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Staff Memorandum

AN ANNOTATED BIBLIOGRAPHY OF RESEARCH ON
TRAINING AIDS AND TRAINING DEVICES

by

Robert T. Root

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Training Methods Division

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TRAINING AIDS AND TRAINING DEVICES

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Robert T. Root

Approved: 

WILLIAM A. McCLELLAND
Director of Research
Training Methods Division

August 1957

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INTRODUCTION

This annotated bibliography was prepared as a comprehensive source of information in training aids and devices. Special consideration has been given to use of training aids and devices in the armed services. Included are articles, reports, and books from psychological, military, and educational literature. The titles were selected and the abstracts prepared from publications of the armed services, publications of the American Psychological Association, other American professional journals, and publications of the Canadian and British governments.) No extensive effort was made to review the foreign literature on this subject.

Abstracts have been prepared to present only the general conclusions of experimental research or a general brief of the content of non-experimental articles.) The intent is to furnish the reader with enough information so that he can decide whether the item is of sufficient value or interest, for his purposes, to warrant further reading.

This bibliography contains only unclassified abstracts.

For this bibliography a training device has been defined as an apparatus that simulates the requirements of the criterion task and facilitates the acquisition of the necessary skills which are presumed to transfer to the operational situation. A training aid has been defined as an object or device used to facilitate the presentation and teaching of informational knowledge.

Section I, Training Devices, contains the titles and abstracts of reports and articles pertaining to the design, construction, utilization, and evaluation of training devices. Included are items concerned with such devices as the Foxboro Trainer, the Link Trainer, and the Pedestal Sight Manipulation Test. This section is subdivided into the following categories: (1) electronic, (2) aerial, (3) gunnery, and (4) miscellaneous.

Section II, Training Aids, contains the titles and abstracts of reports and articles pertaining to the use and evaluation of training aids in facilitating instruction and in increasing the amount of informational knowledge gained during instruction. Discussion and investigation of motion pictures and television as aids to instruction comprise most of the literature in this area; each has been assigned a separate category. Other training aids, such as flannelgraphs, chalkboards, and charts, have been given little attention in the literature and are grouped together. A fourth category lists books that are concerned with the entire area of audio-visual education and the materials and techniques employed. This section is subdivided into the following categories: (1) motion pictures, (2) television, (3) other training aids, and (4) single source references on audio-visual materials and techniques.

Section III, Requirement and Evaluation Methodology, contains methodological articles concerned with methods for determining the need for training aids and devices, ascertaining design requirements, and the evaluation of training aids and devices already in use.

Section IV, Basic Research and Its Applications, contains items concerned with basic research relevant to training aids and device theory and items concerned with military training in general, its relation to psychological theory, and the use of training aids and devices within a military setting. This section is subdivided into two parts: (1) basic research with application to training aids and devices, and (2) basic research with application to military training.

The available literature has been surveyed up to 1 December 1956.

ANNOTATED BIBLIOGRAPHY OF RESEARCH ON
TRAINING AIDS AND TRAINING DEVICES

Training Devices

A. Electronic

1. Anderson, I.H. et al. Recommendations for the Use of the Foxboro Trainer (BC-968). Applied Psychology Panel, National Defense Research Committee, OSRD, Washington, 1943, OSRD Report 3103.

A description of the proper operating conditions for Foxboro Trainer's use if it is to be of aid in the instruction and training of SCR-268 radar operators. Previous studies had shown that the trainer was acceptably reliable and valid and that the tracking task was a good representation of that presented by the SCR-268.

2. Anderson, I.H. et al. Use of the Philco Trainer in the Training of A-Scan Oscilloscope Operators. Applied Psychology Panel, National Defense Research Committee, OSRD, Washington, 1943, OSRD Report 2096.

A determination of the training effectiveness of the Philco Trainer, which was designed to feed signals into the actual indicator units of the SCR 270-71 radar equipment. The Philco Trainer proved effective to train operators for A-scan oscilloscopes, if a means of scoring operator proficiency was provided. The human element in azimuth determination could be reduced to a point where it was exceeded by errors in the equipment. No statistically significant relationship was found among the ranging, azimuth, and detection of minimal echoes.

3. Anderson, I.H. et al. A Radar Trainer and Flash-Reading Method for Operators of the PPI. Applied Psychology Panel, National Defense Research Committee, OSRD, Washington, December 1944, OSRD Report 4489.

The optical-mechanical trainer described simulates the scope presentation of the Plan Position Indicator and momentarily flashes target echoes or signal blips whose locations may be read in terms of either polar or grid coordinates. The flash-reading method used stresses speed and accuracy of performance and was organized to train the radar operator and plot reader to perform at levels of proficiency expected in actual combat operation. The trainer and flash-reader method permitted standard conditions of training and objective methods of scoring proficiency during training.

4. Arnold, T.G., Jr. and Hamburger, F., Jr. Radar Target Simulator for a Three-Dimensional Display. Institute for Cooperative Research, The Johns Hopkins University, November 1949, (ICR 166-1-98) (CONFIDENTIAL)

The radar simulator described in this report generates six synthetic targets for display on the Plan-Position and Range-Height Indicators of a three-dimensional radar system. It is used in conjunction with Target Generating System TGS-1, Automatic Target Positioning Units, Maneuverable Target Positioning Units, and the Indicator Console of the Navy Model SX Radar.

- 4a. Arnold, T.G. and Hamburger, F., Jr. Control Central: A Radar Simulator for Psychological Research. Special Devices Center, ONR, Port Washington, L.I., N.Y., March 1950, Technical Report SDC 166-1-104.

A description of a method for generating a simulated radar target having its position and many of its characteristics controlled through use of Control Central, a radar simulator designed and constructed for psychological research. It is used with the Plan Position Indicator type of radar indicator which gives range and bearing information to the observer. Each of the integral units of Control Central is described in some detail.

5. Barger, D.M. Target Generating System TGS-1. Special Devices Center, ONR, Port Washington, L.I., N.Y., June 1949, Technical Report SDC 166-1-76.

A description of a target generating system designed as a research instrument to furnish the principal experimental variable by means of which equipment and operational methods might be compared and evaluated. This system makes possible the precise control of targets generated. The complete system consists of 18 signal units, 21 target positioning units, 2 trigger units, 2 antenna simulators, and a switching panel.

6. Berkshire, J.R. Field Evaluation of a Trouble Shooting Aid. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., 1954, Technical Report AFPTRC TR 54-24.

A description of the development and preliminary evaluation of a set of trouble shooting materials by means of which a mechanic can trace symptoms of malfunction to their underlying cause or causes. The experimental materials included color-coded schematics of the entire chain with its sub-systems and written directions called "trouble locators." In preliminary evaluation of this device, the investigator stated "the results appear sufficiently promising to suggest that similar materials might profitably be developed for larger portions of newer equipments."

7. Besnard, G.G. and Briggs, L.J. Comparison of Performance Upon the E-4 Fire Control System Simulator and Upon Operational Equipment. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., April 1956, Developmental Report AFPTRC TN 56-47.

Designed to compare students' performance on selected maintenance procedures in the E-4 Fire Control System Procedural Simulator with performance of these tasks on an operating fire control system. Highly similar

performances were considered necessary to justify the use of the simulator in the measurement of students' proficiency in these tasks. The experimental and control groups did not differ significantly in the total number of errors made, and the average total time taken to complete the three tested procedures was significantly less for the simulator group. It was felt the simulator represented the operational equipment to a sufficiently great extent to justify further use of it in measuring student maintenance proficiency for the procedures sampled.

8. Blackston, M.W. and Rabine, E.N. Electronics Trouble Shooting Trainer. Training Analysis and Development Division, 3380th Technical Training Group, Keesler AFB, Miss., February 1956, Keesler Report 56-1.

A description of the Electronics Trouble Shooting Trainer, a paper-and-pencil training device designed to acquaint the student with the principles of the training method during his initial training in trouble shooting. The student is tested on his trouble shooting logic and knowledge of equipment. In utilizing the exercise as a training device, the instructor conducts a class critique of student results, guiding the student in developing logical trouble shooting techniques.

9. Briggs, L.J. and Morrison, E.J. An Assessment of the Performance Capabilities of Fire Control System Mechanics. Maintenance Laboratory, Air Force Personnel and Training Research Center, ARDC, Lowry AFB, Colo., 1956, Technical Memorandum ML TM 56-19.

Designed to measure the proficiency of Air Defense mechanics in maintaining the E-4-5 and -6 Fire Control Systems. The men were tested on an operating mock-up, the Trouble Shooting Simulator, a Procedural Simulator, and the Subject-Matter Trainer. The above devices and the testing methods are described.

10. Brown, J.L. and Diamond, A.L. "A Device Simulating the Visual Displays of PPI Scores." J. opt. Soc. Amer., 1953, 43, 1143-1146.

Describes a device that duplicates the decay characteristics of a P-7 phosphor and is carried by a rotating annulus. Two important reasons for using it rather than the Plan Position Indicator scope itself are: 1) Many problems of measurement and specification are avoided since photometric measurements can be made directly over the entire range to be investigated with this apparatus, and 2) the range

of relevant variables is greater and they can be varied with more independence than would be possible in the operational equipment where electrical elements and the characteristics of phosphorescent coatings impose limitations.

11. Bryan, G.L. et al. The Automast: An Automatically-Recording Test of Electronic Trouble Shooting. (University of Southern California), Office of Naval Research and Bureau of Naval Personnel, Department of the Navy, August 1954, Technical Report 11.

A detailed description of an automatically recording version of the MASTS Test (Multiple Alternative Symbolic Trouble Shooting Test), a job-sample test. Mechanical and administrative features of the test are given; test problems and proposed scoring procedures are discussed, and applications are suggested.

12. Cantor, J.H. and Brown, J.S. An Evaluation of the Trainer-Tester and Punchboard Tutor as Electronics Training Aids. Naval Training Device Center, Special Devices Center, ONR, Port Washington, L.I., N.Y., October 1953, Technical Report NAVTRADEVCEM 1257-2-1.

An evaluation of two paper-and-pencil training aids.
 1) The Trainer-Tester presents the student with a written list of symptoms exhibited by a malfunctioning piece of equipment and requires him to try a number of hypothetical tests and measurements to determine the defective component or the required adjustment.
 2) The Punchboard Tutor allows the student to track down malfunctions by means of multiple choice answers. In the Basic Electronics Course, students using the two training aids were superior to students using equipment only. In Advanced Radar Training, students who used the Trainer-Tester during basic training were superior to other groups in Radar Laboratory grades.

13. Cornell, F.G. et al. Proficiency of Q-24 Radar Mechanics: III. The Tab Test - A Group Test of Trouble Shooting Proficiency. Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Lowry AFB, Colo., 1954, Research Bulletin AFPTRC TR 54-52.

A description of the development of the format and scoring methods for the Tab Test, a group-administered paper-and-pencil testing device used to test electronics technicians. The authors believe the Tab Test to require the subject to make the same major decisions required in the process of diagnosing malfunctions (trouble shooting) in complex electronic equipment. The test provides a record of the checks and diagnoses chosen by the subject and the order in which they are selected.

14. Damrin, D.E. and Saupe, J.L. Proficiency of Q-24 Radar Mechanics: IV. An Analysis of Checking Responses in Trouble Shooting on Tab Test Problems. Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Lowry AFB, Colo., 1954, Research Bulletin AFPTRC TR 54-53.

Twenty Tab Test problems were administered to 77 Q-24 radar mechanics. (The Tab Test is a group-administered, paper-and-pencil test used to assess certain aspects of the trouble shooting performance of radar line mechanics.) Seven hypotheses were formulated concerning ways in which the checking responses of the more proficient trouble shooters differ from those of the less proficient trouble shooters.

- 14a. Dubrovner, R. and Searle, L.V. The Pin-Pointer Technique and Its Use in the Study of Target Identification. Human Resources Research Center, ARDC, Lackland AFB, Tex., June 1953, Technical Report 53-19. (CONFIDENTIAL)

Describes the use of the Pin-pointer Technique in the study of target identification. The pin-pointer apparatus presents a static radar picture upon which the subject can mark the aiming point (AP). This device not only yields a precise measurement of accuracy in target recognition but also permits recording of the speed of recognition.

15. Edgerton, H.A. et al. A Study of the Utilization of Four Representative Training Devices. Special Devices Center, ONR, Port Washington, L.I., N.Y., April 1952, Technical Report SDC 383-7-2.

The four electronic training devices evaluated are the Individual Wiring Board, Electro-Dynamic Kit, Philco Kit, and Universal Bread Board. Recommendations are made to increase effectiveness both in design and use of these devices. The last chapter deals with suggestions concerning the best use of training aids in general.

16. Fattu, N.A. A Catalog of Trouble Shooting Tests. (Institute of Educational Research, University of Indiana, Contract No. 908(07)) Personnel and Training Branch, Psychological Services Division, ONR, December 1956, Research Report 1.

This catalog contains examples of trouble shooting tests developed up through December 1956. It summarizes and illustrates materials assembled from scattered sources and makes them available in one report. Two Sections on training aids and training device research are "Mock-up or Simulator Tests" and "ARC (Automatic Recording of Checks) Type Tests." The first includes those tests performed on equipment that simulates the actual operating equipment. All the simulator tests described provide for automatic recording of behavior. The second section lists those tests that "attempt to translate some of the features of the simulator tests into paper-and-pencil form." In contrast with the simulator test, the ARC tests are less realistic, since verbal description must replace simulation.

17. French, R.S. The K-System MAC-1 Trouble Shooting Trainer: I. Functional Description. Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Lowry AFB, Colo., April 1956, ASPRL TM 56-8.

A functional description of the K-System MAC-1 Trouble Shooting Trainer. This trainer represents the operation and circuitry of the K-3A Bombing-Navigational System for training in knowledge of data flow, system functioning, and trouble shooting procedures, under both normal and malfunctioning states; but avoids the complexities of and costs less than the typical realistic simulator. The trainer was designed as a demonstration or practice device for the classroom, supplementing practical training on the equipment itself.

18. French, R.S. The K-System MAC-1 Trouble Shooting Trainer: II. Derivation of Training Characteristics. Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Lowry AFB, Colo., April 1956, ASPRL TM 56-9.

Shows how the training characteristics of the MAC-1 Trainer were derived. The discussion is organized in terms of training characteristics derived from: 1) training requirements and limitations, 2) the nature of the K-System and its maintenance, 3) the nature of K-System flight-line trouble shooting, 4) the functions of the system, and 5) an analysis of related training devices.

19. French, R.S. The K-System MAC-1 Trouble Shooting Trainer: III. Technical Supplement. Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Lowry AFB, Colo., April 1956, ASPRL TM 56-10.

The third in a series of reports describing the development and use of the MAC-1 Trainer. Included in this report are technical data related to the design, use, and maintenance of the trainer.

20. French, R.S., Crowder, H.A., and Tucker, J.A., Jr. The K-System MAC-1 Trouble Shooting Trainer: II. Effectiveness in an Experimental Training Course. Maintenance Laboratory, Air Force Personnel and Training Research Center, ARDC, Lowry AFB, Colo., October 1956, Technical Note AFFTRC TM 56-120.

Describes an experimental training program conducted both to evaluate the K-System MAC-1 Trainer and to investigate the feasibility of teaching systematic trouble shooting to apprentice mechanics of average

aptitude. This trouble shooting trainer represents the operation and circuitry of the K-3A Bombing-Navigational System. In the evaluation, the effectiveness of trouble shooting training conducted on the Trainer was compared with the effectiveness of training on the actual K-System equipment. Proficiency measures on 40 trainees were taken before, during, and at the end of training, and after a six-month period. The group of trainees who received all their trouble shooting practice on the MAC-1 Trainer showed no evidence of having received less effective training. The authors conclude that "the MAC-1 Trainer, possibly with some modifications, could be used effectively in the classroom as a supplement to the equipment either in formal training courses or for on-the-job training. The study further demonstrates that apprentice mechanics can learn systematic trouble shooting procedures based on a logical analysis of the data flow of the system."

21. Gagne, R.M. and Madden, H.L. The Radar Aiming Proficiency Test. Human Resources Research Center, ATC, Lackland AFB, Tex., May 1951, Research Note P&MS 51-4.

A description of the Radar Aiming Proficiency Test, designed primarily to make possible the accurate scoring of students' performance in finding and holding aiming points during simulated bombing training missions. Specifications, diagrams, and pictures of the apparatus are included.

22. Herman, I.L. and Church, S.A. Analysis of Radar Aiming Point Identification Motion Picture Group Tests. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., April 1954, Technical Report AFPTRC TR 54-2.

Group tests of ability to identify a radar aiming point were developed from motion pictures taken of an AN/AP Q-23 radar scope during several bomb runs. Cross-hairs were superimposed on the films to correspond with items of a paper-and-pencil test. The results indicate that these tests have satisfactory characteristics as measuring instruments.

23. Hixson, W.C., Harter, G.A. and Warren, C.E. A Radar Simulator for Use in Air Traffic Control. Wright Air Development Center, ARDC, Wright-Patterson AFB, Ohio, January 1954, Technical Report WADC TR 53-418.

Describes a radar simulator capable of simulating 30 moving aircraft targets on a PPI-type radar indicator. Control of target heading, velocity, position, and turn rate is available at each aircraft target operating station. Other features of this simulator are also described.

24. Knauft, E.B., Spragg, S.D.S., and Taylor, H.S. The Design, Construction, and the Validation of a Mechanical Radar Pip-Matching Trainer for Learning to Track Aerial Targets With Mark 4 Radar on the Gun Director Mark 37. Applied Psychology Panel, National Defense Research Committee, OSRD, February 1945, OSRD Report 4635.

A mechanical pip-matching trainer was constructed to simulate the training task presented to an operator using the Mark 37 gun director and Mark 4 radar. This report contains details on the design, construction, and validation of this trainer. The investigators concluded that "the pip-matching trainer described is a valid training device for training radar operators to point and train the Mark 37 gun director with Mark 4 radar."

25. Lindsley, D.B. A Study of the Foxboro Trainer as a Training Device for Learning to Track by Means of Pip-Matching. Applied Psychology Panel, National Defense Research Committee, OSRD, Washington, December 1943, OSRD Report 3102.

An experiment to determine the value of the Foxboro Trainer as an aid in improving tracking ability. The degree of skill obtainable at different stages of practice was sought. Results showed that: 1) This trainer could effectively be used to train oscilloscope operators in pip-matching, and tracking ability; 2) 43 per cent of over-all improvement took place during the first four days; 83 per cent during the first seven days under the conditions of this experiment; 3) the reliability of the trainer was satisfactory; 4) inter-day correlations were not sufficiently high to allow the trainer's use to predict terminal performance.

26. Lindsley, D.B. A Study of the SCR-584 Basic Trainer as a Tracking Device for Learning Range Tracking. Applied Psychology Panel, National Defense Research Committee, OSRD, Washington, 1944, OSRD Report 3344.

The SCR-584 Basic Trainer is a light-weight, mechanical-optical device which simulates the J-scan, 2000 yard range scope of the SCR-584 radar set. An experimental investigation was made to evaluate the trainer as an aid in improving tracking ability. Data from 25 subjects without prior tracking experience showed: 1) The Basic Trainer could be used to effect improvement in tracking ability involving the keeping of a hairline on a moving pip; 2) the reliability of the trainer as a measuring instrument is satisfactory; 3) inter-day correlations of performance were not sufficiently high to warrant prediction of terminal performance from initial performance.

27. Lindsley, D.B. et al. Use of the PPI Flash-Reading Trainer in Training of Navy Search Radar Operators. Applied Psychology Panel, National Defense Research Committee, OSRD, Washington, March 1945. OSRD Report 4831.

A description and evaluation of the Flash-Reading Trainer, which mechanically and optically simulates a Plan Position Indicator screen. Targets may be presented in any desired order and position, and with varying persistence time. The accuracy with which the targets are read can be objectively checked and can be exposed on either a grid coordinate or a polar coordinate screen. Short exposure times, varying from one to five seconds, were used to provide training in rapid target reading as well as in accuracy. The original model of this trainer consisted of a single scope; the present model is a group trainer utilizing three scopes. "It (the trainer) provides a standardized scope reading situation that can be scored accurately; the best use of the trainer is obtained when the scope markings are made to simulate the bearing and range scales of an actual radar; significant increases in scope reading ability occur with training by this method; poorer scores were made on the trainer by those who were poor in operating actual radar gear."

28. McClelland, W.A., Abbott, P.S., and Stobie, W.H. Teaching Radar Scope Interpretation with Motion Pictures: I. Radar Navigation, the Ellington Study. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., July 1954, Technical Report AFPTRC TR 54-25.

Designed to test the hypothesis that radar scope motion picture training is an adequate substitute for an equivalent number of air training hours in elementary radar scope interpretation (radar navigation). Differences between the all-air trained and all-motion picture trained group, while not statistically significant, favored the latter group in 16 of 19 groups and air criterion variables. When the half-air trained and half-motion picture trained group was added to the comparison, essentially the same finding was obtained: There was no evidence that the all-air trained group was superior.

29. McClelland, W.A. and Abbott, P.S. Teaching Radar Scope Interpretation With Motion Pictures: Two Exploratory Studies in Early Learning - Part II. Aiming Point Identification (The Sheppard Study), Part III. Radar Navigation. Aircraft Observer Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Mather AFB, Calif., January 1956, Technical Memorandum AORL TM 56-1.

Part II - determining whether or not proficiency in radar aiming point identification was improved with practice in bomb run radar scope motion pictures, using the Radar Navigation - Radar Scope Interpretation Trainer. Subjects experienced in radar scope interpretation were used. There was a slight tendency towards improved performance with practice. More positive was the finding that factors specific to the bomb run account for the major proportion of total variance in student performance. Part III - determining whether or not proficiency in radar scope interpretation was improved by motion picture training. Using college students as subjects, the investigators found that those trained by motion pictures made significantly higher radar interpretation scores than those not trained by motion pictures.

30. Murnin, J.A., VanderMeer, A.W. and Vris, T. Comparison of Training Media: Trainee Manipulation and Observation of Functioning Electrical Systems Versus Trainee Drawing of Schematic Electrical Systems. Special Devices Center, ONR, Port Washington, L.I., N.Y., June 1954, Technical Report SDC 269-7-101.

The training effectiveness of a wiring board on which the trainee manipulated components was compared with a chart (diagram) on which circuits were drawn by the trainee for the purpose of learning basic electricity; i.e., circuit theory, circuit problems, and use of electrical meters. Results indicated: 1) The diagram of the wiring board and the wiring board improved learning how to use meters to an equal extent; 2) learning to solve electrical problems was not improved by the use of the devices; 3) learning of theory by the lower GCT group was slightly improved by the use of the diagram of the wiring board but not by the wiring board; 4) over-all learning of basic principles was not improved by the use of either device.

31. Schiemer, E.W. Automatic Target Positioning Unit, Model 1. (Institute for Cooperative Research, The Johns Hopkins University), OIR, 17 January 1951, Technical Report 166-1-75.

By means of the Automatic Target Positioning Unit, a simulated target in the TGS-1 can be made to follow a pre-set course for one hour. Tests on the automatic positioning unit show that one hour long course can be reproduced with a range accuracy of 0.02 per cent of full scale and a bearing accuracy of 0.1° when the unit is operated in conjunction with the TGS-1.

32. Psychological Services. Basic Trouble Shooting: Student Handbook. (Psychological Services Inc., Los Angeles, Calif.) ARDC, (Contract AF 18 (600)-1206). UNDATED.

A student workbook, to be used in training on the Generalized Electronic Trouble Shooting Trainer (GETS), which outlines rules and methods for trouble shooting electronic equipment in general. Included are chapters dealing with kinds of data flow chains, trouble shooting linear chains, trouble shooting diverging chains, trouble shooting converging chains, and trouble shooting complex systems.

33. Searle, L.V. and Murray, N.L. The Radar Navigation Trainer. Human Resources Research Center, Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., May 1952, Research Note AO 52-5.

The Radar Navigation Trainer, incorporating motion pictures of the airborne radar scope, was used in an experimental ground course conducted at Ellington Air Base. The feasibility of substituting ground training for flight training in basic radar scope interpretation was tested. The trainer gave each student a means of acquiring skill in interpreting typical scope returns, obtaining fixes, determining wind, plotting course, and maintaining the navigational log.

34. Tucker, J.A., Jr. "Approaches to Training for Trouble Shooting of Electronic Equipment." Symposium on Electronic Maintenance, Advisory Panel on Personnel and Training Research, Office of the Assistant Secretary of Defense, Research and Development, 3-5 August 1955, 137-147, PFT 202/4.

Four commonly accepted approaches to electronic trouble shooting are discussed: trial and error, probability data, "cookbook" or malfunction indexing device, and problem solving. In addition there is further discussion of the K-System Trouble Shooting Trainer developed by R. S. French for training electronics maintenance personnel in logical trouble shooting procedures. Included are comments on the evaluation of part-task trouble shooting trainers.

B. Aerial

35. Air Research and Development Command. Flight Simulator Utilization Handbook. Human Factors Operations Research Laboratories, ARDC, Bolling AFB, Washington, August 1953, HFORL Report 42.

This handbook was written to assist training personnel assigned to develop and operate a flight simulator program. The handbook is meant to be as general as possible. Principles or suggestions, believed applicable to all multi-seat simulators for bomber and cargo-type aircraft are given. (It should be noted that most principles and all examples given in this handbook have been derived from three programs: The B-50, the B-47, and the C-97 simulator programs.)

36. Bell, J.M. A Landing Display for Use With a Contact Flight Simulator. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1951, Technical Report SDC 71-16-8.

A mathematical analysis is presented of the visual perspective cues when they occur during an approach to a landing.

37. Bennett, G.K. et al. Evaluation of the SNJ Operational Flight Trainer. Special Devices Center, ONR, Port Washington, L.I., N.Y., March 1954, Technical Report SDC 999-2-1.

The aim was to conduct an experimental evaluation of the SNJ Operational Flight Trainer in such a way that some of the findings might apply to other modern electronic flight simulators. The results showed 1) synthetic flight trainers such as the NAVBIT and SNJ OFT do contribute to basic instrument training, 2) for this purpose the specialized SNJ OFT is not superior to the generalized NAVBIT, 3) synthetic trainer time is as effective given in a single block as when alternated with actual flight, 4) air time can be saved by giving the student thorough ground training under a blocked sequence and then allowing him to progress through flight training as rapidly as possible, 5) the SNJ OFT does not excel the combination SNJ cockpit mock-up and cycloramic Link trainer used before the SNJ OFT became available for pre-flight cockpit familiarization.

38. Boyle, D.J. and Hagin, W.V. The Light Plane as a Pre-Primary Selection and Training Device: I. Analysis of Operational Data. Pilot Training Research Laboratory, Human Resources Research Center, Goodfellow AFB, Tex., October 1953, HRRC Technical Report 53-33.

An analysis of the operational data showed 1) light plane training helped students over the T-6 solo hurdle (90.3% of the light plane students soloed as compared to 73.3% of the control students; the light plane students required, on the average, 4 hours less T-6 instruction prior to solo than did the control students), 2) significantly more light plane students were successful in completing primary pilot training, and 3) light plane students had markedly fewer accidents during primary training than did members of the control group.

39. Brown, C.W. and Ghiselli, E.E. Investigation of A-6 Bombing Ground Trainer Utilization in the USAF Bombardment School: Design of a Long Range Research Project Intended to Identify Optimum Results in the Utilization of the A-6 Ground Trainer for Training Aircraft Observers (Bombardment). Human Resources Research Center, ATC, Lackland AFB, Tex., July 1951, Research Note AO 51-2.

A description of a long-range research program consisting of several experiments through which more valid estimates could be made of the contribution of the A-6 trainer to learning the bombing problem in the air, and by which a thorough-going analysis could be made of the psychological factors that facilitate and inhibit the learning and retention of bombing procedure and accuracy. Suggestions are given for experiments in number of areas.

40. Brown, C.W. and Ghiselli, E.E. Investigation of Bombing Ground Trainer A-6 Utilization in the USAF Bombardment School: An Evaluation of the Effectiveness of Utilization of the A-6 Ground Trainer. Human Resources Research Center, ATC, Lackland AFB, Tex., July 1951, Research Bulletin 51-14.

An evaluation of the bombing ground trainer A-6. This study reports that "trainer scores are reported as generally unreliable. Improvement as a result of practice is noted in procedure scores but not in average circular error scores. Significant decreases in both types of scores occur 74 days after completion of the regular training of navigators on the trainer. For both navigators and bombardiers little or no correlation is shown between trainer and aerial scores."

41. Brown, C.W. and Ghiselli, E.E. Investigation of Bombing Ground Trainer A-6 Utilization in the USAF Bombardment School: Recommendations for Changes in the Utilization of the Ground Trainer A-6 Based on the Findings of Preliminary Research. Human Resources Research Center, ATC, Lackland AFB, Tex., July 1951, Research Bulletin 51-15.

Presents suggestions for the more effective utilization of the A-6 Bomb Trainer. The A-6 trainer program is reviewed with respect to objectives and uses. Three levels in student achievement are outlined and the training and evaluation of procedure and accuracy by means of the A-6 trainer are discussed.

42. Brown, C.W. and Ghiselli, E.E. Investigation of A-6 Bombing Ground Trainer Utilization in the USAF Bombardment School: Suggestive Program of Changes in A-6 Utilization to be Executed by Mather Field Personnel. Human Resources Research Center, ATC, Lackland AFB, Tex., July 1951, Research Note AO 51-3.

Written to highlight areas where field action should be taken, not only to achieve immediate improvement in training, but also to initiate action toward obtaining the cooperation of higher echelons through which other fundamental changes can be introduced. Background material for the suggestions in the report can be found in previous reports from this center. (See ATC, HRRC, Research Bulletins 51-14, 51-15.)

43. Brown, E.L., Matheny, W.G., and Flexman, R.E. Evaluation of the School Link as an Aid in Teaching Ground Reference Maneuvers. Special Devices Center, ONR, Port Washington, L.I., N.Y., Technical Report SDC 71-16-7.

Concerned with preliminary study involving the use of a synthetic flight trainer for teaching ground reference maneuvers. Analysis showed errors made while learning to land a light aircraft could be reduced by prior instruction in the Link trainer. A discussion is presented in instructional techniques for utilizing synthetic contact flight trainers and the importance of determining the reliability of performance records.

44. Coakley, J.D. and Thomas, L.L. Training Equipment, Instrument Flying Under Simulated Instrument Conditions. (Dunlap and Associates, Stanford, Conn.), Air Force Technical Report 6431.

Directed towards a determination of the requirements and equipment for instrument flying under simulated instrument conditions in order to develop the best system of instrument flying training. Extensive consideration is given to a view-limiting training aid.

45. Dorny, L.R., Campbell, J.W., and Channell, R.C. Study of Helicopter Flight and Tactics Training. Special Devices Center, ONR, Port Washington, L.I., N.Y., August 1953, Technical Report SDC 971-0-1.

Intended primarily to identify areas in which training problems exist and to indicate suggestions and recommendations for their solution. Included are proposals for training aids and devices and specifications for simulation in device development.

46. Edgerton, H.A., Heinemann, R.F.C., and Barrett, R.S. Human Engineering Considerations in the Design of the Instructor's Station of Trailerized Operational Flight Trainers. Special Devices Center, ONR, Port Washington, L.I., N.Y., March 1954, Technical Report SDC 1042-00-1.

Presents a human engineering approach to standardizing and simplifying the design of the instructor's station in the Trailerized Operational Flight Trainer. Recommendations are made concerning general principles, the primary working area, the repeater panel, the radio aids panel, and trailer arrangements.

47. Fitzpatrick, R. The Development of a Research Program on Advanced Synthetic Electronic Type Flight Simulators. (American Institute for Research) Committee on Aviation Psychology, National Research Council, Washington, February 1950.

Investigates the current use of electric flight simulators, which reproduce instrument and control responses of particular aircraft to a high degree of accuracy, and develops a program of research for more effective use of these devices. Written sources were reviewed and experts in the field were consulted. A research program was recommended to include four areas: 1) Criterion studies, 2) evaluation of pilot skills in simulators, 3) similarity studies, 4) validation studies.

48. Flexman, R.E. and Latham, A.J. Use of a Contact Flight Simulator in the Training of Basic Student Pilots. Human Resources Research Center, ATC, Lackland AFB, Tex., April 1952, Research Note Pilot 52-1.

Presents information concerning the performance of 10 student pilots during their first flight in a T-6 aircraft, following approximately 10 hours of instruction in a contact flight simulator, the P-1. The 10 men were able to acquire information and habits from the trainer that could be transferred to aircraft flying. Data from this study were not suitable for statistical analysis and could only point to certain generalizations.

49. Flexman, R.E., Matheny, W.G., and Brown, E.L. "Evaluation of the School Link and Special Methods of Instruction in a Ten-Hour Private Pilot Flight Training Program." Univ. Ill. Bull., 1950, 47, No. 80.

Designed to test the feasibility of 10-hour preparation for the CAA Flight Test with a revised training syllabus employing modified models of the School Link. Results favor Link training. Although not all experimental subjects passed after 10 hours, it was concluded that considerably less than the present 35 hours would suffice.

50. Flexman, R.E., Townsend, J.C., and Ornstein, G.N. Evaluation of a Contact Flight Simulator When Used in an Air Force Primary Pilot Training Program: Part I. Overall Effectiveness: Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., September 1954, Technical Report AFPTRC TR 54-38.

Indicated that the efficiency of instruction in the Primary Pilot Training Program could be greatly improved by the incorporation of a contact flight simulator into the experimental training program. Trainees with 100 hours flying time plus 30 hours on the simulator were as proficient as those with 130 hours flying time. It was also indicated that simulator-trained men were more proficient at flying than those not simulator trained.

51. Flyer, E.S. and Bigbee, L.R. The Light Plane as a Pre-Primary Selection and Training Device: III. Analysis of Selection Data. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., December 1954, Technical Report AFPTRC TR 54-125.

Results indicate that performance data collected during light plane training predicted Primary and Basic flight performance criteria. The Pilot Stanine combined with these light plane measures resulted in more accurate prediction of graduation and elimination during later phases of pilot training than did either type of measure alone.

52. Forgas, D.G. and Irwin, I.A. Measures of Combat Crew Performance Used in B-29 Training. Human Resources Research Center, ATC, Lackland AFB, Tex., December 1952. Technical Report 52-14.

An exploratory evaluation of a number of measures of crew effectiveness obtained during training--a single radar bombing circular error score, accumulated radar bombing error scores, average error in making "good" control

time, and circular error scores on the ultrasonic trainer. The most reliable measure of crew effectiveness appeared to be the average error in making "good" control time. Error scores on the trainer also proved quite reliable, although there was little indication of a relationship between trainer scores and radar bombing scores.

53. Fryer, D.H. Source Book on the Application of Research to Ground Training in Aviation. Special Devices Center, OAR, Port Washington, L.I., N.Y., 1949, Technical Report SDC 383-1-11.

Summarizes and applies the results of research done in government agencies during and since World War II to the solution of problems in ground aviation training. Covered in the report are 1) study skills, 2) establishment of the curriculum, 3) evaluation of proficiency, 4) validation of training procedures, 5) student attrition, 6) mass training, 7) instructor training, 8) speech-hearing perceptual training, 9) training in perceptual ability (vision), 10) aircraft recognition, 11) kinesthetic (motor) training, 12) audio-visual aids (special devices), and 13) air calibration (transfer of training from ground to air).

54. Directorate of Training Headquarters. Report of Aircraft Simulator Conference. Special Training Devices Division, Headquarters USAF, Washington, 9-11 February 1953.

This conference was held to gather information to revise or add to existing Headquarters USAF directed policies on Flight Simulator design, procurement, and support. Given extensive consideration were simulator characteristics that should be required, design tolerances, proper utilization, and cost reduction. Participants were divided into three groups--Quality, Maintenance, and Supply--to answer specific questions in each of these three areas. Included as Appendices are talks by military personnel, military civilian researchers, and factory representatives.

55. Directorate of Personnel, Procurement and Training. USAF World Wide Flight Symposium. Special Training Devices Division, Headquarters USAF, Washington, 19-21 January 1954.

This world wide symposium was called "to exchange ideas and information regarding all types of simulators, their development, use, and support." Attending were military personnel from the three services, representatives from simulator contractors, commercial airlines, and various foreign military agencies. A summary and recommendations for future development of flight simulators are included.

56. Horn, R.E. A Method for Simulated Night Flying During Daylight Hours. Aero Medical Laboratory, Wright Air Development Center, ARDC, Wright-Patterson AFB, Ohio, October 1954, WADC Technical Report 54-505.

Describes a method for simulating night flying conditions during daylight hours. The pilot taking night flying training wears lenses of very low light transmission mounted in a special goggle that excludes all extraneous light. Supplemental lighting is provided for the essential instruments. The absence of ground lights simulates the actual conditions of the combat zone.

57. Houston, R., Smith, J., and Flexman, R.E. Performance of Student Pilots Flying the T-6 Aircraft in Primary Pilot Training. Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Lowry AFB, Colo., December 1954, Research Bulletin AFPTRC TR 54-102.

Summarizes a method employed by the Basic Pilot Research Laboratory in the development of refined and relatively objective descriptions of performance of defined flight maneuver components. Empirical performance data such as that contained in this report can be used to develop performance standards for flight instruction and flight simulators.

58. Jones, E.R. and Dubois, P.H. The Use of Expert Judgments in the Development of Flight Simulator Training Courses. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., 1955, AFPTRC TH 55-14.

Presents a resume of the judgments of aircraft commanders, pilots, and flight engineers concerning their squadrons' training needs. These judgments provided a basis for anticipating future training needs which should be included in a simulator training course. Although the aircraft (the B-50D) involved in this study is not a new type, the authors believe the method could be used with other planes for which pertinent information is unavailable from other sources.

59. Killian, D.C. Survey of Training Characteristics of the B-52 Flight Simulator. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., 1956, Technical Note AFPTRC TH 56-69.

Summarizes information gathered in a study to determine what additional functional characteristics might be incorporated into later models of the B-52 Flight Simulator (Models B-52C, B-52D) to improve their training capabilities. Suggested are several major and a number of minor additions and changes to improve the simulator as a training device.

50. Mahler, W.R. and Bennett, G.K. Special Devices in Primary Flight Training: Their Training and Selection Value. Special Devices Center, OHR, Port Washington, L.I., N.Y., August 1949, Technical Report SDC 151-1-8.

Presents the results of an experimental study to evaluate synthetic flight trainers for primary training. Results indicated that the types of synthetic flight trainers studied tend to reduce the number of accidents and flight failures, and to reduce the amount of extra flight time 1/2 hour per student. However, the authors feel the results do not justify either abandonment or full-scale incorporation of such training into the regular syllabus. Part II presents data concerning the value of the orientation test and three synthetic flight trainers in predicting subsequent flight performance.

61. Mahler, W.R. and Bennett, G.K. An Experimental Study of the Transfer Value of Synthetic Flight Trainers for Advanced Multi-Engines Flight Training in the Naval Air Training Command. Amer. Psych., 1950, 5, 358 (Abstract).

Designed to determine how much actual syllabus flight time could be saved by utilization of synthetic flight trainers, to obtain information which would be of value in the design of future flight trainers, and to determine what principles of utilization provide the maximum transfer value.

52. Mahler, W.R. and Bennett, G.K. Psychological Studies of Advanced Naval Air Training: Evaluation of Operational Flight Trainers. Special Devices Center, Port Washington, L.I., N.Y., Technical Report SDC 999-1-1.

Two operational flight trainers, one for the PBM and one for the PB4Y, aircraft were evaluated. Results showed 1) with regard to flight time there are no savings during the familiarization phase, but during the instrument stage some light instruction can be saved; 2) with regard to student proficiency there are fewer serious errors and fewer total errors on most maneuvers; 3) the most effective use of operational flight trainers is in providing a superior type of briefing; 4) the authors believe more research should be done on maintenance of proficiency, training on emergencies, and the transition from one aircraft to another.

63. Matheny, W.G. et al. Study of Army Aviation Training. Special Devices Center, ONR, Fort Washington, L.I., N.Y., October 1953, Technical Report SDC 71-43-1.

Conducted to determine existing training aids and devices which should be acquired by the Army Aviation School, the requirements for the development of new training techniques and aids, methods for improving instruction, and subject areas to be improved. Among the recommendations made are those for the acquisition of training aids for specific needs, and the development of trainers for helicopter basic flight training and instrument training.

64. Matheny, W.G. et al. The Effectiveness of Varying Control Forces in the P-1 Trainer Upon Transfer of Training to the T-6 Aircraft. Human Resources Research Center, ARDC, Lackland AFB, Tex., September 1953, Technical Report 53-31.

Designed to determine whether the fidelity with which control pressures were simulated in the P-1 trainer influenced the amount of transfer of training to the T-6 aircraft. Subjects were tested in two flight maneuvers, the climb and the glide. Results indicated that training in the P-1 trainer transferred significantly to the T-6 in the glide maneuver only. It was hypothesized that the transfer of training depended more upon the correspondence between sequence or pattern of control forces required in trainer and aircraft than it did upon a correspondence between the absolute amounts of control force required.

65. Miller, M.R., Lt. Col., and Woolman, M. "Role of the Instructor in Simulator Training." ATC Instructors J. 1954, 5.

Aimed at the instructor using a simulator in instruction. The discussion centers on the B-47 flight trainer and its function in the Air Force's training program. Included are discussions of how the instructor should relate the trainer to his particular course, and the value of using simulators. Certain misconceptions that instructors have about simulator use are discussed.

- 65a. Murfin, F.L. Human Engineering Recommendations for Training Equipment for the B-58 Weapon System: Part I. Pilot Training Equipment. American Institute for Research, Pittsburgh, March 1955. (CONFIDENTIAL)

This report contains human engineering recommendations for training devices to be used in transition training of B-58 pilots. Described in the report are a flight simulator, with provision for stations for a student-pilot and instructor, and equipment cabinets to house the necessary computers and control devices, and a part-task procedural trainer, to be used to teach the student-pilot checks and procedures and to increase his skill in nomenclature and location. The procedures for determining the human engineering requirements in this report are based on Handbook Training and Training Equipment Design (TR 53-126), A Method for Man-Machine Task Analysis (TR 53-137), and Human Engineering Design Schedule for Training Equipment (TR 53-138).

66. Murphy, C.H.S. Two Simulators for Training Pilots and Controllers in Air Traffic Control Procedures. Special Devices Center, ONR, Port Washington, L.I., N.Y., June 1955, Technical Report SDC 71-16-15.

Two training techniques, the paper-and-pencil method and the Link Trainer crab method of simulating air traffic control procedures were evaluated. Results showed no differences in the effects of training. The paper-and-pencil method proves to be adequate for teaching low frequency and omni-range procedures, while the second method permits training on radar approach procedures as well.

67. Ornstein, G.N., Nichols, I.A., and Flexman, R.E. Evaluation of a Contact Flight Simulator When Used in an Air Force Primary Pilot Training Program: Part II. Effectiveness of Training on Component Skills. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., December 1954, Technical Report AFPTRC TR 54-110.

Presents an analysis of the effectiveness of the P-1 simulator in teaching specific components of contact and flying skills. Maneuvers, dimensions, and families of maneuvers are investigated and the contribution of simulator training to each is evaluated. This study indicates that training which utilizes the P-1 simulator is effective, especially in maneuvers which do not exceed the design limitations of the trainer and maneuvers which are heavily weighted with "procedural" components.

68. Payne, T.A. A Study of the Moving Figure and Orientation of Symbols on Pictorial Aircraft Instrument Display for Navigation. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1950, Technical Report SDC 71-16-6.

This study consists of two separate experiments. In both, private pilots drew solutions to navigation problems, using printed drawings of pictorial aircraft instrument displays. When subjects drew the movement of the moving figure under two conditions, it took over seven times as long to work the station movement problems, with only 1/5 correct, as it took to work the aircraft movement problems, with 4/5 correct. In the second part, the moving figure was always the aircraft and the two variables were the location of the fixed station and the orientation of the compass rose. It made no significant difference whether the compass rose was oriented with "north" at the top or rotated so that "north" appeared at some other position. Both time and error scores indicated it makes a difference where the station is located, the center position being significantly better than any peripheral location.

69. Payne, T.A. et al. Improving Landing Performances Using a Contact Landing Trainer. Special Devices Center, ONR, Port Washington, L.I., N.Y., March 1954, Technical Report SDC 71-16-11.

Designed to test the effectiveness of a contact landing display, developed for use with the cycloramic Link Trainer, and the effectiveness of a program of instruction called "principles training," developed to meet the requirements of the above training aid. Both an experimental and a control group were

taught the principles of approach and landing through lectures and demonstration flights. The control group qualified in the aircraft, and the experimental group qualified on the approaches in the trainer first. Results show that those subjects who used the trainer required 61 per cent fewer trials in the aircraft and made 74 per cent fewer errors than those who did not use the device. The experimental group demonstrated superior ability in both approach and landing.

70. Poe, A.C., and Lyon, V.W. The Effectiveness of the Cycloramic Link Trainer in the U.S. Naval School, Pre-Flight. U.S. Naval School of Aviation Medicine, (Project No. NM COL 058.07.01) March 1952, Research Report.

Designed to determine the contribution of instruction in the SNJ Cycloramic Link Trainer during pre-flight school to flight proficiency in the initial stages of flight training. The experimental group used the Link Trainer for five periods of instruction in addition to the regular pre-flight instruction, while the control group was given only the regular pre-flight curriculum. The performance of the two groups during the initial stages of flight training were compared on five criteria: 1) the number of flight attritions in each group, 2) the number of Student Pilot Disposition Boards convened to consider flight deficiencies in each group, 3) the number of extra flights necessary for each group to reach flight proficiency standards, 4) instructional flight grades, and 5) check flight grades. No statistically significant differences were found between the two groups on any of the five criteria.

- 70a. Rabideau, G.F. Human Engineering Considerations in the Design of Training Equipment for the F-102 Fighter-Interceptor. American Institute for Research, Pittsburgh, June 1954. (CONFIDENTIAL)

Recommendations of this study indicated the desirability of three kinds of pilot training devices to make for efficient transition from simpler training aircraft to the TF-102 and F-102 aircraft: 1) an instrument flight trainer, 2) a radar interception trainer, and 3) a procedural flight trainer. Those trainer components about which specific design recommendations were made were: 1) the general characteristics of the machine's interactions, 2) programming, 3) scoring, 4) the instructor's station.

71. Ritchie, M.L., and Michael, A.L. "Transfer Between Instrument and Contact Flight Training." J. Appl. Psychol., 1955, 39, 145-149.

A study of the transfer between instrument and contact flight training. The authors found positive transfer from instrument to contact flight training and negative transfer from contact to instrument flight training. Results also confirm indications from previous research studies that the instruments involved learning habits which are incompatible with established perceptual habits.

72. Roscoe, S.N. et al. Comparative Evaluation of Pictorial and Symbolic VCR Navigation Displays in the I-CA-1 Link Trainer. Committee on Aviation Psychology, National Research Council, Washington, 1950, N75NR 291.

Three experiments described in detail, consistently confirm the superiority of pictorial as opposed to symbolic display for VOR navigation displays in the 1-CA-1 Link Trainer.

72. Smith, A.H. et al. The Problem of the Utility of the Flight Simulator. Defense Research Medical Laboratories. (Canada), July 1954, DRML Report 1, Report HR-92. (CONFIDENTIAL)

A general survey of the flight simulator field, undertaken to provide the RCAF with information pertinent to conducting a simulator program, and to set up a fund of information for use in research on simulators. The information was gathered from a review of the literature and field visits. The findings are reported under the following headings: 1) the origin and current status of flight simulators; 2) the development of a flight simulator program; 3) the evaluation of flight simulators; and 4) flight simulator research questions. Most of the many problem areas in the use of flight simulators are indicated.

73. Smith J.F., Flexman, R.E., and Boyle, D.J. Three Place Modification of the T-6 Aircraft. Human Resources Research Center, ATC, Lackland AFB, Tex., April 1951, Research Note PILOT 51-2.

Modification of the T-6 aircraft was made necessary by the need for checking the reliability of Performance Record Sheets, in this case an observer-observer reliability. So that each aircraft could carry a student pilot as well as two observers, two T-6 type aircraft were so modified. This report describes the necessary modifications and states the reasons for them.

74. Special Devices Center. Phase A - Review of Methods. (American Institute for Research, Project No. NM 001-035) Special Devices Center, ONR, Technical Report ONR SDC 1.

A review of the methods of simulated blind flying that have been used or are now in use. The literature, commercial aviation organizations, and personnel at various Naval and other aviation activities comprised the primary sources of information. A principle function of the review was to define specific areas for a field survey of flight personnel.

75. Sutter, E.L., Townsend, J.C., and Ornstein, G.N. The Light Plane as a Pre-Primary Selection and Training Device: II. Analysis of Training Data. Basic Pilot Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Goodfellow AFB, Tex., August 1954, Technical Report AFPTRC TR 54-35.

The investigators found that students who received light plane training in pre-flight were superior in their T-6 flying performance at the completion of 18 hours of primary training to students who had not received the light plane training. However, check-flight scores at the 60-hour level revealed that the average performance of light plane students who reached this point in training was not appreciably different from that of the control students. Significantly more control than light plane students were eliminated in the course of the T-6 primary training; significantly more light plane than control students were eliminated before the 18-hour level.

76. Tomlinson, R.M., O'Malley, T.R., and Schmidt, R. Study of Contact Flight Training. Special Devices Center, ONR, Fort Washington, L.I., N.Y., July 1952, Supplement to Technical Report SDC 383-5-2.

Concerned with providing information for the design and development of flight training aids and devices and for the improvement of flight training programs. An important finding was that the flight student breaks up the whole learning task into more readily assimilated parts. These parts can be separately identified as skill areas which are later integrated into a total "skill pattern." Each area can be distinguished by the visual cues associated with it. Recommendations are given for training aids and devices in terms of the basic flight skill areas found.

77. Townsend, J.C., Evaluation of the Link ME-1, Basic Instrument Flight Trainer. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., June 1956, Developmental Report AFPTRC TN 56-84.

An evaluation of the Link ME-1 primary flight trainer which was devised to teach instrument flight training for the Cessna T-37 twin engine jet. It was found that the trainer was excellent in instructional facilities, below-average in human engineering, average in engineering, and excellent in validity and stability of performance curves. Evaluative opinions of all persons who "flew" the trainer were generally highly favorable.

78. Voiers, W.D. A Comparison of the Components of Simulated Radar Bombing Error in Terms of Reliability and Sensitivity to Practice. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., December 1954, Research Bulletin AFPTRC TR 54-74.

A description of the simulated radar performance of B-29 crews during combat crew training. Of three measures (circular error, range error, and deflection error) range error was the most responsive to practice; (a significant trend, however, was found with circular error.) Deflection exhibited no systematic changes with practice. It was found that the simulator measures actual circular error most reliably, actual range error almost as well, and actual deflection error least reliably.

- 78a. Warren, N.D. et al. Research on Aircraft Observer Training Procedures: Part I. An Introduction to the Task of the K-System Aircraft Observer. Human Resources Research Center, Mather AFB, Calif., December 1953, Technical Report 53-36. (CONFIDENTIAL)

Concerned with a comparison of the K-System installations in the TB-50D aircraft and the K Supersonic Trainer. A "link analysis" showed that nearly 25 per cent of the controls were not used in either the ground trainer or in the TB 50D aircraft and that 10 controls were observed to make up over 90 per cent of the man-machine "links." The desirability of a trainer which would include a minimum number of the most frequently used controls is discussed.

- 78b. Warren, N.D. et al. Research on Aircraft Observer Training Procedures: Part II. An Analysis of the Activities in the K-System Observer. Human Resources Research Center, Mather AFB, Calif., December 1953, HRRC Technical Report 53-37. (CONFIDENTIAL)

The primary purpose of this research was to assess the similarities and differences in the way in which K equipment operators utilize their time during training missions on the K Supersonic Trainer and the TB 50D, respectively. The similarities and differences are noted and recommendations are given for improving K-System training procedures.

79. Wilcoxon, H.C. and Davy, E. Fidelity of Simulation in Operational Flight Trainers: Part I. Effectiveness of Rough Air Simulation. Special Devices Center, ONR, Port Washington, L.I., N.Y., January 1954, Technical Report SDC 999-2-3a.

An experimental investigation of the effectiveness of rough air simulation in basic instrument and radio range procedure training. Rough air simulation consisted of mild pitching and rolling movements of the trainers, the SNJ Operational Flight Trainer and the NAVBIT. Results showed that movement produced by rough air simulation adds realism to the synthetic training situation but does not appear to result in higher pilot proficiency in either the synthetic trainer or the SNJ aircraft.

80. Wilcoxon, H.C. and Davy, E. Fidelity of Simulation in Operational Flight Trainers: Part II. The Effect of Variations in Control Landings on the Training Value of the SNJ OFT. Special Devices Center, ONR, Port Washington, L.I., N.Y., January 1954, Technical Report SDC 999-2-3.

Designed to investigate the effect of varying the control loadings on basic instrument and radio range procedure training (Stage D Basic Flight Training). Results showed that variations in control pressures had no significant effect on learning basic instrument or radio procedures. Students were able to compensate for stick pressure differences and objected to stiff or loose controls since they had to expend more effort to maintain control.

81. Wilcoxon, H.C. and Webster, J.L. Survey of Utilization of Fleet-Type Operational Flight Trainers. Special Devices Center, Port Washington, L.I., N.Y., March 1954, Technical Report SDC 999-2-2.

An investigation of the use to which the Navy's operational flight trainers have been put, with particular emphasis on the relation between training needs and the appropriateness of the design characteristics of the trainers. It was found that the amount of utilization varied widely from installation to installation.

82. Williams, A.C., Jr. and Flexman, R.E. An Evaluation of the Link SNJ Operational Trainer as an Aid in Contact Flight Training. (University of Illinois and Link Aviation, Incorporated), Special Devices Center, ONR, Port Washington, L.I., N.Y., 1949, Technical Report SDC 71-16-3.

Designed to ascertain whether certain aspects of basic flight training could successfully be learned in a synthetic flight trainer. It was concluded that 1) training in the SNJ Operational Trainer resulted in saving flight training time in the aircraft, 2) the saving achieved averaged 7 hours and 14 minutes per student for the syllabus used, 3) the saving in training time for the entire population of such students lies somewhere within the limits of 4 hours and 47 minutes and 8 hours and 47 minutes.

33. Williams, A.C. and Adelson, M. Some Considerations in Deciding About the Complexity of Flight Simulators. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., December 1954, Research Bulletin AFPTRC TR 54-106.

The construction of a variable characteristic simulator is proposed; the simulator would have 34 performance characteristics of the T-33 aircraft and each characteristic would be capable of variation over an average range of five steps.

34. Woolman, M. Some Effects of Synthetic Trainers in a B-47 Training Program. McConnell AFB, Kan., 20 February 1955, Final Project Report MCAFB TA&D 54-18.

Concerned with the training value of two synthetic flight trainers, the C-11 Link Trainer and the B-47 Simulator. The experiment was designed to test the transfer value of the C-11 trainer to later work on the B-47 simulator. Results showed 1) C-11 training made little or no differences in final air performance, 2) the B-47 simulator had greater transferability to the B-47 aircraft than the C-11 trainer, and 3) successful prediction of performance may be made from the B-47 simulator to the B-47 air training situation.

C. Gunnery

85. Bilodeau, E.A. and Morin, R.E. A Preliminary Investigation of the Effect of Removal of the Pippier From the Projected Recticle Pattern of the Pedestal Sight Manipulation Test. Human Resources Research Center, ATC, Lackland AFB, Tex., February 1951, Research Note Lab 51-2.

An investigation was made of the effects of removing the pippier from the Pedestal Sight Manipulation Test (a flexible gunning training device, utilizing projected target images). Data were not subjected to statistical analysis, but inspection of the data suggested that: 1) Ranging scores improved throughout the four experimental blocks; 2) tracking scores (azimuth, elevation, azimuth-elevation) were somewhat depressed; 3) total performance (azimuth, elevation, range & azimuth, elevation, range, triggering) seemed unaffected.

86. Bilodeau, E.A. and Morin, R.E. Rate and Extent of Improvement in Performance on the Pedestal Sight Manipulation Test. Human Resources Research Center, ATC, Lackland AFB, Tex., May 1951, Research Bulletin 51-10.

Concerned with determining the rate and extent of improvement in learning to track, range, and trigger a moving target as presented by the Pedestal Sight Manipulation Test. The training extended 19 days, more practice time than in previous studies. Results showed that performance in a complex perceptual-motor task such as this is amenable to improvement over extended periods of training. Azimuth and elevation scores improved throughout approximately the first 17 days; range scores reached their peak earlier in training. Improvement in "making hits" was still evident after 17 days of practice.

87. Bilodeau, E.A. and Morin, R.E. Proficiency on the Pedestal Sight Manipulation Test With and Without the Tracking Pippier. Human Resources Research Center, ATC, Lackland AFB, Tex., December 1951, Research Bulletin 51-27.

Designed to investigate the effects of removal of the tracking pippier in the Pedestal Sight Manipulation Test CM 824B, an apparatus which simulates aspects of the flexible gunnery task. Results indicate that removal of the pippier facilitated ranging performance. The group using the pippier, however, was superior in tracking performance as indicated by the proportion of time the subjects had the sight properly positioned in azimuth and elevation simultaneously.

85. Brown, J.S. et al. An Exploratory Study of Performance on the E-2 Flexible Gunnery Trainer. Human Resources Research Center, ATC, Lackland AFB, Tex., June 1952, Research Note FG 52-1.

Conducted to measure the reliability of the E-2 Flexible Gunnery Trainer and to obtain data about the amount and rate of learning resulting from extended practice with the trainer. Of elevation, range, and azimuth tracking, only the scores on first two are acceptably stable. The fluctuations for azimuth tracking could be attributed to the azimuth scoring system. Inter-day correlation coefficients, though based on an insufficient number of cases, suggested that if problems of apparatus variability are reduced, the reliability of the trainer might prove to be reasonably satisfactory.

89. Edgerton, H.A. et al. Study of Basic Fixed Gunnery-SDC. Special Devices Center, ONR, Port Washington, L. I., N. Y., July 1952, Supplement to Technical Report SDC 383-5-3.

Conducted to determine which training aids might be appropriate to the basic fixed gunnery phase of flight training. It was found that two precision maneuvers (high side run and flat side run), the main substance of training at this stage, are not learned as integrated tasks but are divided into segments, based on the order in which precision is developed. The main thing distinguishing students from skilled aerial gunners is their different use of visual cues. It was also found that the starting position is the segment of the gunnery run that causes most difficulty. Recommendations given are based on the conclusion that learning precision maneuvers for fixed gunnery proceeds in two ways--learning to picture the entire maneuver and learning the correct cues and responses for each segment of the gunnery run.

90. Ellis, D.S. Gun-Camera Records as Measures of Pedestal Sight Gunnery Proficiency. Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Lowry AFB, Colo., February 1956, Technical Note AFPTRC TN 56-30.

An attempt was made to evaluate the extent to which skills developed on gunnery training devices transfer to the aerial situation. The gun-camera scores were found to be too unreliable to support any definite conclusions concerning the effectiveness of the training devices in developing transferable skills.

90. Folley, K.W. and Davock, A. Target Presentation for Gunnery Trainers. (Jim Handy Organization, Incorporated, Detroit) October 1953, WADC Technical Report 53-395. (CONFIDENTIAL)

Presents recommendations for the best methods of presenting targets to student gunners both visually and by means of radar in flexible and fixed gunnery systems (airborne) trainers. The recommendations were based on a field survey of existing training devices, interviews with operational personnel, consultations with gunnery and training specialists, and an examination of available pertinent literature. The trend towards a desire for training on spotting and acquisition as well as tracking and ranging led to the recommendation of a motion picture film system using a wide angle lens and 70mm film for presenting the target in a visual flexible system gunnery trainer. For fixed gunnery an epidiascope projection system was given preference for a strict air-to-air trainer with a television system suggested for a joint air-to-ground and air-to-air presentation.

91. Goldstein, M. and Ellis, D.S. Pedestal Sight Gunnery Skills: A Review of Research. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., February 1956, Technical Note AFPTRC TN 56-31.

Reviews the research on pedestal sight gunnery skills conducted from 1944 to the present. (The pedestal sight is a part of the standard flexible gunnery equipment on the B-29 and B-36 aircraft.)

92. Goldstein, M., Rittenhouse, C.H., and Woods, J.P. Studies of Performance on the E-26 Flexible Gunnery Trainer. Human Resources Research Center, ATC, Lackland AFB, Tex., May 1952, Research Bulletin 52-17.

Represents the second evaluation of the E-26 Flexible Gunnery Trainer. Results indicated that certain deficiencies evident in the first study were corrected. Reliability of scores was improved, although malfunction continued to be a problem. It was also found that appropriate instruction resulted in appreciable improvements in performance.

93. Goldstein, M. and Rittenhouse, C.H. The Effects of Practice With Triggering Omitted on Performance of the Total Pedestal Sight Gunnery Task. Human Resources Research Center, ARDC, Lackland AFB, Tex., 1953, Technical Report 53-9.

Concerned with the omission of triggering during the early stages of practice on the Pedestal Sight Manipulation Test, a flexible gunnery training device, and its effect on subsequent performance of the complete task. Results showed that omission or inclusion of the triggering task made little difference with respect to performance on the whole task at the end of training.

94. Goldstein, M. and Rittenhouse, C.H. Knowledge of Results in the Acquisition and Transfer of a Gunnery Skill. Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., 1955, Technical Note AFPTRC TN 55-45.

Knowledge of results was presented in pedestal sight gunnery training by the use of a buzzer during trials or by spoken evaluative statements at the conclusion of trials. Amount and "pattern" of knowledge of results made little difference in performance. Buzzer introduction and removal caused the greatest increase and decline in performance; there were no such effects for the spoken statements. When transfer to a second training device was required the buzzer subjects were at a disadvantage. It was concluded that the buzzer subjects had learned to act upon situational factors particular to the original training device, and use of the buzzer was therefore not recommended. Definitive results concerning the spoken statements were lacking.

95. Gottsdanker, R.M. and Armington, J.C. Final Report: Ranging-Tracking-Aiming Point Assessor Device 3-E-7. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1947, Technical Report SDC 58-1-5.

An experimental evaluation of the Ranging-Tracking-Aiming Point Assessor which consists of systems for representing a simulated target to the operator of a free gunnery sight and for measuring the accuracy of his gun pointing. The data obtained lacked the necessary precision and the device did not prove suitable for an extended analysis of operator performance.

96. Human Resources Research Center. Research Planning Conference on Flexible Gunnery Training. Human Resources Research Center, ATC, Lackland AFB, Tex., April 1951, Conference Report 51-1.

The main purpose of this conference was to answer four questions put to the members by Headquarters, USAF: 1) What are the basic skills which must be taught gunners to score hits with present equipment? 2) To what degree are these skills transferred from one gunnery system to another? 3) What are the means of measuring the extent to which these skills have been mastered by an individual? 4) What are the characteristics of a device required to develop these skills? The Human Resources Research Center sought to obtain tentative answers to these questions and to review the psychological research on flexible gunnery in World War II.

97. Hirsch, R.A. and Saul, E.V. Army Marksmanship and Gunnery Training. Special Devices Center, ONR, Port Washington, L.I., N.Y., June 1952, Technical Report SDC 494-01-1.

Designed to determine where modifications in instructional techniques and development of training aids can improve training effectiveness and permit more economical and efficient use of training ammunition. Concerning training aids, the authors found that good training aids, especially training films, are few and, where available, are not fully utilized. The authors suggest a long-range program to investigate and specify the training aid requirements for individual weapons marksmanship training.

99. Hobbs, H. Psychological Research on Flexible Gunnery Training. Government Printing Office, Washington, 1947, WAF Aviation Psychology Progress Research Report 11.

A summary and synthesis of the work of aviation psychologists in the flexible gunnery program of the Army Air Force. An attempt was made to describe research techniques and results to facilitate using these techniques in other areas of applied psychology. Included in the report is a chapter on the evaluation of training devices and procedures for their use (Chapter 9), a chapter on the development and evaluation of training programs (Chapter 11), and a chapter on the gunner's job (Chapter 2).

100. Horrocks, J.E., Bowlus, D.R., and Krug, R.E. Training 90 MM AA Gun Crews, Appendix IV Training Aids and Devices. Special Devices Center, OAR, Port Washington, L.I., N.Y., 1953, Technical Report SDC 495-01-4.4.

This appendix contains a description of aids and devices developed and recommended by the subject project. Also included are recommendations for new training devices.

100. Horrocks, J.E., Krug, R.E., and Bowlus, D.R. Training for Antiaircraft Artillery Gunnery. Special Devices Center, OAR, Port Washington, L.I., N.Y., August 1952, Technical Report SDC 495-01-1.

A survey of antiaircraft marksmanship and gunnery training to determine where modifications in instructional procedures and development of training aids could improve training effectiveness and permit more economical use of training ammunition. The authors conclude 1) there were no major program weaknesses in the Antiaircraft and Guided Missiles branch of the Artillery School, 2) unit training suffers greatly from the fact that needed specialists are not present in the cadre, and 3) too little advantage has been taken of the potentialities of training devices and synthetic training aids. Recommendations for more efficient utilization of training aids and devices are also given.

101. Knauft, E.B. and Buxton, C.E. An Experimental Study of the Effectiveness of Various Training Procedures Used With the Aerial Gunnery Training Devices 3-A-35 and 3-A-2. Special Devices Center, OOR, Port Washington, L.I., N.Y., July 1944. Technical Report SDC 57-1 1.

Designed to determine the optimum training method to be employed with the 3-A-35 aerial gunnery device and the 3-A-2 device, which is part of the 3-A-35. Five different training conditions were used. The results did not indicate that any one training method was superior to any other, mainly because of the large variability of scores from gunner to gunner on any one training method.

102. Knauft, E.B., Spence, K.W., and Hamilton, C.E. An Experimental Study of Learning on the Aerial Gunnery Training Device 3-A-2. Special Devices Center, OOR, Port Washington, L.I., N.Y., April 1947, Technical Report SDC 57-1-5.

Concerned with the investigation of the nature and extent of the learning process involved in the mastery of the 3-A-2 aerial gunnery training device. Results showed: 1) The learning curves for the two parts of the experiment take the form of fairly well defined S-shaped curves; 2) under the conditions of this experiment approximately 25 to 30 practice sessions are required to attain maximum level of performance; 3) there was low consistency in day-to-day performance which may be explained both by variation in the sensitivity of the scoring device and variation in individual performance.

103. Knauft, E.B., Spragg, S.D.S., and Taylor, H.A. Validation of the Modified Army BC-968-A Radar Trainer as a Training Device for Aerial Tracking of the Mark 37 Gun Director With Mark 4 Radar. Applied Psychology Panel, National Defense Research Committee, OSRD, Washington, February 1945, OSRD Report 4476.

Designed to investigate the validity of the BC-968-A Trainer (an instrument providing training in matching the heights of two synthetic pips produced in the oscilloscope unit of the SCR 268 radar), modified to fit Navy specifications, for training on the pointer's and trainer's tasks in tracking the Mark 37 gun director with Mark 4 radar. The results of this research led the investigators to recommend that the training device be used as modified in training Navy radar operators to give them primary pip-matching practice, so that practice time in the Mark 37 gun director could be concentrated on crew training rather than elementary tracking.

104. Morin, R.E. and Jagne, R.M. Pedestal Sight Manipulation Test Performance as Influenced by Variations in Type and Amount of Psychological Feedback. Human Resources Research Center, ATC, Lackland AFB, Tex., October 1951, Research Note F&MS 51-7.

In this experiment both the type of feedback (auditory or visual) and the amount of feedback (50% or 100% of the time) were varied to find their effects on initial performance of pedestal sight gunnery. Subsequent performance was measured with no feedback of either type being given. Results showed that the variations in type and frequency of feedback in early practice did not influence later performance on the Pedestal Sight Manipulation Test, a flexible gunnery training device requiring the trainee to fire at a projected target image using a B.49 pedestal sighting station, when the supplementary feedback was no longer given.

105. Parks, R.B. Verbal Feedback in Pedestal Sight Manipulation. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., December 1954, Research Bulletin AFFTRC TR 54-91.

Designed to investigate the role of accuracy of information in the effectiveness of verbal feedback. The experimental data led to the conclusion that precision of verbal feedback information with respect to the complex psychomotor task employed was important to performance improvement.

106. Parks, R.B. Some Aspects of Part-Whole Task Performance in Flexible Gunnery Pedestal Sight Manipulation. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., 1954, Technical Report AFFTRC TR 54-117.

Concerned with inter-day subject performance reliabilities on each of the three sighting components on the pedestal sight, when the three were performed together in the Azimuth-Elevation-Range whole-task context. The form of ranging and azimuth performance data was examined when these sighting components were separated out of the usual whole-task context. While all inter-day correlations were significant, they were generally of only moderate magnitude. The author suggests a "general learning," which incorporates elimination of generalized responses leading to consequent learning facilitation.

107. Parks, R.B., Wood, E.D., and Perkins, D.R. Development of the Flexible Gunnery Proficiency Evaluator. Human Resources Research Center, ATC, Lackland AFB, Tex., 1953, Technical Report 52-23.

The Flexible Gunnery Proficiency Evaluator consists of a small scale model aircraft which can be moved through a great variety of arbitrarily selected attack courses up to speeds of 100 miles per hour. The stability of the operational calibration of the apparatus was indicated to be satisfactory.

108. Rittenhouse, C.H., Goldstein, M., and Woodward, D.H. A Preliminary Study Concerning the Effect of Special Training in Ranging on Performance of the Total Pedestal Sight Task. Human Resources Research Center, ATC, Lackland AFB, Tex., July 1952, Research Note FG 52-3.

The first in a series designed to investigate the effects of total pedestal sight performance on special practice with the components. The range component was selected for initial study because past research indicated that ranging was one of the greatest sources of difficulty in manipulation of the pedestal sight. It was indicated that practice on the ranging task in isolation results in improved performance of the total pedestal sight task. This was especially evident during later practice stages of the total task.

109. Rittenhouse, C.H. and Goldstein, M. Target Flight Characteristics as Determinants of Training Transfer and Task Difficulty in Flexible Gunnery. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., December 1954, Research Bulletin AFPTRC TR 54-90.

An investigation of the effects of target movement characteristics on the flexible gunner's performance. The apparatus used, the Flexible Gunnery Research Device, presents a larger variety of attack patterns than the Pedestal Sight Manipulation Test, of which it is a redesigned version. The findings concern degree of learning, transfer of training, and differences in performance level by subpatterns for azimuth, elevation, range, and speed.

110. Rittenhouse, C.H. and Goldstein, M. The Role of Practice Schedule in Pedestal Sight Gunnery Performance. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., 1954, AFPTRC TR 54-97.

Presents the results of four studies designed to determine an optimal schedule for the pedestal gunnery task. Results showed that: 1) Only occasionally was distributed practice superior to massed practice,

and no statistical reliability was found; 2) reminiscence was not demonstrable in most cases; 3) few dependable inter-group differences were produced by variations either in amount of practice or amount of time. The only differences occurred early in practice.

111. Sanderson, D.A. Report on Evaluation and Refinement of Synthetic Gunnery Trainer. 3525th Aircraft Gunnery Squadron, Nellis AFB, Nev., 1951, (Project N-49-14).

This project was designed to evaluate and improve a synthetic gunnery trainer for instruction in the use of the K-14 gun sight. The trainer sufficiently reproduced the sight picture, pursuit curve, rate of closure, and angle-off for training purposes. The author concluded that the gunnery trainer will be of value to the beginner if used in the initial stages of air-to-air gunnery training. No further development of this type trainer is recommended.

112. Seashore, R.H. et al. The Effect of Knowledge of Results on Performance on the SAM Pedestal Sight Manipulation Test. School of Aviation Medicine, Randolph AFB, Tex., 1946, (Unpublished; Reported in Underwood, 1949, 414-417).

This study, reported in Underwood's Experimental Psychology, is concerned with determining how a motor skill is improved when the subject has knowledge of results. For those subjects given a report on the adequacy of their responses, there was little difference in performance on the tracking component of the Pedestal Sight Manipulation Test but a great improvement in ranging performance. When information was withheld, performance scores on the ranging component dropped.

113. Spence, K.W. Preliminary Report on Fixed Gunnery Slide Film Deflection Trainer (93-C-9). Special Devices Center, ONR, Port Washington, L.I., N.Y., July 1945, Technical Report SDC 57-1-2.

Reports the results of a preliminary investigation of the Fixed Gunnery Slide Film Deflection Trainer (93-C-9). Ten graduate students in psychology were trained on the apparatus with one film and then tested on a second. Considerable learning took place in the early stages of practice, as subjects became more skillful in estimating the direction and line of flight of the plane and recognizing the 21 planes presented to them on each strip. When time intervals were shortened the subjects abandoned calculations based on gunnery rules and resorted to judgments based on quick estimates of line of flight and firing angle.

114. Spieth, W. An Exploratory Study of Operator and Apparatus Characteristics of a Flexible Gunnery Research Device. Human Resources Research Center, ATC, Lackland AFB, Tex., October 1952, Technical Report 52-2.

Concerned with a preliminary evaluation of a redesigned Pedestal Sight Manipulation Test, the Flexible Gunnery Research Device. The apparatus and its operating characteristics are described. It was found 1) reliability of the simulator was sufficiently high to meet the requirements of a research instrument, 2) men's performance improved over the seven days of practice, and 3) certain inadequacies in the consistency of score tolerances were evident in the elevation scores (it was anticipated that these inadequacies could be corrected).

115. Voss, H.A. and Rhoads, C.S. Evaluation of Gunnery Training Devices - Devices 3-E-7 and E-A-40. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1950, Technical Report SDC 58-1-6.

Device No. 3-E-7 (Ranging, Tracking, Aiming-point Assessor) and Device No. 3-A-40 (Mark 18 Coordination Trainer) were given experimental evaluation. Results indicated that the former device, because of certain inherent weaknesses in engineering design and overall unreliability, was a dubious investment as a trainer for gunners. Device No. 3-A-40 (as improved at Tufts College) was found useful in studying aptitudes and rates of learning and effectively training men in a simulated gunnery situation.

116. Willard, N., Bancroft, C.A., and Reddan, J.G. The Training Effectiveness of a Stereoscopic Range-Finder Trainer. Human Resources Research Office, The George Washington University, Washington, D.C., October 1954, Technical Report 12.

Designed to discover whether a range-finding training instrument, Device OROPT - TL, could be used to satisfactorily identify potentially good operators, give remedial training for poor operators, and provide satisfactory range-finder training. It was found 1) after approximately 130 rangings this device could aid in differentiating those operators who would make normal progress from those who would need special training, 2) the device had no especial value for training poor students, and 3) use of the trainer resulted in improved performance on the range finder.

D. Other training devices

117. Allen, M.J., Fitts, P.M., and Siivinske, A.J. A Moving Target Optical Projector For Use in Air Traffic Control Research. Wright Air Development Center, ARDC, Wright-Patterson AFB, Ohio, 1954, WADC Technical Report 53-417.

The specifications and design of a moving target optical projector are described. This projector was designed to meet the requirements of a versatile research apparatus in human engineering studies of air traffic control studies. It can be used singly or in combination with other projectors. It can provide a static display or, when connected with a suitable course generator, a moving target display.

118. Besnard, G.G., Briggs, L.J., and Walker, E.S. The Improved Subject-Matter Trainer. Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Lowry AFB, Colo., April 1955, Technical Memorandum ASPRL TM 55-11.

A description of the second model of the Subject-Matter Trainer which incorporated several improvements over the original model. The device was originally designed to enable students in Air Force Technical schools to practice and learn certain information and skills without the continuous aid of their instructor. The three general types of learning that can be used on the trainer are paired, associate, serial learning, and problem solving.

119. Black, J.W. Evaluation of the Primary Flight Helmet, Device 12-BK-5. Impact Audible Signal System for Flight Training. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1950, Technical Report SDC 41-1-18.

The Primary Flight Helmet, a device consisting of a helmet with four electric buzzers, was given 10 tests; it was the conclusion that the helmet was generally unsatisfactory. The author urged study of auditory-tactile communication apart from the helmet.

120. Crowder, N.A. The Concept of Automatic Tutoring. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., (Organizational paper).

Automatic tutoring attempts to simulate the entire learning situation without either an instructor or the apparatus which is the subject of instruction. The student is presented with a book in which he finds a question followed by a list of alternative answers. Choosing the answer he thinks correct, he

turns to the page the answer indicates and finds whether he is right. If not, he is informed what was wrong with his answer and instructed to return to the original page and try again. When he is correct, the text gives him more information and leads him to the next question. The main disadvantage of this method of instruction is that the student is clued by the list of possible alternatives, the author says. He feels that this method has definite possibilities for augmenting direct instruction in a formal or an on-the-job training course at comparatively little cost in time or material.

121. Davidson, S. and Verdini, A.J. Countermeasures Training Device and Appendices I. Through III. - Final Engineering Report. General Electric Company, Government Division, Syracuse, N.Y., December 1951.

The specified purpose of the Countermeasures Trainer is to simulate radar X-band radiation to train jammer-equipment operators. It was concluded that the trainer is a versatile tool for training jammer operators. It features complete automatic programming and simulation of any type of radar radiation between 8500 and 9000 megacycles.

122. Denenberg, V.H. The Training Effectiveness of a Tank Hull Trainer. Human Resources Research Office, The George Washington University, Washington, February 1954, Technical Report 3.

Designed to determine the effectiveness of the Tank Hull Trainer 3-T-3 as a training aid. This trainer is used to teach three driving and maintenance lessons concerned with the M47 tank. During the course of the study an inexpensive mock-up of the instrument panel and driver's controls was made available. Experimentation with both these devices indicated that: 1) The inexpensive mock-up was a better training aid for the teaching of starting and stopping procedures; 2) the mock-up, the Hull Trainer, and actual work with tanks were all equally effective for teaching nomenclature and location of the various driver's instruments and controls; 3) trainees learned more about the track and suspension system from working on the track system of the Hull trainer.

123. Hanley, T.D. and Steer, M.D. Functional Specifications For a Voice Communications Training Device. Special Devices Center, ONR, Port Washington, L.I., N.Y., February 1955, Technical Report SDC 104-2-45.

Undertaken to examine contributory elements of speech intelligibility, and to prescribe characteristics which should be incorporated into a voice communications training device. Based on pertinent voice communications studies and investigations, functional specifications were formulated for such a device.

124. Johnson, B.E., Williams, A.C., and Roscoe, S.H. A Simulator For Studying Human Factors in Air Traffic Control Systems. Bureau of Medicine and Surgery, Division of Aviation Medicine, U.S. Navy, Washington, 1951, Naval Research Council Committee on Aviation Psychology Report 11.

A description of a simulator, under construction at the University of Illinois at the time of the report, for use in the study of human engineering problems in air traffic control systems. It was designed to study 1) systems and procedures for air traffic control and 2) display problems in the presentation of navigation information in the aircraft.

125. Katzell, R.A. et al. Navy Recognition Training. Special Devices Center, ONR, Port Washington, L.I., N.Y., July 1952, Technical Report SDC 383-6-2.

An investigation into the requirements for effective recognition of targets in combat, with recommendations for improving current recognition training. Recommendations were 1) the lookout's job be made more important, 2) motion pictures of the targets in combat be used as a training aid, and 3) recognition training be spread over a longer period of time, with context directed from the general to the specific.

126. Kelly, J.C. and Mason, H.M. An Experimental Comparison of Five Conditions for Voice Communication Training. Special Devices Center, ONR, Port Washington, L.I., N.Y., July 1947, Technical Report SDC 104-2-3.

Five groups of subjects were trained to increase word-intelligibility under difficult communication conditions, using course content founded on experience gained during World War II. Each group was trained in a situation presenting a different type or amount of interference. The Portable Interphone

Trainer, Device 8 I, was used. After the training period, performance was evaluated by word-intelligibility tests and by judgments of connected speech. Results showed that where Device 8-I or similar equipment was used, training results were improved by using low noise levels; when practice was performed under severe noise levels there was little gain.

127. Kelly, J.C. et al. Retention of Voice Communication Training After One Year. Special Devices Center, ONR, Port Washington, L.I., N.Y., March 1947, Technical Report SDC 104-2-13.

A study of retention of voice communication training. It was found that after one year subjects performed essentially as well as they had immediately after completion of the training. Trained subjects again made higher scores in voice communication than did control subjects.

128. Moser, H.M. and Dreher, J.J. Research on the Language of Voice Procedures--Air Defense Training Aids. /The Ohio State University Research Foundation, Contract AF18(300)316, Air Research and Development Command, June 1953, Report 2. (AF Project 519)

Due to a need for standardization in voice procedures and a need for training spotters of enemy aircraft, the Human Resources Research Laboratory and the Civil Air Defense Survey group worked jointly in the development of a training aids kit constructed to fit the requirements of Air Defense. Included in this kit are: 1) voice procedure training cards, 2) a plotter's training device, giving practice in both "telling" the plot and plotting one's own 'tells,' 3) training records, emphasizing important points in diction, 'telling' procedures, and standard terminology.

129. Murnin, J.A. Comparison of Training Media: Transfer of Principles Involved in a Manipulative Skill: Operation of the Aircraft Load Adjuster Slide Rule. Special Devices Center, ONR, Port Washington, L.I., N.Y., September 1955, Technical Report SDC 269-7-103.

The results indicate there is no evidence that the Multi-Engine Weight and Balance Trainer is more effective than the individual load adjuster slide rule for teaching transfer of weight and balance principles to other aircraft. Also, there is evidence that transparencies of the aircraft models are not as effective as the Multi-Engine Weight and Balance Trainer for teaching transfer of weight and balance principles to other aircraft.

130. Pressey, S.L. "Development and Appraisal of Devices Providing Immediate Automatic Scoring of Objective Tests and Concomitant Self Instruction." J. Psychol., 1950, 29, 417-447.

Discusses the development of devices providing immediate automatic scoring of objective tests. The appraisal indicates that test devices allowing the subject to "find" the right answer at the time of taking the test contribute to increased learning.

131. Rose, H.W. and Fleck, H. Night Vision Trainer and Training Techniques--1-A Projector For Basic Night Vision Training of Pilots. School of Aviation Medicine, Randolph AFB, Tex., June 1952, Report 1.

Description of a projector for wide-angle projection at five different low levels of illumination, permitting projection of any six fixed slides and, simultaneously, a moving slide with an aircraft silhouette. The report recommends that this projector be introduced as a standard device for basic night vision training for Air Force pilots.

132. Schaefer, W.C. Recommended Training Aids for Night Vision and Oxygen Training Programs. Naval Research Laboratory, Washington, D.C., August 1953, Report 797-01-1.

Attempts to answer the following: What oxygen and night-vision requirements will the aircraft of the next five years place on aviation personnel? and What plans must be made for training aids and procedures which will train aviation personnel to meet these operational requirements? Part I discusses the oxygen high altitude training program with recommendations on operation and training; Part II discusses the night vision training program, also with recommendations for operational requirements and training.

133. Schoban, B. Human Engineering Recommendations for a Visual Reconnaissance Ground Trainer. American Institute For Research, Pittsburgh, Pa., September 1954.

Contains recommendations for a Visual Reconnaissance Ground Trainer to be used to develop and integrate skills required in conducting aerial reconnaissance while flying a fighter-type aircraft. Forty two recommendations are made, categorized under 1) controls, 2) displays, 3) programs, 4) scoring and error analysis, and 5) instructor's station. This report was intended to test the usability of techniques and procedures for determining human behavioral requirements training

devices as developed in A Method for Determining Human Engineering Design Requirements for Training Equipment (WADC TR 53-135); Handbook of Training and Training Equipment Design (WADC TR 53-136); A Method for Man-Machine Task Analysis (WADC TR 53-137); Human Engineering Design Schedule for Training Equipment. (WADC TR 53-138).

134. Sulpizio, T.J. et al. Design Study for Visual Reconnaissance Simulator. Wright Air Development Center, ARDC, Wright-Patterson AFB, Ohio, November 1955, WADC Technical Report 55-419.

A description of the Visual Reconnaissance Simulator which employs direct projection of a relief-map model by reflected light, standard electro-mechanical flight computers of proven design, and a cockpit configuration modeled upon the RF-101 airplane, a reconnaissance-type aircraft scheduled to be in first line service with the U.S. Air Force in the next two or three years.

135. Swanson, R.A. The Relative Effectiveness of Training Aids Designed for Use in Mobile Training Detachments. Training Aids Research Laboratory, Air Force Personnel and Training Research Center, ARDC, Chanute AFB, Ill., March 1954, Technical Report AFPTRC TR 54-1.

Six devices were studied for use during lecture: operating mock-ups, nonoperating mock-ups, cutaway mock-ups, animated panels, charts, and symbolic diagrams. Results showed no appreciable differences in effectiveness among the various training aids employed. It was concluded that some complex and expensive training aids may not be any more effective than are less complex training aids.

136. Swanson, R.A. and Aukes, L.E. Evaluation of Training Devices for B-47 Fuel, Hydraulic, and Rudder Power Control Systems. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., January 1956, Technical Note AFPTRC TR 56-82.

Investigators studied animated panels, charts, cutaway trainers, nonoperating trainers, operating trainers, and symbolic diagrams in the classroom with lecture demonstration. No significant statistical differences in effectiveness were found among the various training aids studied. In a second experiment each aid was studied in an experimental situation in which no lecture or oral instruction

was given. Effectiveness was then measured solely in terms of the extent of learning from the devices themselves. Some evidence was found to differentiate immediate effectiveness of the several devices. This evidence, however, was not consistent, and no differences were found six to eight weeks after the experimental situation had taken place.

137. Torkelson, G.M. The Comparative Effectiveness of a Mock-Up, Cutaway and Projected Charts in Teaching Nomenclature and Function of the 40mm Antiaircraft Weapon and the Mark 13 Type Torpedo. Special Devices Center, GTR, Port Washington, L.I., N.Y., March 1954, Technical Report SDC 259-7-100.

It was found that: 1) There were no differences in training effectiveness between the cutaways, mock-ups, transparencies, and manual illustrations, 2) slight (but not statistically significant) differences in favor of 3-D devices were demonstrated for retention of information.

II. Training Aids

A. Motion Pictures

I. General

138. American Council on Education. The Motion Picture in Education: Its Status and Its Needs. American Council on Education, Washington, 1937.

Surveys the status of motion pictures in education in the U.S., views the development of the Educational Motion Picture Project, summarizes its work to date, and outlines a series of proposed activities for it.

139. American Council on Education. Films for America at War. Supplement 1 to Selected Educational Motion Pictures. Committee on Motion Pictures in Education, American Council on Education, Washington, 1943.

Intended "to supply teachers and leaders of community groups with essential information on films related to the all out drive for victory in World War II." Included are descriptions and sources of 75 films.

140. Business Screen. Entire Issue, June 1945, 6, Number 5, 18-120.

Consists of 29 articles written by Navy personnel describing the Navy film training program as of 1945.

141. Business Screen. Entire Issue, January 1946, 7, Number 1, 19-97.

Consists of 28 articles written by personnel of the Army Pictorial Service, Signal Corps, describing the activities of the Army Pictorial Service as of 1946.

142. Carpenter, C.R. Logistics of Sound Motion Pictures for Military Training. Special Devices Center, ONR, Port Washington, L.I., N. Y., September 1952, Human Engineering Report SDC 269-7-31.

The findings and implications of research studies of the Instructional Film Research Program prior to 1952 were drawn together into a cohesive training film program. It is recommended that: "The military should establish some procedure for integrating the various phases of film production and utilization. It should incorporate the points outlined in this report and subsequent research reports."

143. Carpenter, C.R. et al. The Classroom Communicator. Special Devices Center, ONR, Port Washington, L.I., N.Y., October 1950, Technical Report SDC 269-7-14.

A report of the planning, design, and construction of experimental equipment appropriate for research on the learning process and evaluation of complex instructional and informational programs. The Classroom Communicator provides a means for recording and measuring the individual reactions in the audience and improving, facilitating, or increasing the rate and effectiveness of learning. The device consists of individual response stations connected to a central unit, which allows the observer or instructor to see the percentage of correct answers as well as the percentage for each of the remaining four possible alternatives.

144. Carpenter, C.R. et al. The Film Analyzer. Special Devices Center, ONR, Port Washington, L.I., N.Y., October 1950, Technical Report SDC 269-7-15.

A description of the Film Analyzer which can be used in conjunction with the Classroom Communicator. The Analyzer consists of a polygraph recorder, the coding relays, and individual response stations. This device provides a method of film evaluation that can be synchronized with specific parts of the film.

145. Carpenter, C.R. and Greenhill, L.P. "A Scientific Approach to Informational Film Production and Utilization." J. Soc. Mot. Pict. Engrs., 1952, 28, 415-427.

Reviews the research program sponsored by the Special Devices Center from 1948 to 1952 which was directed toward the production of 16mm informational films. Research findings and implications are reported for the following: Viewing conditions, repetition, rate of development, participation, errors to be avoided, camera angle, motion, idea density, introductions and summaries, pretests and knowledge of results, color versus black and white, special effects, exclusive use of films, personalized commentary, and practice in learning from films.

146. Dale, E. et al. Motion Pictures in Education: A Summary of the Literature. New York: H.W. Wilson Company, 1938.

Issued under the direction of the Committee on Motion Pictures in Education of the American Council of Education. Detailed summaries of significant articles, theses, and books that appeared from approximately 1925 to 1940 have been classified and assembled with editorial comments.

147. Exton, W. "Motion Picture Training Films in the Navy." Proc. U.S. Nav. Inst., 1943, 59, 933-938.

Discusses the task of the Training Aids Section of the Navy, which coordinates training films, school curricula, text books, wall charts, posters, models, and other educational devices. Of these training aids, it was found that audio-visual presentation of material such as that in the Motion Picture Training Films presented the most comprehensible material in the least time.

148. Gibson, J.J. (ed.) Motion Picture Testing and Research. Army Air Forces Aviation Psychology Program Research Reports, Washington, Report 7. (Government Printing Office)

A report of the work performed by the Army Air Forces Aviation Psychology Program under the directorship of J.J. Gibson. Of general interest among the studies reported are those concerned with audience participation in pictorial learning, and effect of room illumination and viewing angle upon learning.

149. Greenhill, L.P. and Tyo, J. Instruction Film Production, Utilization and Research in Great Britain, Canada and Australia. Special Devices Center, OMR, Fort Washington, L.I., N.Y., May 1949, Technical Report SDC 269-7-1.

Before initiating research to determine the principles of effective production and utilization of film instructional devices, the Special Devices Center gathered information about film production, utilization, and research activities in Great Britain, Canada, and Australia. Findings are presented in this report.

150. Greenhill, L.P. A Study of the Feasibility of Local Production of Minimum Cost Sound Motion Pictures. Special Devices Center, ONR, Port Washington, L.I., N.Y., July 1955, Technical Report SDC 269-7-48.

"A series of successful films were made by unskilled enlisted men using a specially designed kit of equipment and manual to explain its use. A typical ten minute film was shot in less than one day, and was available in less than two weeks, at a very low cost... The films were completely successful for their purpose" -- to produce an efficient training aid at a minimum of cost.

151. Greenhill, L.P. The Recording of Audience Reactions by Infrared Photography. Special Devices Center, ONR, Port Washington, L.I., N.Y., September 1955, Technical Report SDC 269-7-56.

A discussion of a method of recording audience reaction which could be related to specific film content. A memo-motion filming technique for economically obtaining infrared photographs, which could be easily related to the corresponding film sequence, was used.

152. Guth, S.K. "Surround Brightness: Key Factor in Viewing Projected Pictures." J. Soc. Mot. Pict. Engs., 1951, 57, 214-224.

Concerned with a means of providing maximal visual comfort and viewing ease of projected pictures and a discussion of those factors which determine whether the surrounding area in which projected pictures are viewed is satisfactory.

153. Hamilton, J.L. "The Factor of Motivation in Learning as Applied to the Making of a Teaching Film." J. educ. Psychol., 1944, 35, 423-431.

The author contends that producers of teaching films are too likely to assume that any film commands attention and therefore automatically provides adequate motivation for learning. The author disagrees and discusses seven specific techniques which he believes should be employed in the production of films.

154. Hoban, C.F., Jr. "Experimental Research in Instructional Films." Part V in Dale, et al. Motion Pictures in Education. New York: H.W. Wilson Company, 1937.

In Part V of Dale, et al, Hoban considers the following aspects of instructional film research: 1) Criteria for evaluation of experimental research in general; 2) neglected factors in experimental procedure; 3) review of experimental data; 4) implications of experimental data for educational practice; 5) a bibliography.

155. Hoban, C.F., Jr. Selected Educational Motion Pictures: A Descriptive Encyclopedia. American Council on Education, Washington, 1942.

Describes and appraises 480 films, selected on the basis of more than 5,500 teacher judgments and 12,000 student judgments and passed upon by preview panels of competent educators. The appraisal indicates purposes for which the film can best serve, noteworthy strong and weak points, and technical quality.

156. Hoban, C.F., Jr. Focus on Learning: Motion Pictures in the School. American Council on Education, Washington, 1942.

The final report of the director of the Motion Picture Project of the American Council on Education reviews and interprets the role of motion pictures as an aid to learning. Psychological requirements and technical characteristics of effective films are analyzed. The appendix includes information about film sources and the services they offer.

157. Hoban, C.F., Jr. Movies that Teach. New York: Dryden Press, 1947.

A report of developments in instructional motion pictures during World War II. Among the studies are a number conducted at the Signal Corps Photographic Center that deal with patterns of film supply, print utilization, and film library administration. These studies underscore the necessity for trained personnel and organized promotion of film utilization, if films are to reach the audiences for which they are intended.

158. Hoban, C.F. and Van Ormer, E.B. Practical Principles Governing the Production and Utilization of Sound Motion Pictures. Special Devices Center, ONR, Port Washington, L.I., N. Y., August 1950, Report E269-7; Special Report 1. (Chapter 9 of Technical Report 269-7-19 covers the content of this report.)

A summary of the principles for the effective production and utilization of sound motion pictures, based on a review of the literature from 1918 to 1950.

159. McIntyre, C.J. and McCoy, E.P. The Application of Sound Motion Pictures for Recording Billet Analysis Information. Special Devices Center, ONR, Port Washington, L.I., N.Y., March 1954, Technical Report SDC 269-7-41.

An attempt to develop economical methods of production and use of motion pictures to communicate information as required for an understanding of the duties of a man performing a job, the level of training he needs, the physical and social environment in which he works, and the physical and intellectual skills he must have or be able to acquire. Several methods of filming were developed, each appropriate to a specific use.

160. May, M.A. "The Psychology of Learning From Demonstration Films." J. educ. Psychol., 1945, 37, 1 12.

Discusses how certain aspects of learning theory can be applied to teaching films. The author feels that this article should serve as a guide in the production and utilization of demonstration films. He lists 10 rules, or "guiding principles", suggested by his analysis.

161. Smith, K.R. and VanOrmer, E.B. Learning Theories and Instructional Film Research. Special Devices Center, ONR, Port Washington, L.I., N.Y., June 1949, Technical Report SDC 269-7-6.

Intended to provide a framework for the later work in this series. The report is divided into five major sections: 1) psychological learning principles and their relationship to learning from films; 2) instructional film characteristics and their influence on learning; 3) development of equipment and procedures for testing instructional films; 4) research on methods of utilizing films in instruction; 5) reviews of pertinent literature and theoretical systems.

162. Special Devices Center. A Bibliography of Production, Utilization and Research on Instructional Films., Special Devices Center, OIR, Port Washington, L.I., N.Y., November 1953, Technical Report SDC 269-7-40.

A bibliography of 1,896 references which relate to the production, utilization, and research on instructional films up to early 1952. Included are references to selected articles and books dealing with indirectly related topics such as radio, music, learning theory, and research methods.

163. Special Devices Center. Instructional Film Research Reports Special Devices Center, OIR, Port Washington, L.I., N.Y., January 1953, Technical Report SDC 269-7-36 or NAVEXOS P-1220.

A compilation of research reports which concern investigations of improving films and promoting their use as effective instructional aids.

164. Special Devices Center. Instructional Film Research Reports: Rapid Mass Learning - Vol. II. Naval Training Special Devices Center, OIR, Port Washington, L.I., N.Y., 1956, Human Engineering Report NAVTRADEVCON 269-7-61, or NAVEXOS P-1543.

A second volume in the compilation of research reports from the Instructional Film Research Program, Special Devices Center (Naval Training Devices Center). These investigations were carried out to determine how to improve films and how to promote their use as effective instructional aids.

165. Thomas, F. "The Cartoon and Training Films." In Various Writers Congress, Proceedings. Berkely, Calif.: University of California Press, 1944.

The use of animated cartoons in training and indoctrination motion pictures in the Army is discussed. The author feels adequate animated cartoons must have humor, clarity of diagrams, a cartoon character, caricature and satire, and fantasy.

166. Twyford, L. Film Profiles. Special Devices Center, OIR, Port Washington, L.I., N.Y., November 1951, Human Engineering Report SDC 269-7-23.

A study based on the comparison of a rating profile with an objective test of learning. Results showed that simply requiring the viewer to state whether or not he thinks he is learning provides a relatively accurate estimate of learning.

167. Zuckerman, J.V. Music in Motion Pictures: Review of Literature With Implications for Instructional Films. Special Devices Center, O&R, Port Washington, L.I., N.Y., May 1949, Technical Report SDC 269-7-2.

A review of the pertinent literature, presenting selected opinions, viewpoints, and hypotheses. Also included is a selected bibliography on motion picture music.

2. Experimental Research

168. Ash, P. The Relative Effectiveness of Masses Versus Spaced Film Presentation. Special Devices Center, ONR, Port Washington, L.I., N.Y., June 1949, Technical Report SDC 269-7-3.

The effect on learning of showing a series of films in a single session lasting 45 to 60 minutes was compared with the effect of showing the reels one at a time on successive days. Although the several reels dealt with the same over-all topic, the spacing did not interfere with film continuity. No differences in delayed retention between the two procedures were found.

169. Ash, P. and Carlton, B.J. The Value of Note Taking During Film Learning. Special Devices Center, ONR, Port Washington, L.I., N.Y., November 1951, Technical Report SDC 269-7-21.

Results indicated that note taking during film viewing, with or without opportunity to review notes prior to taking a test, interferes with learning from the film.

170. Ash, P. and Jaspen, N. The Effects and Interaction of Rate of Development, Repetition, Participation, and Room Illumination on Learning from a Rear-Projected Film. Special Devices Center, ONR, Port Washington, L.I., N.Y., October 1953, Human Engineering Report SDC 269-7-39.

Intended to determine whether it is possible, when teaching a skill with films, to have trainees participate along with the demonstration. With enough light and slow enough film demonstration, trainees could practice and participate. A slow rate of development, repetition, and participation all increased learning. Interaction between repetition and rate of development was found; this suggested that repetition cannot entirely compensate for a fast rate of development in a film.

171. Cameron, V.E. "A Comparison Between the Use of Motion Pictures and the Question Discussion Method in Teaching High School Physics." University of Southern California, 1933. (Unpublished Master's Thesis)

Compared the ordinary lecture-discussion method of teaching high school physics with a film course in which each film was followed by a short question period. There was a slight, though, insignificant, advantage for the film class.

172. Cogswell, J.F. Effects of a Stereoscopic Sound Motion Picture on the Learning of a Perceptual Motor Task. Special Devices Center, ONR, Port Washington, L.I., N.Y., September 1952, Technical Report SDC 259-7-32.

Designed to discover whether the three-dimensional aspect in films is important for teaching a motor skill such as the assembly of the breech block of the 40mm anti-aircraft gun. Results inferred that the 3-D effect did not improve learning and may have distracted the viewer because of its novelty.

173. Department of Agriculture. What Research Shows About Visual Aids. Department of Agriculture, Washington, 1949. USDA Extension Service 612(6-49).

A pamphlet summarizing principles in the design and use of visual aids which were published in the literature of that field. Included are a 35-item annotated bibliography and a summary of the bibliography containing conclusions drawn from the literature cited.

174. Greenhill, L.P. The Evaluation of Instructional Films by a Trained Panel Using a Film Analysis Form. Special Devices Center, ONR, Port Washington, L.I., N.Y., September 1955, Technical Report SDC 259-7-57.

Designed to develop a film appraisal form incorporating important variables discovered in the instructional film research program; such a form could be used for pre-production or pre-release evaluation of films. A film analysis form was developed for use by trained film production personnel, and a trainee film evaluation form was developed for evaluation by trainees while the film is in the final productions stage. A high degree of correspondence was obtained between the predictions of teaching effectiveness obtained with the two forms.

175. Grosslight, J.H. and McIntyre, C.J. Exploratory Studies in the Use of Pictures and Sound for Teaching Foreign Language Vocabulary. Special Devices Center, ONR, Port Washington, L.I., N.Y., August 1955, Technical Report SDC 269-7-53.

Still and motion pictures with and without sound were used under several conditions to discover their value in improving military language instruction. The results of this experimentation showed:

- 1) Pictures of an object or an act are an aid to learning to write foreign words;
- 2) the pictures need not be in motion;
- 3) pronunciation of the words by the narrator or learner seems to inhibit learning to write foreign words;
- 4) women appear to be superior to men in learning foreign vocabulary;
- 5) films are a convenient method for repetitive presentation of new words.

176. Harby, S.F. Evaluation of a Procedure for Using Daylight Projection of Film Loops in Teaching Skills. Special Devices Center, ONR, Port Washington, L.I., N.Y., May 1952, Technical Report SDC 269-7-25.

Sought answers to three questions: 1) In teaching an athletic skill, are film loop demonstrations of the task projected in daylight as effective as demonstrations by a live instructor? 2) Are demonstrations more effective when interspersed with practice? 3) Is coaching during practice more effective than no coaching? The results showed that instruction by means of film loops in daylight proved as effective as live demonstration; coaching during practice was significantly superior to not coaching; demonstrations were not more effective when interspersed with practice.

177. Harby, S.F. Comparison of Mental Practice and Physical Practice in the Learning of Physical Skills. Special Devices Center, ONR, Port Washington, L.I., N.Y., June 1952, Human Engineering Report SDC 269-7-27.

Designed to determine whether students can learn a physical skill simply by watching a motion picture and by "mentally going through the motions" of the skill as it is demonstrated on the film. Results showed: 'Mental practice' was found to be effective in teaching a skill. It was believed that a combination of 'mental practice' and physical practice would be most effective in teaching a skill.

178. Hirsch, R.S. The Effects of Knowledge of Test Results on Learning of Meaningful Material. Special Devices Center, ONR, Port Washington, L.I., N.Y., September 1952, Human Engineering Report SDC 269-7-10.

Investigated the effect of knowledge of results in a realistic training situation with highly meaningful material. In this experimental training situation the instructional material consisted of six Navy training films covering aerodynamics, the carbine rifle, theory of guided missile operation, hydrostatic fuses, navigation plotting board, and star identification. It was found that in general the more explanation given with the correct answer, the more the answer aided learning.

179. Hovland, C.I., Lumsdaine, A.A., and Sheffield, F.D. Experiments on Mass Education. Princeton, N.J.: Princeton University Press, 1949.

Includes reports of film studies by the Experimental Section, Research Branch, Information and Education Division of the War Department. The problems investigated include opinion and motivational effects of orientational films, factors in audience response, and effects of alternate methods of presentation of audience participation.

180. Jaspens, N. Effects on Training of Experimental Film Variables, Study II: Verbalization, 'How it Works,' Nomenclature, Audience Participation, and Succinct Treatment. Special Devices Center, ONR, Port Washington, L.I., N.Y., March 1950, Technical Report SDC 269-7-11.

A study of the effects on training of experimental film variables. Results showed: 1) Medium verbalization (100 words per minute of film) proved most effective; 2) including a 'how it works' sequence explaining principles of operation did not contribute to learning an assembly task; 3) audience participation was effective if development of the film was slow enough to permit learners to view the film and perform the task without too much loss of attention to either; 4) the succinct treatment (a concise but complete film presentation) is likely to be exceedingly ineffective; 5) merely using technical nomenclature in the films does not effectively teach the names of the parts.

181. Jansen, H. Effects on Training of Experimental Film Variables, Study I: Verbalization, Rate of Development, Nomenclature, Errors, How it Works, Repetition. Special Devices Center, ONR, Port Washington, L.I., N. Y., October 1950, Technical Report SDC 209-7-17.

Experimental control of a number of film variables showed: 1) A slow rate of development is a most important factor in making a teaching film effective (in general, this speed would be slower than is customary in present production practice); 2) repetition of the demonstration of the task adds considerably to the teaching effectiveness of a given film; 3) showing common errors to be avoided increases the effectiveness of the film; 4) the use of technical nomenclature does not appear to facilitate the learning of an assembly skill and may actually interfere with such learning.

182. Johnson, D.A. "An Experimental Study of the Effectiveness of Films and Film Strips in Teaching Geometry." J. exp. Educ., 1949, 17, 363-372.

Investigated the claim that geometry instruction emphasizing visualization and application by the use of sound motion pictures or film strips is more effective than instruction using other supplementary aids. In the data, on some aspects differences favored the groups using three experimental training programs (both films and film strips, films alone, and film strips alone.) Other differences favored the control groups. The one area in which the results were consistently in favor of the experimental groups was in the retention of learning.

183. Kale, S.V. Learning and Retention of English-Russian Vocabulary Under Different Conditions of Motion Picture Presentation. Pennsylvania State College, State College, Pa., 1953.

Found that learner participation with a sound film did not increase learning or retention of English-Russian vocabulary. The investigator also found that sound films are superior to both silent films and sound tracks alone.

184. Kendall, K. "Film Production Principles: The Subject of Research." J. Soc. Mot. Pict. Engrs., 1952, 58, 428-443.

The results of the research of the Instructional Film Research Program are reported and assessed for their possible meaning for other productions. Learning accelerators were reported to be verbal level, participation, rate of development, and showing of errors. Also reported are variables that showed inconclusive or negligible differences such as music, viewing angle, and consecutive versus spaced film showings. Several principles which govern the dynamics of film influence on behavior are also given.

185. Kishler, J.P. The Effects of Prestige and Identification Factors on Learning From Sound Films. Special Devices Center, ONR, Port Washington, L.I., N.Y., March 1950, Technical Report SDC 259-7-10.

Designed to determine if identification with and attitude toward the protagonist of a film has an effect on learning from the film. The picture selected was "Keys of the Kingdom," in which Gregory Peck played a priest. Those who ranked the position of priest as high in prestige and those who were affiliated with the Catholic church learned more but not significantly more than those who ranked a priest as low in prestige and those who were not Catholic.

186. Kurtz, A.K., Walter, J.S., and Brenner, H.R. The Effects of Inserted Questions and Statements on Film Learning (Rapid Mass Learning). Special Devices Center, ONR, Port Washington, L.I., N.Y., September 1950, Technical Report SDC 259-7-16.

The investigators found that the insertion of questions in the sound track of a film improved learning but was no more effective than a repetition of the film.

187. Lange, C.J., Rittenhouse, C.H., and Atkinson, R.C. Films and Group Discussions As a Means of Training Leaders. Human Resources Research Office, The George Washington University, Washington, March 1956, Technical Report 27.

Conducted to develop and experimentally evaluate a sound film-discussion technique for training junior officers in military leadership. The

aims of the modified course were to increase the realism of the leadership problems presented to the students, and to provide each student with maximum opportunity to participate in solving problems. Ten films depicting officer leadership problems were produced. Both students and the instructors reacted favorably to the films. On the average, the student who received the special training showed greater improvement in the quality of his solutions to leadership problems than did the student who received regular training.

188. Lathrop, C.W., Jr. and Norford, C.A. Contributions of Film Introductions and Film Summaries to Learning From Instructional Films. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1949, Technical Report SDC 259-7-8.

Concerned with investigating the contributions to learning of some typical introductory and summarizing sequences in existing instructional films. The investigators found that in two cases introductions had an insignificant adverse effect. All three summaries presented made small, positive contributions to learning (only one of the differences was statistically significant.)

189. Lockhart, J.A. "The Value of the Motion Picture as an Instructional Device in Learning a Motor Skill." Res. Quart. Amer. Hlth. Phys. Educ. 1944, 15, 181-187.

Results showed a decided advantage for those students of bowling who had had additional instruction by film, in comparison with those who received no film instruction.

190. Lumsdaine, A.A. and Sulzer, R.L. The Influence of Simple Animation Techniques of the Value of a Training Film. Human Resources Research Laboratory, Headquarters Command, USAF, Bolling AFB, Washington, April 1951, HRRL Report 24.

The training value of simple animation techniques in teaching an instrument reading skill was examined. For the animation used (pop-in labels, moving arrows, etc.), there was a marked increase in the amount men learned from the film. Recommendations for the use of simple animation are included.

191. Lumsdaine, A.A. The Value of Using Multiple Examples in Training Film Instruction. Human Resources Research Laboratory, Headquarters Command, USAF, Bolling AFB, Washington, May 1952, HRRL Report 25.

Designed to study the training value of multiple examples in films teaching how to read the micrometer. Results showed: 1) Learning increased consistently with a greater number of examples, whether the examples were given in the film itself or in the supplementary instruction; 2) giving further supplementary examples made a significant improvement even after the number of examples in the original film had been doubled; 3) the rate of improvement decreased as the number of examples increased; 4) the more intelligent men benefited even more from the additional examples than did the less intelligent men.

192. McCoy, E.P. An Application of Research Findings to Training Film Production. Special Devices Center, ONR, Port Washington, L.I., N.Y., May 1955, Technical Report SDC 269-7-44.

Research findings from the Instructional Film Research Program were incorporated in a series of films on marksmanship to make them maximally effective. When tried, these films reduced training time, expenditure, and ammunition and considerably increased training effectiveness.

193. McHiven, M. The Effects on Learning of the Perceived Usefulness of the Material To Be Learned. Special Devices Center, ONR, Port Washington, L.I., N.Y., August 1955, Technical Report SDC 269-7-54.

A rating form and attitude scale were developed and tested to discover whether material that was perceived to be useful was learned better than material which was not. The three films used were entitled "Help Wanted", "Atomic Energy", "Know your Car." The results showed that the greater the usefulness or relevance of film material as perceived by the learner the greater will be his learning from that material. Also a reliable scale was developed which measures how useful or relevant material appears to the trainee.

194. Margolius, G. and MacCoby, H. "Methods of Combining Practice With Filmed Demonstration in Teaching Complex Response Sequences." Paper read at the American Psychological Association, 1955.

Optimum methods for combining filmed demonstration and practice in learning a lengthy, complex, serial, manual task were investigated. In all four experimental groups the learners saw the entire demonstration three times and practiced the entire mechanical assembly three times; what was varied was the timing of demonstration and practice used prior to the final test. The results indicated that when training was in accordance with theoretically prescribed demonstration and practice segments, or when demonstration and practice were lengthened during succeeding trials, performance of the task was optimum. When training segment length exceeded the theoretically prescribed length, test performance was lowered.

195. McTavish, C.L., Tratue, M.R., and Carpenter, C.R. Effect of Repetitive Film Showings on Learning. Special Devices Center, ONR, Port Washington, L. I., N. Y., November 1949, Technical Report SDC 269-7-12.

It was found that the repetition of a science film added significantly to learning, but that third or fourth showings were relatively ineffectual.

196. Maneval, R.V. "The Relative Value of Sound Motion Pictures and Study Sheets in Science Teaching." J. exp. Educ., 1939, 8, 39-43.

In this experimental comparison of the sound motion picture and study sheet methods, objective tests for immediate recall, delayed recall, and immediate recall after reteaching showed that pupils of higher mental ability tend to be taught more effectively by the study sheet method, the average group equally well by either method and pupils of lower mental ability more effectively by the sound film method.

197. Mercer, J. The Relationship of Optical Effects and Film Literacy to Learning From Instructional Films. Special Devices Center, OAR, Fort Washington, L. I., N. Y., November 1952, Technical Report SDC 259 7-34.

Optical effects such as fades, dissolves, and wipes increase film production time and expense. This work was undertaken to determine whether producers are consistent in their use of these effects and whether the techniques aided learning from films. The results indicated that: 1) Optical effects in a film did not aid factual learning; 2) film viewers attached no specific meaning to specific optical effects; 3) other cues in the picture and sound track were the deciding factors in interpreting optical effects to indicate transitions; 4) producers were found to be inconsistent in their use of optical effects.

198. Michael, D.N. and MacCoby, N. Some Factors Influencing the Effects of Audience Participation on Learning From a Factual Film. Human Resources Research Laboratory, Headquarters Command, USAF, Bolling AFB, Washington, December 1951, HRRL Memorandum Report 13A (revised).

Assessed the relative contributions of practice and motivation factors to the increased teaching efficiency of film showings which use a participation procedure. In addition, three experimental conditions were studied which were expected to affect the level of learning. Within the conditions of the experiment, audience participation procedures utilizing either covert or overt practice with the provision of correct responses (feedback) were found to result in considerable improvements in learning verbal material. "This increase in learning seems to be due primarily to the effects of practice and not to the effects of changes in motivation to learn. The most important factor influencing the learning was the provision of knowledge of the correct response after practice (feedback)."

199. Michael, D.N. and MacCoby, N. "Factors Influencing Verbal Learning From Films Under Varying Conditions of Audience Participation." J. educ. Psychol., 1953, 45, 411-418.

A film was interrupted four times to permit practice in answering questions based on the preceding section of film. On the test which

followed there were no differences between subjects who had written out answers during practice and subjects who had been instructed to "think" the correct answer. The participation subjects were superior to groups without any kind of practice. Knowledge of results was the most important variable that differentiated between the different conditions of presentation, subjects informed of the answers to practice questions being superior on the final test.

200. Murnin, J.A., Hayes, W., and Harby, S.F. The Daylight Projection of Film Loops as the Teaching Medium in Perceptual-Motor Skill Training. Special Devices Center, ONR, Port Washington, L.I., N.Y., May 1952, Human Engineering Report SDC 269-7-25.

The conclusions of the authors were: 1) Film-taught groups learned skills without an experienced instructor, 2) live instruction is superior to film instruction (the advantage could be attributed to coaching), 3) using film loops, instructors with a minimum amount of training and experience can teach skills effectively.

201. Nelson, H.E. and Moll, K.R. Comparison of the Audio and Video Elements of Instructional Films. Special Devices Center, ONR, Port Washington, L.I., N.Y., November 1950, Technical Report SDC 269-7-18.

Designed to compare the relative effectiveness of the audio and video elements in instruction films. The investigators found that learning, in addition to accruing from the presentation of a film as a whole, accrued from presentation of either the audio or video alone, but neither element was consistently better than the other. The relative effectiveness seemed to depend on the particular film and its content.

202. Nelson, H.E. and VanderMeer, A. W. The Relative Effectiveness of Differing Commentaries in an Animated Film on Elementary Meteorology. Special Devices Center, Port Washington, L.I., N.Y., June 1955, Technical Report SDC 269-7-43.

The sound track of a film on elementary meteorology, "The Weather," was modified in a number of ways with stress on simplifying the commentary and increasing the personal pronouns. Only small changes in over-all learning resulted

from rearranging the wording and reorganizing the commentary while keeping the same visual content. The investigators also report that this study confirms the results obtained previously that the sound track contributes a much larger share to learning than does the visual element.

203. Neu, D.M. The Effect of Attention Gaining Devices on Film Mediated Learning. Special Devices Center, ONR, Port Washington, L.I., N.Y., March 1950, Technical Report SDC 269-7-9.

No added effectiveness was found for the insertion of attention-getting sound or visual devices in a training film. The author reported some evidence that irrelevant devices may detract from film teaching effectiveness.

204. Northrop, D.S. Effects on Learning of the Prominence of Organizational Outlines in Instructional Films. Special Devices Center, ONR, Port Washington, L.I., N.Y., October 1952, Human Engineering Report SDC 269-7-33.

The addition of audio and visual outline material was found to increase film effectiveness for subjects of lower intelligence. A detailed outline was no more effective than an outline stressing the salient points.

205. O'Connor, V.J. "An Examination of Instructional Films for Characteristics of an Effective Teaching Presentation." Harv. Educ. Rev., 1950, 20, 271-284.

Educational sound motion pictures were evaluated with respect to 1) The amount of information retained by children viewing them and 2) ratings by experimental educators. Of 21 film characteristics, 10 showed coefficients of .35 or higher with either recall scores or committee ratings as the standard. Intercorrelations of seven significant elements of the film analysis showed three groups of related measures. The results support the conclusion that an effective teaching presentation is characterized by "iconicity," or the use of communication signs with universally accepted referents, and "salience," or presentation in a fashion that provokes a response from the student.

206. Radlow, R. The Relation of Some Measures of Ability to Measures of Learning From Sound Motion Pictures. Special Devices Center, ONR, Port Washington, L.I., N.Y., September 1955, Technical Report SDC 259-7-58.

Designed to discover the relationship of various mental abilities to learning from films. The results indicated that high verbal comprehension, general reasoning, and spatial orientation were characteristics of superior film learners.

207. Rimland, B. Effectiveness of Several Methods of Repetition of Films. Special Devices Center, ONR, Port Washington, L.I., N.Y., May 1955, Technical Report SDC 259-7-45.

Several methods of repeating film demonstrations were compared for a simple knot-tying task. The results showed that: 1) More learning occurred when a single demonstration was repeated than when an equivalent number of different demonstrations was given; 2) a motor skill learned from one vantage point can best be performed when the vantage point of performance is the same; 3) in this fairly simple task practice between repetitions of the film did not improve learning.

208. Roskal, S.M. Effects of Learner Representation in Film Mediated Perceptual Motor Learning. Special Devices Center, ONR, Port Washington, L.I., N.Y., December 1949, Technical Report SDC 259-7-5.

Exploratory study of some degrees and kinds of realism in sound-film-mediated learning of a perceptual motor skill. The study showed that when a task was presented to subjects on the screen from the vantage point of the learner performing the task, more learning resulted than when the task was presented on the screen from the vantage point of the subjects watching a demonstrator. Also it was shown that the use of action or "motion" in training films results in important learning gains over the representation of the task in still or static form.

209. Saul, E.V. et al. A Review of Literature Pertinent to the Design and Use of Effective Graphic Training Aids. Naval Training Devices Center, Special Devices Center, ONR, Port Washington, L.I., N.Y., February 1956, Technical Report SDC 494-08-1.

Presents annotated reviews of the literature bearing on the problem of developing standards

and criteria in the design, preparation, and utilization of effective graphic training aids. These reviews were to serve as a preliminary basis for the formulation of principles of design and utilization of graphic training aids. The areas covered by this report are 1) vision, 2) perception, aesthetics, and art, 3) audio-visual education, 4) advertising, 5) engineering graphics, 6) graphic training aids, 7) instructor utilization.

210. Scollon, R.W., Jr. The Relative Effectiveness of Several Film Variables in Modifying Attitudes: A Study of the Application of Films Influencing the Acceptability of Foods. Special Devices Center, CRR, Port Washington, L. I., N.Y., June 1950, Technical Report SDC 209-7-50.

An attempt to define and manipulate motion picture variables considered to be related to the effectiveness of films in restructuring trainee attitudes toward certain foods thereby making the foods more acceptable. Results indicated that the communicator in such a film should be an influential figure rather than an anonymous narrator, and that he should have a high degree of relationship to the audience.

211. Smith, H.A. "The Relationship Between Intelligence and the Learning Which Results From the Use of Educational Sound Motion Pictures." J. educ. Res., December 1949, 43, 241-249.

A review of previous research in this area and a description of two studies. On the basis of data from these studies the author felt there was a positive relationship between intelligence and learning from educational sound films as measured by the tests used, and that the difference is independent of the methods of instruction. The positive correlations though not significant, appeared to the author to be conclusive evidence that bright children learned more of the information demanded by the five tests employed than did dull children.

212. Smith, H.A. "Intelligence as a Factor in the Learning Which Results From the Use of Educational Sound Motion Pictures." J. educ. Res., 1952, 45, 249-261.

Reports data obtained by the University of Nebraska in an educational motion picture program. Data yielded little evidence to indicate that the use of motion pictures in the classroom greatly affects the ranking of students with respect to the amount which they learn. The data also showed that bright students profited more than dull students with respect to actual learning as measured by tests.

213. Staudohar, F.T. and Smith, R.G., Jr. The Contribution of Lecture Supplements to the Effectiveness of an Attitudinal Film. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., 1955, Technical Note AFPTHC TR 55-82.

Designed to find out the effect of brief lecture supplements to a film on expressed attitudes toward military discipline. The effects of such a lecture, at the beginning, at the end, or at both the beginning and the end of the film were compared with no lecture at all. The results showed that airmen who heard one of the lectures with the film expressed more favorable opinions concerning military discipline than those who had seen the film without a lecture. No one lecture was more effective than any other.

214. Stein, J.J. The Effect of a Pre-Film Test on Learning From an Educational Sound Motion Picture. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1952, Human Engineering Report SDC 259-7-35.

Designed to discover the effect of testing the audience before the film showing with and without immediate knowledge of results. When the specific items to be learned were given with knowledge of results before the film showing, more learning and retention resulted than from the film showing alone. The content of the pre-film test should be identical with what is to be learned to have optimum effect.

215. VanderMeer, A. W. "The Economy of Time in Industrial Training: An Experimental Study of the Use of Sound Films in the Training of Engine Lathe Operators." J. educ. Psychol., 1945, 35, 55-90.

An experimental study of the use of sound films in the training of engine lathe operators. It was concluded that insofar as learning problems of other operators are similar to those of the lathe trainees, time can be saved in the training periods of machine operators by using motion pictures.

216. VanderMeer, A. W. Relative Effectiveness of Color and Black and White in Instructional Films. Special Devices Center, ONR, Port Washington, L.I., N.Y., June 1952, Technical Report SDC 269-7-28.

The author found that where color is not relevant to the material being presented, use of color does not increase film effectiveness.

217. VanderMeer, A. W. and Cogswell, J. Instructional Effect of the Film "How to Operate the Army 16mm Sound Projector set". Special Devices Center, ONR, Port Washington, L.I., N.Y., September 1951, Technical Report SDC 259-7-29.

Designed to determine whether a complex skill such as operating a motion picture projector could be taught by film. When a film was used to teach men to operate a JAN projector, training scores of 62 per cent to 92 per cent were obtained; this was an increase of 37 per cent to 62 per cent over pre-film scores. The men learned more when they were told exactly what they were to learn from the film. More was learned when a film was shown twice rather than once.

218. VanderMeer, A. W., Trabue, M. R., and Carpenter, C. R. Relative Effectiveness of Instruction By: Films Exclusively, Films Plus Study Guides and Standard Lecture Methods. Special Devices Center, ONR, Port Washington, L.I., N.Y., July 1950, Technical Report SDC 259-7-13.

It was found that there were no reliable differences in learning among classes of ninth grade general science students who were instructed by 1) 44 sound films, 2) 44 sound films plus study guides, and 3) usual methods. The films reduced instructional time by 20 per cent.

219. VanderMeer, A.W. Effects of Film Viewing on Learning From Instructional Films. Special Devices Center, ONR, Port Washington, L.I., N.Y., November 1951, Technical Report SDC 259-7-20.

The question tested was whether prior experience in viewing 44 films on general science topics would increase the ability of a group of high school students to learn from four additional films on general science. Three different teaching methods (the 44 films as the only means of instruction, the 44 films with study guides, and the conventional method) were used. The author found that, when the students were shown additional science films, "even unguided practice in viewing films (as represented by the films-only group) results in improvement of the groups' ability to learn from other films in the same subject matter field."

220. Vernon, P.E. 'An Experiment on the Value of the Film and Film Strip in the Instruction of Adults.' Brit. J. educ. Psychol. 1946, 16, 149-162.

Contrasted the effectiveness of the film and film strip with conventional methods in training 774 naval recruits in the elements of seamanship. Percentage improvement, especially in comprehension score, was greatest in the film strip classes. Addition of the film caused considerable improvement in both the control and film strip groups. Of the techniques, the film was probably the most effective considering the shorter time required for presentation.

221. Vincent, W.S., Ash, P., and Greenhill, L.P. Relationship of Length and Fact Frequency to Effectiveness of Instructional Motion Pictures. Special Devices Center, ONR, Port Washington, L.I., N.Y., November 1949, Technical Report SDC 269-7-7.

Designed to determine the effect on learning of varying the amount of factual information in a film of a given length and the length of time allotted to conveying a fixed amount of information. Testing three different populations (12th grade high school students, Air Force basic trainees, and college students), the investigators found that the "best" version (Long-Heavy, Long-Light, Short-Heavy, Short-Light) differed from population to population. The authors concluded that "packing more and more information into a film yields only very slight increments in total measured learning."

222. Witty, P.A. and Goldberg, S. 'The Use of Visual Aids in Special Training Units in the Army.' J. educ. Psychol., 1944, 35, 82-90.

This non-evaluative article describes the visual aids used in a unit of the Army which gives special training to illiterate, non-English-speaking and educationally retarded soldiers. Among the aids used were flash cards (used to teach words, phrases, and sentences), training films, film strips, pictures for bulletin boards, posters, cartoons, maps, diagrams, and charts (for parts of weapons, gas masks, etc.), objects, and models (such as sound tables).

223. Yale Motion Picture Research Project. 'Do Motivation and Participation Questions Increase Learning?' Educ. Screen, 1947, 26, 256-259, 274-283.

This study of the effect of questions inserted in an instructional film showed that the questions helped facilitate learning, and that writing answers to the questions presented was also effective in helping the student learn from a biological film.

224. Zuckerman, J.V. Commentary Variations: Level of Verbalization, Personal Reference, and Phase Relations in Instructional Films on Perceptual Motor Tasks. Special Devices Center, ONR, Port Washington, L.I., N.Y.; December 1949, Technical Report SDC 269-7-4.

The author states that a medium level of verbalization seems most effective. (Level of verbalization is defined roughly in terms of the number of words used to describe a particular shot.) He also found that verbal commentary preceding a film was slightly superior to commentary following the film.

II. Training Aids. (cont'd)

B. Television

1. General

225. American Council on Education. Teaching by Closed Circuit Television. American Council on Education, Washington, D.C., 1956.

A conference, sponsored jointly by the Committee on Television of the American Council on Education and the State University of Iowa, which explored the role of closed circuit television in utilizing the experienced and outstanding teacher, accelerating the learning process, and widening course offerings. There are reports on the different types of experimentation at institutions engaged in full-scale television teaching programs as well as experiments on a smaller scale.

226. American Psychological Association. Amer. Psychol. (Entire issue), October 1955, 10, No. 10.

Devoted to television and its role in education. Among articles included are: "The Proper Study for TV is Man," "Television and the Teacher," "The Role of Closed-Circuit Television in University Resident Instruction," "Psychological Research Using Television," "Some Thoughts on Television as an Educational Tool."

227. Research and Development Board. Symposium on Television Training and Training Research. Committee on Human Resources, Research and Development Board, Washington, 10-11 December 1952, Report HTD 210.

Papers are presented on educational television in the United States; fundamentals of TV; TV at the Special Devices Center; survey of developments in education; TV utilization at Michigan State College; utilization of theater TV; TV utilization in the Army, Navy, and Air Force; civilian broadcast TV research; Army and Navy military TV research; and implications for training and research.

228. Fritz, M.F. et al. Survey of Television Utilization in Army Training. Special Devices Center, ONR, Port Washington, L.I., N.Y., December 1952, Human Engineering Report SDC 530-01-1.

Intended to interpret previous findings and experiences in terms of direct application to Army training problems, and to fill in, when necessary, gaps in the available information.

229. Jackson, R. Visual Principles for Training by Television. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1952, Technical Report SDC 20-TV-2.

One hundred and five training devices made by the Special Devices Center were tested for visibility on television. Twenty-six devices gave a highly understandable TV image; 26 were extremely difficult to see on the TV receiver. Both kinds of devices were studied to identify aspects of design causing these results. Out of the study came 31 principles to ensure an understandable TV image for training devices and training material. These principles are discussed.

230. Naval Training Device Center. Instructional Television Research Reports. Naval Training Device Center, Special Devices Center, ONR, Port Washington, L.I., N.Y., June 1956, Technical Report NAVTRADEVCEM 20-TV-4 or NAVEXOS P-1544.

Combines and summarizes Naval Training Device Center reports showing areas for successful application of television to training and areas requiring further research. Included are six experimental studies on the use of television for military training, a survey of television utilization in Army training, and a summary of the fundamentals of training by television.

231. Naval Training Device Center. "Fundamentals of Training by Television," Instructional Television Research Reports, Naval Training Device Center, Special Devices Center, ONR, Port Washington, L.I., N.Y., June 1956, Technical Report NAVTRADEVCEM 20 TV-4 or NAVEXOS P 1544.

Description of the present status of the development of television for military training purposes. Trends exhibited by commercial,

industrial, and educational television as well as military television are considered. Conclusions are based on experimental evidence, and the experience of the Special Devices Center and other military television projects; of commercial, industrial and educational television, and of The Pennsylvania State College and other film research projects applicable to television.

232. Newsom, C.V. (ed.) A Television Policy for Education. American Council on Education, Washington, D.C. 1952.

The report of the Television Programs Institute at Pennsylvania State College under the auspices of the American Council on Education. Participating were operators of TV stations, representatives of public schools and colleges that pioneered in TV classroom instruction, engineering specialists, legal counselors, leaders from the television industry, and other specialists. This volume reports the experiments and experiences of the participants.

233. Special Devices Center. Equipment Studies I of the Television Studio-Laboratory. Special Devices Center, ONR, Port Washington, L.I., N.Y., undated, NAVEXOS P-979.

Presents a history and general description of the Special Devices Center television studio-laboratory, with a listing and description of the major pieces of equipment.

B. Television

2. Experimental Research

234. Boehm, W.R. Report of an Evaluation of the US Naval Academy Educational Television System. Department of Electrical Engineering, U.S. Naval Academy, Annapolis, Md., 1954.

A general evaluation of television as utilized at the Naval Academy. This study, in agreement with previous studies in this area, reported that students were as efficiently taught by television as by lecture methods.

235. Hurst, R.M., Jr. Relative Effectiveness of Verbal Introductions to Kinescope Recordings and Training Films. Special Devices Center, ONR, Port Washington, L.I., N.Y., May 1955, Technical Report SDC 269-7-42.

Certain instructions given prior to a film showing have been shown to increase learning (SDC 20-TV-1 and SDC 269-7-24.) This study was made to check training effectiveness of television and kinescope recordings now that they were no longer believed to be novelties. It was seen that trainees learned about the same amount from a film whether they were told that it was a kinescope or a film. The authors felt that apparently the novelty of kinescopes no longer stimulated trainees to greater learning.

236. Husband, R.W. "Television Versus Classroom for Learning General Psychology." Amer. Psychol., 1954, 9, 181-183.

In agreement with other studies, the results indicated that students learn as much from television as from a lecture. Also, that groups trained by television and by live instruction learned equivalent amounts with less time required for television instruction.

237. Jackson, R. Learning From Kinescopes and Films. Office of Naval Research, Special Devices Center, ONR, Port Washington, L.I., N.Y., April 1952, Technical Report SDC 20-TV-1.

It was concluded that when a kinescope or a standard training film is described as a kinescope, learning increases significantly. The superior learning resulting from describing the film as a kinescope occurs whether or not the presentation is in color.

238. Kanner, J.H., Runyon, R.P., and Desiderato, O. Television in Army Training: Evaluation of Television in Army Basic Training. Human Resources Research Office, The George Washington University, Washington, November 1954, Technical Report 14.

The investigators sought to obtain basic information on the comparative teaching effectiveness of television and the Army's regular basic training instruction. The results of this experiment indicated that: 1) TV instruction was at least as effective as regular instruction; 2) it was more effective for lower aptitude groups than for higher aptitude groups; 3) TV instruction was remembered at least as well as regular instruction; 4) kinescopes were as effective as regular instruction. When kinescopes were used for review purposes following initial instruction the scores were significantly higher than the scores obtained after initial instruction; the test scores of low-aptitude trainees receiving the kinescope review approached those of high-aptitude groups following initial instruction.

239. Rock, R.T., Jr., Duva, J.S., and Murray, J.E. The Effectiveness of Television Instruction in Training Naval Air Reservists. Special Devices Center, ONR, Port Washington L.I., N.Y., April 1951, Technical Report SDC 476-02-52.

The effectiveness of television and of kinescopes was compared to the usual lecture method, using both enlisted men and officers in the experimental groups. The results showed that: 1) Television is an effective means of conveying instruction to classes at widely separated stations; 2) for both officers and enlisted airmen, television instruction was found to be more effective than was teaching by local instructors in half of the comparisons made, and it was equally effective in an additional one-fourth; 3) recordings of instructional telecasts were extremely effective when projected as sound moving pictures.

240. Rock, R.T., Jr., Duva, J.S., and Murray, J.E. A Study of Learning and Retention From Television Instruction Transmitted to Army Field Force Reservists. Special Devices Center, ONR, Port Washington, L.I., N.Y., May 1951, Technical Report SDC 476-02-53.

The results of this study of learning and retention from television instruction transmitted to Army Field Force reservists showed that: 1) Television is

an effective means of training large numbers of reservists in widely separated groups; 2) reservists remembered most of what they had learned from television instruction when re-tested four or six weeks later; 3) the amount of gain on test items is related to the explicitness of treatment of the topics on which the items are based; 4) the type of instructional treatment given a topic influences learning effectiveness (in descending order, narration with meaning-conveying film, drama with some form of narration, narration with "atmospheric" film, drama.)

241. Stover, R.E. and Tear, D.G. Evaluation of Two Kinescopes. Special Devices Center, ONR, Port. Washington, L.I., N.Y., October 1953, Technical Report SDC 269-7-38.

Designed to compare the value, as training media, of two kinescopes and conventional training films. The investigators concluded, within the limits of the methods used, that two kinescopes were at least as effective in communication of information as the average training film studied by the Instructional Film Research Program.

C. Other Training Aids

242. Cook, D.C., and Menzek, C.L. "The Effectiveness of Teaching by Radio." J. educ. Res., 1939, 33, 105-110.

The achievements of two equated groups of 150 children each, attending the eighth and ninth grades were compared. One group listened to 15 educational programs broadcast by a local radio station, while the second group was taught the same lessons but was not allowed to listen to the broadcasts. The results indicated that materials taught by the radio method were retained at least as well as those taught in the regular classroom situation.

243. Jensen, B.T. "An Independent Study Laboratory Using Self Scoring Tests." J. educ. Res., 1949, 43, 134-137.

In this study of self-scoring tests, the author found that when the student was able to "find" the right answer at the time of taking the test, learning was facilitated.

244. Lefkowitz, E.F. The Validity of Pictorial Tests and Their Interaction With Audio-Visual Teaching Methods. Special Devices Center, ONR, Port Washington, L.I., N.Y., August 1955, Technical Report SDC 269-7-49.

Pictorial tests were studied to discover how accurately they should simulate the actual equipment that would be used in a performance test. The results showed that: 1) The more nearly pictorial tests resemble the object they represent, the better they measure learning; 2) test scores will be highest when the pictorial teaching aid is similar to the pictorial tests (slide or motion picture tests); 3) there is a practical limit beyond which increased reality in a pictorial test will not result in increased validity.

245. Vernon, H.D. "Learning From Graphic Material." Brit. J. Psychol., 1946, 36, 145-158.

Two sets of numerical data, on vital statistics and on the British war effort, were presented graphically (in graphs and pictorial charts) to subjects who were then required to recall the information given. The author said that understanding and remembering these data depended on

ability to 1) interpret graphical material, 2) understand and use language efficiently, 3) generalize from particular sets of factual data to general statements, and 4) think relevantly and not be swayed by preconceived and emotionally toned opinions.

246. Vris, T. A Comparison of Principles Training and Specific Training Using Several Types of Training Devices. Special Devices Center, OAR, Port Washington, L.I., N.Y., July 1955, Technical Report SDC 269-7-102.

Designed to determine whether three-dimensional training aids might not be used to advantage to teach motor skills. It was believed that teaching the general principles of performing the skill might be more effective than teaching the specific operations. For a complex motor skill it was found that: 1) a three-dimensional model and the actual equipment were equally effective and each is better than the two-dimensional aid; 2) when the task must be performed on other related equipment it is better to teach principles rather than specifics; 3) principles training and specifics training were equally effective methods of instruction when two-dimensional aids were used.

247. Washburn, J.N. "An Experimental Study of Various Graphic, Tabular, Textual Methods of Presenting Quantitative Material." J. educ. Psychol., 1927, 18, 351-376, 465-476.

Reports the results of an objective measurement of the effect upon several thousand junior high school children of various arrangements of quantitative material. The author found that the three methods tested each had their advantages and disadvantages and that each should be used in its own special place: Textual = most favorable to recall of quantitative data; Bar Graph = most favorable to recall of relative amounts; Line Graph = most favorable to recall of increase, decrease, and fluctuation.

248. Witty, P.A., and Goldberg, S. "The Use of Visual Aids in Special Training Units in the Army." J. educ. Psychol., 1944, 35, 82-90.

Discusses the use of training aids such as flash cards, training films, film strips, charts, and maps, at Special Training units, where illiterate, non-English speaking, and educationally retarded men receive instruction before regular basic military training.

B. Single Source References on Audio-Visual Materials and Techniques

249. Beecroft, R.S. The Effectiveness of Different Training Methods in School Situations. Training Methods Division, Human Resources Research Office, The George Washington University, Washington, September 1955, Staff Memorandum.

Reviews the results of objective investigations of the effectiveness of different training methods in school situations. In all cases the instructional aim was to inform the subjects of facts or principles in some subject matter. The review is primarily from the literature on training methods since 1940.

250. Brown, J.W. and Vandermeer, A.W. "School Use of Audio-Visual Instructional Materials." Audio-Visual Materials of Instruction: 48th Yearbook, Part I, National Society for the Study of Education, Chicago: University of Chicago Press, 1949.

A discussion of audio-visual materials and learning experiences, integration of audio-visual instructional material with the school curriculum, present practices in the use of audio-visual instructional materials in the schools, encouraging trends, and some deterring factors.

251. Dale, E. Audio-Visual Methods in Teaching. New York: Dryden Press, 1946.

A survey of both the practical and the theoretical aspects of audio-visual education. The four parts of this book are entitled: 1) Theory of Audio-Visual Materials, 2) Audio-Visual Teaching Materials, 3) Audio-Visual Methods Applied in the Classroom, 4) Audio-Visual Methods Applied in the School System.

252. Dale, E., Finn, J.D., and Hoban, C.F., Jr. "Research on Audio-Visual Materials." Audio-Visual Materials of Instruction: 48th Yearbook, Part I. National Society for the Study of Education, Chicago: University of Chicago Press, 1949.

Included are chapters on 1) general aspects of research, 2) audio-visual materials in World War II, 3) instructional motion pictures, 4) theatrical motion pictures, 5) field trips, 6) still pictures, filmstrips, and lantern slides, 7) museum materials, 8) graphic materials, and 9) radio and recordings.

253. De Kieffer, R. and Cochran, L.W. Manual of Audio-Visual Techniques. Englewood Cliffs, N.J., Prentice-Hall, 1955.

Organized to provide all necessary information on appropriate audio-visual materials and techniques and to give a step-by-step practical guide to effective use of most audio-visual materials and techniques. The techniques are not limited to materials as such but extend to evaluation procedures, organization, and preparation.

254. Exton, W. Audio-Visual Aids to Instruction. New York: McGraw-Hill, 1947.

A description of the work done by the armed services during World War II in the area of audio-visual aids to instruction. Included are chapters on 1) aids to training, 2) projected training aids, 3) graphic training aids, 4) sound training aids, 5) three-dimensional training aids. (Special attention is given to the work done by the Navy in this area.)

255. Hoban, C.F., Hoban, C.F., Jr., and Zisman, S.B. Visualizing the Curriculum. New York: Dryden Press, 1937.

A general introductory text on audio-visual aids, containing bibliographies at the end of each chapter. Graphic training aids are classified in seven categories: illustrations, cartoons, posters, maps, charts, graphs, and diagrams. The authors believe that seeing is a process of selection; when seeing turns to observation, selection is based on a pattern determined by differentiation of forms and shapes, color separation, and evaluation of relationships. Graphic materials are the result of this process.

256. Kinder, James. Audio-Visual Materials and Techniques. New York: American Book Company, 1950.

An attempt "to bring together the best modern theory and practice in the use of the newer and more varied instructional materials." Each is treated functionally and practically. The volume is arranged in four parts: introduction, visual materials, audio materials, and the organization and administration of an audio-visual program.

257. Kinder, J.S. and McCluskey, F.D. The Audio-Visual Reader. Dubuque, Iowa, William C. Brown Company, 1954.

Contained in this book are a number of articles on various aspects of audio-visual instruction, organized to give a comprehensive view of the field including basic assumptions and technical administrative procedures. Theoretical considerations of learning theory and effective communication are developed.

258. Larson, L.C. "Suggested Answers to Some Pertinent Questions in the Audio-Visual Field." Audio-Visual Materials of Instruction: 48th Yearbook, Part I. National Society for the Study of Education, Chicago: University of Chicago Press, 1949.

Questions are answered by committees of experts and classes of persons working in the area of audio-visual materials. Among the answers given are those on the role of audio-visual materials in education, materials to be used, proper utilization, proper school preparation for the introduction of audio-visual materials, physical facilities needed, and proper administration and financial practices.

259. McCluskey, F.D. The A-V Bibliography. Dubuque, Iowa: William C. Brown Company, 1955.

Presents, with short annotations, a comprehensive index of references that covers in great detail various areas of audio-visual instruction. Comprehensive references are given for the philosophy and psychology of teaching with audio-visual materials, for audio-visual teaching materials and their use, as well as for specific applications to elementary schools, secondary schools, and higher education.

260. Miles, J.R. and Spain, C.R. Audio-Visual Aids in the Armed Services. American Council on Education, Washington, 1947.

Intended to give an over-all review of the training aids program in the Army and Navy up to 1947. The study was designed to provide suggestions for those who wish to utilize the experience of the services in improving instructional programs through the use of audio-visual aids.

261. Noel, F.W. The Navy Turns to Training Aids. Educational Department, RCA Victor Division, Radio Corporation of America, Camden, N.J., 1944.

Contains three articles: "Getting Underway," which describes the beginning of the Navy training aids program and the influence of civilian education in its development; "Full Steam Ahead," which describes the Navy's program of production, distribution, and utilization of training aids, particularly motion pictures; and a third article which develops 21 implications of the Navy's training aids program for civilian education.

262. Sands, L.B. Audio-Visual Procedures in Teaching. New York: Ronald Press, 1956.

Presents a critical analysis of particular audio-visual aids, describes the necessary equipment, and relates such aids to the entire teaching process. "It could be used as a text for special training courses for teachers in service, as a reference to sources of all types of audio-visual materials, and also as a tool for technical and general information," Contemporary Psychology reported.

263. U. S. Office of Education. Use of Training Aids in the Armed Services. United States Office of Education, Federal Security Agency, Washington, 1945, Government Printing Office Bulletin.

A description of the scope, objectives, and pattern of military training and the use of training aids and devices in the armed services.

264. U. S. War Department, Military Training Aids. Washington: Government Printing Office, 1945, Basic Field Manual FM 21-8.

Describes the graphic portfolios, charts, posters, medals, devices, and general displays which Army instructors were able to procure or make for training purposes. Suggestions for local production and effective use are included.

265. Wendt, P. "Postwar Implications for Education in the Audio-Visual Programs of the Armed Services." Educ. Screen, XXIII April 1944, 23.

Describes the planning and production of visual aids, the utilization practices in the services, and some of the implications of the successful service program for civilian education.

266. Wittich, W.A. and Schuller, C.F. Audio-Visual Materials. New York: Harper and Brothers, 1953.

Contains a comprehensive survey of audio-visual materials that are available for classroom use. Included in this book are chapters on such aids as the chalkboard, flat pictures, globes and wall maps, educational recording, filmstrips, and sound motion pictures.

267. Witty, Paul A. "Some Uses of Visual Aids in the Army." J. educ. Sociol. December 1944, 18, 241-249.

Describes the following visual aids as they were used in the Army as of 1944: 1) the film strip, 2) the instructional film, 3) comics, cartoons, and pictures, 4) graphic portfolios, 5) maps, and 6) actual objects and models. Many of the illustrations were drawn from the use of visual aids in a training program designed for functionally illiterate and non-English speaking men.

III. Requirement and Evaluation Methodology

268. Beals, L.S., Jr. "The General Practice of Training." J. Aviat. Med., 1952, 23, 271-279.

Discusses the role of training devices in a training program, and some psychological principles that apply to the design and use of training devices.

269. Bellows, R.M., Estep, H.F., and Scholl, C.E. "A Tool for Analyzing Training Needs: the Training Evaluation Check List." Personnel, 1953, 25, 412-418.

A description of a tool for assessing a company's training needs rapidly and grading them by degree of urgency. The check list covers about 90 aspects of training. The development, final form, and results of use are presented.

270. Bureau of Naval Personnel. Special Devices. Bureau of Naval Personnel, January 1949, NAVPERS 10833.

A discussion of the work of the Special Devices Center and a description of the use of its devices in the field of naval training. The history, mission, and organization of the Special Devices Center are covered in the first chapters.

271. Covner, B.J. and Orlansky, J. Training Aids and Devices. Research and Development Board, Department of Defense, Washington, June 1951, HRM 200/1, Appendix 45.

Prepared for the working group on human behavior under conditions of military service, this pamphlet reviews research findings and principles pertaining to training aids and devices. Its purpose was to provide the armed forces with sound principles and recommendations for making effective use of training aids and devices in military training. The report is based upon studies of audio-visual materials which have been published in the educational, military, and industrial literature. It is also based upon the authors' personal experiences with training aids and devices in industry and education, and in military training during World War II.

272. Eckstrand, Gordon A. "A Human Factors Approach to the Design of Training Equipment." USAF, ATC Instructors J., 1954, 5, 145-151.

The aim was to develop systematic methods and materials for studying complex tasks and to make recommendations concerning trainer design. Consideration was given to selection of trainer tasks from the whole job, levels of proficiency proposed, assumptions about subjects' backgrounds, and instructors' skills needed, as well as ways to convey knowledge of results to motivate students.

273. Edgerton, H.A. and Fryer, D.H. The Development of an Evaluation Procedure of Training Aids and Devices. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1950, Technical Report SDC 383-2-1.

A method of systematizing and improving preliminary judgments of training value and effectiveness of training aids. This evaluation procedure covers a great variety of training aids, and includes the major factors and the details necessary for the valid evaluation of a training aid.

274. Edgerton, H.A. and Fryer, D.H. Phase I of Project 20-M-2: Development of Evaluation Procedures for Prototype Devices, Special Devices Center, ONR, Port Washington, L.I., N.Y., April 1950, Supplement I to Technical Report SDC 383-2-1.

The construction of preliminary forms of procedures for evaluating prototypes of training aids and devices led to the development of three forms, a Free-Answer form, with open end questions, a Checklist form, and a Factor Rating form consisting of seven scales for rating the device according to the different areas or factors of evaluation. The material used in these forms was obtained from a review of the literature, descriptions of Navy devices in use, evaluation of Navy devices, and a study of industrial training devices. The criterion score developed for use later in the validation was the result of the pooled nominations for the "best" and "worst" devices by a number of training officers and instructors.

275. Edgerton, H.A. and Fryer, D.H. Phase II of Project 20-M-2: Validation Field Study of Evaluation Procedures Research. Special Devices Center, ONR, Port Washington, L.I., N.Y., April 1950, Supplement II to Technical Report SDC 383-2-1.

Designed to test the validity of the three device evaluation procedures, the Free-Answer Procedure, the Check-List Procedure, and the Factor Rating Procedure, each as a whole and item by item, and to furnish a valid basis for the revision of the three experimental procedures. Using a priori scoring keys, the investigators rated the Free-Answer Procedure as having the highest validity when compared with the criterion ratings of over-all training effectiveness. The check list was next in validity, with the factor rating procedure yielding correlations only slightly lower. The authors felt that the first two procedures could be improved the most by using the data from this study as the basis for revision and for developing empirical scoring keys.

276. Edgerton, H.A. et al. How to Get More Out of Training Aids. Special Devices Center, ONR, Port Washington, L.I., N.Y., March 1952, Technical Report SDC 383-7-1.

Intended as a guide for determining the value and best use of training aids. Attention is also given to methods for determining requirements for training aids. The forms and procedures provided are based upon experience and research conducted at military training activities over a period of three years and are designed to examine training aids realistically in terms of actual instructor-trainee needs.

277. Edgerton, H.A., Heinemann, R.F.D., and Gray, E.J. Construction of the 1953 Form of the Evaluation Procedure for Training Aids and Devices. Special Devices Center, ONR, Port Washington, L.I., N.Y., January 1953, Technical Report SDC 383-2-2.

A description of the technical methodology used in developing the 1953 form of the evaluation procedure for training aids and devices, as well as of the form itself and of the scoring technique. The only characteristic evaluated is the teaching ability of a device; engineering and design characteristics are considered only where they had effect on the teaching situation.

278. Fryer, D.H. and Feinberg, M.R. A Guide for Determining Training Aid and Device Requirements. Special Devices Center, ONR, Port Washington, L.I., N.Y., May 1952, Technical Report SDC 383-04-1.

A method whereby a military activity can determine its requirements for training aids and devices. The procedure developed was found to be effective at Camp Lejeune in indicating the various aids and devices which should be incorporated into the curriculum.

279. Mead, L.C. Synthetic Training Devices. Research and Development Board, Department of Defense, Washington, June 1951, HRI 200/1, appendix 121.

Prepared for the Working Group on Human Behavior Under Conditions of Military Service, this report is a discussion of synthetic training devices on the basis of: Psychological principles regarding their design, development, and use; reviewing and appraising these presently known principles; comparing these principles with current service policies and practices and recommending action of both an administrative and a research nature so that the greatest value could be obtained from synthetic training devices.

280. Miller, R.B. A Method for Determining Human Engineering Design Requirements for Training Equipment. Wright Air Development Center, ARDC, Wright-Patterson, AFB, Ohio, June 1953, WADC Technical Report 53-135.

Three technical reports (ASTIA numbers AD-16 859, AD-15 921, AD-14 768) are summarized, and recommendations are presented which relate to the design and optimal use of training devices.

281. Miller, R.B. Handbook on Training and Training Equipment Design. Wright Air Development Center, ARDC, Wright-Patterson AFB, Ohio, June 1953, WADC Technical Report 53-136.

Intended to aid in preparation of recommendations on the design and use of training equipment. Sections included are: I. Human Learning--An Overview; II. The Role of the Instructor in Training; III. The Trainer as a Demonstrator of Principles; IV. The Use of Knowledge of Results; V. The Problem of

Simulation; VI. The Problem of Motivation; VII. Preparing Specifications for a Training Device. The author emphasizes that different kinds of tasks and different degrees of learning have different implications for transfer of training and for the best form of presenting knowledge of results.

282. Miller, R.B. Suggestions for Short Cuts in Task Analysis Procedures. American Institute for Research, Pittsburgh, December 1954.

This report is the result of a study into methods for reducing the time and effort expended in task analysis preparatory to making design recommendations for training devices. Following a discussion of task analysis, a set of conclusions and recommendations are presented. (See also Miller, R.B., A Method for Man-Machine Task Analysis. WADC TR 53-137.)

283. Miller, R.B. A Method for Man-Machine Task Analysis. Wright Air Development Center, Wright-Patterson AFB, Ohio, 1953, WADC Technical Report 53-137.

A procedure for making a task analysis of the operator's job in a man-machine system is presented for use in planning for training and training equipment. The operator is treated as a part of the total system from input to output; the information supplied to the operator and control actions are analyzed into discrimination and response requirements respectively.

284. Miller, R.B. Human Engineering Design Schedule for Training Equipment. Wright Air Development Center, ARDC, Wright-Patterson AFB, Ohio, June 1953, WADC Technical Report 53-138.

Considerations are presented in design schedule form for the design and function of a proposed or actual training device. These considerations are applicable during the initial planning, specification, prototype, or production-model stages of trainer development.

285. Miller, R.B. Psychological Considerations in the Design of Training Equipment. Wright Air Development Center, ARDC, Wright-Patterson AFB, Ohio, December 1954, WADC Technical Report 54-563.

Presents considerations and recommendations for trainer design under the following headings:

I. Some Principle Concepts in Learning and Transfer of Learning; II. Problems of Physical Simulation; III. Stage of Learning and Degree of Physical Simulation; IV. Knowledge of Results and Scoring; V. Recording Procedures; VI. Proficiency Measurement; VII. The Design of the Instructor's Station; VIII. The Trainer as a Demonstrator of Principles; IX. Outline of Steps in Designing a Training Device.

286. Pitt, D.L. "Consideration in the Research and Development of Trainers and Simulators." ATC Instructors J., 1954, 5, 95-102.

Increasing use and appreciation of simulators is given credit for economy in flying hours, lower accident rate, improved quality of combat crews, supervisory training under emergency conditions, and financial savings. The simulator is a complement, not a substitute for flying. Development of a simulator should be timed as a part of the whole weapon program to be ready for use with each new model.

287. Special Devices Center. Special Devices Guide. Special Devices Center, ONR, Port Washington, L.I., N.Y., February 1953, NAVEXOS P-530-1, (Supersedes NAVEXOS P-530).

A guide to the training aids and devices available from the Special Devices Center. Included is information on how to request existing devices and how to request the development of new devices.

288. Special Devices Center. Evaluation Procedure for Training Aids and Devices 1953 Form. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1953, NAVEXOS P-1090.

Constructed to provide a quick method for determining the effectiveness of a training aid or device and whether the device should be modified, used

differently, or abandoned. This form was tested on a wide variety of training aids and found to be useful for the variety studied. It does not apply to films, slides, projectors, charts, blackboards, or similar training aids.

289. Swain, A.D. Guide for the Design and Evaluation of the Instructor's Station in Training Equipment. American Institute for Research, Pittsburgh, Pa., December 1954, WADC Technical Report 54-564.

Design to provide procedures for the collection of data on the design of the instructor's station and to provide a guide in the evaluation and design of existing or proposed instructor's station. The contents represent a human engineering and systems analysis approach to this area.

290. Swanson, R.A. A Survey of Research Problems in the Utilization of Mobile Training Units. Human Resources Research Center, ATC, Lackland AFB, Tex., 1951, HRRC Research Bulletin 51-6.

Semi-structured interviews were conducted with some 250 Air Force personnel to determine what aspects of mobile training could be increased in effectiveness. The survey records administrative problems and recommends future research on defining and isolating factors which lead to greater effectiveness of training devices used in conjunction with classroom lectures.

291. Viteles, M.S. Psychological Principles in the Design and Operation of Synthetic Trainers with Particular Reference to Antiaircraft Gunner. University of Pennsylvania, Philadelphia, 1945a, Memorandum 19. (Project N-105)

Discusses the psychological principles in the design, operation, and use of synthetic trainers with particular reference to antiaircraft gunnery. Appendix 1 presents evaluations and recommendations concerning the following synthetic antiaircraft gunnery training devices: mirror range estimation trainer, portable aiming teacher, multiple forward area sight trainer, Mark VI trainer, Mark II, model 1 and 2 trainers, Mark IV trainer, and the Mark 1 trainer.

292. Wolfle, D. The Use and Design of Synthetic Trainers for Military Training. Applied Psychology Panel, National Defense Research Committee, Office of Scientific Research and Development, Department of Defense, July 1946, OSRD Report 5246.

A summary of the psychological principles that should be observed in the design and use of trainers. The section headings in this report are the characteristics of good trainers, the use of trainers, advantages of trainers over real equipment, the evaluation of a trainer, and report on trainers experimentally studied or observed, or designed and built, by projects of the Applied Psychology Panel.

293. Woolman, M. A Method of Training Aids Selection. Air Training Command, McConnell AFB, Kan., December 1954, MCAF B TA&D 54-8.

Intended to present a student-oriented method of training aid selection and to provide a guide to efficient training aid selection. To orient all training aid selection to the student learning task, one must identify the student learning task, evaluate it, and relate it to the appropriate training aids. This method suggests that any kind of a learning task is best related to particular training aids.

294. Yarnold, K. and Orlansky, J. Special Training Devices. Research and Development Board, Department of Defense, Washington, 1951, HBM 200/1, Appendix 179.

Concerned with the use of display boards, mock-ups, instructional models, cut-aways, and synthetic trainers to increase the efficiency of training. There is discussion of the objectives of training, the time element in training, the contributions of training devices of various kinds, the design of the particular devices mentioned above, and recommendations for design and utilization.

IV. Basic Research and Its Applications

A. Basic Research With Application to Training Aids and Devices.

295. Ammons, R.B. "Effect of Distribution of Practice on Rotary Pursuit 'Hits'." J. exp. Psychol., 1951, 41,17-22.

Designed to determine the effects of distribution of practice early in rotary pursuit learning on number of hits, variability in number of hits, mean duration of hits, variability in mean duration of hits, mean duration of misses, and variability in mean duration of misses. It was concluded that the hit indices described differentiate clearly between performance during massed practice and during distributed practice.

296. Archer, E.J., Kent, G.A., and Mote, F.A. "Effect of Long Term Practice and Time on Target Information Feedback on a Complex Tracking Response." J. exp. Psychol., 1956, 51, 103-112. (Distributed separately as Research Report AFPTRC TN 56-102, August 1956.)

Undertaken to investigate changes in complex tracking performance over a relatively long training period of 50 sessions and the effect of a delayed feedback signal on this performance as measured by "time continuously on target." The results show that as extended practice on a modified B-29 pedestal sight continues, improvement in cumulative time-on-target performance results from a shift in the frequency distribution of duration of "hits." No differences in performance were found between the group that was given a feedback signal on their performance and those that were not. The authors suggest that a more sensitive measure of tracking skill can be provided by recording hit duration rather than simply a cumulative time on target score.

297. Bartlett, F. and Mackworth, N.H. Planned Seeing: Some Psychological Experiments. I. Visibility in the Control Rooms of Fighter Command. II. The Synthetic Training of Pathfinder Air Bombers in Visual Centering on Target Indicators. London: His Majesty's Stationery Office, 1950.

In the first part of this experiment evidence was obtained on role of viewing distance, viewing angle, light/dark contrast between object and background, and other factors determining the accuracy of reporting position, direction, and identity of aircraft visually displayed in the Section Operation rooms; in the second part, work of air bombardiers in aiming at an enemy target during high level bombing was analyzed, the target having been identified by a complex pattern of colored markers. A synthetic device was developed for training flying personnel to identify with greater accuracy the center point of the patches of colored light.

298. Bechtoldt, H.P. and Mager, R.F. Stimulus Presentation Devices for Use in Studies of Discrimination Abilities. Human Resources Research Center, ARDC, Lackland AFB, Tex., 1953, Research Bulletin 53-23.

Describes two pieces of apparatus designed for the measurement of certain aspects of human ability in tasks involving the learning or discrimination of a series of visual stimuli. The two devices are the Tape Reaction Time Unit and the Projector Reaction Time Unit, both of which make possible variations in the pacing of sequences of visual stimuli and the measurement of response latency as well as error made to each individual stimulus.

299. Bilodeau, E.A. A Further Study of the Effects of Target Size and Goal Attainment Upon the Development of Response Accuracy. Human Resources Research Center, ATC, Lackland AFB, Tex., 1952, Research Bulletin 52-7.

Previous studies have shown that in some training activities, allowing tolerances larger than those required in the field situation have little effect on the final proficiency. The results of this study

are in agreement with this prior research, and extend these findings to a wider range of tolerances and response situations.

300. Bilodeau, E.A. Recent Experiments on Knowledge of Results With Psychomotor Devices. Human Resources Research Center, Lackland AFB, Tex., December 1954, Research Bulletin AFPTRC TR 54-68.

Experimental results on skill acquisition have consistently shown that certain variations in 1) immediately discriminable target extent and location, 2) learned target extent and location, and 3) extra information--giving stimuli, are not attended by criterion differences in behavior at least over considerable ranges of the variable. This review suggests that skill can be acquired independently of its measurement and that some psychomotor training situations exist where the operator's knowledge of response measured is of no real consequence.

301. Bilodeau, E.A. Some Effects of Various Degrees of Supplemental Information Given at Two Levels of Practice Upon the Acquisition of a Complex Motor Skill. Human Resources Research Center, ATC, Lackland AFB, Tex., 1952, Research Bulletin 52-15.

Directed toward evaluating the effect of knowledge of results in training on the Pedestal Sight Manipulation Test. Neither azimuth nor elevation scores were improved. Ranging scores were improved only while knowledge of results was given. Later practice without knowledge of results showed that ranging scores were not essentially different for those men who had been trained with a knowledge of results when compared to these who had been trained in the usual way.

302. Briggs, G.E., Bahrick, H.P. and Fitts, P.I. The Influence of Force and Amplitude Cues on Learning and Performance in a Complex Tracking Task. Operator Laboratory, Air Force Personnel and Training Research Center, ARDC, Randolph AFB, Tex., 1957, Research Report AFPTRC TN 57-33.

The problem investigated was whether a training simulator needs to incorporate "feel control" characteristics identical with those found in the operation system, or whether these characteristics in the simulator can be radically changed and maximum training effectiveness in terms of performance on the operational system still be obtained. Four groups were studied:

Group 1 - no change in amplitude cues or force cues; Group 2 - force cues reduced $3/4$; no change in amplitude cues; Group 3 - amplitude cues reduced by $3/4$; no change in force cues; Group 4 - amplitude and force cues both reduced by $3/4$.

Training consisted of 60 40-second tracking trials. Following training, Groups 2, 3, and 4 transferred to the control column utilized by Group 1, and all four groups continued for an additional 30 trials. The score of tracking proficiency was the accuracy of tracking during the final three seconds of each 40-second run, measured as the amount of time the target was within $1/8$ inch of the center of the cathode-ray tube display. The results showed that Group 1 was significantly superior, and Group 2 slightly superior, to Groups 3 and 4 in tracking proficiency. There were no significant differences among groups during the first 10 transfer trials. "It can be concluded that a particular combination of force and amplitude cues in a control column may markedly improve performance level with such a tracking system. However, learning does not appear to be specific to the particular control used."

303. Briggs, G.E., Fitts, P.M. and Bahrick, H.P. Learning and Performance in a Complex Tracking Task as a Function of Visual Noise. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., June 1956, Research Report AFPTRC TN 56-67.

Investigated the effect of visual noise on the radar display of the E-4 fire-control system in the F-86D all-weather interceptor. Four groups of students in Air Force ROTC at The Ohio State University were trained in a simplified aircraft simulator which represented some of the over-all flight characteristics of the F-86D. Training consisted

of 100 intercept runs, each of 40 second duration. Performance at all stages was found to be markedly depressed by the presence of visual noise on the steering error dot. Performance at the end of the fourth day of practice dropped from 81 percent time on target for the no-noise group to 20 percent for the group with the highest noise level. However, at the end of training when all groups were transferred to the mixed noise condition, no significant difference was found in the performance of the different groups. "This indicates that, in spite of the marked performance differences, learning had progressed at approximately the same rate under the four different training conditions."

304. Brown, J.S. and Jenkins, W.O. "An Analysis of Human Motor Abilities Related to the Design of Equipment and a Suggested Program of Research." In P.M. Fitts (ed.) Psychological Research of Equipment Design, U.S. Government Printing Office, Washington, AAF Aviation Psychology Program Report 19.

An attempt to classify motor reactions into several fairly distinct types and to suggest experimental procedures and significant variables in each case. The scope of the treatment was restricted to the study of movements of the articulate members of the body. The complex motor activities were given no space; also not treated are the complex problems associated with the learning of skilled movements.

305. Carter, L.F. and Murray, N.L. "A Study of the Most Effective Relationships Between Selected Control and Indicator Movements." In P.M. Fitts (ed.) Psychological Research in Equipment Design, U.S. Government Printing Office, Washington, 1947, AAF Aviation Psychology Program Report 19.

Designed to investigate the relationship between the line of movement of the spot on the face of the oscilloscope and the axis of movement of two control knobs. Also studied was the relationship between the direction of display movement and the direction of rotation of the control knob. The

results suggested these hypotheses: 1) in a display-control relationship it is important to insure that the axis of movement of a rotary control is perpendicular to a line parallel to the line of movement of the display; 2) the relationship between the plane of movement of the display and the axis of the control movement will be effective only if there is also a proper relationship between the direction of movement of the control and the direction of movement of the display.

306. Cook, T.W. Similarity and Transfer. Defence Research Board (Canada), May 1954, Report HR-61.

Intended to present the writer's evaluation of the impact of the work of C.E. Osgood (paired associates verbal learning), R.M. Gagne (two-term motor learning), and F.C. Bartlett (construction of synthetic training aids) on the area of similarity and transfer. Included are summaries of each view, with areas of agreement and disagreement, a discussion of motor transfer and interference, and military implications and suggestions for further work.

307. Dexter, L.A. "On Teaching the Systematic Transfer of Training: An Attempt to Identify Procedures for the Investigation of Skills Common to the Social and Physical Sciences." Harv. Educ. Rev., 1949, 19, 127-141.

On the thesis that general education necessarily implies transfer of learning, the author attempted to demonstrate procedures for investigating and teaching transferable skills common to the social and physical sciences and to daily life. Emphasis was placed upon the teaching of method rather than fact. Illustrative of skills which can be taught in the social and physical sciences as transferable are 1) the systematic questioning of evidence, 2) statistical analysis and inference, and 3) "explanation."

308. Duncan, C.P. and Underwood, B.J. Retention of Transfer in Motor Learning After 24 Hours and After 14 Months as a Function of Degree of First Task Learning and Inter-Task Similarity. Wright Air Development Center, Wright-Patterson AFB, Ohio, October 1952, WADC Technical Report 52-224.

The task was a complex manual position. The results showed that there was some forgetting over 24 hours, but in relearning the positive transfer obtained during acquisition of the transfer task continued to be manifest and to vary directly with degree of first task learning and with similarity. Proactive facilitation of retention was obtained. Forgetting over 14 months was great and showed evidence of differential proactive inhibition as a function of degree of learning. Relearning proceeded rapidly. Performance during relearning varied directly with degree of first task learning but not with intertask similarity.

309. Duncan, C.P. and Underwood, B.J. Transfer of Training in Motor Learning As a Function of Degree of First Task Learning and Inter-Task Similarity, Wright Air Development Center, Wright-Patterson AFB, Ohio, April 1952, WADC Technical Report 52-64.

In this experiment there were four degrees of first-task learning, defined by the number of practice trials, and three degrees of inter-task similarity, defined by the number of stimuli and responses newly paired on the second task. It was found that acquisition of the second task was facilitated by practice of the first task and that the facilitation increased directly with degree of first-task learning. Positive transfer also occurred with all degrees of inter-task similarity and increased directly as similarity increased.

310. Eckstrand, G.A. Studies in Cue Utilization Behavior: Part I. The Influence of a Relevant but "Unused" Cue in the Training Upon Transfer in a Positive Transfer Situation. Wright Air Development Center, ARDC, Wright-Patterson AFB, Ohio, April 1952, WADC Technical Report 52-79.

four experiments to see if, when secondary cues are available and used by the student, he will also learn to use the cues which are primary and are to be relied upon in the operational situation. Results supported the hypothesis that little or nothing is learned about performing a task on the basis of the "primary" cue while learning is occurring on the basis of the secondary cue.

311. Eckstrand, G.A. and Morgan, R.L. A Study of Verbal Mediation as a Factor in Transfer of Training. Aero Medical Laboratory, Wright Air Development Center, Wright-Patterson AFB, Ohio, February 1953, WADC Technical Report 53-34.

Transfer of training between tasks involving physically dissimilar sets of stimuli was investigated by having the subjects learning a common naming response (color names) to six color stimuli and six nonsense forms. Motor responses learned to the color stimuli were thereby more readily learned to the two different sets of stimuli. No differences in results occurred when actual colors were substituted for color names.

312. Edwards, A.L. Applications of Ranking in Film Research and the Statistical Analysis of Ranks. Special Devices Center, ONR, Port Washington, L.I., N.Y., September 1955, Technical Report SDC 269-7-59.

This report describes ways of making statistical analyses of ranks. It is primarily applicable in developing rating forms for evaluating films by means of judges where construction or administration of tests is not feasible. The report describes the following statistical concepts: 1) rank difference correlation, 2) coefficient of concordance, 3) reliability of mean ranks, 4) average correlation of "m" sets of "n" ranks, 5) analysis of a two-way classification, and 6) test of significance for means of ranks.

313. Gagne, R.M. Training Devices and Simulators: Some Research Issues. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., May 1954, Technical Report AFPTRC TR 54-16.

Discusses the fundamental research issues that should be considered in the development, evaluation, and use of training devices and simulators. A basic distinction is made between the purposes of measuring performance and improving performance. Closeness of simulation is considered in relation to these purposes.

314. Gagne, R.M. et al. On the Relation Between Similarity and Transfer of Training in Learning of Discriminative Motor Tasks. Special Devices Center, ONR, Port Washington, L.I., N.Y., July 1949, Technical Report SDC 316-1-5.

An analysis of the kind and amount of transfer to be expected when an individual learns a first task and then proceeds to a second task in which certain types of alterations have been made. Although the report is concerned mostly with theory, consideration is given to the implications for training device design.

315. Gagne, R.M. et al. Stimulus Pre-Differentiation as a Factor in Transfer of Training. Special Devices Center, ONR, Port Washington, L.I., N.Y., August 1949, Technical Report SDC 316-1-7.

Investigated the transfer to a discriminative motor task from various amounts of training involving "stimulus pre-differentiation." In this experiment the subjects practiced associating four letters with four light stimuli which later signalled manual responses to four switches in the motor task. The results indicate that preliminary training which requires the subjects to differentiate the stimuli of a motor task by learning their "names" has a certain degree of effectiveness for transfer to the learning of the motor task. More than a small amount of such training is apparently required, however, in order for significant degrees of positive transfer to be obtained.

316. Gagne, R.A. et al. Transfer of Discrimination Training to a Motor Task. Special Devices Center, OAR, Port Washington, L.I., N.Y., June 1949, Technical Report SDC 316-1-6.

Studied a complete motor task which required four different manual responses to be made to four light stimuli which would be discriminated on the basis of color or position. The results showed that training in the more difficult discrimination (color) brings about a greater over-all transfer effect than does training in the easier discrimination (position).

317. Gagne, R.H. and Foster, H. A Study of Transfer in a Motor Task With Varying Display Control Relationships. Special Devices Center, OAR, Port Washington, L.I., N.Y., 1948, Technical Report SDC 316-1-2.

A study of the amount of transfer of training resulting from practice on a motor skill involving the presentation of stimuli in one sector of an instrument face, to the same motor task practiced with the use of another sector. The task required the moving of a control handle to the right or left in response to a combination of stimuli. Positive transfer was found for the transfer from one sector to another and also when the display-control movement was reversed.

318. Gagne, R.H. and Foster, H. "Transfer of Training From Practice on Components in a Motor Skill." J. exp. Psychol., 1949a, 39, 47-68.

Designed to determine the extent to which transfer of training takes place in the learning of a complex motor skill with varying amounts of initial practice on a task which is itself component activity of the skills. The motor skill involved four differential manual responses to four lights. With similarity of stimuli kept constant and practice varied, the data were consistent with the hypothesis that increasing the amount of preliminary practice on one or more components of the total skill would at first increase, and later decrease, the tendency to generalize.

317. Gagne, R.M. and Foster, H. "Transfer to a Motor Skill From Practice on a Pictured Representation." J. exp. Psychol., 1949b, 39, 342-354.

Designed to determine the extent of positive transfer to the learning of a motor skill from varying amounts of practice on a paper-and-pencil representation of the skill. The results indicate the considerable effectiveness of preliminary training on a pictured representation of the total motor task, by a reduction in the tendency to generalize.

320. Gagne, R.M. Foster, H., and Crowley, H.E. "The Measurement of Transfer of Training." Psychol. Bull., 1948, 45, 97-130.

A summary of the methods which have been used to give quantitative expression to measures of transfer of training. Six separate methods are described and the advantages and disadvantages of each are studied.

321. Hartman, B.O. and Fitts, P.H. Relation of Stimulus and Response Amplitude to Tracking Performance. Air Force Personnel and Training Research Center, ARDC, Lackland AFB, Tex., AFPTRC TN 55-20, (Reprinted from J. exp. Psychol., February 1955, 49, No. 2).

Investigated the effects of visual stimulus and motor response amplitude and their interactions in a continuous tracking task. All except one of the experimental conditions showed that relative performance improved significantly as display amplification was increased from $\frac{1}{4}$ to 4 inches and as the amplitude of required arm control motion was increased from 5° to 80° . Thus, both scale effects were progressive and a Weber function did not hold. However, the extent of this effect varied markedly with different tracking tasks. Changes in visual and motor scale effects are postulated to accompany a shift from primary dependence on visual cues to increased dependence on proprioceptive information in controlling sequences of movement.

322. Jones, E.I. and Bilodeau, E.A. Retention and Relearning of a Complex Perceptual-Motor Skill After Ten Months of No Practice. Human Resources Research Center, ARDC, Lackland AFB, Tex., June 1953, Research Bulletin 53-17.

The reported research demonstrates that, over a 10-month period of no practice, significant amounts of retention were achieved of all the task components and combinations of task components measured in the Standard Pedestal Sight Manipulation Test situation. In ranging the previous level of highest attainment was again reached; this did not hold for any of the tracking dimensions. It was concluded that ranging is the major factor involved in the relatively rapid reacquisition of the total skill.

323. Jones, E.I. and Bilodeau, E.A. Differential Transfer of Training Between Motor Tasks of Different Difficulty. Human Resources Research Center, ARDC, Lackland AFB, Tex., December 1952, Research Bulletin 52-35.

Designed to ascertain the effect on performance of guided practice on two different two-hand coordination tracing patterns, and also to measure the amount of transfer from each of these patterns to the other. Results showed that: 1) the more complex task is more difficult than the simple task; 2) the transfer from a complex task to a simple task is as great as or greater than the effect of direct practice on the simple task; 3) transfer from a complex to a simple task is greater than transfer from a simple task to a complex task; 4) transfer from a simple task to a complex task is positive but less than direct practice on the complex task throughout.

324. Kresse, F.H., Peterson, R.H., and Grant, D.A. "Multiple Response Transfer as a Function of Supplementary Training with Verbal Schematic Aids." J. exp. Psychol., 1954, 48, 381-390.

The hypothesis was that verbal conceptualization would facilitate transfer of training from one method of coding on a display to another when the data coded (range, azimuth, and elevation of a simulated target) are the same. A paper and pencil task was interspersed with training trials to provide drill in conceptualizing position. Comparison of results suggested that the paper and pencil task effectively supplemented the conceptual instructions and also provided some direct transfer to the apparatus performance.

325. Lewis, D. Devices for Studying Interference in Psychomotor Performance: III. The Double Disk Pursuit Apparatus. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1950, Technical Report SDC 57-2-13.

Three attempts were made with rotary pursuit apparatus to induce decrements in performance subsequent to interpolated practice. The first device used was Koerth-type rotor with mirror vision practice preceding direct-vision practice; the second device was the double-disk pursuit apparatus, subjects learning to trace a kind of figure-eight pattern; the third device was a second model of the Double-Disk Pursuit Apparatus which provided for a variable pursuit pattern. None of the devices showed a decrement that was clearly identifiable as a product of interference.

326. Lewis, D. and Shepard, A.H. Devices for Studying Associative Interference in Psychomotor Performance: IV. The Turret Pursuit Apparatus. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1950, Technical Report SDC 57-2-14. (In J. Psychol., 1950, 29, 173-182.)

A description of the Turret Pursuit apparatus, a modified version of the U.S. Navy Basic Turret Trainer, Mark II, Type 3-C-13-C, with a presentation of sample results from a pilot study on associative interference. This pursuit device requires the subject to manipulate two controls so as to effect continuous changes in the azimuth and elevation positions of a spot of light,

keeping the light on a target (photocell) throughout its course. The author reports that "... if a skill is first acquired with the controls arranged in a standard way, and if the practice is then given with the controls reversed, reliable decrements in ability to perform the original task appear at the outset of relearning."

327. Montgomery, V.E., Duncan, C.P., and Underwood, B.J. Transfer of Training in Motor Learning as a Function of Distribution of Practice. Wright Air Development Center, Wright-Patterson AFB, Ohio, October 1952, WADC Technical Report 52-115.

Consists of two parts: 1) three degrees of distribution of practice over days on two tasks were used (all trials on any one day were separated by 10-second rests and 2) practice within a day was continuous. The groups in both experiments were given the same total amount of practice. In the first experiment distribution of trials over days did not produce differential performance on either task. Positive transfer to the second task was the same for all groups; transfer did not vary as a function of distribution of practice trials. In the second experiment acquisition of the second task did not vary as a function of the distribution of continuous practice trials over days. Performance late in practice was poorer for those given continuous trials.

328. Morgan, R.L. and Eckstrand, G.A. Effects of a Changed Environmental Context Upon Performance of a Tracking Task. Aero Medical Laboratory, Wright Air Development Center, ARDC, Wright-Patterson AFB, Ohio, October 1953, WADC Technical Report 53-235.

The effects of a changed environmental context upon a two-dimensional compensatory tracking task were investigated. Training under simple conditions (open cockpit, ambient illumination, no helmet, no noise, no vibration, etc.) appeared as effective for performing the task as training under complex conditions (unclosed cockpit, red

panel lights, helmet, engine noise, vibration, etc.). Skill gained in one context apparently transferred to a high degree to performance under another context. The results implied that environmental stimuli accompanying the operational task need not always be incorporated into the training situations.

329. Morin, R.E. The Functions of Informative Feedback and Rewarding Feedback in Acquisition of a Lever Positioning Habit. Human Resources Research Center, ATC, Lackland AFB, Tex., December 1951, Research Note P&MS 51-11.

Represents an attempt to obtain further information on the influence of variations in rewarding feedback under conditions in which informative feedback is held constant, using the Manual Lever, which tests the ability of the subject to position (manually) a lever which moves in a plane in front of the subject and perpendicular to the lateral plane of his body. No differences were found between groups, supporting the hypothesis that rewarding feedback covaries with informative feedback. The utility of the two distinct concepts is questioned.

330. Noble, J.E., Fitts, P.M., and Marlowe, E. The Interrelations of Task Variables in Continuous Pursuit Tasks: II. Visual Display Scale, Arm Control Scale and Target Frequency in Compensatory Tracking. Human Resources Research Center, ARDC, Lackland AFB, Tex., December 1953, Research Bulletin 53-55.

Designed to investigate the interrelations of these task variables in compensatory tracking problems rather than following tracking problems. Analysis of the data indicated that tracking performance was significantly better for lower problem frequency and larger amplitude of arm control. The form of the learning curves indicated that even after 520 trials the limit of performance had not been reached. The results also indicated that relative error is more or less independent of the visual-scale factor and increases as amplitude of arm control movement decreases.

331. Perceptual and Motor Skills Laboratory. Learning and Transferring of Training in Two Forms of Rudder Control Tasks. Human Resources Research Center, ATC, Lackland AFB, Tex., February 1950, Research Note Lab 50-1.

Presents the results of an experiment conducted to study the transfer of training between two Rudder Control Tasks which differ from each other in width of target. For this experiment a modified version of the Rudder Control Test (CM 1200) was used. The implications of the results are that, within the limits of this experiment, precision of movement has not been identified as a significant dimension of the two tasks included in this study.

332. Perceptual and Motor Skills Laboratory. Learning and Transfer of Training in Two Forms of Rudder Control Tasks. Perceptual and Motor Skills Laboratory, Human Resources Research Center, ATC, Lackland AFB, Tex., February 1950, Research Notes Lab 50-1.

Designed to measure the degree of transfer between tasks which varied in the precision of movement. The attempt was made to produce different degrees of this supposed dimension by varying the target widths. It was believed that practice on a task demanding a lower degree of motor precision would transfer to a high precision task to a lesser extent than practice on the high precision task itself. The results indicated that preliminary training on the narrow target task produces a performance on the wide target task which is not significantly different from the performance produced by the same amount of practice on the wide target task itself. Preliminary training on the wide target task produces a performance on the narrow target task which is not significantly different from the performance produced by the same amount of practice on the narrow target task itself. The amount of transfer is not differentially affected by the variation in target width used in this experiment.

333. Senders, J.W. and Cruzen, M. Tracking Performance on Combined Compensatory and Pursuit Tasks. Wright Air Development Center, ARDC, Wright-Patterson AFB, Ohio, 1952, WADC Technical Report 52-39.

Five subjects with normal uncorrected vision and without prior experience in radar or oscilloscope operation were subjected to different task variations to compare compensatory and pursuit tracking for a one-dimensional visual-tracking task. The results indicated that an operator can track satisfactorily, even if he must compensate for movements of his own follower pip, as long as the compensatory component does not exceed the pursuit component.

334. Shepard, A.H. and Lewis, D. Devices for Studying Associative Interference in Psychomotor Performance: II. The Modified Two-Hand Coordinator. Special Devices Center, ONR, Port Washington, L.I., N.Y., 1950, Technical Report SDC 57-2-12. (In J. Psychol. 1950, 29, 53-66.)

A description of the Modified Two-Hand Coordinator, a pursuit device, with a presentation of sample results from a pilot study on associative interference. In keeping a small button on the moving target, the subject turned two handles of the type found on a lathe. For this study the device was so modified that the direction of movement of the button for a given direction of turning of a control handle could be reversed, the rate of movement could be changed, and response errors could be recorded. The sample results given indicated interference and the authors concluded that "the Modified Two-Hand Coordinator promises to be a highly useful device for investigating associative interference in psychomotor performance."

u. Basic research with application to military training

335. Asher, J. A., Hanley, T. D., and Steer, R. D. A Field Study of Voice Communication Problems as Related to Training Devices, Procedure, and Equipment. Special Devices Center, ONR, Port Washington, L. I., N. Y., April 1955, Technical Report SDC 104-2-41.

a compilation of the data collected within the operating fleet in order to examine voice communications systems as they exist in the Navy today and to determine the scope of existing communications problems. Problem areas as pointed out by both officers and enlisted men were 1) inadequate training, 2) unstandardized communications procedures, 3) inefficient use of equipment and 4) lack of proper supervision.

336. Department of Defense. Program Guidance in Training for 1952. Committee on Human Resources, Research and Development Board, Department of Defense, Washington, 1951, Report HTD 107/3.

The present status of military training is discussed. Program guidance in specific technical fields--training and education, and training devices--and undesirable duplication of effort are discussed.

337. Chambers, M. M. Opinions on Gains for American Education From Wartime Armed Services Training. American Council on Education, Washington, 1946.

Summarizes the responses of both professional educators and 3000 veterans to questions on selection and training methods in the armed services. Also included is a 23-page annotated bibliography on the implications of armed services training.

338. Department of Defense. Training Research: Scope, Methodology, and Contributions. Joint Panel on Training and Training Devices, Research and Development Board, Department of Defense, Washington, April 1951, Report HTD 200/2.

Consists of talks delivered at the Symposium on Training Research. Included in the report are the following papers: "Scope and Purpose of Training Research" by H.A. Edgerton; "Training Research Design and Methods" by W. Kappauf; and "Contributions from Training Research" by W. McGehee.

339. Department of Defense. Report of Working Group on Human Behavior Under Conditions of Military Service. Research and Development Board, Department of Defense, Washington, June 1951, HBM 200/1.

A joint report of the Research and Development Board and the Personnel Policy Board. Included in this report is a section on military training covering motivation, content, methods, and management. A subdivision, methods of training, is concerned with the use of training aids and devices.

340. Finch, G. and Cameron, F. Air Force Human Engineering, Personnel, and Training Research. Headquarters Air Research and Development Command, USAF Baltimore, 1956, ARDC Technical Report 56-8.

Contains reports of the Air Force aviation psychology research program. All of the papers were submitted for presentation at the Symposium on Air Force Human Engineering, Personnel, and Training Research, which was held at the National Academy of Sciences in November, 1955. Of particular interest to those concerned with training aids and devices are articles by Bilodeau ("Studies of Target Size and Control of Psychomotor Behavior Through Systematic Transformation of Knowledge of Results"), Briggs and Besnard ("Experimental Procedures for Increasing Reinforced Practice in Training Air Force Mechanics for an Electronic System"), French ("Evaluation of a K-System Trouble Shooting Trainer"), Senders ("Tracking with Intermittently Illuminated Stimuli") and Swanson, Lumadaine, and Aukes ("Two Studies in Evaluation of Maintenance Training Devices").

341. Grace, A.G. et al. Educational Lessons From Wartime Training. American Council on Education, Washington, 1948.

General report of the Commission on Implications of Armed Services Educational Programs. "The magnitudes, methods, and motives of armed services training in World War II have been studied for the lessons they may offer for the development of human resources." Included are discussions of training aids and training devices as utilized in the armed services.

342. Highland, R.W. A Consideration of Some Pertinent Problems Relative to Radar Mechanic Training Research. Human Resources Research Center, ATC, Lackland AFB, Tex., November 1951, Research Note TECH 51-9.

The result of a series of interviews to examine the possibilities of simplifying radar mechanic training. It was recommended that: 1) Research planning should continue with the intention of designing projects to compare the kinds of radar mechanic training which have been considered in this report; 2) a project should be initiated to build a proficiency test for radar mechanics in general; 3) a project should be initiated for collecting job analysis information from the using agencies and relating job duties to experience and formal training.

343. Katzell, R.A. et al. Combat Recognition Requirements, Army. Special Devices Center, ONR, Port Washington, L.I., N.Y., April 1952, Technical Report SDC 383-6-1.

The authors' recommendations for bettering Army combat recognition included: 1) recognition training should be spread throughout a soldier's career; 2) audio-visual methods, sound recordings, and simulated maneuvers against enemy tactics and equipment should be utilized; 3) there should be a general Army combat recognition training plan.

344. McAninch, W.D., Rush, C.H., and Scholl, C.E. Survey of Training Aids in the Strategic Air Command. Human Resources Research Lab., Headquarters Command, Bolling AFB, Washington, March 1951, HRRL Report 22.

An intensive survey of the use of training aids and devices in the Strategic Air Command (SAC). Conferences were held with personnel from SAC, Air Materiel Command, and Training Aids wing, and field trips were made to several SAC bases. The conference indicated that the training aids program in SAC was in need of attention; in many instances training aids were obsolete, insufficient in number, or in poor operating condition; parts were hard to obtain, and the requirements for new training aids were numerous. Elaboration of the problems and suggested solutions are included in this report which is two parts: 1) a summary of over-all survey findings and recommendations and 2) detailed reports of findings at each SAC station visited.

- 344a. National Defense Research Council. Human Factors in Military Efficiency: Training and Equipment. Applied Psychology Panel, Washington, 1946. Summary Technical Report. (CONFIDENTIAL)

This book is a summary report of the work of the Applied Psychology Panel, National Defense Research Committee during World War II. The first half of this volume describes research on the training for various military specialties; the second half, the design and operation of the equipment for which training is necessary. Of particular interest is the chapter entitled "The Use and Design of Synthetic Trainers for Military Training" (see Item 10). In the chapters concerned with the training of specialists the various training aids and devices utilized in such training are discussed.

345. Shettle, G.P. and Kessler, R. R. An Appraisal of Certain Major Synthetic Training Devices Employed by the Army Air Forces to Supplement Operational Equipment. OSRD, Department of Commerce, Washington, 1945.

An attempt to measure the value of certain synthetic training devices to the training program of the Army Air Forces. Supplementary comment is given on the general advantages and disadvantages of each device to assist in the planning of a postwar training program.

346. Special Devices Center. Army Development of Training Devices. Army Participation Group, Special Devices Center, AGC, Port Washington, L.I., N. Y.

Describes the formation and purpose of the Army Participation Group, Special Devices Center. This group provides for the research, development, and production of training devices, training aids, and other equipment as directed by the Chief, Army Field Forces. It also provides for field testing of training equipment and for research in human engineering and the development of training methods and doctrines.

347. Stolurow, L.M., Weiss, B., and Levit, D.W. Report of Navigation Air Check Study. Human Resources Research Center, AIC, Lackland AFB, Tex., November 1950, Research Note BON 50-8.

As a result of a navigation air check study the authors put forth a number of recommendations, among them: 1) Within all training organizations a requirement should be established for a unit which would be responsible for both proficiency evaluation and quality control of training; 2) existing ground trainers should be systematically evaluated with the dual purpose of improving both methods of use and design of present equipment, and of developing new trainers if found needed.

348. U.S. Department of Defense. Symposium on Psychology of Learning Basic to Military Training Problems. Panel on Training and Training Devices, Committee on Human Resources, Research and Development Board, Department of Defense, Washington, 7-8 May 1953, HR HTD 201/1.

A review of learning research, with particular stress on its application for military training problems, would prove helpful in planning and conducting military training research. Covered in this symposium were: theories and models (Session 1), motor skill and learning for performance in groups (Session 2), and motivation, perceptual learning, and human problem solving (Session 3).

349. Wolfe, D. "The Use and Design of Synthetic Trainers for Military Training." Human Factors in Military Efficiency: II. Training and Equipment. Applied Psychology Panel, NDRC, Washington, 1946. Summary Technical Report, pp. 140-154. (CONFIDENTIAL)

This chapter is concerned with a general approach to the use and design of synthetic trainers for military training. Sections are included on the characteristics of good trainers (validity, knowledge of results, physical features of trainers), the use of trainers (necessity for good instruction, characteristics of good instruction, lesson plans, preparation of lesson plans), advantages of a trainer over real equipment (economy, availability, safety, control of difficulty of practice). Also included in this report is a list of the trainers designed and built by projects of the Applied Psychology Panel, and the National Defense Research Committee.

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