the subjects during scheduled class periods. The overt responding subjects were instructed to write or check their responses (as required) in the spaces provided in the text. A mask (slider) concealed the confirmations, and the subjects were told to record their responses before checking the confirmations. Two instructors closely monitored the activity to insure compliance with these instructions. To simulate conditions for peeking, the covert subjects were not given masks to cover confirmations. They were instructed to read the stimulus material in a frame, then read the confirmation, and continue this procedure until they completed the program. The two groups took the programs in separate (but identical) classrooms. It is unlikely that the two groups of subjects realized that they were taking the program in a different manner. The activities of the covert group were monitored also by two instructors to insure compliance with the instructions for completing the program. It can be argued that the students may not have peeked if they had not been instructed to do so; however, an attempt was made to simulate circumstances whereby all students in the covert group did peek. Conclusions drawn from this study should, therefore, consider this aspect of the experiment.

# Section V

## RESULTS AND DISCUSSION

**Results.** An analysis of variance, as shown in Table I, yielded no significant differences among the groups as measured by the AFOQT; therefore, the six groups were considered as two separate groups, i.e., cvert and covert, for this experiment.

TABLE I

Analysis of Variance for AFOQT Scores for Six Groups

| *Source of Variation* | *SS* | *DF* | *MS* | *F* |
|---|---|---|---|---|
| Between | 2120.82 | 5 | 424.16 | .796* |
| Within | 38334.63 | 72 | 532.43 | |
| Total | 40455.45 | 77 | | *Not significant |

The AFOQT Officer Quality Composite scores and the post-test scores of the overt and covert groups were correlated for the overt groups $r = .20$ and for the covert group $r = .24$. These low correlations between the test scores and the AFOQT composite raises some doubt as to the appropriateness of matching groups on the basis of this particular composite for programmed instruction experimental purposes.

The subjects were given a post-test the day after they completed the programmed text. Ratio gain scores (Appendix II) were calculated for each subject for the 35-item, multiple-choice, pre-test and post-test. The scores are obtained by dividing the actual gain by the possible gain and can be used for comparative purposes. The following is an example of the computation of a ratio gain score for a 35-item test:

| | |
|---|---|
| Pre-test scores: | 10 |
| Post-test scores: | 30 |
| Actual gain: | 20 |
| Possible gain: | 25 |

$$\frac{20}{25} = .80 \text{ (ratio gain score)}$$

The time required to complete a task is very important in the development and administration of programmed instruction. For this reason, the completion times were recorded, and inverse efficiency scores were obtained by dividing the completion time in minutes by the post-test score for each student (Appendix III). The inverse efficiency scores were used instead of the conventional learning efficiency measure (gain divided by completion) because the post-test performance varied much less than the completion time in the experiment. It is believed that, in this case, the use of the post-test achievement (instead of the gain) as the denominator of the ratio score provided a more meaningful measure of student learning. However, if desired, the conventional learning efficiency scores may be derived from the gain scores in Appendix II and the completion times in Appendix III. The results of t-tests between the overt and covert groups for pre-test scores, ratio gain scores, and inverse efficiency scores are shown in Table II.

TABLE II

Results of t-tests between Overt and Covert Groups

| | *Overt* $\overline{X}$ | *Covert* $\overline{X}$ | *df* | *t* | *significant* |
|---|---|---|---|---|---|
| Pre-test Scores | 17.90 | 17.49 | 77 | .238 | No |
| Ratio Gain Scores | 93.69 | 92.05 | 77 | .820 | No |
| Inverse Efficiency Scores | 2.63 | 2.82 | 77 | 1.250 | No |

No statistical difference was found between groups for inverse efficiency scores; however, average completion time, while not statistically significant ($t=1.27$), slightly favored the overt group. The average completion time for the overt group was 1 hour and 30 minutes. For the covert group, the average completion time was 1 hour and 35 minutes. McCrystal and Jacobs (1966) found that the completion time average favored the covert group in their study, but the difference was not significant. In the present study, the slight difference in the means for completion times may be due to chance.

**Discussion.** No statistical difference was found between the overt and covert groups in this experiment. The results support the theoretical expectation that, in programmed instruction, students who respond covertly learn as efficiently as students who respond overtly. In the past, various techniques were designated to elicit responses and to preclude peeking by students. These preventive efforts ranged from complex electromechanical devices to less sophisticated book formats. In this study, however, peeking (under the stated simulated conditions) did not reduce learning. The experiment did not support the hypothesis that covert responding saves time. Although not statistically significant, the average completion time slightly favored the overt group. The difference in the means for completion times may be due to chance.

The results of this study should not suggest that the overt response mode is unimportant in programmed instruction. The instructional programmer needs student response feedback during initial, group, and field testing of programs. Such information provides a basis for refinement or revision of the instructional materials. However, when the program has been extensively tested on students of the target population, it should teach the desired behaviors to other students of the same population, provided they desire to learn the material. It should do this even though a covert response mode is used.

It may be assumed that the subjects in this study were highly motivated to learn the stimulus material. They were pilot trainees and aspirant pilot trainees (AFROTC juniors and seniors) and they considered the subject matter to be useful in their chosen pilot careers. If students are not motivated to learn a particular subject, it is doubtful that the use of peek-resistant formats or devices is the best solution of the problem.

# Appendix I

## SAMPLE OF PROGRAMMED TEXT

### INSTRUCTIONS

This programmed text will teach you the Undergraduate Pilot Training syllabus objectives for radar.

The program is self-teaching and easy to follow. You need to read all of the information presented on each page including the illustrations. After you read the information, usually you will be asked to answer a question or to complete a sentence about the material you read. The items which call for responses usually have more than one correct answer.

You should be able to finish the material in this programmed text (PT) during the classroom hours allotted, provided you apply yourself diligently to the task. This may be your first exposure to this particular style of programming. In such an event, a few words of explanation are in order. This text (program) presents the information in small steps called frames. After each frame you are asked to respond to a situation or question. Use a 5 x 8 card, or heavy paper you can't see through, as a mask. Slide the mask down the page until you expose the diagonals (//////////). You now have one frame exposed. Read the information given and respond in the space provided. After you have made your response, slide the mask further down and compare your answer with the correct answer. If you should write an incorrect answer, do not erase it, but draw a line through it and enter the correct response.

---

<u>See how well you understand what to do.</u>

1. Circle the statements that are correct.

   a. An instructor will teach this course.
   b. Responses are required to answers.
   c. Classroom instruction will supplement this PIP.
   d. Responses to instructional items are confirmed on the right-hand column of each page.
   e. Response items may contain more than one correct answer.
   f. This PT will be supplemented by tape recorded lessons on radar.

////////////////////

b d e

---

A different type of programming technique called branching is used between pages 20 and 23. Do not be confused! You will not follow the pages in numerical order. Just follow the instructions when you get there.

## Unit 1—BASIC RADAR PRINCIPLES

OBJECTIVES:

a. Given a list of terms and a list of definitions, you will correctly match each term with its definition.

b. Given a block diagram of a basic radar set and a set of labels, you will correctly label each block and indicate the direction of data flow.

c. Given a list of factors affecting radar operation, you will correctly identify those which determine whether a usable portion of the transmitted energy will be reflected.

d. You will be able to correctly rank object materials in the order of reflectivity from a given list.

e. You will be able to identify plan position indicators (PPI) and B-scan indicators as to type from illustrations in the text.

f. Given illustrations of radar indicators with a variety of traces, you will correctly identify the traces as to function.

---

Read and select the correct response to each frame:

1. The American preoccupation with code words possibly had something to do with simplifying the phrase "radio detection and ranging" into the term RADAR. The principles involved in radar were understood long before the equipment was built. The problem was one of building hardware that would carry out the principles. The problem was first solved during World War II.

Check the statements below that are true:

a. Radar means radio direction and reading
b. Radar units were used extensively prior to World War II
c. Radio detection and ranging is known as radar
d. The principles of radar were discovered during World War II

////////////////////

c

---

2. Once the equipment was built, the basic principles were no longer the concern of a few research scientists, but rather they became the property and responsibility of thousands of technicians and supervisors. Today, radar principles are taught to and understood by mechanics, navigators, pilots, and traffic officers. These principles permit finding objects that cannot be seen, or determining accurately the factors in a ballistic problem involving a moving target and a mobile gun. They are now used to detect a speeding automobile on the city streets.

After radar equipment was finally developed:

a. It became too complex to be operated by the average person
b. People from many different career fields became familiar with it
c. Its use was limited to aviation purposes
d. None of the above

////////////////////

b

---

14. Check the true statements below:

a. Radar principles were understood before the hardware was built
b. Radar is used in ballistics
c. The timer synchronizes the antenna and the power supply
d. Direction is determined by the receiver
e. The power supply furnishes radio frequency energy

////////////////////

a b

---

15. Here is a set of terms and definitions for you to match:

a. ( ) radar
b. ( ) transmitter
c. ( ) receiver
d. ( ) power supply
e. ( ) timer
f. ( ) indicator
g. ( ) antenna
h. ( ) radar echo
i. ( ) radar trace

1. the unit that radiates and receives electromagnetic energy
2. the source of electrical energy
3. the pattern produced on the screen of the indicator
4. the component that generates the timing signals for the complete set
5. the unit that provides a visual indication of the reflected energy
6. a system using beamed and reflected energy for detecting and locating objects
7. the unit that generates electromagnetic energy
8. the device that amplifies the reflected echo and sends a signal to the indicator
9. the energy received after reflection from an object

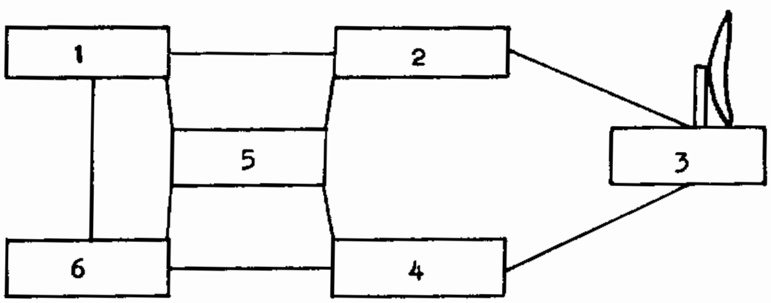
////////////////////

a - 6 b - 7 c - 8 d - 2 e - 4 f - 5 g - 1 h - 9 i - 3

---

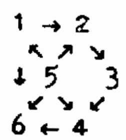
16. Complete the block diagram of a basic radar system shown. From the following list, select the correct label and write it in the block. Also indicate the direction of the data flow.

Transmitter Timer Antenna Power supply Receiver Indicator




////////////////////

1. Timer
2. Transmitter
3. Antenna
4. Receiver
5. Power supply
6. Indicator




---

17. There are four factors that determine whether an object will return a useable radar echo. One of these factors is the vertical and horizontal size of the object that is exposed to the radar beam. Another factor is radar range, or the distance between the antenna and the object. In the situation below, indicate which factor is the more significant by writing size or range next to the statement.

1. There are two objects in formation, one is a KC-135, the other is an F-104. (    )
2. There are two F-100's, one is 800 yards away, the other is 1800 yards away. (    )
3. There are two F-100's at unknown distances, one returns a good echo, the other does not. (    )
4. There are two echoes on the radar indicator, both are four miles away, but one trace is much brighter than the other. (    )

////////////////////

1. size    2. range    3. range    4. size

---

18. In addition to size and range, the material the object is made of makes a difference in the amount of energy in the returned echo. Metal objects return a better echo than wooden objects, for instance, and water is somewhere in between. The reflection angle is also a factor. This is the angle between the radar beam and the face of the object. The more nearly the object is to the perpendicular, the better will be the echo. Below are some targets. Each statement includes two or more targets. You are to decide which factor is the most significant in determining the amount of echo and write the factor next to the statement.

1. KC-135 and an F-104 at 1000 yards (    )
2. a desert and a mountain (    )
3. a wood water tank and a steel water tank (    )
4. three flights of fighter aircraft (    )
5. a gabled roof and a flat roof (    )
6. a frame house and a tin building (    )

////////////////////

1. size
2. reflection angle
3. material of object
4. radar range
5. reflection angle
6. material of object

---

19. Listed below are some statements that relate to radar. Check the four that are factors in determining whether a useable echo will be returned.

1. ( ) vertical and horizontal size of the object
2. ( ) frequency of radiated energy
3. ( ) reflection angle
4. ( ) radar range
5. ( ) type of indicator used
6. ( ) material of the object
7. ( ) sweep rate

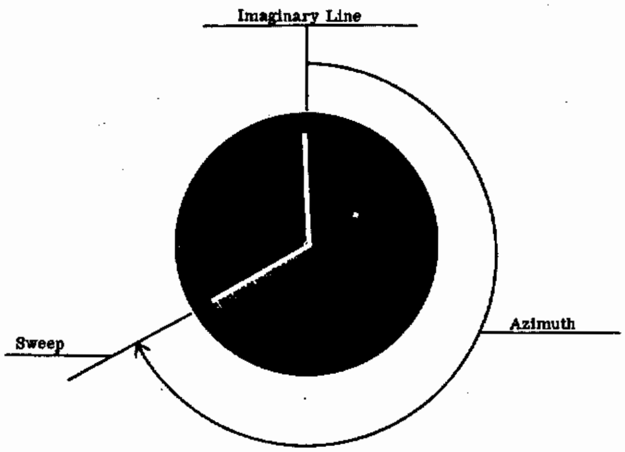
////////////////////

1    3    4    6

---

6

26. Most radar indicators are cathode ray tubes (CRT). A CRT is a device which converts an electronic signal into a visible display on its face. A TV picture tube is a familiar example of a CRT. The real difference in radar indicators is the difference in the way in which they are scanned or swept. In a plan position indicator (PPI), the sweep moves in a circular manner about a center point. The range (concentric circles) is indicated by distance from the center of the screen and the bearing is indicated by its radial angle. In operation, a radius line is constantly moving about the face of the tube and concentric circular traces are displayed. Note in the diagram shown that the Azimuth, the direction toward which the antenna is pointing, is measured clockwise from North.




Plan Position Indicator (PPI)

Check the true statements below.

a. Indicators differ mainly in the types of cathode ray tubes used
b. Indicators differ in the way in which they are scanned
c. The PPI is similar to a TV picture tube in design
d. Azimuth is measured clockwise from North

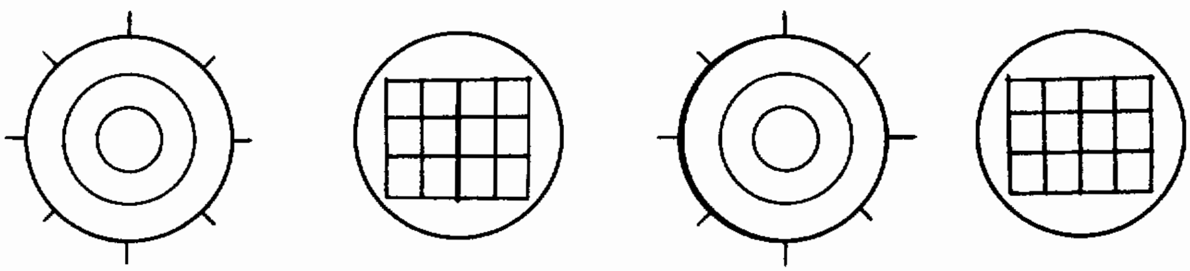
////////////////////

b c d

---

27. There are many scans in addition to the PPI scan. For comparison purposes only, we will consider B-scan in this program. A B-scan is a cathode ray tube in which the sweep is vertical and moves side to side like a vertical windshield wiper. Also there is a grid system of traces which are used to determine the bearing of the echo. Below are examples of two indicators. Cross out the incorrect label.

1. PPI/B-SCAN 2. PPI/B-SCAN 3. PPI/B-SCAN 4. PPI/B-SCAN



////////////////////

1. PPI 2. B-SCAN 3. PPI 4. B-SCAN

---

## RANGE

39. Range is the distance from the center of the PPI to the trace. The process of determining range involves the measurement of the time it takes a specific burst of energy to travel from the antenna to some object, be reflected by that object, and return to the antenna of the radar set. To be able to measure this time, it is necessary to emit radar energy in individual pulses. These pulses, which usually last about 1/2 microsecond, are long enough apart to permit one pulse to travel to an object and return to the antenna before the next pulse is transmitted. The timer determines the interval at which these pulses will be released, and a cathode-ray tube measures the time between the transmission and reception of the reflected impulses. The trace of sweep, which is formed by the movement of a flourescent spot on the face of the tube, is used as the time base.

Check the true statements below:

a. A PPI gives a map-like representation of an area.
b. Glass is a better reflector than is water.
c. The timer measures time between transmission and reception of radar pulses.
d. The sweep is used as a time base.

////////////////////

a d

---

## AZIMUTH

40.

Refer to diagram at left. To determine the distance from objects other than those directly in the aircraft's line of flight, it is necessary to rotate the antenna 360° so that it will point at objects in all directions from the aircraft. This rotation of the antenna is known as scanning. The trace follows the rotation of the antenna, so that at any given instant the position of the traces on the azimuth scale represents the direction at which the antenna is pointing. By using the scanning and pulsing techniques simultaneously, you can determine both range and azimuth of an object.

Match the terms listed below to their definitions by placing the number of the term next to its definition.

| | |
|---|---|
| 1. radar trace | a. ( ) a better reflector than soil |
| 2. radar echo | b. ( ) rotation of the antenna |
| 3. PPI | c. ( ) a pattern shown on the flourescent screen of a CRT. |
| 4. wood | d. ( ) gives a map-like representation of an area. |
| 5. scanning | e. ( ) radio frequency energy received after reflection from an object. |
| 6. transmitter | f. ( ) represents direction toward which antenna is pointing. |
| 7. azimuth | g. ( ) a unit in which the radio frequency energy for radar action is generated. |

////////////////////

a - 4 b - 5 c - 1 d - 3 e - 2 f - 7 g - 6

---

## CLOUD RETURNS

50. Clouds that are of sufficient size and contain sufficient moisture will present a return on the radar scope. You have learned that water is an excellent reflector, but in the case of lakes and rivers, it does not show on the scope because of the reflection angle. In contrast to lakes and rivers, the clouds present a very good reflection angle.

Select the correct answer below and continue working the program by turning to the page indicated after your chosen response.

a. The size and number of water droplets in a cloud determine the strength of a cloud return. Page 21

b. Water causes dark returns on a scope; therefore, a cloud return will present dark returns in contrast to other areas. Page 23

c. The large size of a cloud is the main determining factor in the brightness of cloud returns. Page 22

---

51. Cumulonimbus clouds (thunderstorms) give the brightest returns, but normal cumulus and heavy stratus clouds will also show on the scope as hazy or foggy returns. The thunderstorms appear as very bright returns with fuzzy edges. See if you can select the correct answer below.

Which one of the following statements would you give as a reason for fuzzy or hazy edges of a thunderstorm?

a. There is more moisture around the outer edges of the thunderstorm. Page 22

b. There is less moisture around the outer edges of the thunderstorm. Page 21

c. The thunderstorm is probably very large which causes the edges to show up dim on the radar scope. Page 23

---

52. Speaking of thunderstorms, hurricanes are a good example! A hurricane is located in an area of extremely low barometric pressure. The eye is an area of calm weather. It is usually outlined by intense thunderstorms. These storms are naturally composed of long lines of cumulonimbus clouds that appear to arrange themselves parallel to the normal wind flow around these intense low pressure areas. Think this over and select the correct answer below.

Which of the following is true concerning a hurricane?

a. The eye shows a dark return and the cumulonimbus appears as a bright area surrounding the dark return. Page 23

b. The eye shows a bright return and the cumulus and heavy stratus clouds show a bright return. Page 22

c. The eye shows a hazy or foggy area and the thunderstorms show an area of no return. Page 21

---

53. Tornadoes are also extremely low pressure areas usually associated with cumulonimbus clouds. Recent experience indicates that a tornado, when it does show on a radar scope, will appear as a finger or a hooked appendage projecting out of the parent thunderstorm. The finger will generally project out of the southwest quadrant of the storm and will present an extremely bright return. Hail can be also detected by radar. Hail echoes usually take the shape of pointed fingers, hooked fingers, or scalloped edges. Now, select the correct answer below.

a. Returns from hail are easily confused with returns from hurricanes. Page 22

b. A tornado usually presents a fuzzy return on the scope. Page 21

c. From the information that you have read in this program, it is possible to mistake hail for a tornado. Page 23

---

Item 50a:

Your answer: The size and number of water droplets in a cloud determine the strength of a cloud return.

Very good. As you know, water is a fine reflector of radar energy as well as a good conductor of electricity, but in some cases, such as lakes and rivers, water does not give a good return. The poor showing is due to the small reflection angle. (Now return to page 20 and proceed with Item 51.)

---

Item 51b:

Your answer: There is less moisture around the outer edges of the thunderstorm.

You are correct, of course. Since the number of droplets of water is less, the moisture content is less, and thus the edges appear hazy in the returns. (Now return to page 20 and proceed with Item 52.)

---

Item 52c:

Your answer: The eye shows a hazy or foggy area and the thunderstorms show an area of no return.

No! However, the first part of your answer was a fair guess. On the other hand, you must not have read all of the answer. Remember that cumulonimbus (thunderstorms) show bright returns. (Return to page 20 and choose the right answer.)

---

Item 53b:

Your answer: A tornado usually presents a fuzzy return on the scope.

Well, this program has given no evidence to support your choice. It has been stated, however, that cumulonimbus clouds are associated with tornadoes. This should be a giveaway for you! (So return to page 20 and select the correct response.)

---

Item 50b:

Your answer: Water causes dark returns on a scope; therefore, a cloud will present dark returns in contrast to other areas.

Well, not exactly. It is true that rivers and lakes give dark returns, but in this case we must consider some other factors. The density of the clouds will have an effect upon the return. Another factor to consider is the reflection angle. (Return to page 20 and select the correct answer.)

---

Item 51c:

Your answer: The thunderstorm is probably very large which causes the edges to show dim on the radar scope.

No. Thunderstorms may be large or small with bright or dim returns. The moisture content is the important factor in this case. (To get back on the track, return to page 20 and select the correct answer.)

---

Item 52a:

Your answer: The eye shows a dark return and the cumulonimbus appears as a bright area surrounding the dark return.

Excellent. Since the eye of the hurricane was an area of calm weather, you might have guessed that there would be no returns. However, cumulonimbus clouds are thunderstorms, so bright returns provide the most positive clue. Hurricane echoes cover an extremely large area and have a distinctive circular appearance. (Now return to page 20 and proceed with Item 53.)

---

Item 53c:

Your answer: From the information you have read, it is possible to mistake hail for a tornado.

Yes. At least, it is a logical conclusion, since both can show on a scope as fingers or hooked appendages. It is wise not to rely too heavily on the ability of airborne radar to detect small tornado funnels. The finger might be lost in ground echoes and it might appear only as a blunt protuberance or scallop at the edge of the thunderstorm. The best method to avoid tornado funnels is to make a wider than usual detour around sharp-edged thunderstorms that show any distinctive projections. (Now proceed to Frame 54 on page 24 and continue to work the program.)

---

54. The following are some characteristics of cloud returns:

a. Returns vary in brightness, but the average thunderstorm return is brighter than the normal ground return.
b. Cloud returns usually have a hazy or fuzzy appearance around the edges and a very bright core.
c. Cloud returns may change shape as the aircraft's position changes, whereas the shape of cities remain relatively constant.
d. Cloud returns will remain on a scope as the antenna tilt is raised. Ground returns tend to decrease in brightness or disappear.
e. Normally, shadows, or dark spots appear on the far side of strong cloud returns.

---

55. Complete the sentences below by writing the appropriate type or category of returns in the blanks:

a. Squall lines and other weather features cause (                    ) returns.
b. Industrial areas cause (                              ) returns.
c. Rivers and lakes are examples of (                              ) returns.

////////////////////

a. Cloud        b. Cultural        c. Topographical

---

56. Check the correct statements below:

a. Usually, thunderstorm returns are darker than normal ground returns.
b. As an aircraft's position changes the shape of cloud returns remain constant.
c. Cloud returns usually have a very bright core.
d. Cloud returns usually have a hazy or fuzzy appearance around the edges.

////////////////////

c    d

---

57.


Hail and sometimes tornadoes have a characteristic finger while on the other hand, heavy fog or stratiform clouds are not dense enough to reflect sufficient energy to cause a weather return. Refer to the diagram at left.

The return marked C could be (                              ).

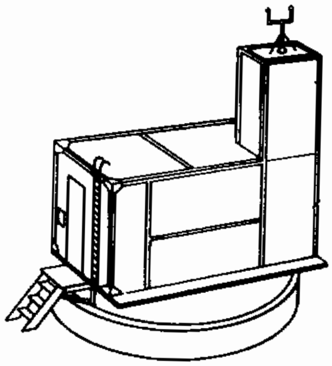
a. a tornado        b. rain        c. stratiform clouds        d. fog

////////////////////

a

---

75.




Upon reaching the final approach gate, the precision approach radar (PAR) component of RAPCON furnishes accurate lateral and vertical guidance. The information permits control of aircraft from a point 7 to 10 miles from the active runway. The control is accomplished by advising the pilot (by voice communications) of the aircraft distance from the approach end of the runway, heading to fly, to line up with the runway, and the aircraft's relationship to a predetermined glide path. A typical PAR is shown at the left.

Check the correct statements below.

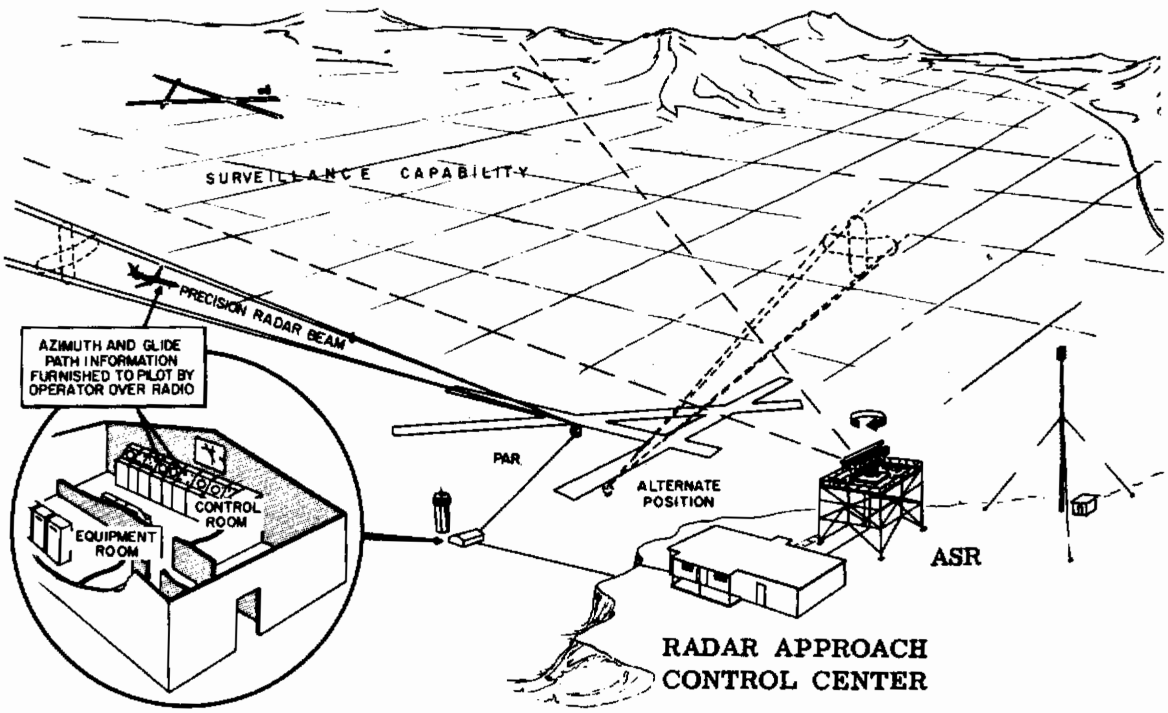
a. PAR is the abbreviation for precision altitude range.
b. PAR gives lateral and vertical guidance information beginning about 7-10 miles from the active runway.
c. The ASR component cannot replace the PAR.

////////////////////

b

---

76. Refer to the diagram below. It shows a typical RAPCON center including an ASR, PAR, and a RAPCON building with control room and equipment room. (Complete the statements on the next page.)




31

# Appendix II

## RATIO GAIN SCORES FOR OVERT AND COVERT GROUPS

## OVERT GROUP – RATIO GAIN SCORES

### *GROUP I*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-Test: | 15 | 13 | 12 | 10 | 10 | 19 | 28 | 14 | 20 | 18 | 13 | 24 | 18 |
| Post-Test: | 35 | 35 | 35 | 34 | 30 | 35 | 33 | 33 | 34 | 34 | 33 | 35 | 34 |
| Actual Gain: | 20 | 22 | 23 | 24 | 20 | 16 | 15 | 19 | 14 | 16 | 20 | 11 | 16 |
| Possible Gain: | 20 | 22 | 23 | 25 | 25 | 16 | 17 | 21 | 15 | 17 | 22 | 11 | 17 |
| Ratio Gain: | 1.00 | 1.00 | 1.00 | .96 | .80 | 1.00 | .88 | .90 | .93 | .94 | .91 | 1.00 | .94 |

### *GROUP II*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-Test: | 19 | 22 | 24 | 31 | 18 | 31 | 28 | 7 | 22 | 25 | 25 | 21 | 23 |
| Post-Test: | 33 | 35 | 33 | 34 | 35 | 35 | 34 | 33 | 35 | 35 | 35 | 34 | 33 |
| Actual Gain: | 14 | 13 | 9 | 3 | 17 | 4 | 6 | 26 | 13 | 10 | 10 | 13 | 10 |
| Possible Gain: | 16 | 13 | 11 | 4 | 17 | 4 | 7 | 28 | 13 | 10 | 10 | 14 | 12 |
| Ratio Gain: | .88 | 1.00 | .82 | .75 | 1.00 | 1.00 | .86 | .93 | 1.00 | 1.00 | 1.00 | .93 | .83 |

### *GROUP III*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-Test: | 11 | 27 | 13 | 14 | 6 | 12 | 14 | 12 | 11 | 12 | 27 | 21 | 8 |
| Post-Test: | 35 | 35 | 34 | 35 | 34 | 35 | 34 | 34 | 35 | 30 | 35 | 31 | 34 |
| Actual Gain: | 24 | 8 | 21 | 21 | 28 | 23 | 20 | 22 | 24 | 18 | 8 | 10 | 26 |
| Possible Gain: | 24 | 8 | 22 | 21 | 29 | 23 | 21 | 23 | 24 | 23 | 8 | 14 | 27 |
| Ratio Gain: | 1.00 | 1.00 | .95 | 1.00 | .97 | 1.00 | .95 | .96 | 1.00 | .78 | 1.00 | .71 | .96 |

## COVERT GROUP – RATIO GAIN SCORES

### *GROUP I*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-Test: | 30 | 28 | 30 | 24 | 20 | 16 | 30 | 30 | 11 | 21 | 14 | 7 | 12 |
| Post-Test: | 35 | 35 | 34 | 34 | 34 | 34 | 33 | 34 | 34 | 32 | 34 | 34 | 35 |
| Actual Gain | 5 | 7 | 4 | 10 | 14 | 18 | 3 | 4 | 23 | 11 | 20 | 27 | 23 |
| Possible Gain: | 5 | 7 | 5 | 11 | 15 | 19 | 5 | 5 | 24 | 14 | 21 | 28 | 23 |
| Ratio Gain: | 1.00 | 1.00 | .80 | .91 | .93 | .95 | .60 | .80 | .96 | .79 | .95 | .96 | 1.00 |

### *GROUP II*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-Test: | 8 | 9 | 19 | 24 | 32 | 32 | 25 | 6 | 12 | 9 | 17 | 7 | 5 |
| Post-Test: | 34 | 34 | 34 | 35 | 35 | 35 | 33 | 33 | 32 | 32 | 34 | 34 | 34 |
| Actual Gain: | 26 | 25 | 15 | 11 | 3 | 3 | 8 | 27 | 20 | 23 | 17 | 27 | 29 |
| Possible Gain: | 27 | 26 | 16 | 11 | 3 | 3 | 11 | 29 | 23 | 26 | 18 | 28 | 30 |
| Ratio Gain: | .96 | .96 | .94 | 1.00 | 1.00 | 1.00 | .73 | .93 | .87 | .88 | .94 | .96 | .97 |

### *GROUP III*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-Test: | 21 | 15 | 13 | 26 | 13 | 15 | 11 | 9 | 19 | 14 | 10 | 26 | 12 |
| Post-Test: | 35 | 32 | 34 | 35 | 35 | 33 | 35 | 35 | 33 | 35 | 27 | 35 | 33 |
| Actual Gain: | 14 | 17 | 21 | 9 | 22 | 18 | 24 | 26 | 14 | 21 | 17 | 9 | 11 |
| Possible Gain: | 14 | 20 | 22 | 9 | 22 | 20 | 24 | 26 | 16 | 21 | 25 | 9 | 13 |
| Ratio Gain: | 1.00 | .85 | .95 | 1.00 | 1.00 | .90 | 1.00 | 1.00 | .88 | 1.00 | .68 | 1.00 | .85 |

# Appendix III

## INVERSE EFFICIENCY SCORES FOR OVERT AND COVERT GROUPS

## INVERSE EFFICIENCY SCORES (TIME/SCORE)

*OVERT*

*GROUP I*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | 55 | 60 | 85 | 55 | 65 | 65 | 60 | 70 | 80 | 75 | 75 | 80 | 80 |
| Post-Test | 35 | 35 | 35 | 34 | 30 | 35 | 33 | 33 | 34 | 34 | 33 | 35 | 34 |
| Inverse Eff. | 1.57 | 1.71 | 2.43 | 1.62 | 2.17 | 1.86 | 1.82 | 2.12 | 2.35 | 2.21 | 2.27 | 2.29 | 2.35 |

*GROUP II*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | 90 | 80 | 90 | 75 | 85 | 85 | 95 | 140 | 120 | 100 | 90 | 140 | 75 |
| Post-Test | 33 | 35 | 33 | 34 | 35 | 35 | 34 | 33 | 35 | 35 | 35 | 34 | 33 |
| Inverse Eff. | 2.73 | 2.29 | 2.73 | 2.21 | 2.43 | 2.43 | 2.79 | 4.24 | 3.43 | 2.86 | 2.57 | 4.12 | 2.27 |

*GROUP III*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | 125 | 95 | 100 | 120 | 95 | 90 | 90 | 85 | 125 | 100 | 110 | 85 | 95 |
| Post-Time | 35 | 35 | 34 | 35 | 34 | 35 | 34 | 34 | 35 | 30 | 35 | 31 | 34 |
| Inverse Eff. | 3.57 | 2.21 | 2.94 | 3.43 | 2.79 | 2.57 | 2.65 | 2.50 | 3.57 | 3.33 | 3.14 | 2.74 | 2.79 |

## INVERSE EFFICIENCY SCORES (TIME/SCORE)

*COVERT*

*GROUP I*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | 55 | 65 | 80 | 80 | 85 | 75 | 55 | 70 | 85 | 70 | 65 | 80 | 95 |
| Post-Test | 35 | 35 | 34 | 34 | 34 | 34 | 33 | 34 | 34 | 32 | 34 | 34 | 35 |
| Inverse Eff. | 1.57 | 1.86 | 2.35 | 2.35 | 2.50 | 2.21 | 1.67 | 2.06 | 2.50 | 2.19 | 1.91 | 2.35 | 2.71 |

*GROUP II*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | 80 | 80 | 80 | 85 | 135 | 150 | 135 | 110 | 90 | 80 | 125 | 100 | 145 |
| Post-Test | 34 | 34 | 34 | 35 | 35 | 35 | 33 | 33 | 32 | 32 | 34 | 34 | 34 |
| Inverse Eff. | 2.35 | 2.35 | 2.35 | 2.43 | 3.86 | 4.29 | 4.09 | 3.33 | 2.81 | 2.50 | 3.68 | 2.94 | 4.26 |

*GROUP III*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | 95 | 100 | 90 | 120 | 85 | 95 | 120 | 125 | 120 | 135 | 95 | 85 | 95 |
| Post-Test | 35 | 32 | 34 | 35 | 35 | 33 | 35 | 35 | 33 | 35 | 27 | 35 | 33 |
| Inverse Eff. | 2.71 | 3.13 | 2.65 | 3.43 | 2.43 | 2.88 | 3.43 | 3.57 | 3.64 | 3.86 | 3.52 | 2.43 | 2.88 |

# References

Ashbaugh, W. H., 'Effects on Achievement Written Responses to Programmed Learning Material for Students of Differing Academic Ability," *Psychological Reports,* 780-782, 1964.

Brown, R. W., "Are We Objective?" *NSPI Journal,* p 8, January- February 1965.

Cartier, F. A., "Another Format for Linear Programs" *NSPI Journal* p. 7, May 1965.

Evans, J. L., Glaser, R., and Homme, L. E., *A Preliminary Investigation of Variation in the Properties of Verbal Learning Sequences of the "Teaching Machine" Type,* paper read at the annual convention of the Eastern Psychological Association, Atlantic City, N. J., April 1959.

Gilbert, T. F., *An Early Approximation to Principles of Programming Continuous-Discourse, Self-Instructional Materials,* a report to Bell Telephone Laboratories, September 1958a.

Gilbert, T. F., *Some Issues Involved in Selecting an Automatic Teaching Device,* a report to Bell Telephone Laboratories, September 1958b.

Goldbeck, R. A., *The Effect of Response Mode and Learning Material Difficulty on Automated Instruction,* Technical Report No. 1, American Institute for Research, Pittsburgh, Pa., September 1960.

Goldbeck, R. A., Campbell, V. N., and Llewellyn, Joan E., *Further Experimental Evidence on Response Modes in Automated Instruction,* Technical Report No. 3, American Institute for Research, Pittsburgh, Pa., December 1960.

Gray, Genevieve, "Tutorial English . . . An Exploratory Project," *NSPI Journal,* p. 15, September 1963.

Holland, J. G., and Skinner, B. F., *The Analysis of Behavior,* McGraw-Hill, New York, 1961.

McCrystal, T. J., and Jacobs, T. O., *The Effect of Programmed Instruction Response Conditions on Acquisition and Retention,* HumRRO Technical Report 66-20, The George Washington University Human Resources Research Office, Alexandria, Virginia, December 1966.

Pressey, S. L., "A Machine for Automatic Teaching of Drill Material," *School and Society,* 25: 549-552, 1927.

Pressey, S. L., "A Simple Apparatus Which Gives Tests and Scores – and Teaches," *School and Society,* 23: 373-376, 1926.

Pressey, S. L., "Further Attempts to Deveolp a Mechanical Teacher," *American Psychologist,* 15: 124-127, 1960.

Silverman, R. E., and Alter, Millicent, *Response Mode, Pacing, and Motivational Effects in Teaching Machines,* Technical Report: NAVTRADEVCEN 507-3, U. S. Naval Training Device Center, Port Washington, New York, June 1961.

Skinner, B. F., "The Science of Learning and the Art of Teaching," *Harvard Educational Review,* 24, 86-97, 1954. Also in A. A. Lumsdaine and R. Glaser, Eds., *Teaching Machines and Programmed Learning: A Source Book,* National Education Association, Washington, D. C., 1960.

Wayne, E. R., and Klein, C., "Teaching Machines Enhance Programmed Instruction," *NSPI Journal,* P. 7, November 1963.

Security Classification

**DOCUMENT CONTROL DATA - R & D**

*(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)*

| | |
|---|---|
| 1. ORIGINATING ACTIVITY *(Corporate author)* Aerospace Medical Research Laboratories, Aerospace Medical Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio 45433 | 2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED<br>2b. GROUP N/A |

3. REPORT TITLE

EFFECT OF CONFIRMATION PEEKING AND RESPONSE MODE ON PROGRAMMED INSTRUCTION

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Final Report, April 1965 - January 1966

5. AUTHOR(S) *(First name, middle initial, last name)*
Horace H. Valverde

| 6. REPORT DATE | 7a. TOTAL NO. OF PAGES | 7b. NO. OF REFS |
|---|---|---|
| December 1968 | 23 | 17 |

| | |
|---|---|
| 8a. CONTRACT OR GRANT NO. | 9a. ORIGINATOR'S REPORT NUMBER(S) |
| b. PROJECT NO. 1710 | AMRL-TR-67-225 |
| c. Task No. 171003 | 9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* |
| d. | |

10. DISTRIBUTION STATEMENT
This document has been approved for public release and sale; its distribution is unlimited.

| 11. SUPPLEMENTARY NOTES | 12. SPONSORING MILITARY ACTIVITY |
|---|---|
| | Aerospace Medical Research Laboratories, Aerospace Medical Div., Air Force Systems Command, Wright-Patterson AFB, OH 45433 |

13. ABSTRACT

An experiment was conducted to determine the effect of peeking on programmed instruction. The study tested the following hypotheses: (1) the requirement for overt responses does not increase learning in programmed instruction, (2) devices or formats to preclude confirmation peeking do not increase the effectiveness of programmed instruction, and (3) time can be saved by eliminating the requirement for overt responses. Two groups of 39 subjects each were used. The subjects were commissioned officer Air Force pilot trainees and Air Force Reserve Officer Training Corps (AFROTC), junior and senior college students matched on the basis of scores obtained on the Officer Quality Composite of the Air Force Officer Qualifying Test (AFOQT). The stimulus material was a radar orientation programmed text. Results of the study were: (1) peeking did not reduce the effectiveness of programmed instruction; (2) students who responded covertly learned as efficiently as students who responded overtly; and (3) covert responding did not save instructional time.

DD FORM 1 NOV 65 1473

Security Classification

Security Classification

| 14. KEY WORDS | LINK A | | LINK B | | LINK C | |
|---|---|---|---|---|---|---|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| Learning | | | | | | |
| Verbal Learning | | | | | | |
| Programmed Instruction | | | | | | |
| Military Training | | | | | | |

Security Classification