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Technical Report 67-5

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An Annotated Bibliography on the Design of Instructional Systems

by
Robert G. Smith, Jr.

May 1967

Prepared for:
Office, Chief of
Research and Development
Department of the Army

Contract DA 44-188-ARC-2

HuMRRRO

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE
operating under contract with
THE DEPARTMENT OF THE ARMY

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The Human Resources Research Office is a nongovernmental agency of The George Washington University, operating under contract with the Department of the Army (DA 44-188-ARO-2). HumRRO's mission is to conduct research in the fields of training, motivation, and leadership.

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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FOREWORD

This annotated bibliography was compiled as the basis for a Human Resources Research Office report, *The Design of Instructional Systems*, Technical Report 66-18, November 1966. Much has been published on the technology of this aspect of developing effective training programs. Publication of annotated information on a selected portion of the literature was undertaken to provide a guide to many of the studies that have been conducted on the development of training methods and total instructional systems. While research activities in this field are continuing steadily, the information presented in this bibliography will provide both ideas for and background on the present technology for designing instructional systems.

This report is part of a series of closely related HumRRO publications by Robert G. Smith, Jr., dealing with several aspects of the technology of developing training. In addition to *The Design of Instructional Systems*, the series includes *The Development of Training Objectives*, Research Bulletin 11, June 1964, and its associated *An Annotated Bibliography on the Determination of Training Objectives*, Research Memorandum, June 1964; and *Controlling the Quality of Training*, Technical Report 65-6, June 1965, and its associated *An Annotated Bibliography on Proficiency Measurement for Training Quality Control*, Research Memorandum, June 1964. The annotated bibliographies are supplemental to the technology reports and provide more detail on the literature available to the instructional system designer.

HumRRO research efforts are conducted under Army Contract DA 44-188-ARO-2 and under Army Project 2J024701A712 01, Training, Motivation, Leadership Research.

Meredith P. Crawford
Director
Human Resources Research Office

SUMMARY

This annotated bibliography supplements an earlier HumRRO report, *The Design of Instructional Systems* (Technical Report 66-18, November, 1966). That report is one of a series of Human Resources Research Office publications on aspects of the technology for developing training. Presenting general guidelines for designing instructional systems, it was based on a survey of available literature and draws heavily on HumRRO experience in research studies on training. An instructional system, as used in the report, includes media, equipment, personnel, and methods--all integrated to efficiently perform the functions required for accomplishing one or more training objectives. Major sections of the report deal with the instructional system as a concept, the research evidence bearing on the major system functions, and methods for the design and evaluation of the system in terms of cost and effectiveness.

Preparatory to writing that report, the author read and collected a definitive number of pertinent references. Because they were so numerous and included works from so many different sources, it appeared that publication of an annotated compilation of especially relevant items would provide a useful "source book" for those involved with the design of instructional systems, or with component training activities. The references used date from 1950 to 1965, and provide a cumulative collection of research studies and background material in this technological field.

The bibliography is presented under seven major headings: I, Systems--General; II, Training Systems; III, Presentation of Knowledge; IV, Practice of Knowledge; V, Practice of Performance; VI, Management of Students; and VII, Additional Material. Four of the major areas are further divided into subtopics containing studies relating to a particular phase of the major topic.

The bibliography contains 449 annotated entries. A key-word-in-context (KWIC) index is included to enable a user to find material on topics of special interest to him. An author index is also included to facilitate locating all reports written by any one author.

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**An Annotated Bibliography
on the
Design of Instructional Systems**

INTRODUCTION

PURPOSE

The concept of a system as an integrated set of components, working in a coordinated manner to accomplish a goal, is an extremely broad and powerful one. It has been, in recent years, applied to many diverse areas, from weapon systems to computer systems.

Within the past few years, interest has grown in applying the system concept to the instructional process. The references in this bibliography were collected as a basis for a report on this topic (*The Design of Instructional Systems*, HumRRO Technical Report 66-18, by Robert G. Smith, Jr., November 1965). The items are presented in this volume in annotated form as an aid to readers interested in the technical literature as a source of information on ways in which the instructional process may be organized.

INSTRUCTIONAL SYSTEMS

An instructional system is an integrated set of media, equipment, methods, and personnel performing efficiently the functions required to accomplish one or more training objectives.

A general model of an instructional system, as conceived in TR 66-18, is presented in Figure 1. The system is composed of a student, training

A Model of an Instructional System

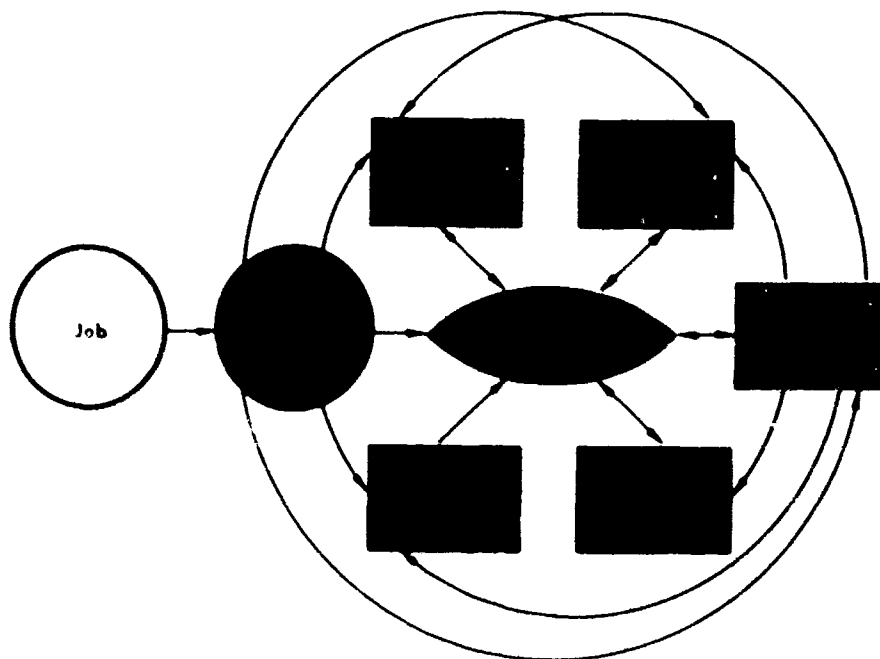


Figure 1

objectives, and the functions of Practice of Performance, Practice of Knowledge, Presentation of Knowledge, Management of Students, and Quality Control. The training objectives are an integral part of the system; they specify the tasks to be learned, including all the component skills and knowledges required for task performance.

Objectives of training are developed from a detailed analysis of the total job and its component tasks. This analysis forms the basis for the design of an instructional system. The objectives, once derived, condition the other functions of the system, which are:

- (1) Practice of the performance and skills required by the job until the student can perform them effectively.
- (2) Practice of the knowledge components, which are required for effective transfer to task performance.
- (3) Presentation of knowledge to the student, which is a one-way procedure.
- (4) Management of student activity, in order to keep him productively participating in the learning process.
- (5) Quality control of the system, to check (and improve, if necessary) its effectiveness in accomplishing its objectives.

Figure 1 illustrates how these functions interact to accomplish the training objectives necessary for performance of the job by the student.

The process of developing objectives has been described in an earlier report (*The Development of Training Objectives*, HumRRO Research Bulletin 11, June 1964, and the associated *An Annotated Bibliography on the Determination of Training Objectives*, HumRRO Research Memorandum, June 1964), as has research on quality control (*Controlling the Quality of Training*, HumRRO Technical Report 65-6, June 1965, and the associated *An Annotated Bibliography on Proficiency Measurement for Training Quality Control*, HumRRO Research Memorandum, June 1964).

SCOPE

The following sources were used in collecting the references listed in this bibliography:

- (1) *Psychological Abstracts* from 1950 to 1965
- (2) *Annual Review of Psychology*
- (3) *HumRRO Bibliography of Publications*
- (4) Recent major publications

It should be pointed out that the purpose for which this bibliography was prepared conditioned the selection of items contained in it. Twice as many reports as appear were scanned and rejected. The following guidelines were used in selecting material:

(1) Only material dealing with human adults and adolescents was included.

(2) Only material viewed as pertinent for potential use in the design of an instructional system was selected. The implications of this policy include the following:

- (a) Material that could make an improvement in methods and procedures was favored. Many experimental studies of the topics covered involved deliberate degrading of effectiveness in order to determine the effect of a variable. These studies were not included.

- (b) Many studies involved changes in the content to be learned that were not feasible for a training program that had to meet specific objectives. These also were excluded.
- (c) Application of an item to the model of a training system provided the framework for the author's judgment of relevance.
- (d) Finally, some studies that did not appear to have any possible application in a practical training system were omitted.

The major categories of the bibliography are as follows:

- I. SYSTEMS--GENERAL: The general topic of system analysis and design.
- II. TRAINING SYSTEMS: The general topic of training systems, and examples and evaluations of specific systems.
- III. PRESENTATION OF KNOWLEDGE: The process of presenting symbolic content to a student.
- IV. PRACTICE OF KNOWLEDGE: Practice involving symbolic content.
- V. PRACTICE OF PERFORMANCE: Practice of the task, or a skill component of the task.
- VI. MANAGEMENT OF STUDENTS: Maintaining student activity at the learning process in an efficient manner. Includes motivation, environment, and adjustments to individual differences.
- VII. ADDITIONAL MATERIAL: Material relevant to instructional systems, but not specific to the major topics covered in the other sections.

In those instances in which a reasonable number of reports were available on a given topic, they were grouped together under a subheading. For example, reports and articles in Section II are subdivided into two groups: A, Concepts--those items concerning the more basic elements of training systems; and B, Specific Training Systems--those items concentrating on a particular aspect of training systems or one system among several different types of training systems.

KWIC AND AUTHOR INDEXES

A key-word-in-context (KWIC) index has been prepared as an aid to the user of this bibliography. The KWIC index is constructed by interchanging and alphabetizing bibliographic titles according to "key words"--those words presenting the greatest amount of subject-oriented content. Every title is listed separately for each key word in it; thus, if a title has four key words it will be listed four times, alphabetically by each of its key words. For easy scanning, the key words are aligned down the middle of the page; the remainder of the title is "wrapped around" the key word. Alphabetization by subject content of the key words enables the user to scan only those titles containing topics of particular interest to him.

To search the index, the user should frame a question and select key words from it. If inspection of titles listed under the first-selected key words does not yield the desired information, the user should look under related topics or synonymous words. For example, if

the user is interested in "feedback" but doesn't find sufficient information, he might look under "reinforcement," "knowledge," or "results" (for Knowledge of Results). Using the KWIC index in this manner, the searcher would find all the information presented in the bibliography on the topic of particular interest to him.

Aligned down the right column of the page is the KWIC code, which is in three segments. The first segment is the item number of the entry; the next segment is the report section in which the item appears; and the third segment is the year in which the item was written. Therefore, the code 120/II/63 indicates the title is entry number 120, it is found in Section II, and it was written in 1963.

An author index has also been included for those users who may wish to examine all the items by any one author. The reference numbers in this index are the item number of the entry rather than the page number on which the item appears.

Section I

SYSTEMS--GENERAL

1. Ackoff, Russell L. (ed.). *Progress in Operations Research*, John Wiley & Sons, Inc., New York, vol. 1, 1961.

Chapter headings in this review of the state of operations research are (1) The Meaning, Scope, and Methods of Operations Research, (2) Decision and Value Theory, (3) A Survey of Inventory Theory from the Operations Research Viewpoint, (4) Mathematical Programming, (5) Dynamic Programming, (6) Dynamics of Operational Systems: Markov and Queuing Processes, (7) Sequencing Theory, (8) Replacement Theory, (9) The Theory and Application of Simulation in Operations Research, (10) Military Gaming, and (11) Progress in Operations Research: The Challenge of the Future.

2. Borko, Harold (ed.). *Computer Applications in the Behavioral Sciences*, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1962.

A description of applications and possible applications of computers in the behavioral sciences is divided into three parts: (1) Computer Systems, (2) Computer Fundamentals, and (3) Computer Applications. It also contains a chapter entitled "Automated Teaching" by H.F. Silberman and J.E. Coulson.

3. Churchman, C. West, Ackoff, Russell L., and Arnoff, E. Leonard. *Introduction to Operations Research*, John Wiley & Sons, Inc., New York, 1957.

Topics covered in this introductory text on operations research include system analysis; use of various models; testing, control and implementation; and administration of operations research.

4. Dean, N.J. "Management Implications of Total Information Systems," paper for Systems and Procedures Association, Booz, Allen, and Hamilton, Management Information System Department, Los Angeles, October 1961.

A general description is presented of management's need for total information systems based on computers.

5. Flagle, Charles D., Huggins, William H., and Roy, Robert H. (eds.). *Operations Research and Systems Engineering*, Johns Hopkins Press, Baltimore, 1960.

This is a general text on systems engineering and operations research. Major subdivisions are Perspectives, Methodologies, and Case Studies.

Systems--General

6. Gagné, Robert M. (ed.). *Psychological Principles in System Development*, Holt, Rinehart and Winston, Inc., New York, 1962.

The role of psychology in system development is discussed. The chapters include (1) Psychology and System Development, (2) Human Functions in Systems, (3) Men and Computers, (4) Human Capabilities and Limitations, (5) Human Tasks and Equipment Design, (6) Task Description and Analysis, (7) The Logic of Personnel Selection and Classification, (8) Aids to Job Performance, (9) Concepts of Training, (10) Training Programs and Devices, (11) Team Functions and Training, (12) Proficiency Measurement: Assessing Human Performance, (13) Evaluating System Performance in Simulated Environments, and (14) The System Concept as a Principle of Methodological Decision.

7. Goode, Harry H., and Machol, Robert E. *System Engineering*, McGraw-Hill Book Company, Inc., New York, 1957.

A general coverage of system design is presented. The major parts are (1) Introduction, (2) Probability--the Basic Tool of Exterior System Design, (3) Exterior System Design, (4) Computers--the Basic Tool of Interior System Design, (5) Interior System Design, and (6) Epilogue.

8. Jordan, Nehemiah. *The Allocation of Functions Between Man and Machines in Automated Systems*, P-2310, Logistics Department, Rand Corporation, Santa Monica, May 1961; presented at meeting of American Society of Mechanical Engineers, Los Angeles, June 1961.

Men and machines are not comparable; they complement each other. Tools are used to make a task easier or possible for humans. Man should be used as a back-up for production machines. Only man can accept responsibility. Motivating men to complement machines must be embedded in the task.

9. Porter, E.H. *The System Thinkers: Parable and Paradigm*, SP-285, System Development Corporation, Santa Monica, 1961.

This introduction to system concepts uses the introduction of the spindle into the restaurant business as a vehicle. Inputs, rate variations, displays, feedback loops, memory devices, queuing, omissions, errors, chunking, approximating, channeling, and filtering are discussed.

10. Raben, Margaret W. *A Survey of Operations and Systems Research Literature*, Institute for Applied Experimental Psychology, Tufts University, Medford, Mass., January 1960.

This survey is a compilation of brief treatments of unclassified publications on the operations and systems research considered important by those working in these fields. The parts include Introduction, Methods, and Problems.

11. Taylor, Franklin V. "Four Basic Ideas in Engineering Psychology," *Amer. Psychologist*, vol. 15, no. 10, October 1960, pp. 643-649.

The four most significant ideas in engineering psychology are the limited flexibility of the man, the concept of the man-machine system, the importance of human input-output relationships, and the use of engineering models to describe the behavior of the human elements within a system.

12. Taylor, F.V., and Birmingham, H.P. "That Confounded System Performance Measure: A Demonstration," *Psychol. Rev.*, vol. 66, no. 3, 1959, pp. 178-182.

System output is not a direct reflection of man's contribution to the system. Instead, the human output is confounded with that of other components of the system. An analog demonstration is presented.

13. Wright, George O. *A General Procedure for Systems Study*, WADD Technical Note No. 60-18, Wright Air Development Division, Air Research and Development Command, Wright-Patterson AFB, Ohio, January 1960.

An abstract system model, is described. The model is developed around the concepts of data input, process, function, system output, data transformation, mediation, operation, outcomes, the output criteria, feedback control, and data flow.

Section II

TRAINING SYSTEMS

A. CONCEPTS

14. Alexander, Lawrence T., Ford, John D., Jr., Jensen, Barry T., Jordan, Nehemiah, and Rogers, Miles S. *Problems Encountered in Developing and Maintaining a Field System Training Program*, System Development Corporation, Santa Monica, September 1959.

This collection of papers presented at the 1959 meeting of the Human Factors Society includes (1) Requirements for a Field System Training Program, (2) The Appropriate Contribution of Simulation Techniques to System Training, (3) Man-Machine Training Techniques, (4) Problems of Conducting System Training in a Military Culture, and (5) The Training Problems of Future Systems.

15. Bushnell, Don D. "Computer-Based Teaching Machines," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 528-531.

A general description of the role of computers in instruction is presented. Abstracts of papers at a 1961 conference on computer-based instruction are included.

16. Bushnell, Don D. (ed.). *The Automation of School Information Systems*, Monograph No. 1, Department of Audiovisual Instruction, National Education Association, Washington, 1964.

The papers contributed in this report of a symposium on educational data processing are divided into six groups: (1) electronic data processing and school administration, (2) the automation of scheduling procedures, (3) the retrieval of educational information, (4) simulation and modeling for educational decision making, (5) computer-based instructional systems, and (6) systems design and analysis.

17. Bushnell, Donald D. "The Role of the Computer in Future Instructional Systems," *AV Communication Rev.*, vol. 11, no. 2, Supplement 7, March-April 1963.

Computer usage in education is predicted, and examples from present applications and experimentation are given. The chapters include (1) Computer Fundamentals, (2) The Computer-Based Teaching Machine, (3) information Retrieval Systems and Education, (4) Computer-Based Simulation: A New Technology for Education, (5) The Automated Classroom, and (6) What is Next in Computer Applications to Instruction?

18. Bushnell, Don, and Borko, Harold. *Information Retrieval Systems and Education*, System Development Corporation, Santa Monica, September 1962.

A description is provided of the role of information retrieval (IR) systems in education. A generalized block diagram of an IR system is presented, and a number of present and future applications are described.

19. Carter, L.F. "Automated Instruction," *Amer. Psychologist*, vol. 16, no. 11, November 1961, pp. 705-710.

A description is presented of the possibilities of computer-controlled automated instruction. Research being conducted at the System Development Corporation is also described.

20. Chapman, Robert L., and Kennedy, John L. "The Background and Implications of the Systems Research Laboratory Studies," in *Symposium on Air Force Human Engineering, Personnel, and Training Research*, Glenn Finch and Frank Cameron (eds.), Publication 455, National Academy of Sciences--National Research Council, Washington, 1956.

A general description is provided of the ways an organization changes under stress when provided critiques of performance. Work methods are changed to handle an increased load.

21. Cogswell, John F. *The System Approach as a Heuristic Method in Educational Development--An Application to the Counseling Function*, SP-720, System Development Corporation, Santa Monica, March 1962.

A preliminary analysis of the counseling function in a city school district is described. Hypotheses for systems research were stimulated by viewing the counseling function from the systems point of view, particularly strengthening the interaction between the counseling and teaching functions.

22. Cogswell, J.F., Egbert, R.L., Marsh, D.G., and Yett, F. *Construction of School Simulation Vehicle*, TM-1409, System Development Corporation, Santa Monica, August 1963.

A description is provided of a model designed to permit computer modeling of any school configuration. Use of the model initially is to simulate a school operating on the Continuous Progress Plan.

23. Cogswell, John F., Egbert, Robert L., Marsh, Donald G., and Yett, Frank A. *Purpose and Strategy of the School Simulation Project*, TM-1493/101/00, System Development Corporation, Santa Monica, December 1963.

Five high schools, varying in the extent of innovation, were selected for analysis. A simulation vehicle will be constructed to serve as a tool for generating and testing hypotheses about ways in which school design and organization can be improved.

Training Systems

24. Coulson, John E. (ed.). *Programmed Learning and Computer-Based Instruction*, John Wiley & Sons, Inc., New York, 1962.

This reports the proceedings of the Conference on Application of Digital Computers to Automated Instruction. The parts deal with (1) theory and experimentation in programmed learning, (2) computer-based instructional systems, and (3) computer technology in automated teaching.

25. Darby, Charles L. *Annotated Bibliography on the Automation of Instruction*, Research Memorandum, HumRRO Division No. 5 (Air Defense), Fort Bliss, Tex., July 1959.

This annotated bibliography of 80 items deals with teaching machines and programmed instruction.

26. DeCarlo, Charles R. "Information Systems in the Educational Environment," in *Proceedings of the 1962 Invitational Conference on Testing Problems*, Eric F. Gardner (chrmn.), Educational Testing Service, Princeton, N.J., 1963, pp. 91-101.

This is a statement of the role of information systems in the educational environment; various computer applications are also described.

27. Eckstrand, Gordan A. *Current Status of the Technology of Training*, AMRL-TR-64-86, Behavioral Sciences Laboratory, Aerospace Medical Research Laboratories, Air Force Systems Command, Wright-Patterson AFB, Ohio, September 1964; also paper read at meeting of American Psychological Association, Los Angeles, September 1964.

The current status of the technology of training is reviewed and analyzed into three areas: (1) determining training requirements, (2) developing the training environment, and (3) measuring the results of training.

28. Egbert, R.L., and Cogswell, J.F. *System Design in the Bassett High School*, TM-1147, System Development Corporation, Santa Monica, April 1963.

This report describes the use of system analysis and design techniques in connection with the development of a high school designed for continuous progress.

29. Egbert, Robert L., and Cogswell, John F. *System Analysis and Design in Schools*, SP-1141, System Development Corporation, Santa Monica, March 1963.

An approach to the design of school systems that will accommodate change more easily is described. Nine general steps including computer modeling are suggested as an approach to the analysis and design of school systems.

30. Egbert, Robert L., and Cogswell, John F. *System Design for a Continuous Progress School: Part II Surveillance and Detection System*, TM-1493/104/00, System Development Corporation, Santa Monica, March 1964.

The design of a Surveillance and Detection System for a Continuous Progress School is presented. This system automatically monitors inputs describing student performance, detects the existence of trouble, and determines the persons to be alerted in case of trouble.

31. Ely, Donald P. (ed.). "The Changing Role of the Audiovisual Process in Education: A Definition and a Glossary of Related Terms," *AV Communication Rev.*, vol. 11, no. 1, Supplement 6, January-February 1963.

A brief history and description of current concepts, in audiovisual communications is presented. Audiovisual communications is that branch of educational theory and practice concerned primarily with the design and use of messages that control the learning process. Most of the content is a glossary of terms in the fields of (1) AV communication and learning, (2) audio reproduction, (3) broadcasting, (4) communication and information theories, (5) computers in instructional settings, (6) electronic learning laboratories, (7) photography and cinematography, (8) programmed instruction and teaching machines, (9) technological developments, and (10) visual media.

32. Finn, James D., Bolvin, Boyd M., and Perrin, Donald G. *A Selective Bibliography on New Media and Instructional Technology*, Staff Paper Number One, Instructional Technology and Media Project, School of Education, University of Southern California, Los Angeles, April 1964.

This unannotated bibliography on new media and instructional technology has the following 18 major divisions: (1) Publications of the Technological Development Project of the National Education Association (1960-1963) and Related Articles; (2) General Audio-Visual References; (3) Audio-Visual Equipment; (4) General Educational Implications of Instructional Technology; (5) Research Summaries and Comment; (6) Communications Theory; (7) Learning Theory and the New Media; (8) Specific Newer Technologies, including (a) Television, (b) Language Laboratories, (c) Teaching Machines and Programed Instruction, (d) 8-mm Sound Film, (e) Instructional Systems, (f) Computers in Education, and (g) Educational Data Processing; (9) General References on Computers of Interest to Educators; (10) Information Storage and Retrieval; (11) School Buildings and the New Technology; (12) Articles Critical of Instructional Technology; (13) Newer Developments Leading Toward the Future; (14) Psychological Testing; (15) Professional Rights and Responsibilities of Teachers (Including Copyrights and Patents); (16) Information on General Educational Implications of Automation; (17) Bibliographies, Guides, and Indexes; and (18) Further Information--Periodicals.

Training Systems

33. Fry, Edward B., Bryan, Glenn L., and Rigney, Joseph W. "Teaching Machines: An Annotated Bibliography," *AV Communication Rev.*, vol. 8, no. 2, Supplement 1, 1960.

An exhaustive compilation of publications about teaching machines as of September 1959 is presented.

34. Gilbert, Thomas F. "Mathetics: The Technology of Education," *J. Mathetics*, vol. 1, no. 1, January 1962, pp. 7-73.

A system of human training based on the principles of reinforcement theory is described. Analysis of behavior and lesson design are also described.

35. Gilpin, John. "Design and Evaluation of Instructional Systems," *AV Communication Rev.*, vol. 10, no. 2, March-April 1962, pp. 75-84.

The concept of instructional systems is discussed, with emphasis on objectives and time and cost as criterion variables.

36. Green, Edward J. *The Learning Process and Programmed Instruction*, Holt, Rinehart and Winston, Inc., New York, 1962.

A theoretical discussion of the relation between the learning process and programmed instruction is presented.

37. Holland, James G. "Teaching Machines: An Application of Principles From the Laboratory," *J. Exp. Anal. Behav.*, vol. 3, 1960, pp. 275-287.

This article is a general introduction to teaching machines. Data are presented that show reduction in time when a program is lengthened to reduce errors.

38. Lumsdaine, A.A., and Glaser, Robert (eds.). *Teaching Machines and Programmed Learning: A Source Book*, Department of Audiovisual Instruction, National Education Association, Washington, 1960.

This is a collection of papers on teaching machines and programmed learning. Major topics include purpose and scope of the book, Pressey's self-instructional test scoring devices, Skinner's teaching machines and programming concepts, contributions from military and other sources, and some recent work.

39. Lysaught, Jerome P. (ed.). *Programmed Learning: Evolving Principles and Industrial Applications*, Foundation for Research on Human Behavior, Ann Arbor, 1961.

The proceedings of a conference to survey the state of the art in programmed learning and its industrial possibilities are presented. Topics include principles of programming, the Eastman Kodak experience with programmed learning, some differences in approach to the programming of instruction, IBM's experience with developing programmed instruction, learning theory, and future research.

40. Mager, Robert F. *Preparing Objectives for Programmed Instruction*, Fearon Publishers, San Francisco, 1961.

This is a presentation, in scrambled book form, of three criteria for clearly stated objectives: behavioral statements, a statement of the conditions under which the behavior is to be observed, and a standard of accuracy or speed that the behavior must reach.

41. Melching, William H., Cox, John A., Rupe, Jesse C., and Smith, Robert G., Jr. *The Text of an Orientation Workshop in Automated Instruction*, Consulting Report, HumRRO Division No. 5 (Air Defense), Fort Bliss, Tex., July 1962.

This reports the content of an orientation workshop given to Army groups during 1962. Contents include Introduction, The Technology of Training, Outline of Programming Activities, Impact of Automated Instruction, Teaching Machines, Decisions Required for Automation of Instruction, and Management of Automated Instruction.

42. Melching, William H., Smith, Robert G., Jr., Rupe, Jesse C., and Cox, John A. *A Handbook for Programmers of Automated Instruction*, Procedural Guide, HumRRO Division No. 5 (Air Defense), Fort Bliss, Tex., September 1963.

This handbook is a textbook and reference for developing programmed instruction courses and treats, in detail, all of the activities necessary to produce effective programs. It is organized to parallel the sequence of activities a programmer should follow when preparing a program. Emphasis is placed on derivation and preparation of instructional objectives, essential to the preparation of an effective program.

43. Morrill, Charles S. "Teaching Machines: A Review," *Psychol. Bull.*, vol. 58, no. 5, September 1961, pp. 363-375.

The literature on teaching machines is reviewed. Major topics include current trends in automated teaching machines, general problem areas, and problems of application.

44. Ofiesh, Gabriel D., and Meierhenry, Wesley C. (eds.). *Trends in Programmed Instruction*, Department of Audiovisual Instruction, National Education Association, and National Society for Programmed Instruction, Washington, 1964.

The papers of the first annual convention of the National Society for Programmed Instruction (1963) are collected here. Major headings include (1) Education, (2) Development of Systems Applications, (3) The Teacher, (4) The Exceptional Student, (5) Industrial Applications, (6) Military and Governmental Applications, (7) The Health Sciences, (8) Instructional Programming, (9) Evaluations, and (10) Future Trends.

Training Systems

45. Schramm, Wilbur. *The Research on Programed Instruction: An Annotated Bibliography*, Bulletin No. 35 (OE-34034), Office of Education, U.S. Department of Health, Education, and Welfare, Washington, 1964.

This is an annotated bibliography of 190 research reports on programed instruction published since 1954. A 15-page introductory summary is provided.

46. Silberman, Harry F. "Self-Teaching Devices and Programmed Materials," *Rev. Educ. Res.*, vol. XXXII, no. 2, April 1962, pp. 179-193.

Research on self-teaching devices and programed materials is reviewed. Topics include (1) Summaries and Reviews; (2) Program Variables, including (a) Definition of Response Modes, (b) Eliciting Desired Responses, and (c) Adaptation of Programs to Individual Differences; (3) Comparisons with Conventional Instruction; and (4) Trends and Problems.

47. Silvern, Leonard C. "Teaching Machine Technology: The State of the Art," *AV Communication Rev.*, vol. 10, no. 3, May-June 1962, pp. 204-216.

The history, concepts, and present status of teaching machines are described in nontechnical terms.

48. Skinner, B.F. "Teaching Machines," *Science*, vol. 128, no. 3330, October 1958, pp. 969-977.

This article is an introduction to teaching machines and programed instruction.

49. Skinner, B.F. "Teaching Machines," *Scient. Amer.*, vol. 205, no. 5, 1961, pp. 90-107.

Rationales for teaching machines based on animal reinforcement studies are presented in nontechnical terms. Social implications of teaching machines and programs are discussed.

50. Stolurow, Lawrence M. *Teaching by Machine*, Cooperative Research Monograph No. 6 (OE-34010), Office of Education, U.S. Department of Health, Education, and Welfare, Washington, 1961.

An extensive treatment of teaching by machine is presented in this report. Chapter headings are (1) Current Instructional Problems, (2) A Systems Approach to Instruction, (3) Teaching Machines, (4) The Learner, (5) Program and Programming Process, (6) Concepts and Techniques, and (7) Research Findings.

51. Stolurow, Lawrence M. "Implications of Current Research and Future Trends," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 519-527.

This article is a discussion related to the following predictions of future trends: (1) these methods and devices are

here to stay; (2) several things will be done to acquaint teachers with the potentiality of these developments; (3) the comparative study of live and automated teaching will stop; (4) future research will concern itself with discovering the important characteristics of the materials and methods; (5) these developments will lead to a theory of teaching; (6) courses will be revised as a result of the new insights provided; (7) basic changes will occur in our thinking concerning what a course is; (8) research will demonstrate the importance of sequence factors; (9) we will see a new form of dynamic individualized programing called ability-pattern programing; (10) the devices of the future will be either books (programed or scrambled) or computer-based machines; small devices will drop out; and (11) learning from auto-instructional programing will be shown to be capable of aiding persons to solve problems creatively.

52. Stolurow, Lawrence M. "Programed Instruction and Teaching Machines," in *The Impact of New Communication Media on Education*, P.H. Rossi and B.J. Biddle (eds.), Aldine Publishing Co., Chicago, 1964.

The impact of programed instruction and teaching machines on education is discussed, with special reference to the system concept. A number of studies indicate the interaction of individual differences in ability and personality with teaching methods.

53. Stolurow, Lawrence M. *Some Educational Problems and Prospects of a Systems Approach to Instruction*, Technical Report No. 2, Training Research Laboratory, University of Illinois, Urbana, March 1964.

The implications of media for the concept of instructional systems are discussed. Teaching by media implies a model of the instructional process. Media permit the analysis of instruction by being objective and repeatable. The computer is an especially promising tool.

54. Stolurow, Lawrence M., and Davis, Daniel. "Teaching Machines and Computer-Based Systems," in *Teaching Machines and Programmed Learning II: Data and Directions*, Robert Glaser (ed.), Department of Audiovisual Instruction, National Education Association, Washington, 1965, pp. 162-212.

The current status of teaching machines and computer-based systems is discussed, with special consideration of models of the instructional process.

55. Tyler, Ralph W. "The Role of Machines in Educational Decision-making," in *Proceedings of the 1962 Invitational Conference on Testing Problems*, Eric F. Gardner (chmn.), Educational Testing Service, Princeton, N.J., 1963, pp. 102-113.

This article is a general discussion of the role of the computer in (1) allocating and scheduling learning resources,

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(2) admitting students to college, (3) placing them in courses and programs, and (4) diagnosing learning difficulties.

56. Wohlwill, Joachim F. "The Teaching Machine: Psychology's New Hobbyhorse," *Teachers Coll. Rec.*, vol. 64, no. 2, November 1962, pp. 139-146.

This is a critique of teaching machines and programs from the standpoint of the broader aims of education.

B. SPECIFIC TRAINING SYSTEMS

57. Allan, M.D. "Learning Perceptual Skills: The Sargeant System of Recognition Training," *Occup. Psychol.*, vol. 32, 1958, pp. 245-252.

The Sargeant system of aircraft recognition training is described. This system showed significant improvement over conventional training in an evaluation.

58. Brown, George H., Zaynor, Wesley C., Bernstein, Alvin J., and Shoemaker, Harry A. *Development and Evaluation of an Improved Field Radio Repair Course*, Technical Report 58, Human Resources Research Office, September 1959.

A revised course for Field Radio Repairmen was constructed. The new course differed from the old in the following ways: (1) emphasis on recognition and correction of the most common troubles in the most frequently repaired items of equipment; (2) emphasis on a systematic troubleshooting procedure; and (3) use of Functional Context Training. Graduates of the revised course were superior in tests of troubleshooting, test equipment, repair skills, and achievement tests. The two groups were equal in Alinement, Manuals, and Schematics tests.

59. Bullock, Donald H. "Comments on Oakes' 'Use of Teaching Machines as a Study Aid in an Introductory Psychology Course'," *Psychol. Rep.*, vol. 8, no. 1, February 1961, p. 96.

Three criticisms are made of Oakes' study, which showed no positive results when using a teaching machine. The criticisms are related to the error rate of the program and the form and content of the criterion test.

60. Cassel, Russell N., and Ullom, William L. "A Preliminary Evaluation of Programmed Instruction With Students of High Ability," *Psychol. Rep.*, vol. 10, no. 1, February 1962, pp. 223-228.

Ninth and twelfth grade students of high ability learned computer mathematics using a teaching machine. A very significant amount of learning took place, as measured by gains on a criterion test. Attitudes of students toward the technique were favorable.

61. Coulson, John E., Estavan, Donald P., Melaragno, Ralph J., and Silberman, Harry F. "Effects of Branching in a Computer Controlled Autoinstructional Device," *J. Appl. Psychol.*, vol. 46, no. 6, December 1962, pp. 389-392.

Two groups of 15 subjects each received instruction in logic from a computer-controlled self-instructional device. One group received a fixed sequence of 233 items. In the other group each subject received a different number and sequence of items, depending on errors and self-estimates of progress. Achievement was significantly higher for the branching group than for the fixed-sequence group. Training time did not differ significantly.

62. Coulson, John E., and Silberman, Harry F. "Effects of Three Variables in a Teaching Machine," *J. Educ. Psychol.*, vol. 51, no. 3, June 1960, pp. 135-144.

The following variables were studied in a simulated teaching machine: (1) student response mode-constructed vs. multiple-choice, (2) size of steps, and (3) sequencing (branching). A multiple-choice and a constructed response criterion test were used. Subjects who took the program learned as compared with a control group that did not. Multiple-choice response mode took less time than the constructed response mode, but there was no difference in achievement. Small steps required more time but also yielded higher test scores than did large steps on the constructed response criterion test. Branching required less time, but results on the criterion test were not significant. Branching and mode of response gave a significant interaction on the constructed response criterion.

63. Della-Piana, Gabriel. "An Experimental Evaluation of Programmed Learning," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 495-501.

Four learner response variations of a linear program were used: (1) standard linear program, constructed response, students repeated missed items for up to three trials; (2) same program, initial letters of correct response given in red; (3) same program, complete response included in program in red, student required to copy it; (4) same program, but each student had a proctor who said "right" if answer was correct, and "wrong, try again" if answer was incorrect. There were no significant differences in achievement, but treatments (2) and (3) required significantly less time.

64. Easley, J.A., Jr., Gelder, H.M., and Golden, W.M. *A PLATO Program for Instruction and Data Collection in Mathematical Problem Solving*, Report R-185, Coordinated Science Laboratory, University of Illinois, Urbana, January 1964.

A computer program for generating and checking geometric proofs is described. The program is intended for use in teaching the development of geometric proofs in a computer-based teaching machine (PLATO).

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65. Eigen, Lewis D. "A Comparison of Three Modes of Presenting a Programmed Instruction Sequence," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 453-460.

Subjects took a 65-frame program on differences between numbers and numerals by one of three modes of presentation: machine, horizontal text, or vertical text. There were no significant differences in achievement or time.

66. Engstrom, John, and Whittaker, James O. "Improving College Students' Spelling Through Automated Teaching," *Psychol. Rep.*, vol. 12, no. 1, February 1963, pp. 125-126.

Sixty college students were randomly divided into two groups on a spelling test. The experimental group used a teaching machine and a spelling program covering the words used in the pretest. The control group studied these words visually for the same amount of time. Both groups showed improvement, but the machine group showed more than the study group, and its retention after a month was higher.

67. Evans, James L., Glaser, Robert, and Homme, Lloyd E. "An Investigation of 'Teaching Machine' Variables Using Learning Programs in Symbolic Logic," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 433-452.

Programs in symbolic logic were presented to six groups. Group 1 used systematic program, constructed response, review card, and Group 2 used systematic program, constructed response, no review card. The remaining groups used a less systematic program: Group 3 wrote responses to items; Group 4 composed answers, but received immediate knowledge of results on items requiring more than one response; for Group 5 the correct answer was shown, but no written response was required; and Group 6 used multiple-choice response. Subjects not required to make a written response completed a program in 65% of the time of those responding overtly. Achievement was not affected by mode of responding. Systematic programs using the Ruleg system produced equal proficiency in less time than less systematic programs.

68. Ferster, Charles B., and Sapon, Stanley M. "An Application of Recent Developments in Psychology to the Teaching of German," *Harvard Educ. Rev.*, vol. xxviii, no. 1, Winter 1958, pp. 58-69.

A self-instructional program in German is described. Twenty-eight students volunteered to take the program and six finished it. Those who completed the program attained a mean achievement score of 88.3% in an average time of 47.5 hours.

69. Follettie, Joseph F. *Development and Evaluation of a Program of Instruction in Basic Land Navigation*, Technical Report 70, Human Resources Research Office, May 1961.

The performance requirement for land navigation was determined, and a 12-hour training program was developed. Seventy-five percent of pairs of subjects tested at night passed the proficiency test. Results of day testing were consistent with the night evaluation.

70. Goffard, S. James. *An Experimental Evaluation of a Basic Education Program in the Army*, Technical Report 28, Human Resources Research Office, April 1956.

Three types of prebasic training were compared: instruction in reading, writing, and arithmetic; an extra period of basic training; and a combination of the two. Criteria were scores on a performance test of military proficiency, scores on a written test of military proficiency, evidence of troublesomeness during basic training, and attitude measures. The special training made an almost negligible contribution to the potential military usefulness of marginally literate men at the end of basic training.

71. Goffard, S. James, Heimstra, Norman W., Beecroft, Robert S., and Openshaw, Joseph W. *Basic Electronics for Minimally Qualified Men: An Experimental Evaluation of a Method of Presentation*, Technical Report 61, Human Resources Research Office, February 1960.

The functional context principle was used experimentally to teach basic electronics and compared with the existing method for teaching Army personnel. Over all, the results slightly favored the experimental course. However, at middle and low aptitude levels, functional context training was clearly the more effective method.

72. Goldstein, Leo S., and Gotkin, Lassar G. "A Review of Research: Teaching Machines vs. Programed Textbooks as Presentation Modes," *J. Programed Instruction*, vol. 1, no. 1, 1962, pp. 29-36.

This article is a review of eight studies comparing teaching machines and programed texts. No significant differences in achievement are reported, although the time saved using programed textbooks was significant in five studies.

73. Goodwin, W. Richard. "The System Development Corporation and System Training," *Amer. Psychologist*, vol. 12, no. 8, August 1957, pp. 524-528.

A general description is provided of the System Training Program for air defense systems, which was prepared by the System Development Corporation.

74. Hammes, John A., Kelly, Henry E., McFann, Howard H., and Ward, Joseph S. *TRAINFIRE II: A New Course in Basic Technique of Fire and Squad Tactics*, Technical Report 41, Human Resources Research Office, July 1957.

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This report describes TRAINFIRE II, a method for conducting squad training. Rifle squads trained by this method are superior in proficiency and use less ammunition than conventionally trained squads.

75. Hatch, Richard S. *An Evaluation of the Effectiveness of a Self-Tutoring Approach Applied to Pilot Training*, WADC Technical Report 59-320, Wright Air Development Center, Wright-Patterson AFB, Ohio, July 1959.

A teaching machine was used to teach instrument flying information. The machine was simply installed in the crew lounge of one of two matched groups. No device was available to the other group. The experimental group improved when retested, while the others did not.

76. Hitchcock, Lloyd, Jr. *Experimental Comparison of Two Basic Electronics Courses for Fire Control Technicians*, Technical Report 60, Human Resources Research Office, February 1960.

Students who had a 12-week basic electronics course followed by training on the M33 antiaircraft system were compared with those who had six weeks of basic electronics followed by training on the M33. There was no significant difference between the groups in ability to repair the M33, to learn other electronics systems, and to grow in the field.

77. Hitchcock, Lloyd, Jr., Mager, Robert F., and Whipple, James E. *Development and Evaluation of an Experimental Program of Instruction for Fire Control Technicians*, Technical Report 46, Human Resources Research Office, May 1958.

A new course in maintenance of the M33 fire control system was developed and compared with the existing course. The new course resulted in increased proficiency in less time. Changes in the new course were based on observations of deficiencies of recent school graduates. Major changes were (1) an initial block of training in system operation, (2) a final block on system maintenance, (3) provision of copies of course objectives to the students, (4) omission or postponement of much of the basic electronics, and (5) an emphasis on system analysis at the block diagram level.

78. Hough, John B. "An Analysis of the Efficiency and Effectiveness of Selected Aspects of Machine Instruction," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 467-471.

A teaching machine and conventional instruction were compared in a college course. They were equally effective, but the teaching machine took less time. None of the three response modes--constructed, selected, or a combination of the two--was more effective than another.

79. Hughes, J.L., and McNamara, W.J. "A Comparative Study of Programed and Conventional Instruction in Industry," *J. Appl. Psychol.*, vol. 45, no. 4, August 1961, pp. 225-231.

Programed texts covering the first 15 hours of a 16-week course on computer servicing were prepared. An experimental group using the programs made higher achievement test scores in less time than the control group, which was taught by lecture and discussion.

80. Jacobs, T.O. *A Program of Leadership Instruction for Junior Officers*, Technical Report 84, Human Resources Research Office, June 1963.

Based on previous research, a 16-hour course in leadership was developed and its acceptability determined.

81. Kopstein, Felix F., and Cave, Richard T. *Preliminary Cost Comparison of Technical Training by Conventional and Programed Learning Methods*, Technical Documentary Report MRL-TDR-62-79, Behavioral Sciences Laboratory, Aeromedical Division, Wright-Patterson AFB, Ohio, July 1962.

Three methods of estimating the costs of the prototype automated course in Communications Electronics Principles at Keesler AFB were compared with estimated costs of current conventional courses. The costs of automated instruction compare favorably with the costs of the conventional course and tend to diminish as the number of students trained increases, while conventional costs remain constant.

82. Kopstein, Felix F., Cave, Richard T., and Zachert, Virginia. *Preliminary Evaluation of a Prototype Automated Technical Training Course*, Technical Documentary Report MRL-TDR-62-78, Behavioral Sciences Laboratory, Aeromedical Division, Wright-Patterson AFB, Ohio, July 1962.

Using intrinsic programs on the Autotutor Mark I, the experimental group received all instruction in electronics normally taught by lecture and discussion; the control group received regular instruction. The experimental group learned adequately from the experimental program.

83. MacCaslin, Eugene F., Woodruff, Arnold B., and Baker, Robert A. *An Improved Advanced Individual Training Program for Armor*, Technical Report 59, Human Resources Research Office, December 1959.

A completely revised course for Armor Advanced Individual Training was developed and compared with the existing course. The new course used job and task descriptions to develop curriculum and picture texts. Certain principles of learning and administrative procedures were used. The new course was 25% shorter and yielded a somewhat higher level of proficiency than the former course.

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84. Mager, Robert F. *Current Practices in Electronics Training in Industry*, Research Memorandum, HumRRO Division No. 5 (Air Defense), Fort Bliss, Tex., May 1960.

A survey was made of the training conducted by 10 industrial firms in the field of electronics. A "model course" is described.

85. McDonald, Frederick J., and Allen, Dwight W. "An Investigation of Presentation, Response, and Correction Factors in Programmed Instruction," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 502-507.

Five program variations were studied: (1) Information and example presented, and response worked at each step--response corrected immediately with an explanation; (2) explanation of correct response omitted; (3) example omitted; (4) only information and example presented; and (5) only information presented. No significant differences in achievement were found.

86. McFann, Howard H., Hammes, John A., and Taylor, John E. *TRAIN-FIRE I: A New Course in Basic Rifle Marksmanship*, Technical Report 22, Human Resources Research Office, October 1955.

An experimental course in rifle marksmanship was developed. The new course required 16 fewer hours of training time and 34 fewer rounds of ammunition than the conventional course and resulted in improved proficiency in detecting and hitting targets.

87. Olson, Howard C., and Baerman, Donald J. *The Effect of Fuel Conservation Training on M-48 Tank Gasoline Consumption*, Staff Memorandum, HumRRO Division No. 2 (Armor), Fort Knox, Ky., September 1955.

A one-hour course in fuel economy resulted in a 6% reduction in gasoline consumption in an armor unit during a march.

88. Pickering, Edward J. *An Experimental Investigation of Doppler Training*, Technical Bulletin 59-29, U.S. Naval Personnel Research Field Activity, San Diego, November 1959.

A review of previous research on Doppler training is presented. A study of training indicated that although training increases proficiency, more might be accomplished by selecting trainees for their Doppler ability than by training poor judges of Doppler.

89. Reed, Jerry E., and Hayman, John L., Jr. "An Experiment Involving Use of *English 2600*, An Automated Instruction Text," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 476-484.

English 2600, a programmed text, was compared with conventional instruction. Learning was substantial for all students; there was no significant difference between groups. *English 2600* was more effective, however, for the better students than for the poorer students.

90. Ripple, Richard E. "Comparison of the Effectiveness of a Programed Text With Three Other Methods of Presentation," *Psychol. Rep.*, vol. 12, no. 1, February 1957, pp. 227-237.

Subjects were assigned to one of four groups: the group that (1) used a standard programed text, (2) read material in text form, (3) listened to a lecture based on the programed material, or (4) used the program without reinforcing feedback. Immediate learning and retention after 10 days were measured. It was concluded that active involvement contributed to increased learning, reinforcement did not contribute to increased learning, retention was not improved, and individual differences were not reduced.

91. Rocklyn, Eugene H., Moren, Richard I., and Zinovieff, Andre. *Development and Evaluation of Training Methods for the Rapid Acquisition of Language Skills*, Research Report 9, Human Resources Research Office, January 1962.

The feasibility of using machines to teach enough of a foreign language to permit soldiers to obtain tactical information from newly captured prisoners of war was considered. Tape recorded lessons, arranged to maximize learning efficiency without using human instructors, were developed and evaluated with favorable results.

92. Roe, Arnold. "Automated Teaching Methods Using Linear Programs," *J. Appl. Psychol.*, vol. 46, no. 3, June 1962, pp. 198-201.

Various automated procedures and lectures were compared, using elementary probability as content. Automated procedures included (1) multiple-choice teaching machines, (2) free-response teaching machines in individual booths, (3) free-response teaching machines in a classroom, (4) programed texts requiring overt responses and providing correct answers, and (5) programed texts requiring no overt responses. Lectures included a "programed" lecturer and a standard lecturer. There were no significant differences between any of the programed text, programed machine, or programed lecturer methods, but all programed methods were superior to the standard lecturer.

93. Roe, Arnold. "A Comparison of Branching Methods for Programed Learning," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 407-416.

Seven branching and sequencing methods were compared: (1) linear; (2) forward--material was skipped if known; (3) backward--material repeated if not learned; (4) same as 3, but branched to new items; (5) pretest forward--took criterion test before and after forward branching program; (6) random sequence; and (7) forward branching in textbook rather than using a card file as in the other methods. The random sequence resulted in poorer performance on the test than the other methods.

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There were differences between the branching procedures, but the branching procedures were not superior to linear sequencing.

94. Rulon, Phillip J., and Brooks, W. Douglas. *A Comparison of Two Methods of Teaching Typewriting*, NAVTRADEVCCEN Technical Report 294-1, U.S. Naval Training Device Center, Port Washington, N.Y., January 1960.

The standard Navy method of teaching typing and the Robins Method were compared. There was no significant difference in the results from the two methods.

95. Shoemaker, Harry A. "The Functional Context Method of Instruction," *IRE Transactions on Education*, vol. E-3, no. 2, June 1960, pp. 52-57.

This is a critique of conventional instruction and a description of the functional context method of instruction. The functional context method is characterized by (1) establishment at the beginning of a maintenance-related meaningful context, (2) organization of the other topics so that the relevance of each to the primary context can be demonstrated to the student at the time it is taught, and (3) a whole-to-part sequence of topics.

96. Shriver, Edgar L. *Determining Training Requirements for Electronic System Maintenance: Development and Test of a New Method of Skill and Knowledge Analysis*, Technical Report 63, Human Resources Research Office, June 1960.

New methods of task and skill analysis were applied to a course in the operation and maintenance of an anti-aircraft fire control system. The new course was 12 weeks long as compared with the standard course of 30 weeks. There was no significant difference in proficiency between the two groups.

97. Shriver, Edgar L., Fink, C. Dennis, and Trexler, Robert C. *FORECAST Systems Analysis and Training Methods for Electronics Maintenance Training*, Research Report 13, Human Resources Research Office, May 1964.

The research presented in this report was directed primarily toward troubleshooting electronic weapon systems. Its principal findings bear upon three interconnected problems: (1) developing training content based upon a cue-response paradigm; (2) developing training and job methods and aids, such as mock-ups, substitute or obsolete equipment, and block diagrams for troubleshooting; (3) planning and managing personnel, with special reference to transition training from old to new weapon systems. Results of the studies made suggest that training based on FORECAST methods of analysis produces men capable of effectively performing the job with less training time than needed for traditional instruction in electronics maintenance.

98. Shriver, Edgar L., Sivy, John, and Rosenquist, Henry S. *MOON-LIGHT IV: Training the Rifle Squad in Night Technique of Fire*, Technical Report 17, Human Resources Research Office, May 1955.

Squads were trained in new experimental methods for achieving adequately controlled fire under low illumination conditions. Squads so instructed were two or three times as effective as those that had not been so trained.

99. Smith, LTC Norman H. "The Teaching of Elementary Statistics by the Conventional Classroom Method Versus the Method of Programmed Instruction," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 417-420.

A comparison was made between conventional and scrambled-book learning in statistics. There was no significant difference in achievement, but the scrambled book took less time.

100. Thomas, Francis H. *Low Altitude Aerial Observation: An Experimental Course of Instruction*, Technical Report 80, Human Resources Research Office, October 1962.

Four aerial observation skills were identified and five experiments were conducted to develop methods for teaching these skills. An experimental course was developed and compared with the conventional training program. Performance as a result of the experimental training improved about 40% in visual search techniques, speed of recognition, and geographic orientation. The experimental students with 32 hours of training matched the performance of experienced observers who had 117 hours of training and practical experience on a simulated combat test.

101. Wendt, Paul R., and Rust, Grosvenor. "Pictorial and Performance Frames in Branching Programmed Instruction," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 430-432.

Freshmen learning to use a university library were taught with programmed instruction and lectures improved by the programming process. Pictorial frames and performance frames (requiring the student to perform various tasks during the program) were validated by performance of various tasks in the library. Students using pictorial frames were better at the .01 level, and those using performance frames were better at the .02 level.

102. Whitlock, Gerald H., Copeland, Lewis C., and Craig, Albert M. "Programming Versus Independent Study in Learning Elementary Statistics," *Psychol. Rep.*, vol. 12, no. 1, February 1963, pp. 171-174.

In a preliminary study, achievement in elementary statistics of an experimental group of 10 students who used a programmed text was superior to a group of equal size who attended regular classes. In comparing seven students who used programmed materials

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with 12 who used independent study, there was no significant difference.

103. Woolman, Myron. *On-Site Training of Guided Missile Operators*, Technical Report 64, Human Resources Research Office, August 1960.

A system for training guided missile operators in the operational context was developed and evaluated. The system resulted in improved proficiency and was considered acceptable for field use.

Section III

PRESENTATION OF KNOWLEDGE

A. FILMS

104. Ash, P. "The Relative Effectiveness of Massed Versus Spaced Film Presentation," *J. Educ. Psychol.*, vol. 41, 1950, pp. 19-30.

Two four-reel series of instructional films were presented to undergraduate psychology students in three spacing patterns: four reels in an hour, two reels in each of two 30-minute periods, and one reel in each of four 15-minute periods. Two three-reel series of films were shown to Navy recruits in two spacing patterns: three reels in one 45-minute period, and one reel in each of three 15-minute periods. The differences in test scores for the spacing variable were not significant. Differences between the film groups and the control groups were highly significant, indicating the films had taught. Ratings of interest were not correlated with test scores.

105. Ash, Philip, and Carlton, Bruce J. "The Value of Note-Taking During Film Learning," *Brit. J. Educ. Psychol.*, vol. 23, 1953, pp. 121-125.

Three methods were used with two films. The methods were (1) viewing the film only, (2) taking notes during the film, and (3) taking notes during the film followed by review of the notes. Taking notes during relatively fast-moving films decreased learning.

106. Ash, Philip, and Jaspen, Nathan. *The Effects and Interactions of Rate of Development, Repetition, Participation and Room Illumination on Learning From a Rear-Projected Film*, Technical Report SPECDEVGEN 259-7-39, Special Devices Center, Port Washington, N.Y., October 1953 (Contractor: Pennsylvania State College).

The following variables were studied in connection with teaching assembly of a 40-mm breech block: (1) rate of development, (2) film repetition, (3) participation in practice during film, and (4) room illumination. Conclusions were (1) a slow rate of development is more helpful to learning than a fast rate, (2) repetition of a film increases learning up to a point, (3) participation in practice during the film increases learning provided the development is sufficiently slow to permit practice without missing important parts of the film, (4) repetition is more helpful with slow films, and (5) a high level

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of illumination is likely to be detrimental to learning only if many students are seated at extreme angles to, or distances from, the screen.

107. Ash, Philip, and Jaspen, Nathan. *Optimum Physical Viewing Conditions for a Rear Projection Daylight Screen*, Technical Report SPECDEVGEN 269-7-37, Special Devices Center, Port Washington, N.Y., October 1953 (Contractor: Pennsylvania State College).

The effect of distance and viewing angle from a rear projection cabinet was studied, using the assembly of the 40-mm breech block as a learning task. In skill learning involving practice along with a film, performance in daylight is better within 30° of the center line and within 12 screen widths of the screen.

108. Bentley, Ralph R. "An Experimental Evaluation of the Relative Effectiveness of Certain Audio-Visual Aids in Vocational Agriculture," *J. Exp. Educ.*, vol. XVII, March 1949, pp. 373-381.

Films vs. instructor-teaching were compared in three agricultural projects: Home Garden, Swine Production, and Pasture Production. Tests of information and application were used as criteria, both as immediate posttests and as retention tests. The only significant difference was in favor of the film group on the information test of the Home Garden Project.

109. Carpenter, C.R. *Logistics of Sound Motion Pictures for Military Training*, Human Engineering Report SPECDEVGEN 269-7-31, Special Devices Center, Port Washington, N.Y., September 1952 (Contractor: Pennsylvania State College).

Findings and implications of research on training films prior to 1952 are reviewed in this report. Conclusions are (1) make sure that a film is the best way to present the training information; (2) decide on objectives, audience, and operational use; (3) evaluate the usefulness of the film before release; (4) train production teams in instructional film methodology; (5) evaluate films in use under normal conditions; and (6) conduct an operational analysis of motion picture requirements in military instruction.

110. Carpenter, C.R. *Instructional Film Research Reports (Rapid Mass Learning)*, Human Engineering Report SPECDEVGEN 269-7-36, Special Devices Center, Port Washington, N.Y., January 1953 (Contractor: Pennsylvania State College).

Thirty-four reports and their implications were compiled from research of the Instructional Film Research Program of Pennsylvania State College. Topics include theory and practice, film research tools, motor skill training, film utilization, attitudes and emotions, and film production.

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111. Carpenter, C.R., and Greenhill, L.P. *Instructional Film Research Reports (Rapid Mass Learning), Volume II*, Human Engineering Report NAVTRADEVCECEN 269-7-61, U.S. Naval Training Device Center, Port Washington, N.Y., June 1956 (Contractor: Pennsylvania State University).

This report summarizes and compiles research reports dealing with the planning, production, and use of films. Information is presented that will be of value to curriculum planners, film planners and producers, instructors, students, and research workers.

112. Cogswell, John F. *Effects of a Stereoscopic Sound Motion Picture on the Learning of a Perceptual-Motor Task*, Human Engineering Report SPECDEVCECEN 269-7-32, Special Devices Center, Port Washington, N.Y., September 1952 (Contractor: Pennsylvania State College).

Subjects were taught to assemble the breech block of the 40-mm anti-aircraft gun. The experimental group saw a three-dimensional stereoscopic film, while the control group learned via a two-dimensional film. The groups were similar in both time and accuracy of assembly. It is concluded that for tasks not making heavy demands on binocular cues to depth perception, three-dimensional films are not a requirement.

113. Deutschmann, Paul J., Barrow, Lionel C., Jr., and McMillan, Anita. "The Efficiency of Different Modes of Communication," *AV Communication Rev.*, vol. 10, no. 3, May-June 1962, pp. 176-178.

Efficiency is defined as the difference between the amount of relevant and irrelevant information a student has learned. The efficiency of the following were compared in teaching strength of materials: (1) laboratory, (2) laboratory and film, (3) film, and (4) television reproduction of film. Television and film were the most efficient.

114. Dworkin, Solomon, and Holden, Alan. "An Experimental Evaluation of Sound Filmstrips vs. Classroom Lectures," *J. Soc. Motion Pict. TV Engrs.*, vol. 68, June 1959, pp. 383-385.

A comparison was made of the effectiveness of lectures and sound filmstrips for presenting information on the bonding of atoms. There was no significant difference.

115. Freeman, John, and Neidt, Charles O. "Effect of Familiar Background Music Upon Film Learning," *J. Educ. Res.*, vol. 53, no. 3, November 1959, pp. 91-96.

This study compared the effect of familiar and unfamiliar background music on learning from an instructional film. There was no significant difference in amount learned from a film when familiarity of music background was varied.

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116. Grosslight, J.H., and McIntyre, Charles J. *Exploratory Studies in the Use of Pictures and Sound for Teaching Foreign Language Vocabulary*, Technical Report SPECDEVCEN 269-7-53, Special Devices Center, Port Washington, N.Y., August 1955 (Contractor: Pennsylvania State University).

This series of studies concerned the use of pictures and sound to teach foreign languages. Conclusions are that pictures of an object or an act are an aid to learning to write foreign words; the pictures need not be in motion; pronunciation of the words by the narrator or learner seems to inhibit learning to write foreign words; and films are a convenient method for repetitive presentation of new words.

117. Heidgerken, Loretta E. "An Experimental Study To Measure the Contribution of Motion Pictures and Slide-Films to Learning Certain Units in the Course Introduction to Nursing Arts," *J. Exp. Educ.*, vol. XVII, no. 2, December 1948, pp. 261-293.

A comparison was made between motion pictures and slide-films, using both or neither in teaching introductory nursing students. There were no significant differences between the groups.

118. Hurst, Paul M., Jr. *Relative Effectiveness of Verbal Introductions to Kinescope Recordings and Training Films*, Technical Report SPECDEVCEN 269-7-42, Special Devices Center, Port Washington, N.Y., May 1955 (Contractor: Pennsylvania State University).

This study found that students learned about the same amount from a film whether they were told they were watching kinescope or a film. Apparently the novelty of kinescopes no longer stimulates trainees to greater learning.

119. Instructional Film Research Program. *A Bibliography of Production, Utilization and Research on Instructional Films*, Technical Report SPECDEVCEN 269-7-40, Special Devices Center, Port Washington, N.Y., November 1953 (Contractor: Pennsylvania State University).

This comprehensive, unannotated bibliography of titles (listed by author) covers the production, utilization, and research of instructional films to early 1952.

120. Johnson, Donovan A. "An Experimental Study of the Effectiveness of Films and Filmstrips in Teaching Geometry," *J. Exp. Educ.*, vol. XVII, March 1949, pp. 363-372.

Live instructors, films alone, filmstrips alone, and films and filmstrips combined were compared for effectiveness in teaching geometry. No consistent differences emerged in favor of any treatment.

121. Ketcham, Carl H., and Heath, Robert W. "Teaching Effectiveness of Sound With Pictures That Do Not Embody the Material Being Taught," *AV Communication Rev.*, vol. 10, no. 2, March-April 1962, pp. 89-93.

A comparison was made among (1) sound only, (2) sound plus images associationally related to sound, (3) sound plus irrelevant pictures, and (4) sound plus pictures of geometric forms. Treatment (2) was superior in achievement, but treatment (1) conveyed 92% of the information conveyed by treatment (2).

122. Laner, S. "The Impact of Visual Aid Displays Showing a Manipulative Task," *Quart. J. Exp. Psychol.*, vol. VI, part 3, 1954, pp. 95-106.

A motion picture film and a filmstrip composed of line drawings were compared for effectiveness in teaching a manual task. No significant differences were found.

123. Laner, S. "Some Factors Influencing the Effectiveness of an Instructional Film," *Brit. J. Psychol.*, vol. 46, 1955, pp. 280-292.

A comparison of training by film vs. printed text and diagrams was made. The content was the trigger mechanism of the Bren gun. Subjects were asked to draw a sketch of the mechanism, explain how it operates, and assemble a model. There were no significant differences in effectiveness. Therefore, it is concluded that a highly realistic pictorial portrayal contributed little to instructional effectiveness.

124. Lange, Carl J., Rittenhouse, Carl H., and Atkinson, Richard C. *Films and Group Discussions as a Means of Training Leaders*, Technical Report 27, Human Resources Research Office, March 1956.

Films to provide a basis for discussion of leadership problems were developed. Compared with graduates of existing leadership programs, graduates of the film discussion showed greater improvement in the quality of their solutions to leadership problems and were better able to judge who the top leaders in their class were. Reactions of both students and instructors were favorable.

125. Lathrop, C.W., Jr., Norford, C.A., and Greenhill, L.P. "The Contributions of Film Introductions and Film Summaries to Learning From Instructional Films," *J. Educ. Psychol.*, vol. 44, 1953, pp. 343-353.

Three films were selected that were judged to have especially good introductions and summaries. The effect of the summaries and introductions was evaluated and it was found that they had only a minor effect. One introduction had a negative effect.

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126. Mercer, John. *The Relationship of Optical Effects and Film Literacy to Learning From Instructional Films*, Human Engineering Report SPECDEVCEN 269-7-34, Special Devices Center, Port Washington, N.Y., November 1952 (Contractor: Pennsylvania State College).

The effect on training of special optical effects, such as fades, dissolves, and wipes, was studied. Results showed that (1) optical effects did not aid factual learning, (2) film viewers did not attach any special meaning to specific optical effects, (3) other cues in both picture and sound track were the deciding factors in interpreting optical effects to indicate transitions, and (4) producers varied in their use of optical effects.

127. Nelson, H.E., and VanderMeer, A.W. "The Relative Effectiveness of Several Different Sound Tracks Used on an Animated Film on Elementary Meteorology," *Speech Monogr.*, vol. 20, 1953, pp. 261-267.

The sound track of an existing film was changed to include three modifications: (1) increasing the number of personal pronouns, using active rather than passive voice, shortening sentences, employing verbal transitions and simpler words; (2) increasing the number of definitions, analogies, explanations, and repetitions; and (3) reducing the number of words and details, simplifying the language, and directing attention to the video element of the film. The commentary variations did not significantly affect learning. Students hearing the "best" sound track without seeing the film answered 80% of the test questions answered by those who heard this sound track and saw the film.

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

The sound track of an animated film was modified by improving language intelligibility; using more personal pronouns; shortening sentences; increasing the number of definitions, explanations, and repetitions of concepts; and by greater use of the visual element of the film. This was compared with the original sound track and film. Results showed that (1) only small changes in overall learning resulted, and (2) the sound track contributed a much larger share to learning than the visual element.

129. Northrop, Dean S. *Effects on Learning of the Prominence of Organizational Outlines in Instructional Films*, Human Engineering Report SPECDEVCEN 269-7-33, Special Devices Center, Port Washington, N.Y., October 1952 (Contractor: Pennsylvania State College).

Three types of films were studied: (1) a discrete item, that is, a relatively unorganized, film, (2) a film with a

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logical organization, and (3) one with a chronological order using a story form. To each of these films was added a "main point" outline and a detailed outline. For the discrete item film, a main point organizational outline aided learning. The detailed outline did not increase learning significantly. Most of the increase in learning was attributable to the less intelligent members of the audience.

130. Rimland, Bernard, McIntyre, Charles J., and Sherk, H. Dennis. *Effectiveness of Several Methods of Repetition of Films*, Technical Report SPECDEVCEN 269-7-45, Special Devices Center, Port Washington, N.Y., May 1955 (Contractor: Pennsylvania State University).

Several methods of repeating film demonstrations of a knot-tying task were compared. More learning occurred when a single demonstration was repeated than when an equivalent number of different demonstrations was given. A motor skill learned from one point of view can be performed best when the viewpoint during performance is the same. In this relatively simple task, practice between repetitions of the film did not improve learning.

131. Stein, J.J. *The Effect of a Pre-Film Test on Learning From an Educational Sound Motion Picture*, Human Engineering Report SPECDEVCEN 269-7-35, Special Devices Center, Port Washington, N.Y., November 1952 (Contractor: Pennsylvania State College).

A study was conducted of the effect various forms of pretests have on learning from an educational sound motion picture. Variables were (1) knowledge of results--none, partial, and complete; (2) type of questions--identical or comparable to the posttest; and (3) order of questions--the same as the content in the film or random order. The study was replicated on two films. The pre-film test that had identical, ordered items with complete knowledge of results was followed immediately by the film and resulted in more learning and retention than showing the film once or twice in immediate succession. Both low and high aptitude groups benefited from the pre-film test.

132. VanderMeer, A.W., and Cogswell, John. *Instructional Effect of the Film "How to Operate the Army 16mm Sound Projector Set,"* Human Engineering Report SPECDEVCEN 269-7-29, Special Devices Center, Port Washington, N.Y., September 1952 (Contractor: Pennsylvania State College).

The purpose of this study was to determine the effect an instructional film would have on teaching a complex set of skills. A film to teach men to operate a JAN projector yielded posttraining scores on a performance test of 62% to 92%, an increase of 37% to 62% over pre-film scores. More learning resulted when subjects were told exactly what they were to learn. Presenting the film twice produced greater learning than showing it once.

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133. Weiss, Walter, and Fine, Bernard J. "Stimulus Familiarization as a Factor in Ideational Learning," *J. Educ. Psychol.*, vol. 47, 1956, pp. 118-124.

Three groups were used: (1) Group C1 was exposed only once to a film strip on the U.N., (2) Group C2 saw the film strip twice, and (3) Group E saw the film strip once, but before that took part in a familiarization procedure in which the subjects learned to associate the names of the six main organs of the U.N. with pictures taken from the film strip. The E group was superior to the C1 group in learning from the film strip, but did not differ reliably from the C2 group. Thus familiarization training appears to be as advantageous as a second viewing of the film strip.

134. Zuckerman, John V. "Commentary Variations in Instructional Films: Their Effect on Learning Perceptual-Motor Tasks," *J. Communication*, vol. 2, no. 2, 1952, pp. 53-57.

A variety of commentaries was prepared for brief instructional films describing how to tie knots. Verbal descriptions assisted the learners, but a very detailed description presented in a short time period reduced learning somewhat. Direct imperative statements and second person statements were more effective than third person passive statements. No data are presented.

B. TELEVISION

135. Benschoter, Reba Patterson, and Charles, Don C. "Retention of Classroom and Television Learning," *J. Appl. Psychol.*, vol. 41, no. 4, 1957, pp. 253-256.

Subjects who had taken part in a study of TV learning in 1953 were tested in 1956 for long-term retention. There were no significant differences in retention between groups who learned originally by TV, classroom sessions, TV in a studio, and kinescope.

136. Buckler, William E. "A College English Teacher Looks at Television: Composition," *J. Educ. Sociol.*, vol. 31, 1958, pp. 346-352.

Conventional teaching in college composition, involving the writing and grading of themes, was compared with partial instruction by TV. There was no difference in test scores between the two groups.

137. Carpenter, C.R., and Greenhill, L.P. *An Investigation of Closed-Circuit Television for Teaching University Courses*, Project Number 1, Instructional Television Research, Instructional Film Research Program, Pennsylvania State University, July 1955.

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An exploratory study of closed-circuit TV in a university is reported. As measured by tests, there were no differences between regular instruction and TV instruction in learning by students taking two different psychology courses and the lecture-demonstration part of general chemistry. Television was acceptable to students; their attitudes toward it were mainly neutral or slightly negative. Administrators accept TV, but experienced instructors do not prefer TV over accustomed teaching procedures.

138. Carpenter, C.R., and Greenhill, L.P. *An Investigation of Closed-Circuit Television for Teaching University Courses*, Project Number 2, Instructional Television Research, Pennsylvania State University, July 1955.

This is a report of a major study of the application of instructional television. Chapters are on effectiveness, appropriateness, acceptability and feasibility.

139. Cobin, Martin T., and Clevenger, Theodore, Jr. "Television Instruction, Course Content, and Teaching Experience Level: An Experimental Study in the Basic Course in Oral Interpretation," *Speech Monogr.*, vol. 28, 1961, pp. 16-20.

A comparison was made between presentation by TV and instruction by graduate students with varying teaching experience. The TV group was approximately equal in achievement to the total group taught by graduate students, but quite superior to the group taught by inexperienced graduate students.

140. Dreher, Robert E., and Beatty, Walcott H. *Project Number One: An Experimental Study of College Instruction Using Broadcast Television*, Instructional Television Research, San Francisco State College, April 1958.

Four courses were presented to three different college groups: (1) students taking the course as normally given on campus, (2) students viewing the course by TV at home, and (3) students viewing the course by TV on campus. There were no significant differences in achievement between the groups. Students preferred regular campus classes. Noncollege groups who completed the courses attained a satisfactory level of achievement. A number of practical problems in using TV are discussed.

141. Evans, Richard I., Roney, H. Burr, and McAdams, Walter J. "An Evaluation of the Effectiveness of Instruction and Audience Reaction to Programming on an Educational Television Station," *J. Appl. Psychol.*, vol. 39, no. 4, 1955, pp. 277-279.

The achievement of students enrolled in elementary psychology instruction sections, some taught by television and some without, was compared. No significant differences were found.

142. Irwin, John V., and Aronson, Arnold E. *Television Teaching: A Comparison of the Effectiveness of a Live Conventional*

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Lecture Versus a Highly Visualized Film Presentation in Television Teaching at the College Level as Measured by an Objective Verbal Examination and by a Film Examination, Research Bulletin No. 11, University of Wisconsin Television Laboratory, Madison, December 1958.

The purpose of this study was to compare the effectiveness of live lecture and highly visualized film presentation as evaluated by a true-false examination and a highly visualized film test. With film testing, film teaching was superior; with verbal testing, verbal teaching was superior. Having the class present in a studio or the monitor room did not affect the results.

143. Kanner, Joseph H., Runyon, Richard P., and Desiderato, Otello. *Television in Army Training: Evaluation of Television in Army Basic Training*, Technical Report 14, Human Resources Research Office, November 1954.

Television and kinescope presentation of 14 hours of instruction in Army basic training were compared with regular instruction. Television instruction was at least as effective in learning and retention as regular instruction and was more effective than regular instruction for low aptitude men. Kinescope instruction was as effective as regular instruction. When kinescopes were used for review following initial instruction, test scores after the review were higher than after initial instruction. The test scores of low aptitude trainees after one review approached those of high aptitude groups following initial instruction.

144. Klapper, Hope Lamin. "Does Lack of Contact With the Lecturer Handicap Televised Instruction?" *J. Educ. Sociol.*, vol. 31, 1958, pp. 353-359.

In some sections of a social science survey course the TV lecturer also taught discussion groups. Lack of personal contact did not affect the amount learned. The lecturers objected to being required to conduct discussions immediately after the TV lectures.

145. Lepore, Albert R., and Wilson, Jack D. *Project Number Two: An Experimental Study of College Instruction Using Broadcast Television*, Instructional Television Research, San Francisco State College, Fall 1958.

Six academic areas were presented in three ways: (1) conventional on campus, (2) TV on campus, and (3) TV at home. There were no significant differences in achievement, but students preferred conventional instruction on campus. Economic analysis indicates that it is economically feasible to offer lecture-discussion courses if 950 students are available. More expensive courses become feasible if a minimum of 1440 students are available. Cost is reduced for subsequent semesters after initial costs have been met.

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146. McGrane, J.F., and Baron, Morton L. "A Comparison of Learning Resulting From Motion-Picture Projector and From Closed-Circuit TV Presentations," *J. Soc. Motion Pict. TV Engrs*, vol. 68, December 1959, pp. 824-827.

A comparison was made between motion picture projection and closed-circuit TV in the presentation of three training films. At low projector noise levels, the projector was superior. At intermediate noise levels, there was no significant difference. At high projector noise levels, TV was superior.

147. Rock, Robert T., Jr., Duva, James S., and Murray, John E. *The Effectiveness of Television Instruction in Training Naval Air Reservists (Rapid Mass Learning)*, Technical Report SPECDEVGEN 476-02-S2, Special Devices Center, Port Washington, N.Y., April 1951 (Contractor: Fordham University).

Eight topics were taught to officers and eight other topics to enlisted naval air reservists by TV, kinescope, and live instructors. TV was found to be generally superior to live instructors, and about equal to kinescope. Comments of students about TV and kinescope were generally favorable. A variety of factors contributing to the success of TV programs are described.

148. Rock, Robert T., Jr., Duva, James S., and Murray, John E. *A Study of Learning and Retention From Television Instruction Transmitted to Army Field Force Reservists*, Technical Report SPECDEVGEN 476-02-S3, Special Devices Center, Port Washington, N.Y., May 1951 (Contractor: Fordham University).

Television was used to present a series of lessons on the operations of an Army division. Both officers and enlisted reservists learned from the programs and remembered most of what they had learned four to six weeks later. The programs were highly acceptable to the reservists even after eight weekly sessions. The amount of gain on test items is positively related to the degree of explicitness of the program. Superior techniques were narration with meaning-conveying film and drama with some form of narration.

149. Rosenstein, Alvin J., and Kanner, Joseph H. "Television and Army Training: Color vs. Black and White," *AV Communication Rev.*, vol. 9, no. 1, January-February 1961, pp. 44-49.

A variety of technical subjects was presented by color or by black-and-white television. There was no significant difference in achievement as a result of the treatment.

150. Siegel, Laurence, and Macomber, F.G. "Comparative Effectiveness of Televised and Large Classes and of Small Sections," *J. Educ. Psychol.*, vol. 48, 1957, pp. 371-382.

In several courses, comparisons were made between large classes, small classes, and closed-circuit TV. Generally, there were no significant differences in achievement.

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151. Williams, D.C., Paul, J., and Ogilvie, J.C. "Mass Media, Learning, and Retention," *Can. J. Psychol.*, vol. 11, no. 3, 1957, pp. 157-163.

A lecture was presented either by television, radio, reading, or lecturing to each of four groups. Subjects were tested immediately and again eight months later. Differences were significant--television was most effective, followed by radio, reading, and lecture, in that order. Eight months later, the only change was that the lecture group was second in effectiveness.

C. TRAINING AIDS AND DEVICES

152. Aukes, Lewis E., and Simon, George B. *The Relative Effectiveness of an Air Force Training Device Used Intact Versus With Isolated Parts*, Research Report AFPTRC TN-57-77, Maintenance Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Lowry AFB, Colo., June 1957.

This study compared the amount of learning from using a complete device, isolated parts of the device, and no device. It was concluded that "(1) In teaching a system of at least moderate complexity to relatively unskilled students, a device that provides a visual map of the system flow and component relationships significantly increases the amount of learning. (2) When a series of conditions or subsystems is involved, a device which eliminates irrelevant materials for each condition or, in effect, presents only that information relevant to each condition is more effective than an over-all device which presents all the information at all times."

153. Denenberg, Victor H. *The Training Effectiveness of the Track and Suspension Trainer, Device 29-FA-61*, Information Report, HUMRRO Division No. 2 (Armor), Fort Knox, Ky., January 1954.

The Track and Suspension Trainer, Device 29-FA-61, was evaluated. Trainees learned as much from this device as from the actual tank.

154. 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*, Technical Report SPECDEVGEN 269-7-101, Special Devices Center, Port Washington, N.Y., June 1954 (Contractor: Pennsylvania State University).

A comparison was made between a wiring board and a plastic covered diagram of the board. There was no significant difference between them as a method for teaching students to use meters. Neither device helped students learn to solve electrical problems.

155. Silverman, Robert E. "The Comparative Effectiveness of Animated and Static Transparencies," *J. Appl. Psychol.*, vol. 43, no. 1, February 1959, pp. 16-20.

Static and animated transparencies were compared with regard to teaching the nomenclature and functions of weapons. On written tests of nomenclature and functions there was no difference. On a performance test, however, the animated transparencies led to superior performance.

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

The effectiveness of various training aids used in conjunction with lectures was evaluated by measuring how much the men learned from the instruction. The aids studied were operating mock-ups, nonoperating mock-ups, cutaway mock-ups, animated panels, charts, and symbolic diagrams. There were no appreciable differences in effectiveness among the aids employed.

157. Swanson, Robert A., and Aukes, Lewis E. *Evaluation of Training Devices for B-47 Fuel, Hydraulic and Rudder Power Control Systems*, Research Report AFPTRC TN-56-2, Training Aids Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Chanute AFB, Ill., January 1956.

In combination with lectures, the following devices were compared: animated panels, charts, cutaways, nonoperating trainers, operating trainers, and symbolic diagrams. Using a multiple-choice test as a criterion, no differences were found in immediate or delayed retention.

158. Torkelson, G.M. *The Comparative Effectiveness of a Mockup, Cutaway, and Projected Charts in Teaching Nomenclature and Function of the 40mm Antiaircraft Weapon and the Mark 13 Type Torpedo*, Technical Report SPECDEVEN 269-7-100, Special Devices Center, Port Washington, N.Y., March 1954 (Contractor: Pennsylvania State University).

The effectiveness of training was compared when using mock-ups, cutaways, and transparencies for instruction on the Mark 13 Type torpedo and the 40-mm antiaircraft gun. There were no significant differences in training effectiveness between the devices.

159. Vris, Thomas. *A Comparison of Principles Training and Specific Training Using Several Types of Training Devices*, Technical Report SPECDEVEN 269-7-102, Special Devices Center, Port

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Washington, N.Y., July 1955 (Contractor: Pennsylvania State University).

Principles vs. specific training was used in connection with various training devices to teach operation of the sound motion picture projector. For teaching 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 a two-dimensional aid; (2) when the task must be performed on other related equipment, it is better to teach principles than specifics; and (3) principles training and specific training were equally effective methods of instruction when two-dimensional aids were used.

D. TAPE RECORDINGS

160. Newman, Slater E., and Highland Richard W. *The Effectiveness of Four Instructional Methods at Different Stages of a Course*, Research Report TN-56-68, Training Aids Research Laboratory, Air Force Personnel and Training Research Center, Chanute AFB, Ill., June 1956.

Four methods of presenting a 21-hour course in radio over a 4-day period were compared. These were (1) live instructor rated above average in ability, (2) tape recordings and workbook, (3) chapters in a notebook, and (4) tape recordings and slides. No overall differences were found. The mass media were as effective as the instructor for the first two-thirds of the course, while the instructor method was superior for the last third of the course.

161. Popham, W. James. "Tape Recorded Lectures in the College Classroom," *AV Communication Rev.*, vol. 9, no. 2, March-April 1961, pp. 109-118.

A course in research methods was taught by two methods: (1) standard lecture-discussion and (2) taped lectures followed by a brief discussion conducted by the instructor. There was no significant difference in achievement.

162. Popham, W. James. "Tape Recorded Lectures in the College Classroom--II," *AV Communication Rev.*, vol. 10, no. 2, March-April 1962, pp. 94-101.

Conventional instruction using the lecture and discussion method was compared with tape recorded lectures combined with student-led discussions. There was no significant difference in achievement.

E. CONTENT ORGANIZERS

163. Ausubel, David P. "The Use of Advance Organizers in the Learning and Retention of Meaningful Verbal Material," *J. Educ. Psychol.*, vol. 51, no. 5, October 1960, pp. 267-272.

This study tested the effect of initial learning of general subsuming concepts as an aid in learning more detailed information.

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Two passages on steel were compared. One had a preliminary section describing the general concepts; the other had a historical introduction. The former treatment led to significant improvement in achievement.

164. Ausubel, David P., and Fitzgerald, Donald. "Organizer, General Background, and Antecedent Learning Variables in Sequential Verbal Learning," *J. Educ. Psychol.*, vol. 53, no. 6, December 1962, pp. 243-249.

The effects of an advance organizer, prior learning, and general background knowledge on the learning of material on endocrinology was studied. The organizer enhanced the learning of material for subjects with low verbal ability. Knowledge of endocrinology, as well as knowledge of a first passage, enhanced later learning.

165. Christensen, C.M., and Stordahl, K.E. "The Effect of Organizational Aids on Comprehension and Retention," *J. Educ. Psychol.*, vol. 46, February 1955, pp. 65-74.

Two passages were selected for study from Air Force correspondence courses. All possible combinations of the following were studied: (1) outline at beginning of the passage, (2) summary at beginning of passage, (3) summary at end of passage, (4) underlining main points, (5) headings in statement form, and (6) headings in question form. No significant differences were found.

166. Goss, Albert E. "Acquisition and Use of Conceptual Schemes," in *Verbal Learning and Verbal Behavior*, Charles N. Cofer (ed.), McGraw-Hill Book Company, Inc., New York, 1961, pp. 42-69.

A framework is provided for analyses and experimentation on conceptual schemes. A conceptual scheme is one or more sets of categories, or two or more variables that stand in an ordinal, functional, or classificatory relationship to each other. History, definition, and use of conceptual schemes are described.

167. Klare, George R., Mabry, James E., and Gustafson, Levarl M. "The Relationship of Patterning (Underlining) to Immediate Retention and to Acceptability of Technical Material," *J. Appl. Psychol.*, vol. 39, no. 1, 1955, pp. 40-42.

This study compared the effects of underlined and nonunderlined material. Underlining selected words, even though subjects are given no explanation for its rationale, may result in somewhat greater immediate retention for more able subjects. Less able subjects may be hindered unless they are told what it means. Patterning appears to have little effect on reading speed or the acceptability of material.

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168. Postman, Leo. "Learned Principles of Organization in Memory," *Psychol. Monogr.*, vol. 68, no. 3, (whole no. 374), 1954, pp. 1-24.

A series of studies is described demonstrating that learned rules of organization can systematically influence both amount and quality of retention. The effectiveness of this training increases with retention interval.

169. Wulff, J. Jepson, and Stolurow, Lawrence M. "The Role of Class-Descriptive Cues in Paired-Associates Learning," *J. Exp. Psychol.*, vol. 53, no. 3, 1957, pp. 199-206.

Two training procedures were developed, one that would facilitate combinations of implicit responses to class and item cues, and one that would not. The former procedure resulted in a reliably higher level of performance.

F. WRITTEN MATERIALS

170. Dale, E., and Chall, J.S. "Developing Readable Materials," in *The Fifty-fifth Yearbook of the National Society for the Study of Education, Part II: Adult Reading*, N.B. Henry (ed.), National Society for the Study of Education, Chicago, 1956, pp. 218-250.

This critical review of the problem of developing readable material includes subtopics as, some problems in communications, how and what adults read, readability formulas, use and interpretation of readability formulas, clear writing for all readers, finding and writing simple reading materials, and some suggestions for writers.

171. Klare, George R., Mabry, James E., and Gustafson, Levarl M. *The Relationship of Verbal Communication Variables to Immediate and Delayed Retention and to Acceptability of Technical Training Materials*, Research Bulletin AFPTRC TR-54-103 Training Aids Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Chanute AFB, Ill., December 1954 (Contractor: University of Illinois).

Technical study guides were modified to introduce variations in readability, use of personal words, and extent of underlining. Patterning did not affect the results. Increased readability, as measured by Flesch and Dale-Chall formulas, produced an increase in immediate retention, reading speed, and judgments of the material as interesting. Use of personal words did not make the guide more interesting.

172. Rubenstein, Herbert, and Aborn, Murray. "Learning, Prediction, and Readability," *J. Appl. Psychol.*, vol. 42, no. 1, February 1958, pp. 28-32.

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One group of subjects memorized as much as possible of 30 passages of English in set periods of study. Another group predicted each successive word from a knowledge of all preceding context. Readability scores were computed for each passage by the Flesch and Dale-Chall formulas. Correlations with amount learned were Flesch, .61; Dale-Chall, .75; and prediction, .73.

173. Schaefer, Halmuth H. "E.A. Poe as a Reinforcer," *Psychol. Rep.*, vol. 8, no. 3, June 1961, p. 398.

Three hundred and fifty German words were used to replace redundant words in three of Edgar Allan Poe's stories. Three college students read the stories. It was found that they could translate simple German sentences and could translate 60% of the words out of context.

G. CLASSROOM ARRANGEMENTS

174. Churchill, Ruth, and John, Paula. "Conservation of Teaching Time Through the Use of Lecture Classes and Student Assistants," *J. Educ. Psychol.*, vol. 49, no. 6, 1958, pp. 324-327.

A comparison was made between teaching mathematics in small sections and teaching by large lecture class combined with a laboratory. There was no significant difference in achievement.

175. Eglash, Albert. "A Group-Discussion Method of Teaching Psychology," *J. Educ. Psychol.*, vol. 45, no. 5, May 1954, pp. 257-267.

An instructor taught one elementary psychology class by group discussion, the other by lecture. Achievement of course content was not significantly different. Morale of the lecture class was higher than that of the discussion class.

176. Feldhusen, John F. "The Effects of Small and Large Group Instruction on Learning of Subject Matter, Attitudes, and Interests," *J. Psychol.*, vol. 55, Second Half, April 1963, pp. 357-362.

A comparison was made between a group of 22 students selected from a large class of 72 students in educational psychology and a matched group of 22 students enrolled in a class of 28 students. There were no significant differences in achievement, interest in teaching, and evaluation of the course and teacher. Scores on the Minnesota Teacher Attitude Inventory were higher for the small-class group.

177. Guetzkow, Harold, Kelly, E. Lowell, and McKeachie, W.J. "An Experimental Comparison of Recitation, Discussion, and Tutorial Methods in College Teaching," *J. Educ. Psychol.*, vol. 45, no. 4, April 1954, pp. 193-207.

The following methods were used to teach introductory psychology: Recitation-Drill, Group-Discussion, and Tutorial-Study.

Presentation of Knowledge

Eight sections were taught by each method. There were no differences of a practical nature between the groups.

178. Haigh, Gerard V., and Schmidt, Warren. "The Learning of Subject Matter in Teacher-Centered and Group-Centered Classes," *J. Educ. Psychol.*, vol. 47, 1956, pp. 295-301.

A comparison was made between group-centered and teacher-centered methods in a psychology course. There was no significant difference between the methods in learning the subject matter.

179. Jenkins, Russell L., "An Appraisal of Teacher-Counselor-Adviser Teaching," *J. Exp. Educ.*, vol. 23, June 1955, pp. 369-373.

In the teaching of communication skills, the lecture method was compared to a method called Teacher-Counselor-Adviser method. There were no significant differences.

180. Marr, John N., Plath, Dean W., Wakeley, John H., and Wilkins, Donald M. "The Contribution of the Lecture to College Teaching," *J. Educ. Psychol.*, vol. 51, no. 5, October 1960, pp. 277-289.

Two methods of conducting introductory psychology--one of four lectures per week and the other of one question-and-answer period per week--were compared. The lecture method resulted in superior achievement.

181. Olson, Kenneth V. "An Experimental Evaluation of a Student-Centered Method and a Teacher-Centered Method of Biological Science Instruction for General Education of College Students," *J. Exp. Educ.*, vol. 27, no. 3, March 1959, pp. 225-230.

A comparison was made between a student-centered and a teacher-centered method of instruction in biology. For one quarter, the teacher-centered method yielded higher achievement of facts; all other results were negative.

182. Parsons, Thomas S. "A Comparison of Instruction by Kinescope, Correspondence Study, and Customary Classroom Procedures," *J. Educ. Psychol.*, vol. 48, 1957, pp. 27-40.

Comparisons were made between groups taught developmental psychology by kinescope, correspondence study, and customary classroom techniques. No method was significantly more effective than another in producing terminal achievement. Correspondence study was as effective as kinescope instruction, and probably more effective than classroom instruction.

183. Rohrer, John H. "Large and Small Sections in College Classes," *J. Higher Educ.*, vol. 28, 1957, pp. 275-279.

The subjects were students in government classes. A comparison was made between student achievement in two classes, one

with 309 students and one with 332 students, and four classes ranging from 23 to 31 students. There was no significant difference in learning between the various classes.

184. Ruja, Harry. "Outcomes of Lecture and Discussion Procedures in Three College Courses," *J. Exp. Educ.*, vol. 22, June 1954, pp. 385-394.

Lecture and discussion approaches were compared in two philosophy courses and one psychology course. In philosophy, there was no significant difference in learning; in psychology, more was learned from the lecture approach.

185. Siegel, Laurence, Adams, James F., and Macomber, F.G. "Retention of Subject Matter as a Function of Large Group Instructional Procedures," *J. Educ. Psychol.*, vol. 51, no. 1, February 1960, pp. 9-13.

A comparison was made between various large group teaching situations and small classes. The situations were: large classes with closed circuit television, large classes with direct contact between student and instructor, and conventional sized classes taught by graduate student assistants. None of the differences between a large group technique and its control group was significant.

H. MISCELLANEOUS

186. Adams, Sydney. "How Good Is a Prescribed Mnemonic Device in Learning Textbook Content?" *J. Educ. Res.*, vol. 55, no. 6, March 1962, pp. 267-271.

A prescribed mnemonic device was used by the experimental group in studying meaningful textbook material, while the control group studied without the prescribed device. There was no significant difference in achievement or time necessary to learn.

187. Beecroft, Robert S. *The Effectiveness of Different Training Methods in School Situations*, Staff Memorandum, HumRRO Division No. 1 (System Operations), Alexandria, Va., September 1955.

Objective investigations of the effectiveness of different training methods in school situations are reviewed. Principal conclusions are that (1) although some lessons are learned better under one overall method of presentation than others, with different subject matter there is no clear evidence of superiority of one method of presentation; (2) effective instruction seems to depend largely on factors that are internal to a lesson rather than being dependent on the method of presentation. Such factors as repeating points within a lesson, telling students specifically what they should learn, and summarizing the principal points are likely to produce effective instruction.

Presentation of Knowledge

188. Beecroft, Robert S., and Anneser, Robert E. *Effectiveness of Increased Repetition in Classroom Learning*, Staff Memorandum, HumRRO Division No. 1 (System Operations), Alexandria, Va., July 1957.

The repetition of major points within a lesson in elementary electricity was found to increase achievement, especially for low-aptitude students.

189. Edgerton, Harold A. *The Relationship of Method of Instruction to Trainee Aptitude Pattern*, Richardson, Bellows, Henry, & Co. Inc., New York, June 1958.

Various subjects were taught in two ways: (1) rote memorization and (2) explanations as to why. For some courses, aptitude factor test scores interacted in complex ways with the method of teaching.

190. Emmons, William H., and Simon, Charles W. "The Non-Recall of Material Presented During Sleep," *Amer. J. Psychol.*, vol. 69, 1956, pp. 76-81.

Subjects monitored by EEG to determine whether they were asleep were presented a list of words. There was no evidence of learning during sleep.

191. Follettie, J.F. *Effects of Training Response Mode, Test Form, and Measure on Acquisition of Semi-Ordered Factual Materials*, Research Memorandum, HumRRO Division No. 4 (Infantry), Fort Benning, Ga., April 1961.

This study compared (1) live and tape-recorded lecture, (2) read and heard presentation, (3) group and self pacing, and (4) plain book and scrambled book format. Results suggest no significant difference between live and tape-recorded lecture, a significant advantage of read over heard material, and a significant advantage of the plain book format over the scrambled book format.

192. Gagné, Robert M. "The Effect of Sequence of Presentation of Similar Items on the Learning of Paired Associates," *J. Exp. Psychol.*, vol. 40, no. 1, February 1950, pp. 61-73.

The effect of grouping similar items vs. separation of similar items by interspersing them among dissimilar items was studied in paired-associate learning. Despite a relatively high rate of initial errors, the grouping of similar items resulted in faster learning.

193. Harcleroad, Fred. "Theoretical Formulations in Audiovisual Communications," *Rev. Educ. Res.*, vol. 32, no. 2, April 1962, pp. 119-126.

Research on theoretical formulations in audiovisual communications between 1956 and 1962 is reviewed. Topics include

(1) social trends affecting audiovisual research; (2) major audiovisual theoretical concepts: (a) concrete-to-abstract relationship, (b) cafeteria of materials, (c) technical theory relating to equipment, (d) optimum use of materials for individual and group learning, (e) systems approach and Finn's Law, (f) models of the communication process, (g) changing role of the teacher, (h) flexibility in design of learning spaces, and (i) total teaching by electronic or mechanical means.

194. Lumsdaine, A.A. "Experimental Research on Instructional Devices and Materials," in *Training Research and Education*, Robert Glaser (ed.), University of Pittsburgh Press, Pittsburgh, 1962, pp. 247-294.

Instructional devices and materials that emphasize research are discussed. Topics considered are instructional devices and materials, characteristics of experimental research on instructional media, student response as a factor in instruction, guidance or cueing of overt and implicit responses, other studies of stimulus factors in instructional media, factors in the content and organization of instruction, and future research and development.

195. Ray, Willis E. "Pupil Discovery vs. Direct Instruction," *J. Exp. Educ.*, vol. 29, no. 3, March 1961, pp. 271-280.

A comparison was made of the methods of directed discovery and direct and detailed instruction in teaching the use of a micrometer. Directed discovery and direct and detailed instruction are equally effective for initial learning and retention after one week. However, directed discovery was superior in retention after six weeks and in transfer to new and related situations.

196. Simon, Charles W., and Emmons, William H. *Considerations for Research in a Sleep-Learning Program*, Rand Corporation, Santa Monica, September 1954.

A review of research on sleep learning. In general, studies fail to support the hypothesis that learning during sleep is practical.

197. Simon, Charles W., and Emmons, William H. "Learning During Sleep?" *Psychol. Bull.*, vol. 52, no. 4, 1955, pp. 328-342.

Ten sleep-learning studies were reviewed, all of which had weaknesses in experimental design, statistics, methodology, or criteria of sleep. The conditions of the studies support the contention that some learning takes place in a special kind of waking state wherein subjects apparently do not remember later if they had been awake.

Presentation of Knowledge

198. Webb, Wilse B., and Wallon, Edward J. "Comprehension by Reading Versus Hearing," *J. Appl. Psychol.*, vol. 40, no. 4, August 1956, pp. 237-240.

College level subjects of high intelligence were taught stories from Greek mythology by one of the following four methods: (1) hearing one time, (2) reading through once, (3) reading and studying, and (4) hearing and reading simultaneously. Methods (1) and (2) were equally effective; methods (3) and (4) were equally effective and superior to the other two methods.

Section IV

PRACTICE OF KNOWLEDGE

A. KNOWLEDGE OF RESULTS

199. Bryan, Glenn L., Rigney, Joseph W., and Van Horn, Charles. *An Evaluation of Three Types of Information for Supplementing Knowledge of Results in a Training Technique*, Technical Report No. 19, Electronics Personnel Research, University of Southern California, Los Angeles, April 1957.

A multiple-choice test, with answers and explanations provided, was used as a training aid. Three types of explanations were compared: (1) those that gave the trainee the correct definition or description of the chosen alternative, (2) those that provided the principal reason why the chosen alternative was keyed as correct or incorrect, and (3) those that pointed out the probable operational consequences of the course of action represented by the alternative. The various types were shown to be equally effective.

200. Chansky, Norman M. "Learning: A Function of Schedule and Type of Feedback," *Psychol. Rep.*, vol. 7, no. 2, October 1960, p. 362.

Four types of feedback were compared in a paired-associate learning task. All combinations of (1) continuous (100%) and intermittent (50%), and (2) correct answer and right-wrong were studied. Continuous correct answer gave fewer trials but lowest recall. Intermittent correct answer was a close second in number of trials, but gave highest recall scores.

201. Cook, John Oliver, and Spitzer, Morton Edward. "Supplementary Report: Prompting Versus Confirmation in Paired-Associate Learning," *J. Exp. Psychol.*, vol. 59, no. 4, April 1960, pp. 275-276.

The following conditions were compared in paired-associate learning: (1) prompting--no overt practice, (2) confirmation--no overt practice, (3) prompting--overt practice, and (4) confirmation--overt practice. Condition (1) was best and (4) worst. Results are interpreted in terms of delay between stimulus and response.

202. Craig, Robert C. "Directed Versus Independent Discovery of Established Relations," *J. Educ. Psychol.*, vol. 47, 1957, pp. 223-234.

Practice of Knowledge

Each of two groups of college students was given a different degree of direction during discovery of the basis for resolving verbal reasoning test items. The group receiving greater direction learned more relations, retained more after 31 days, and was equal to the discovery group in ability to solve new problems.

203. Della-Piana, Gabriel M. "Searching Orientation and Concept Learning," *J. Educ. Psychol.*, vol. 48, 1957, pp. 245-253.

Two variations of knowledge of results were studied in a concept learning task. The first variation, presumed to reduce searching behavior, was to give the correct concept whenever a subject made an error. The second variation, presumed to increase searching behavior, was to tell the subject he was wrong and to try again. The second group gave significantly more definitions of concepts.

204. Gilbert, Arthur C.F. "Effect of Immediacy of Knowledge of Correctness of Response Upon Learning," *J. Educ. Psychol.*, vol. 47, 1956, pp. 415-423.

The use of the SRA self-scorer, which gives automatic knowledge of results by revealing a red dot when an answer is correct, was compared with meaningful explanation of answers to questions. On an achievement test, meaningful explanation was superior. On a test covering the concepts of the most difficult items of the achievement test, there was no difference.

205. Hirsch, Richard S. *The Effects of Knowledge of Test Results on Learning of Meaningful Material*, Human Engineering Report SPECDEVCEN 269-7-30, Special Devices Center, Port Washington, N.Y., September 1952 (Contractor: Pennsylvania State College).

Five methods of providing knowledge of test results (including providing no knowledge) following a training film were compared. Results show the desirability of providing an answer to test questions in meaningful terms rather than simply providing the number of the correct alternative. Repeating the film aided retention.

206. Krumboltz, John D., and Bonawitz, Barbara. "The Effect of Receiving the Confirming Response in Context in Programmed Material," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 472-475.

A program of 153 frames was prepared to teach prospective teachers how to write valid classroom tests. The "isolation" approach involved presenting the desired response as a single word or phrase. The "context" approach was to present the desired response as a complete thought, typically by inserting the desired response in a repetition of the appropriate part of terminology. The context group was superior in application of principles.

207. Melaragno, Ralph J. "Effect of Negative Reinforcement in an Automated Teaching Setting," *Psychol. Rep.*, vol. 7, no. 2, October 1960, pp. 381-384.

Three groups were used in this study: (1) one had an all-positive reinforcement teaching sequence, (2) one had a spaced-negative reinforcement teaching sequence, and (3) one had a massed-negative reinforcement sequence. As measured by a post-test, there was no difference between (1) and (2), while both were superior to (3).

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

Studies of the use of a punchboard to test and provide knowledge of results are described. Punchboards were used as an integral part of regular course work; for superior students they were used in an acceleration seminar, credit by examination, and a self-instructional laboratory. It is concluded that the punchboard with self-instructional tests is a simple way to combine into one process the taking of a test, its scoring, informing students of their errors, and guidance in finding the right answers. Substantial gains were realized when the tests were used in college courses as an integral part of instruction. Other simple devices, such as a chemo-card, are described.

209. Schutz, Richard E., and Whittemore, Robert G., Jr. "Procedures for Giving Immediate Reinforcement in Programmed Instruction," *J. Exp. Anal. Behav.*, vol. 5, no. 4, 1962, pp. 541-542.

Several procedures involving special inks or chemicals for providing immediate knowledge of results are described. The techniques are currently available, considered economically feasible, and administratively practical.

210. Standlee, Lloyd S., and Popham, W. James. "Quizzes' Contribution to Learning," *J. Educ. Psychol.*, vol. 51, no. 6, December 1960, pp. 322-325.

The following conditions were compared: (1) weekly quizzes graded by a teacher, (2) weekly quizzes graded by a student, (3) an instructor reading and answering quiz questions aloud, and (4) no quizzes. The use of quizzes improved achievement early in the course, but the increase is lost by the end of the course.

211. Woiff, Peter C., Van Loo, Joseph A., and Burnstein, David D. *Target Detection: Study 3, Partial Point-out of Targets as Collective Reinforcement in Group Target Detection Training*, Research Memorandum, HumRRD Division No. 2 (Armor), Fort Knox, Ky., August 1962.

Practice of Knowledge

Point-out of the location of targets was considered reinforcement. A percentage schedule required that a certain percentage of the group give a correct response on a given trial. Percents were 80, 60, and 40. A cumulative ratio schedule was used, in which reinforcement was administered each time the cumulative total correct reached 14, 11, or 8. None of the groups receiving partial point-out performed as well as a previous group that had been given 100% point-out.

B. PRINCIPLES

212. Di Vesta, Francis J., and Blake, Kathryn. "The Effects of Instructional 'Sets' on Learning and Transfer," *Amer. J. Psychol.*, vol. 72, 1959, pp. 57-67.

Subjects were asked to give numbers from 1 to 9 in response to words. The following treatments were compared: (1) instructions to search for a principle, (2) instructions not to search for a principle, and (3) random reinforcement. Groups told to search for a principle showed superior learning.

213. Forgas, Ronald H., and Schwartz, Rudolph J. "Efficient Retention and Transfer as Affected by Learning Method," *J. Psychol.*, vol. 43, First Half, January 1957, pp. 135-139.

Three groups learned a new alphabet. Group M simply memorized the alphabet list, Group O received an explanation of the principle underlying the new alphabet, and Group P discovered the principle for themselves. Learning by principle was superior on both recall and transfer to rote learning.

214. Haslerud, G.M., and Meyers, Shirley. "The Transfer Value of Given and Individually Derived Principles," *J. Educ. Psychol.*, vol. 49, no. 6, December 1958, pp. 293-298.

Each subject translated a common four-word sentence into 20 different codes. The rule for translating was given for half of the problems; for the other half, the subjects were required to derive the rule from examples. Subjects did significantly better in initial learning when the rule was given. One week later on a transfer test, the subjects did significantly better on problems in which the rule had been individually derived.

215. Kersh, Bert Y. "The Adequacy of 'Meaning' as an Explanation for the Superiority of Learning by Independent Discovery," *J. Educ. Psychol.*, vol. 49, no. 5, 1958, pp. 282-292.

Subjects learned a mathematical task under one of three treatments: (1) no help, (2) direct reference, and (3) rule given. Acquisition, and recall and transfer tests were given. It is concluded that the advantage of learning by discovery over direct teaching of rules is not explained in terms of increased "meaningfulness." It is suggested that the effect is in terms of increased motivation to continue practicing the task.

C. RESPONSE MODE

216. Goldbeck, Robert A., and Campbell, Vincent N., "The Effects of Response Mode and Response Difficulty on Programed Learning," *J. Educ. Psychol.*, vol. 53, no. 3, June 1962, pp. 110-118.

Two experiments in junior high school classes compared overt, covert, and reading response modes. In Experiment I, 63 subjects completed a program of independent facts at one of three levels of difficulty. An analysis of covariance of test scores showed an interaction between response mode and difficulty, the overt group performing below the other groups at the low difficulty level and above the other groups at the intermediate difficulty level. In Experiment II, 62 subjects completed a continuous discourse program on light. The three response modes plus a fourth option mode were used in a simple randomized design. The reading group had higher scores than the other groups on both immediate and 10-week retention tests, but the difference was significant only on the 10-week test. In both experiments the reading groups learned most per time spent.

217. Krumboltz, John D., and Weisman, Ronald G. "The Effect of Overt Versus Covert Responding to Programed Instruction on Immediate and Delayed Retention," *J. Educ. Psychol.*, vol. 53, no. 2, April 1962, pp. 89-92.

Subjects were assigned to one of four groups that either (1) wrote each response required by a program, (2) "mentally composed" each response, (3) read a program with the blanks filled in, or (4) wrote answers to a completely different program (control). The three experimental groups did not differ in immediate retention, but after two weeks, the written response group was significantly higher than the other two. The control group was significantly lower on both tests.

218. Lambert, Philip, Miller, Donald M., and Wiley, David E. "Experimental Folklore and Experimentation: The Study of Programmed Learning in the Wauwatosa Public Schools," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 485-494.

Ninth grade students worked a programed unit in mathematics without help. Intelligence was significantly related to achievement, but there was no difference of consequence attributable to overt vs. covert response mode. The covert mode took less time.

219. Stolurow, L.M., and Walker, C.C. "A Comparison of Overt and Covert Response in Programmed Learning," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 421-429.

One group worked through a standard programed text writing the answers. The other thought the answers. There was no difference of statistical significance in achievement, but the second response group took less time.

Practice of Knowledge

220. Wolff, Peter C., and Van Loo, Joseph. *Target Detection: Study 3, The Relative Usefulness of Active Participation and Verbal Description Techniques in Target Detection Training*, Research Memorandum, HumRRQ Division No. 2 (Armor), Fort Knox, Ky., July 1962.

Verbal description of tank targets, use of a response box, and a combination of the two were compared. Active participation with the response box improved performance in a training program using stationary targets and in a transfer situation using moving targets. Participation increased the number of false detections. Verbal descriptions hindered target detection, but also suggested a reduction in number of false detections. Transfer from stationary to moving targets occurred, but was not very pronounced.

D. SEQUENCE OF MATERIALS

221. Evans, James L., Homme, Lloyd, and Glaser, Robert. "The Ruleg System for the Construction of Programmed Verbal Learning Sequences," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 513-518.

A description is presented of the Ruleg System of preparing linear programs and its application to program construction.

222. Hickey, Albert E., and Newton, John M. *The Logical Basis of Teaching: I. The Effect of Subconcept Sequence on Learning*, ENTELEK Incorporated, Newburyport, Mass., January 1964.

In a program on the concept of the Gross National Product, 12 versions were prepared to study (1) the order of the subconcepts, (2) the position of the subconcepts in the program, and (3) the directionality of the program with respect to definitions. Sequence of the variables did not affect the error rate. Time required to complete the program was less when the overall program, and each part of the program, began with a statement of the principle to be learned, and then proceeded to more rudimentary definitions. Time required to complete the program was less when the two subconcepts were learned together, instead of being separated by basic definitions. Transfer test scores were lower when learning of both subconcepts was remote from learning of the major concept.

223. Holland, James G., and Porter, Douglas. "The Influence of Repetition of Incorrectly Answered Items in a Teaching-Machine Program," *J. Exp. Anal. Behav.*, vol. 4, 1961, pp. 305-307.

One group repeated missed items in a program until each was correctly answered while a second group did not repeat missed items. Learning was superior for the first group. Retention was influenced by the difficulty of the items, the easier items being retained more than difficult items.

224. Roe, K. Vlachouli, Case, H.W., and Roe, A. "Scrambled Versus Ordered Sequence in Autoinstructional Programs," *J. Educ. Psychol.*, vol. 53, no. 2, April 1962, pp. 101-104.

A 71-item program on elementary probability was given in scrambled sequence to one group, and in properly ordered sequence to another. Sequence differences had no significant effect on time required for learning, error, score during learning, criterion test score, or time required during criterion test.

225. Rotberg, Iris C., and Woolman, Myron. "Verbal Paired-Associate Learning as a Function of Grouping Similar Stimuli or Responses," *J. Exp. Psychol.*, vol. 65, no. 1, January 1963, pp. 47-51.

Verbal paired-associate learning was measured when similar or dissimilar responses and stimuli were grouped. The results indicated that learning was better when groups of stimuli were composed of similar items than when they were composed of dissimilar ones.

226. Rothkopf, Ernst Z. "Automated Teaching Devices and a Comparison of Two Variations of the Method of Adjusted Learning," *Psychol. Rep.*, vol. 8, no. 1, February 1961, pp. 163-169.

Two plans for using the method of adjusted learning are described. Using paired associates, the following plans are compared: (1) An item answered correctly is withdrawn from item storage; practice continues until all items have been answered correctly, then the machine repeats the cycle a predetermined number of times. (2) An item is removed whenever it has been answered correctly an appropriate number of times. There was no significant difference in learning between the two plans. It is expected that the first plan will require a less expensive device.

227. Senter, R.J., Nieberg, A., Abma, J.S., and Morgan, R.L. *An Evaluation of Branching and Motivational Phrases in a Scrambled Book*, Technical Documentary Report No. 63-122, Behavioral Sciences Laboratory, 6570th Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio, November 1963 (Contractor: University of Cincinnati).

Three versions of a scrambled text were evaluated. The versions were (1) unmodified, (2) changed by deletion of motivational phrases, and (3) straight line having neither motivational phrases nor branching. Results showed no significant differences in amount learned or in study time.

E. MEANINGFULNESS

228. Dowling, Robert M., and Braun, Harry W. "Retention and Meaningfulness of Material," *J. Exp. Psychol.*, vol. 54, no. 3, 1957, pp. 213-217.

Practice of Knowledge

Subjects learned lists selected to be of high, medium, and low meaningfulness. Rate of original learning was found to be positively related to meaningfulness. Retention was measured after one and seven days. As measured by aided recall and unaided recall, the effects of meaningfulness and retention interval were significant. Neither variable was significant when measured by the reconstruction and relearning methods.

229. Noble, C.E. "The Role of Stimulus Meaning (m) in Serial Verbal Learning," *J. Exp. Psychol.*, vol. 43, no. 6, June 1952, pp. 437-446.

A standard serial anticipation method was used in which 72 college students learned three lists of 12 dissyllabic words differing in average meaningfulness. Verbal learning difficulty was a decreasing curvilinear function of average meaningfulness. The introduction of a two-minute rest pause, involving color naming, at the stage of 7 out of 12 correct resulted in decreased errors for all lists, the reduction in errors being greatest for the list of lowest average meaning.

230. Noble, Clyde E. "An Analysis of Meaning," *Psychol. Rev.*, vol. 59, no. 6, November 1952, pp. 421-430.

Meaning is defined as a relationship between a stimulus and a response. Meanings are assumed to increase as a simple linear function of the number of responses to a given stimulus. An index of stimulus meaning is operationally defined as the mean frequency of continued written associations made by subjects within a 60-second time interval. A scale of m values was developed which had a range from 0.99 to 9.61, and had a mean intergroup reliability coefficient of .975.

231. Sarason, Irwin G. "The Effect of Associative Value and Differential Motivating Instructions on Serial Learning," *Amer. J. Psychol.*, vol. 70, 1957, pp. 620-623.

The effects of associative value and motivating instructions on verbal learning were studied. Subjects who learned a list of 80% associative value were superior to those who learned 53% to 27% lists. Experimenter- and subject-centered motivating instructions led to performance superior to that of a control group. On a retention test only the variable of associative value was significant. There was no interaction between associative value and motivating instructions.

F. DISTRIBUTION OF PRACTICE

232. Underwood, Benton J. "Studies of Distributed Practice: VIII. Learning and Retention of Paired Nonsense Syllables as a Function of Intralist Similarity," *J. Exp. Psychol.*, vol. 45, no. 3, March 1953, pp. 133-142.

Practice of Knowledge

The variables studied in the learning and retention of paired nonsense syllables were (1) intertrial interval--4, 30, and 60 seconds, and (2) intralist similarity-response and stimulus. Retention was measured after 24 hours. Results were that (1) there was no influence of intertrial rest on rate of learning, but error frequency was inversely related to intertrial rest in experiments in which stimulus similarity was varied; (2) difficulty of learning increased with an increase in stimulus similarity, but was not affected by variation in response similarity, and errors increased with response similarity, but not with stimulus similarity; and (3) neither similarity nor intertrial rest affected retention.

233. Underwood, Benton J. "Studies of Distributed Practice: IX. Learning and Retention of Paired Adjectives as a Function of Intralist Similarity," *J. Exp. Psychol.*, vol. 45, no. 3, March 1953, pp. 143-149.

The variables studied in relation to learning of paired adjective lists were (1) intertrial interval--4, 30, and 60 seconds, (2) three degrees of stimulus similarity, and (3) three degrees of response similarity. Similarity was varied by changing the degree of synonymy among sets of words in a list. Results were that (1) intertrial interval was not related to learning or retention, (2) variations in response similarity did not influence rate of learning, but errors increased with similarity, (3) lists of medium stimulus similarity took the longest to learn, (4) during learning, errors decreased directly with intertrial interval, and (5) neither types of similarity produced significant effects on retention.

234. Underwood, Benton J. "Studies of Distributed Practice: X. The Influence of Intralist Similarity on Learning and Retention of Serial Adjective Lists," *J. Exp. Psychol.*, vol. 45, no. 4, April 1953, pp. 253-259.

Three lists of adjectives, which varied in degree of synonymy of clusters within each list, were learned serially by groups that had rests of 2, 30, and 60 seconds. The lists were learned to a criterion of one perfect trial, followed by a retention test after 24 hours. The relative similarity of the lists did not affect the results. However, learning was faster for the 30- and 60-second rest groups than for the 2-second rest groups. No differences in retention were evident. Additional lists of wide differences in similarity were constructed and wide differences in rate of learning occurred, favoring the list of low similarity.

235. Underwood, Benton J. "Studies of Distributed Practice: XI. An Attempt to Resolve Conflicting Facts on Retention of Serial Nonsense Lists," *J. Exp. Psychol.*, vol. 45, no. 5, May 1953, pp. 355-359.

Practice of Knowledge

A previous study by Hovland, which found better retention after distributed practice than after massed practice, conflicted with a study by Underwood, which found the reverse. Two experiments were conducted. In Experiment I the rest periods between trials were 60, 90, and 120 seconds, and the retention interval was 24 hours. In Experiment II, the rest intervals were 2, 60, and 120 seconds, while the retention interval was 48 hours. Relearning was by massed practice. Results showed (1) better learning by distributed practice, but no significant difference between 60 and 120 seconds, and (2) better retention following massed practice, but little difference between 60 and 120 seconds.

236. Underwood, Benton J. "Ten Years of Massed Practice on Distributed Practice," *Psychol. Rev.*, vol. 68, no. 4, July 1961, pp. 229-247.

Distributed practice effect in learning of verbal lists is small compared with motor learning. The evidence indicates that distributed practice enhances learning only when interference occurs in the response-learning phase. The greater the interference the shorter the distribution interval required to facilitate learning.

G. CLASSIFICATIONS

237. Hake, Harold W., and Eriksen, Charles W. "Effect of Number of Permissible Response Categories on Learning of a Constant Number of Visual Stimuli," *J. Exp. Psychol.*, vol. 50, no. 3, 1955, pp. 161-167.

Subjects were required to learn to apply either two, four, or eight irrelevant verbal labels to unfamiliar visual patterns. They were then required to learn a new set of labels for the same patterns. Success on the transfer task was positively related to the number of labels on the transfer task, but not to the number of labels on the initial task.

238. Helson, Ravenna Mathews, and Cover, Anne. "Specificity-Generality of Classificatory Categories as a Variable in Recall," *Percept. Mot. Skills*, vol. 6, 1956, pp. 233-236.

Subjects classified names of famous persons into either a specific or a general category. Each specific category was a subcategory of one of the general categories. After an interval of other activity, the subjects attempted to recall the names. Those using specific categories recalled significantly more names with fewer errors than those using general categories.

239. Mathews, Ravenna. "Recall as a Function of Number of Classificatory Categories," *J. Exp. Psychol.*, vol. 47, no. 4, 1954, pp. 241-247.

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The subjects classified names of famous people into two, three, or six categories. The more categories used, the more names subjects recalled. The categories were also easily learned.

H. MISCELLANEOUS

240. Arnoult, Malcolm D. *A Comparison of Training Methods in the Recognition of Spatial Patterns*, Research Report AFPTRC TN-56-27, Skill Components Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Lackland AFB, Tex., February 1956.

Subjects were taught to recognize spatial patterns by one of several methods: (1) reproduction of patterns from memory, (2) general questioning about patterns, (3) specific questioning about patterns, and (4) observation of patterns. The reproduction method was clearly superior. Questioning methods were relatively ineffective.

241. Callantine, Mary F., and Warren, J.M. "Learning Sets in Human Concept Formation," *Psychol. Rep.*, vol. 1, 1955, pp. 363-365.

Subjects, divided into groups, each learned a set of concepts, with varying numbers of different examples. The group having the largest number of examples made most errors in initial learning, but was best on a transfer test.

242. Eisner, Sigmund, and Rohde, Kermit. "Note Taking During or After the Lecture," *J. Educ. Psychol.*, vol. 50, no. 6, December 1959, pp. 301-304.

During one lecture in English literature students took notes and studied later. During the other lecture they listened and then took notes and studied afterward. There was no difference between the groups in true-false and essay tests.

243. Feldhusen, John F., and Birt, Andrew. "A Study of Nine Methods of Presentation of Programmed Learning Material," *J. Educ. Res.*, vol. 55, no. 9, June-July 1962, pp. 461-466.

A 37-frame program on concepts of programmed instruction was used to study variables of mode of presentation, feedback, and group vs. individual study. There were no significant differences in achievement.

244. Freibergs, Vaira, and Tulving, Endel. "The Effect of Practice on Utilization of Information From Positive and Negative Instances in Concept Identification," *Canad. J. Psychol.*, vol. 15, 1961, pp. 101-106.

In a series of concept identification problems, one group was given only positive instances, while the other had only negative instances. Considerable improvement in performance was found

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for both groups over the practice period. The positive instance group was markedly superior in the beginning, but both groups were similar by the completion of 20 trials.

245. Klaus, David J. *The Investigation of Step Size and Error Rate in Programmed Instruction*, Technical Report NAVTRADEVCFN 1208-1, U.S. Naval Training Device Center, Port Washington, N.Y., July 1964 (Contract: American Institute for Research).

Step size was defined, measured, and manipulated to determine its effects on error rate and achievement for students at three levels of ability. The size of step affected the number of errors and the time needed to learn the material, but did not affect achievement. Ability was related to errors, time to learn, and achievement. If ability differences are controlled, the number of errors made have no relationship to achievement. Implications are that (1) in the selection of linear programs, less importance can be placed on step size and reported error rate; (2) assignment of students varying in ability to programs varying in step size is not warranted; and (3) unless it is excessively high, error rate should not be a primary basis for revising a program.

246. Kristofferson, Alfred B. "Repetition and Paired Associates Learning," *Science*, vol. 134, no. 3495, December 1961, pp. 2036-2037.

Recent experiments by Rock and Estes have suggested that paired associates that are practiced but missed are equivalent to new items on later trials. This supports an all-or-none theory of the formation of associations. Two experiments in this article report that if correct items are eliminated after each trial, the probability of a correct response to a previously missed item is higher than the probability of a correct response to a new item.

247. Kurtz, Kenneth H., and Hovland, Carl I. "The Effect of Verbalization During Observation of Stimulus Objects Upon Accuracy of Recognition and Recall," *J. Exp. Psychol.*, vol. 45, no. 3, 1953, pp. 157-164.

Without indication that there would be a retention test, 72 elementary school children observed an array of 16 familiar objects. Half of the subjects named the objects, while half did not. Verbalization resulted in superior retention, in both recall and recognition.

248. Maltzman, Irving. "On the Training of Originality," *Psychol. Rev.*, vol. 67, no. 4, July 1960, pp. 229-242.

The problem in the training of originality is to develop a means of increasing the frequency of uncommon behavior so that it may be reinforced. A procedure that consistently facilitated originality is described. The procedure involves repeated presentations of a list of stimulus words with instructions to give

a different response to each stimulus. Such training transfers to other test situations.

249. Maltzman, Irving, Bogartz, William, and Breger, Louis. "A Procedure for Increasing Word Association Originality and Its Transfer Effects," *J. Exp. Psychol.*, vol. 56, no. 5, November 1958, pp. 392-398.

Training and instructions to give original responses to a word association were effective in transferring to a list of words not practiced. Verbal reinforcement of every fifth original response was not.

250. Maltzman, Irving, Simon, Seymore, Raskin, David, and Licht, Leonard. "Experimental Studies in the Training of Originality," *Psychol. Monogr.*, vol. 74, no. 6, Whole No. 493, 1960.

Four experiments in the training of originality are described. The standard method of requiring different responses to the same list is effective. Originality is a form of operant behavior. The effects of training may persist as long as two days. Originality varies as a function of the number of repetitions of the training list.

251. McClendon, Paul I. "An Experimental Study of the Relationship Between the Note-Taking Practices and Listening Comprehension of College Freshmen During Expository Lectures," *Speech Monogr.*, vol. 25, 1958, pp. 222-228.

The following procedures were compared: (1) taking no notes on a lecture, (2) taking notes on main points only, (3) taking detailed notes, and (4) taking notes in usual manner. There was no significant difference in immediate and delayed retention because of different note-taking practices.

252. McKeachie, W.J., and Hiler, Wesley. "The Problem-Oriented Approach to Teaching Psychology," *J. Educ. Psychol.*, vol. 45, 1954, pp. 224-232.

Two experiments were undertaken to obtain evidence of the effectiveness of work sheets in an elementary psychology course. The results were highly significant in favor of the group using the work sheets.

253. Newman, Slater E. "Student vs. Instructor Design of Study Method," *J. Educ. Psychol.*, vol. 48, 1957, pp. 328-333.

Subjects were required to learn the names of 70 electrical symbols. A student group studied using its own methods. An instructor group used materials and study methods designed by psychologists. The student group was superior to the instructor group. The need for research on how to apply laboratory-derived principles to the design of instructional materials is emphasized.

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254. Noble, Clyde E. "The Effect of Familiarization Upon Serial Verbal Learning," *J. Exp. Psychol.*, vol. 49, no. 5, 1955, pp. 333-338.

Subjects were presented with 0, 1, 2, 3, 4, 5, 10, or 20 exposures of six meaningless and unfamiliar verbal stimuli and were required to pronounce them. Then the six items were encountered in serial lists to be learned by the anticipation method. The effect of prior familiarization was a significant reduction in the number of trials necessary to mastery.

255. Postman, Leo. "Retention as a Function of Degree of Over-learning," *Science*, vol. 135, no. 3504, February 1962, pp. 666-667.

Subjects learned serial lists of high and low frequency of usage. For both types of lists, the amount of recall showed a positively accelerated rise with degree of overlearning. Speed of relearning to mastery was directly related to degree of overlearning.

256. Resnick, L.B. "Programmed Instruction and the Teaching of Complex Intellectual Skills: Problems and Prospects," *Harvard Educational Rev.*, vol. 33, no. 2, 1963, pp. 439-471.

This article provides a discussion of the implications of operant conditioning and cognitive theory for the learning of complex intellectual skills by programmed instruction.

257. Rock, Irvin. "Repetition and Learning," *Scient. Amer.*, vol. 199, no. 2, 1958, pp. 68-72.

Associations are formed on one trial. Repetition is necessary to strengthen them. The "villain" in rote learning is interference. Drill can be reduced by presenting small amounts of information at a time.

258. Smith, Wendell, and Moore, J. William. "Size-of-Step and Achievement in Programmed Spelling," *Psychol. Rep.*, vol. 10, no. 1, February 1962, pp. 287-294.

Subjects learned spelling words by one of six methods in which size-of-step and cueing were varied. The various methods had no effect on errors, but large steps saved time.

259. Vanderplas, James M. "Transfer of Training and Its Relation to Perceptual Learning and Recognition," *Psychol. Rev.*, vol. 65, no. 6, November 1958, pp. 375-385.

An analysis is made of transfer of training and the applicability of its concepts to perceptual learning and recognition.

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260. Williams, Joanna P. "Supplementary Report: A Selection Artifact in Rock's Study of the Role of Repetition," *J. Exp. Psychol.*, vol. 62, no. 6, December 1961, pp. 627-628.

Data are presented which suggest that Rock, with his procedure of showing all-or-none associations, tended to select easy items to learn.

Section V

PRACTICE OF PERFORMANCE

A. KNOWLEDGE OF RESULTS

261. Ammons, Robert B. *Knowledge of Performance; Survey of Literature, Some Possible Applications, and Suggested Experimentation*, WADC Technical Report No. 54-14, Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, February 1954.

The literature on knowledge of results is reviewed, with 11 empirical generalizations, 8 statements as a basis for a theory, and 11 application principles.

262. Annett, John. "Learning a Pressure Under Conditions of Immediate and Delayed Knowledge of Results," *Quart. J. Exp. Psychol.*, vol. 11, February 1959, pp. 3-15.

A variety of studies comparing different forms of simultaneous visual feedback in learning a pressure were performed. Immediate feedback improved performance during practice, but its removal resulted in poorer performance.

263. Annett, John, and Kay, Harry. "Knowledge of Results and Skilled Performance," *Occup. Psychol.*, vol. 31, 1957, pp. 69-79.

A review and theoretical analysis of the role of knowledge of results is discussed. Distinctions between different kinds of feedback cues are drawn.

264. Archer, E. James, and Namikas, Gediminas A. "Pursuit Rotor Performance as a Function of Delay of Information Feedback," *J. Exp. Psychol.*, vol. 56, no. 4, October 1958, pp. 325-327.

Subjects learned a rotary pursuit task for 45 trials. During the first 30 trials, subjects heard a tone after being on target for one of five durations--delays of 0, .2, .4, .8, and 1.6 seconds. No tone was heard for the last 15 trials. Delay of informational feedback did not significantly affect performance.

265. Bilodeau, Edward A. *Some Effects of Various Degrees of Supplemental Information Given at Two Levels of Practice Upon the Acquisition of a Complex Motor Skill*, Research bulletin 52-15, Perceptual and Motor Skills Research Laboratory, Human Resources Research Center, Air Training Command, Lackland AFB, Tex., April 1952.

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The experimental variable was a cue involving the target of the Pedestal Sight Manipulation Test. The target turned red whenever the subjects were on target in azimuth, range, and elevation simultaneously. This procedure improved ranging scores, but not scores for azimuth and elevation. When the cue was withdrawn, performance dropped to that of the control group. The results suggest caution in providing, during training, knowledge of results information of a kind not available in the operational situation.

266. Bilodeau, Edward A. *Speed of Acquiring a Simple Motor Response as a Function of Systematic Transformations of Knowledge of Results*, Research Bulletin 52-33, Perceptual and Motor Skills Research Laboratory, Human Resources Research Center, Air Training Command, Lackland AFB, Tex., November 1952.

Subjects were required to adjust a micrometer knob to achieve a reading of 200 when they could not see the scale. They were informed of their actual reading or of a linear transformation of the reading. Initially, learning was faster in the group given correct knowledge of results. The rate of initial learning varied with the degree of correctness. However, after 16 trials, the differences between the groups disappeared.

267. Bilodeau, Edward A. "Accuracy of Response as a Function of Target Width," *J. Exp. Psychol.*, vol. 47, no. 3, March 1954, pp. 201-207.

Scores were reported to subjects with varying degrees of tolerance. However, the actual target used was the same. Groups with the narrower targets learned most rapidly.

268. Bilodeau, Edward A., and Bilodeau, Ina McD. "Variable Frequency of Knowledge of Results and the Learning of a Simple Skill," *J. Exp. Psychol.*, vol. 55, no. 4, April 1958, pp. 379-383.

An experiment was conducted to test the effects of relative and absolute frequency of knowledge of results on learning a simple skill by varying the proportions of trials on which knowledge of results was given, while keeping the total number of knowledges of results constant. Learning was independent of relative frequency and positively related to absolute frequency.

269. Bilodeau, Edward A., and Bilodeau, Ina McD. "Variation of Temporal Intervals Among Critical Events in Five Studies of Knowledge of Results," *J. Exp. Psychol.*, vol. 55, no. 6, June 1958, pp. 603-612.

Five studies are described in which the variables were the durations of delay of knowledge of results (KR), post KR delay, and intertrial interval. Mainly because there was no formal interpolated activity before and after KR and the subject learned a simple response, no differential effect of delay of KR was expected or found. Performance varied inversely with the duration of the intertrial interval.

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270. Bilodeau, Edward A., Bilodeau, Ina McD., and Schumsky, Donald A. "Some Effects of Introducing and Withdrawing Knowledge of Results Early and Late in Practice," *J. Exp. Psychol.*, vol. 58, no. 2, August 1959, pp. 142-144.

In a lever-displacing task, knowledge of results was introduced at various stages of practice. The results were (1) no improvement without knowledge of results, (2) progressive improvement with knowledge of results, and (3) response deterioration after withdrawal of knowledge of results.

271. Bilodeau, Edward A., and Rosenback, John H. *Acquisition of Response Proficiency as a Function of Rounding Error in Informative Feedback*, Research Bulletin 53-21, Perceptual and Motor Skills Research Laboratory, Human Resources Research Center, Lackland AFB, Tex., July 1953.

In a micrometer setting task, subjects were given feedback that was subject to various degrees of rounding. In the early trials, subjects receiving more accurate feedback were superior. By trial number 5, groups were similar in performance.

272. Cotterman, Theodore E. *Effects of Variations in Specificity of Knowledge of Results on the Improvement of a Perceptual Skill*, WADC Technical Report 58-673, Behavioral Sciences Laboratory, Aerospace Medical Division, Wright Air Development Division, Air Research and Development Command, Wright-Patterson AFB, Ohio, August 1960.

Subjects estimated how many degrees a $1/4$ -inch arrow would have to be turned to parallel a line drawn across a $3\frac{1}{2}$ -inch circle. Knowledge of results given after each estimation varied in specificity from right-wrong to amount and direction of error. No knowledge was provided a control group. It was concluded that knowledge of results increases the rate and level of learning to perform an absolute judgment of spatial extent and this effect is generally greater the more specific the knowledge.

273. Goldstein, Mymon, and Rittenhouse, Carl H. "Knowledge of Results in the Acquisition and Transfer of a Gunnery Skill," *J. Exp. Psychol.*, vol. 48, no. 3, September 1954, pp. 187-196.

Knowledge of results was presented in pedestal sight gunnery using either a buzzer during trials or verbal comments after trials. Amount and pattern of feedback made little difference. Buzzer introduction and removal led to sharp rises and drops in scores. No such effects accompanied the verbal feedback. Buzzer subjects were at a disadvantage when transferring to a new device.

274. Greenspoon, Joel, and Foreman, Sally. "Effect of Delay of Knowledge of Results on Learning a Motor Task," *J. Exp. Psychol.*, vol. 51, no. 3, March 1956, pp. 226-228.

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Blindfolded subjects attempted to draw a three-inch line. Knowledge of results was delayed for 0, 10, 20, and 30 seconds in four different groups. No information was given a control group. Increasing the delay reduced the rate of learning. A delay of 30 seconds was superior to no information.

275. Hillix, W.A., and Marx, Melvin H. "Response Strengthening by Information and Effect in Human Learning," *J. Exp. Psychol.*, vol. 60, no. 2, August 1960, pp. 97-102.

A pattern of lights was learned with either information only or information plus reward following the response. During acquisition in two experiments the information-only group was superior. Transfer tests yielded inconsistent results.

276. Karlin, Lawrence, and Mortimer, Rudolf G. "Effect of Verbal, Visual, and Auditory Augmenting Cues on Learning a Complex Motor Skill," *J. Exp. Psychol.*, vol. 65, no. 1, January 1963, pp. 75-79.

The effects of additional cues on performance of a compensatory tracking task were studied. A group receiving a verbal cue was superior in final training and transfer trials to a control group. Results from visual and auditory cues were superior to the control condition, but individually none of these differences was significant. It is suggested that augmenting cues were most effective in transfer when they operated to reward desirable patterns of behavior and develop standards of performance rather than when they operated to guide immediate action.

277. Kinkade, R.G. *A Differential Influence of Augmented Feedback on Learning and on Performance*, WADC Technical Report AMRL-TDR-63-12, Aerospace Medical Research Laboratories, Air Force Systems Command, Wright Air Development Center, Wright-Patterson AFB, Ohio, February 1963 (Contractor: Ohio State University).

A test was made of the hypothesis that the value of augmented feedback during training depends on the discernibility of input and fundamental feedback signals. Four groups were used in a tracking task. Two had augmented feedback, while two did not. Two had noisy reference elements, two had stable reference elements. The performance of the group with augmented feedback and the noisy display deteriorated when augmented feedback was removed. However, the group with augmented feedback and the noise-free display continued unchanged and superior to that of its control group trained without feedback.

278. Kinkade, R.G. *Augmented Feedback and Tracking Skill*, Technical Report NAVTRADEVCEEN 508-3, U.S. Naval Training Device Center, Port Washington, N.Y., 1959.

Three studies were conducted of augmented feedback, which is feedback information provided an operator in addition to that provided by the task itself. In the first study, optimum

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augmented feedback depended on the skill of the operator, large amounts being required in early practice, less in later practice. There was a significant interaction between amount and schedule of augmented feedback. A change to no feedback caused performance to asymptote at a previously attained level.

279. Lincoln, Robert S. "Learning a Rate of Movement," *J. Exp. Psychol.*, vol. 47, no. 6, June 1954, pp. 465-470.

Subjects were required to produce a rate of turning a handwheel. During learning trials, they were provided verbal feedback on the direction and amount of their average rate error. One group was also provided with a continuous visual indicator of rate errors. During test trials, the group with the visual indicator performed poorest.

280. MacPherson, S.J., Dees, Valerie, and Grindley, G.C. "The Effect of Knowledge of Results on Learning and Performance: II. Some Characteristics of Very Simple Skills," *Quart. J. Exp. Psychol.*, vol. 1, 1948-1949, pp. 68-78.

The introduction and removal of visual knowledge of results in simple tasks was studied. The tasks included drawing a line of a certain length, exerting a given pressure on a lever, or pressing a key for a given time. A series of readings with visual knowledge of results led to more accurate performance than a series without it. The effect was different on various tasks.

281. Noble, Clyde E., and Alcock, Wayne T. "Human Delayed-Reward Learning With Different Lengths of Task," *J. Exp. Psychol.*, vol. 56, no. 5, November 1958, pp. 407-412.

Subjects practiced a short or a long task under one of six delays of reinforcement up to three seconds. Delay of reinforcement was not an effective variable.

282. Parks, Robert B. *Verbal Feedback in Pedestal Sight Manipulation*, Research Bulletin AFPTRC-TR-54-91, Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Lowry AFB, December 1964.

Five variations in feedback were studied: (1) time and direction of error in range, elevation, and azimuth; (2) time only; (3) group trends; (4) no feedback; (5) no feedback, but personal attention. The time and direction group, which received the most accurate feedback, was superior.

283. Pollack, Irwin, and Johnson, Lawrence B. "Reproduction and Identification of Elements of Auditory Displays," *J. Acoust. Soc. Amer.*, vol. 31, no. 1, January 1959, pp. 7-8.

Short periods of producing or reproducing tones improves verbal identification of frequency better than that attained

with no feedback. This improvement is no better than that attained with verbal information about the correct response. Substantial improvements in the identification of tones are possible with the use of an available catalog of possible signals.

284. Reynolds, Bradley, and Adams, Jack A. "Motor Performance as a Function of Click Reinforcement," *J. Exp. Psychol.*, vol. 45, no. 5, May 1953, pp. 315-320.

Five groups of subjects performed on the rotary pursuit test. The condition that was varied was the duration of the time on target to obtain a click. The durations were .10, .20, .50, 1.0, and 2.0 seconds. All experimental groups were superior to a control group (no click), with the .50-second group showing the highest level of performance. The fact that the experimental groups did not shift to the level of the control group during a no-click period suggests that the superiority of the experimental groups can, in part, be attributed to learning rather than motivational variables.

285. Stockbridge, H.C.W., and Chambers, B. "Aiming, Transfer of Training, and Knowledge of Results," *J. Appl. Psychol.*, vol. 42, no. 3, June 1958, pp. 148-153.

The effect of added artificial knowledge of results on learning to aim at moving targets, using a synthetic trainer, is described. Toward the end of the training period, there were significant differences between the group receiving artificial feedback and the group not receiving it, but these differences were not significant when the added knowledge of results was removed.

286. Wolff, Peter C., Burnstein, David D., and Van Loo, Joseph A. "Effects of Schedules of Collective Reinforcement on a Class During a Target Detection Course," *Percept. Mot. Skills*, vol. 15, no. 3, December 1962, pp. 727-735.

On a target detection task, one group received praise whenever 80% gave the correct response, one received praise whenever the cumulative total of correct responses reached 24, and one received no reinforcement. Another variable was graded vs. random presentation of slides. The ratio method led to better performance and the percentage method to poorer performance than the no-praise method. Graded presentation of slides was superior to random presentation.

B. VERBAL PRETRAINING

287. Arnoult, Malcolm D. "Transfer of Predifferentiation Training in Simple and Multiple Shape Discrimination," *J. Exp. Psychol.*, vol. 45, no. 6, June 1953, pp. 401-409.

Subjects were given either verbal predifferentiation training or no training on nonsense shapes and then given a shape discrimination test. No overall significant differences occurred

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as a result of the experimental treatment. However, there were indications that positive results might be obtained if more intensive pretraining were given.

288. Arnoult, Malcolm D. "Stimulus Predifferentiation: Some Generalizations and Hypotheses," *Psychol. Bull.*, vol. 54, no. 4, July 1957, pp. 339-350.

A review of the literature on stimulus predifferentiation (verbal pretraining) is discussed. Generalizations are that the most effective method is Relevant S-R pretraining followed closely by Relevant S. Positive transfer may be expected after a minimum of 4 to 8 pretraining trials, and reaches a maximum after 8 to 12 pretraining trials.

289. Bailey, Joan H., and Jeffrey, Wendell E. "Response Strength and Association Value in Stimulus Predifferentiation," *Psychol. Rep.*, vol. 4, no. 4, December 1958, pp. 715-721.

The conditions of the study included (1) overlearning of a single nonsense syllable pair, (2) learning multiple responses to a single stimulus, and (3) learning a single response to multiple stimuli. Greater facilitation resulted when the pre-trained item appeared as the response member in the paired-associate list than when it was the stimulus member. The treatment conditions did not result in differential effects.

290. Baker, Katherine E., and Wylie, Ruth C. "Transfer of Verbal Training to a Motor Task," *J. Exp. Psychol.*, vol. 40, no. 5, October 1950, pp. 632-638.

Subjects were given 0, 8, and 24 trials of verbal practice on the stimulus-response relationships involved in a task requiring the operation of one of four toggle switches in response to red or green signal lights appearing in either of two positions on a vertical panel. When the criterion was time, eight verbal trials showed no transfer but 24 verbal trials resulted in significant transfer. Similar results were found when error was the criterion.

291. deRivera, Joseph H. *Some Conditions Governing the Use of the Cue Producing Response as an Explanatory Device*, Research Project NM 14 02 11, Subtask 11, Report No. 2, U.S. Naval School of Aviation Medicine, U.S. Naval Aviation Medical Center, Pensacola, Fla., January 1958.

Variations in methods of teaching differential responses to cues were studied. All groups receiving training were better on a transfer task than those receiving no training. The group which overlearned achieved greater transfer.

292. Eckstrand, Gordon A., and Morgan, Ross L. *The Influence of Training on the Tactile Discriminability of Knob Shapes*, WADC Technical Report 56-8, Aero Medical Laboratory, Wright Air

Development Center, Air Research and Development Command,
Wright-Patterson AFB, Ohio, January 1956.

Three groups were studied to determine the influence of training on tactual discriminability of four knob shapes: (1) Control group--no training, (2) Tactual-Name Group--experience in the feel of the knobs with associated names, and (3) Tactual Group--experience in only the feel of the knobs. Group T-N was superior to Group C by both time and error criteria. Group T was superior to Group C in the error criterion only.

293. Gagné, R.M., and Baker, Katherine E. "Stimulus Pre-Differentiation as a Factor in Transfer of Training," *J. Exp. Psychol.*, vol. 40, no. 4, August 1950, pp. 439-451.

Four matched groups of 32 subjects were respectively given 0, 8, 16, and 32 trials of training in which they practiced the association of the letters J, V, S, and M to four different light stimuli on a panel. Then time and error scores were obtained for each subject during 60 trials of practice on a motor task in which the same stimuli were paired with manual responses to four different switches. Eight and 16 predifferentiating trials yielded little transfer, while 32 trials resulted in considerable transfer. It is suggested that if a training aid is designed to depend for its effectiveness on the practice it provides in differentiating the stimuli of a motor task, a brief period of practice is of little value.

294. Gagné, Robert M., Baker, Katherine E., and Foster, Harriet. "Transfer of Discrimination Training to a Motor Task," *J. Exp. Psychol.*, vol. 40, no. 3, June 1950, pp. 314-328.

The task in this study required responses to four lights that varied in color and position. Pretraining was given for responding to color alone and to position alone. More transfer to the total task was found for color than for position pretraining. Since the color discrimination was more difficult, it was concluded that if a choice was to be made, the most difficult discrimination should be selected for training.

295. Goss, Albert E., and Greenfeld, Norman. "Transfer to a Motor Task as Influenced by Conditions and Degree of Prior Discrimination Training," *J. Exp. Psychol.*, vol. 55, no. 3, March 1958, pp. 258-269.

Several types of verbal pretraining were studied. All resulted in some positive transfer. Amount of positive transfer increased with mastery of verbal material.

296. Hake, Harold W., and Eriksen, Charles W. "Role of Response Variables in Recognition and Identification of Complex Visual Forms," *J. Exp. Psychol.*, vol. 52, no. 4, 1956, pp. 235-243.

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Subjects were given practice in the use of sets of irrelevant labels before associating them with unfamiliar nonsense shapes. The results suggest that verbal labeling practice has two functions. The first function is that of forcing subjects to differentiate the stimulus set and responses used. The second function is to provide a denotative process whereby subjects organize and identify the stimulus aspects differentiated by practice. The second function occurs only with the use of larger sets of practiced responses.

297. Holton, Ruth B., and Goss, Albert E. "Transfer to a Discriminative Motor Task as a Function of Amount and Type of Preliminary Verbalization," *J. Gen. Psychol.*, vol. 55, First Half, July 1956, pp. 117-126.

Fifteen different types of verbal pretraining were studied to identify degree of transfer to a psychomotor task. All yielded positive transfer of approximately equal amounts.

298. Kinkade, R.G., and Kidd, J.S. *The Use of an Operational Game as a Method of Task Familiarization*, WADC Technical Report 59-204, Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, July 1959 (Contractor: Ohio State University).

A sample of 20 subjects was divided into two groups after individual skill training. One group practiced five hours on an operational game derived from an air traffic control task. The other group had training only on the final task provided by an electronic simulator. There was a constant superiority on the end task for the group that practiced the operational game.

299. McAllister, Dorothy Elsey. "The Effects of Various Kinds of Relevant Verbal Pretraining on Subsequent Motor Performance," *J. Exp. Psychol.*, vol. 46, no. 5, 1953, pp. 329-336.

The experimental task was the Star Discrimeter, which required the subject to move a lever in one of six radial directions in response to a light of a given color. Pretraining of the following kinds was given: (1) Irrelevant S, (2) Relevant S, (3) five types of Relevant S-R: analogues in terms of degrees, clocks, and directions; and a 4-hour and an 8-hour rotation of S-R relationships. Results were: (1) Relevant S-R pretraining facilitated subsequent motor performance, with the clock or directions analogue superior to the degrees analogue. (2) Motor performance did not vary with the amount of rotation of S-R relationships during pretraining. (3) Relevant S pretraining resulted in more errors than irrelevant training.

300. Rossman, Irma L., and Goss, Albert E. "The Acquired Distinctiveness of Cues: The Role of Discriminative Verbal Responses in Facilitating the Acquisition of Discriminative Motor

Responses," *J. Exp. Psychol.*, vol. 42, no. 3, September 1951, pp. 173-182.

In this study the stimulus materials were a 12-unit figure syllable paired-associate list, and a list of the same 12 figures alone, both of which were presented at a 2-second rate on a memory drum. A group that had learned to master the discrimination between pairs of similar figures by means of nonsense syllable responses acquired discriminative motor responses to the same figure stimuli more rapidly than groups that had been given only one and four verbal learning trials.

C. VERBALIZATION DURING PRACTICE

301. Esper, Erwin A., and Lovaas, O. Ivar. "The Effect of Verbal Symbolization on the Serial Position Curve in Motor Perceptual Maze Learning," *J. Gen. Psychol.*, vol. 66, First Half, January 1962, pp. 47-51.

Subjects learned a button-maze. The experimental group was instructed to verbalize the manual responses by assigning verbal labels to each position and choice at that position. The control group learned the maze without verbal labels being provided. The serial position curve of the experimental group was more symmetrical and significantly flatter than the curve of the control group.

302. Gagné, Robert M., and Smith, Ernest C., Jr. "A Study of the Effects of Verbalization on Problem Solving," *J. Exp. Psychol.*, vol. 63, no. 1, January 1962, pp. 12-18.

The purpose of this study was to determine the effects on problem-solving performance of (1) requiring subjects to verbalize during practice, and (2) instructions to find a principle and state it verbally. Verbalization was superior to nonverbalization. It is suggested that requiring subjects to verbalize during practice makes them think of new reasons for their moves, and facilitates discovery and application of new principles.

303. Neumann, Eva. "Frequency and Usefulness of Verbal and Nonverbal Methods in the Learning and Transfer of a Paired-Associate Serial Motor Task," *J. Exp. Psychol.*, vol. 60, no. 2, August 1960, pp. 103-110.

Subjects learned two out of three different spatial arrangements of the Schlosberg Board Task, and reported on their method of learning. Four methods were distinguished: counting, verbal spatial designation, motor references, and visual image. The nature of the pattern influenced choice of method of learning. Verbalization did not facilitate original learning, but did facilitate transfer.

304. Ray, Wilbert S. "Verbal Compared With Manipulative Solution of an Apparatus-Problem," *Amer. J. Psychol.*, vol. 70, 1957, pp. 289-290.

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One group of subjects solved an equipment problem resembling a search for a malfunction. Another group solved the problem, but only after telling the experimenter what they would do before actually doing it. The latter subjects made fewer errors and required fewer trials.

D. PACING

305. Adams, Jack A. "The Effect of Pacing on the Learning of a Psychomotor Response," *J. Exp. Psychol.*, vol. 47, no. 2, 1954, pp. 101-105.

Groups were trained on the Complex Coordination Test under each of the following conditions: self-pacing and pacing at intervals of 5, 7, 9, and 11 seconds. Then they were tested under self-paced conditions. There was no difference between groups in mean performance.

306. Anderson, Norman H., Kresse, Frederick H., and Grand, David A. "Effect of Rate of Automatically-Paced Training in a Multi-Dimensional Psychomotor Task," *J. Exp. Psychol.*, vol. 49, no. 4, April 1955, pp. 231-236.

Subjects who had practiced an aiming task at different levels of automatic pacing were tested on a self-paced schedule. There was no difference in errors, but less time per pattern was required for the automatically paced groups.

307. Nystrom, Charles O., Morin, Robert E., and Grant, David A. *Transfer Effects Between Automatically Paced and Self-Paced Training Schedules in a Perceptual-Motor Task*, Research Bulletin 50-66, Perceptual and Motor Skills Research Laboratory, Human Resources Research Center, Air Research and Development Command, Lackland AFB, December 1953 (Contractor: University of Wisconsin).

Subjects were given four 25-trial blocks of automatically paced (AP) or self-paced (SP) training on a task which called for a rapid succession of responses to temporally discrete visual patterns. When tested under SP conditions, the AP group was poorer on the first block, but showed significantly greater improvement than the SP group. When tested under AP conditions, differences were not significant.

308. Nystrom, Charles O., Morin, Robert E., and Grant, David A. "Effects of Amount, Rate and Stage of Automatically-Paced Training on Self-Paced Performance," *J. Exp. Psychol.*, vol. 49, no. 4, April 1955, pp. 225-230.

Using a psychomotor task, groups of subjects were given automatically paced (AP) practice, varying in amount, rate, and stage (early or late). On later self-paced (SP) practice, the following results were found: (1) the greater the amount of AP practice, the greater the rate of improvement on SP trials;

(2) the faster the AP practice, the greater the rate of improvement during the test blocks; (3) there was no significant effect due to early vs. late AP practice.

309. Nystrom, Charles O., Morin, Robert E., and Grant, David A. "Transfer Effects Between Automatically-Paced Training Schedules in a Perceptual-Motor Task," *J. Gen. Psychol.*, vol. 55, First Half, July 1956, pp. 9-17.

Subjects practiced on an automatically paced (AP) or self-paced (SP) task. Half the subjects transferred from one type of pacing to another, while half continued on the same type. When tested for transfer under the SP condition, the AP group performed poorer than the SP group on the initial test trials, but better on the last three blocks of transfer trials. When tested for transfer under AP conditions, the SP group performed poorer than the AP group on the first, but better on the last three blocks of transfer trials.

E. COMPONENT VS. WHOLE TASK PRACTICE

310. Adams, Jack A., and Hufford, Lyle E. "Contributions of a Part-Task Trainer to the Learning and Relearning of a Time-Shared Flight Maneuver," *Human Factors*, vol. 4, no. 3, June 1962, pp. 159-170.

Two experiments were conducted, one on initial learning and one on relearning, using a part-task trainer to teach part of a time-shared whole task. Practice on the whole-task trainer was necessary in both instances to raise proficiency to satisfactory levels. The functions of the part-task trainer could be to fully learn procedures that are not time-shared, reduce whole-task simulator utilization time, and provide training before availability of simulators.

311. Bilodeau, Edward A. *Transfer of Training After Part Practice on a Dual-Control Tracking Apparatus*, Research Report AFPTRC 56-110, Operator Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Randolph AFB, Tex., September 1956.

Transfer effects for various methods of administering part practice on a two-hand tracking task were tested. The methods were (1) practice with one hand exclusively, (2) alternating between right and left hands in one-hand practice, and (3) two hands in passive following. Some methods were used in situations varying the point of introduction and the number of training trials devoted to part practice. The results showed variation in training effectiveness, fairly sizable positive transfer, and a reasonable doubt that any of the treatments led to differential amounts of transfer.

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312. Briggs, George E., and Brogden, W.J. "The Effect of Component Practice on Performance of a Lever-Positioning Skill," *J. Exp. Psychol.*, vol. 48, no. 5, 1954, pp. 375-380.

Subjects received varying degrees of practice on components of a task and on the whole task in a lever-positioning skill. There was a clear superiority of whole-task practice over part-task practice.

313. Briggs, George E., and Naylor, James C. "The Relative Efficiency of Several Training Methods as a Function of Transfer Task Complexity," *J. Exp. Psychol.*, vol. 64, no. 5, November 1962, pp. 505-512.

The efficiency of the following methods in acquisition of skill was studied in a three-dimensional tracking task: (1) pure part, (2) progressive part, (3) simplified-whole, and (4) whole task. Two levels of transfer task complexity were used. Eight daily training sessions were followed by two transfer sessions on the entire task. Training by whole and progressive part methods resulted in statistically equivalent performance, superior to the other methods. As task complexity increased, the absolute superiority of the whole and progressive part methods increased. Results are explained in terms of time-sharing and similarity between training and transfer tasks.

314. Briggs, George E., and Waters, Lawrence K. "Training and Transfer as a Function of Component Interaction," *J. Exp. Psychol.*, vol. 56, no. 6, December 1958, pp. 492-500.

A task using various degrees of interaction between task components was studied. Three hypotheses were tested: (1) Pure part-task practice will be progressively less beneficial in transfer as the degree of component interaction increases in the whole task; (2) transfer performance level will be proportional to the similarity of component interaction in the training and transfer tasks; and (3) transfer from higher to lower degrees of interaction will be greater than that found when transfer is from lower to higher degrees of interaction. The first two hypotheses were substantiated.

315. Dougherty, Dora J., Houston, Robert C., and Nicklas, Douglass R. *Transfer of Training in Flight Procedures From Selected Ground Training Devices to the Aircraft*, Technical Report NAVTRADEVGEN 71-16-16, U.S. Naval Training Device Center, Port Washington, N.Y., September 1957 (Contractor: University of Illinois).

A comparison was made between groups that practiced on a photographic mock-up of the cockpit, a partly activated trainer, an aircraft flight simulator, and the combination of a part task (procedures trainer) and time-shared tracking task. Conclusions were that (1) each device made a significant contribution to learning in-flight procedures; (2) an operational flight trainer

and a procedures trainer make equally effective contributions to training, equal to that in the aircraft itself; (3) training on procedural tasks alone does not adversely affect performance on flight tasks when both are simultaneously required in the aircraft; and (4) time-sharing while learning procedures does not aid in-flight performance on flight and procedure skills.

316. Haggard, Donald F. *Training Methods for Simulators of Remote Control Human-Guided Missile Systems: 1. A Comparative Evaluation of Component Skill and Total Skill Training Exercises*, Research Memorandum, HumRRO Division No. 2 (Armor), Fort Knox, Ky., July 1962.

The following patterns of component skill and total skill training were compared: total, simplified total, two-component, two-component-simplified total, geometric component, geometric component-simplified total exercise, and progressive exercise. The total skill exercise was superior.

317. McGuigan, F.J., and MacCaslin, Eugene F. "Whole and Part Methods in Learning a Perceptual Motor Skill," *Amer. J. Psychol.*, vol. 68, 1955, pp. 658-661.

Part, whole, and incomplete whole methods were compared in teaching rifle marksmanship. The whole method was superior to the the part method in slow-fire.

318. North, Alvin J., and Harrington, James, Jr. "Learning Response Compounds Having Two Critical Components," *J. Exp. Psychol.*, vol. 47, no. 3, 1954, pp. 173-178.

Movements having both a distance and a direction component were learned in response to lights. Variation in each component was different for two groups, while a third group practiced each component with equal variation. There was equal learnability of distances and directions. The component that was varied more frequently in training became the one more accurately learned. A response incorrect in one component was more likely to be correct than incorrect in the other. It is believed that components acquire response strength independently.

319. Seymour, W. Douglas. "Experiments on the Acquisition of Industrial Skills. Part III," *Occup. Psychol.*, vol. 30, 1956, pp. 94-104.

Whole vs. part training in capstan lathe operation was studied. Workers who used a part method progressed more rapidly than those who used the whole method. The methods of isolating the most perceptually difficult part and the progressive part method show results superior to the whole method. There was little loss in performance when elements previously practiced separately were combined into the total performance.

320. Slivinske, Alec J. *The Factors of Task Complexity and Previous Practice on Patterned Component*, WADC Technical Report 53-313,

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Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, December 1953 (Contractor: University of Virginia).

A complex visual-discrimination motor task was divided into components. Previous practice on the component was positively related to total task performance, while task complexity was negatively related.

F. PRACTICE AND TASK DIFFICULTY

321. Day, R.H. "Relative Task Difficulty and Transfer of Training in Skilled Performance," *Psychol. Bull.*, vol. 53, no. 2, March 1956, pp. 160-168.

The literature on relative task difficulty as a factor in transfer of training is critically reviewed. The problems in defining dimensions of difficulty are discussed, and the U-hypothesis is described.

322. Green, Russel F. "Transfer of Skill on a Following Tracking Task as a Function of Task Difficulty (Target Size)," *J. Psychol.*, vol. 39, Second Half, April 1955, pp. 355-370.

The hypothesis tested was that transfer should be greater from a difficult to an easy two-hand coordination task than from easy to difficult. Transfer in both directions was positive and essentially complete.

323. Holding, D.H. "Transfer Between Difficult and Easy Tasks," *Brit. J. Psychol.*, vol. 53, no. 4, November 1962, pp. 397-407.

Two studies of transfer between difficult and easy tasks were conducted. Results were inconsistent. It was concluded that difficulty is not a useful concept for prediction of the degree of transfer, and that the solution lies in examining the skills involved.

324. Jones, Earl I., and Bilodeau, Edward A. *Differential Transfer of Training Between Motor Tasks of Different Difficulty*, Research Bulletin 52-35, Perceptual and Motor Skills Research Laboratory, Human Resources Research Center, Air Training Command, Lackland AFB, December 1952.

Transfer between a simple and a complex tracking pattern using the SAM Two-Hand Coordination test was studied. Transfer from the complex to the simple task was as great as the effect of practicing directly on the simple task. There was positive transfer from the simple to the complex task, but not as much as in the reverse direction.

325. Lawrence, Douglas H., and Goodwin, W. Richard. *Transfer in Tracking Behavior Between Two Levels of Speed*, Research Bulletin AFPTRC-TR-54-70, Air Force Personnel and Training Research

Center, Air Research and Development Command, Lackland AFB, Tex., December 1954 (Contractor: Stanford University).

The experimental task was a tracking task with two levels of speed. A subject practicing at a low level of speed can transfer more skill if he chooses the point at which transfer to a higher speed is made.

G. VARIATION IN PRACTICE

326. Adams, Jack A. "Multiple Versus Single Problem Training in Human Problem Solving," *J. Exp. Psychol.*, vol. 48, no. 1, 1954, pp. 15-18.

Two methods of training subjects in the solution of problems of a given class were studied. The class of problems was one in which the general solution was the same, but stimulus characteristics could change from problem to problem. A group trained on repeated presentations of the same problem was more proficient in solving a new problem of the class than a group trained on a number of different problems.

327. Duncan, Carl P. "Transfer After Training With Single Versus Multiple Tasks," *J. Exp. Psychol.*, vol. 55, no. 1, 1958, pp. 63-72.

Transfer between perceptual and motor was studied as a function of two variables: degree of variation in training and amount of training. Transfer increased as a direct function of degree of variation in training. Transfer increased, up to a limit, with amount of training. There was no interaction between variation and amount of training. The results are interpreted in terms of learning to pay close attention to stimuli.

328. Duncan, Carl P., and Underwood, Benton J. *Transfer of Training After 10 Days of Practice With One Task or With Varied Tasks*, WADC Technical Report 54-115, Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, May 1954 (Contractor: Northwestern University).

Transfer was studied among paired-associate perceptual-motor tasks. Over 10 days of practice, the following conditions were varied: (1) same task every day, (2) different task every day, and (3) same task with stimuli and responses re-paired each day. Varied training yielded superior transfer initially, but the advantage disappeared after three days.

329. Duncan, Carl P., and Underwood, Benton J. *Transfer of Training After Two Days of Practice With One Task or With Varied Tasks*, WADC Technical Report 54-381, Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, September 1954 (Contractor: Northwestern University).

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Transfer was studied among paired-associate perceptual-motor tasks. Over two days of practice the following conditions were varied: (1) same task each day, (2) five different tasks each day, and (3) same task with stimuli and responses re-paired, five pairings each half-day. Neither method of variation yielded transfer superior to constant training.

330. Duncan, Carl P., and Underwood, Benton J. *Transfer of Training After Five Days of Practice With One Task or With Varied Tasks*, WADC Technical Report 54-533, Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, December 1954 (Contractor: Northwestern University).

Transfer was studied among paired-associate perceptual-motor tasks. Over five days of practice, the following conditions were varied: (1) same task every day, (2) 10 different tasks, 2 each day, and (3) 10 different pairings of the stimuli and responses of the same task, 2 pairings each day. Neither method of varied training yielded transfer superior to constant training.

331. Duncan, Carl P., and Underwood, Benton J. *The Effect on Transfer of Varying Stimulation During Training*, WADC Technical Report 56-279, Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, December 1957 (Contractor: Northwestern University).

Among groups trained with different sets of stimuli, transfer increased as a direct function of degree of variation as expressed by numbers of sets of stimuli during training. The cost of providing variation may not justify designing training devices to obtain a full range of variation.

332. Goffard, S. James. *Effectiveness of Variations in Code Practice*, Staff Memorandum, HUMRRO Division No. 1 (System Operations), Alexandria, Va., May 1958.

In an attempt to relieve the monotony of code practice, new materials were developed to be more interesting. When compared with existing materials, the new materials were more interesting but did not result in faster learning.

333. Morrisett, Lloyd, Jr., and Hovland, Carl I. "A Comparison of Three Varieties of Training in Human Problem Solving," *J. Exp. Psychol.*, vol. 58, no. 1, July 1959, pp. 52-55.

Subjects were given different distributions of training trials and then tested on the same transfer problem. Different groups of subjects were trained on 1, 24, and 3 problems. Both a high degree of learning on a single problem and variation in problems are necessary for effective transfer.

H. OTHER TRANSFER STUDIES

334. Briggs, George E., Fitts, Paul M., and Bahrick, Harry P. *Transfer Effects From a Single to a Double Integral Tracking System*, Research Report AFPTRC-TN-56-135, Operator Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Randolph AFB, December 1956.

Subjects were given 10, 30, or 50 trials on a velocity tracking system simulating the F-86D aircraft. A control group had all its practice on the criterion task, which was an acceleration tracking system. Groups showed increasing levels of performance on the criterion task as a function of the number of trials on the simpler device. The use of simpler devices may permit a saving in cost of training on the entire system.

335. Colville, Frances M. "The Learning of Motor Skills as Influenced by Knowledge of Mechanical Principles," *J. Educ. Psychol.*, vol. 48, no. 6, October 1957, pp. 321-327.

Three mechanical principles and appropriate motor skills to which the principles applied were studied. Subjects practiced each skill, some with and some without knowledge of the principle. There was no evidence that instruction concerning mechanical principles aided learning of the skills.

336. Duncan, Carl P. "Transfer in Motor Learning as a Function of Degree of First-Task Learning and Inter-Task Similarity," *J. Exp. Psychol.*, vol. 45, no. 1, January 1953, pp. 1-11.

The experimental task required the subject to position a lever in one of six slots in response to a light of a particular color. First-task learning was defined in terms of number of trials on a particular set of S-R connections. Inter-task similarity involved the number of S-R connections that were the same on first and second task. Transfer was positive for all experimental groups and increased directly with both first-task learning and inter-task similarity, with no interaction. Differential transfer due to varying first-task learning occurred throughout acquisition of the final task, while that due to inter-task similarity occurred only during the first half of second-task practice. There was almost no evidence of interference, measured by errors, between tasks.

337. Holland, James G., and Henson, Jean B. "Transfer of Training Between Quickened and Unquickened Tracking Systems," *J. Appl. Psychol.*, vol. 40, no. 6, 1956, pp. 362-366.

Four groups of subjects were trained as follows: (1) 140 40-second trials on a quickened system, (2) same number of trials on an unquickened system, (3) 260 40-second trials on a quickened system, and (4) same number of trials on an unquickened system. Then each group was switched to the system about which it was naive. Positive transfer occurred in all groups. The different

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amounts of training resulted in no difference in the extent of transfer. Transfer of training between these two systems is not complete.

338. Mohr, Dorothy R., and Barrett, Mildred E. "Effect of Knowledge of Mechanical Principles in Learning to Perform Intermediate Swimming Skills," *Res. Quart. Amer. Ass. Hlth. Phys. Educ. Recr.*, vol. 33, no. 4, 1962, pp. 574-580.

An experiment using two groups was conducted to determine the effect of teaching mechanical principles on learning swimming. The group that was taught mechanical principles was superior to the group that was not.

339. Nelson, Dale O. "Studies of Transfer of Learning in Gross Motor Skills," *Res. Quart. Amer. Ass. Hlth. Phys. Educ. Recr.*, vol. 28, no. 4, 1957, pp. 364-373.

Ninety men learned six paired gross motor skills with order and method of teaching as variables. The following conclusions are drawn: (1) Skills involving similar elements and patterns should not be learned at the same time; and (2) deliberate teaching for transfer of training (at least at the beginning stages of learning) appears to be ineffective in later learning of skills with similar patterns and movements.

340. Ritchie, Malcolm L., and Michael, Archer L. "Transfer Between Instrument and Contact Flight Training," *J. Appl. Psychol.*, vol. 39, no. 3, June 1955, pp. 145-149.

Twenty-two student pilots were taught two maneuvers on contact and on instruments. One group learned contact first, the other instruments. Contact training took fewer trials to learn. Transfer from contact to instruments was -22%. Transfer from instruments to contact was 47%.

I. DISTRIBUTION OF PRACTICE

341. Adams, Jack A., and Reynolds, Bradley. "Effect of Shift in Distribution of Practice Conditions Following Interpolated Rest," *J. Exp. Psychol.*, vol. 47, no. 1, 1954, pp. 32-36.

All groups were given 40 15-second trials with 5-second inter-trial rest periods for massed practice and 45-second rest periods for distributed practice. A control group received distributed practice throughout. Four experimental groups were given either 5, 10, 15, or 20 trials of massed practice, a 10-minute rest, and the remaining trials under distributed practice. Each experimental group showed a significant gain after rest. Then all experimental groups readily shifted to the level of the control group. Distribution of practice is regarded as a performance rather than a learning variable.

342. Norris, Eugenia B. "Performance of a Motor Task as a Function of Interpolation of Varying Lengths of Rest at Different Points in Acquisition," *J. Exp. Psychol.*, vol. 45, no. 4, 1953, pp. 260-264.

The SAM Two-Hand Coordination test was used to study the post-rest effects of 2-hour or 10-minute rests after 4, 6, or 28 minutes of pre-rest practice. Length of rest was not a differential determiner of performance as measured by post-rest gains. With continued practice, the longer rest seemed to be more beneficial than the shorter one. The shorter the pre-rest practice period, the greater the gain after rest.

343. Reynolds, Bradley, and Bilodeau, Ina McD. "Acquisition and Retention of Three Psychomotor Tests as a Function of Distribution of Practice During Acquisition," *J. Exp. Psychol.*, vol. 44, no. 1, July 1952, pp. 19-26.

Groups of subjects were given massed or distributed practice on the Rudder Control, Complex Coordination, and Rotary Pursuit tests. Distributed practice yielded an advantage during acquisition trials, but this advantage did not hold up during massed retention trials.

J. TRAINING DEVICES AND SIMULATORS

344. Adams, Jack A. *Some Considerations in the Design and Use of Dynamic Flight Simulators*, Research Report AFPTRC-TN-57-51, Operator Laboratories, Air Force Personnel and Training Research Center, Air Research and Development Command, Randolph AFB, Tex., April 1957.

This is a general discussion of the requirements for fidelity in dynamic flight simulators. Topics covered include whole-task simulators, part-task simulators, fidelity of simulation and transfer of training, fidelity of simulation and proficiency measurement.

345. Cox, John A., Wood, Robert O., Jr., Boren, Lynn M., and Thorne, H. Walter. *Functional and Appearance Fidelity of Training Devices for Fixed-Procedures Tasks*, Technical Report 65-4, Human Resources Research Office, June 1965.

Twelve training devices of reduced fidelity were prepared. Several five-man groups were trained using each device, and then each man was given a proficiency test. Intelligence of trainees, teaching method, and instructor effects were statistically controlled. No significant differences in proficiency or length of training time were found to be associated with the training device used, regardless of degree of functional or appearance fidelity. As a field test under more realistic Army conditions, with military instructors and soldiers chosen at random, a low fidelity device was used to train one group while another group was instructed with high fidelity equipment. A comparison of

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proficiency levels and training times showed only chance differences between these two groups.

346. Creelman, John A. *Evaluation of Approach Training Procedures*, Research Project No. NM 001 109 107, Report No. 2, U.S. Naval School of Aviation Medicine, Naval Air Station, Pensacola, Fla., 1955.

A contact approach trainer was evaluated within the context of Navy Primary Flight Training. The group receiving instruction in the trainer received significantly higher ratings on approaches, required fewer landings during presolo stage, and had fewer unsatisfactory check flights than the control group.

347. Denenberg, Victor H. *The Training Effectiveness of a Tank Hull Trainer*, Technical Report 3, Human Resources Research Office, February 1954.

A comparison was made between the tank hull trainer, costing \$10,000, and a mockup whose materials cost \$27. The mockup was a better training aid than the tank hull trainer for teaching starting and stopping procedures. Trainees who had been taught by the mockup started and stopped the M47 tank nearly as well as trainees who had previous experience in starting and stopping the M47 tank. The mockup, the trainer, and the actual tank were equally effective in teaching the nomenclature and location of the driver's instruments and controls. Trainees acquired more information concerning the track and suspension system from work on the hull trainer than they did from work on actual tanks.

348. Flexman, Ralph E., Townsend, John C., and Ornstein, George N. *Evaluation of a Contact Flight Simulator When Used in an Air Force Primary Pilot Training Program: Part I. Overall Effectiveness*, Technical Report AFPTRC-TR-54-38, Basic Pilot Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Goodfellow AFB, Tex., 1954.

A simulator-trained group was given 100 hours of T-6 flying time plus 40 hours of P-1 contact simulator time. The control group received 130 hours of T-6 flying time and no simulator training. The simulator group was superior in proficiency to the control group. No adverse effect of simulator training was observed in terms of attrition or accidents.

349. French, Robert Stanton, Crowder, Norman A., and Tucker, Joseph A., Jr. *The K-System MAC-1 Trouble-Shooting Trainer: II. Effectiveness in an Experimental Training Course*, Development Report AFPTRC-TN-56-120, Maintenance Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Lowry AFB, Colo., October 1956.

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An evaluation was made of the K-System MAC-1 Trouble-Shooting trainer, compared with training on actual equipment. The trainer groups compared favorably with those trained on actual equipment. The trainer, perhaps with modifications, could be used effectively as a supplement to equipment either in formal or on-the-job training. Apprentice mechanics can learn systematic troubleshooting procedures based on a logical analysis of the data flow of the system.

350. Gagné, Robert M. "Simulators," in *Training Research and Education*, Robert Glaser (ed.), University of Pittsburgh Press, Pittsburgh, 1962, pp. 223-246.

This is a general discussion of the uses of simulators in training, and includes (1) what is meant by simulation, (2) purposes of simulation, (3) what is simulated, (4) simulators in their training function, (5) simulators in performance assessment, and (6) implications for education.

351. Mahler, W.R., and Bennett, G.K. *Psychological Studies of Advanced Naval Air Training: Evaluation of Operational Flight Trainers*, Technical Report SPECDEVCEM 999-1-1, Special Devices Center, Port Washington, N.Y., September 1950 (Contractor: Psychological Corporation).

The effectiveness of Operational Flight Trainers (OFTs) for the PBM and PB4Y in transferring skills to the actual aircraft was studied in Naval Advanced Aviation Training. Attention was restricted to the familiarization (FAM) and instrument (INST) bases of the training program. Conclusions were that (1) there was no saving in flight time in FAM, and a small but not practically significant saving in INST; and (2) experimental students made fewer errors.

352. McClelland, William A., Abbott, Preston S., and Stovie, William H. *Teaching Radar Scope Interpretation With Motion Pictures: I. Radar Navigation, the Ellington Study*, Technical Report AFPTRC-TR-54-25, Aircraft Observer Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Mather AFB, Calif., July 1954.

The training device studied used motion picture presentations of radar scope returns on a simulated display. One group had all training on the ground trainer. Another had half of its instruction on the trainer, and half in the air. A third group had all instruction in the air. There was no significant difference in radar navigation proficiency between the groups. The all-trainer group was slightly deficient in set operation in later training, but this deficiency was quickly overcome.

353. McKnight, A. James (ed.). *Methods and Devices for Teaching Data Flow to Electronics Maintenance Personnel*, Research Memorandum, HumRRO Division No. 1 (System Operations), Alexandria, Va., November 1962.

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Pilot studies were conducted on a brief course in general principles of troubleshooting logic for electronics maintenance training. It was found that, after prolonged periods dealing with a particular signal-flow pattern, students tended to concentrate on specific symptom-cause relations rather than on principles. This experience suggested that important general aspects of troubleshooting logic should be covered before training in any particular system, and that prolonged practice on particular systems should be confined to those the man being trained will use. Several signal-flow simulators were developed for training and training research.

355. Miller, Robert B. *Psychological Considerations in the Design of Training Equipment*, WADC Technical Report 54-563, Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, December 1954 (Contractor: American Institute for Research).

This is a general treatment of design considerations for training equipment. Topics covered include (1) some principal concepts in learning and transfer of learning, (2) problems of physical simulation, (3) stage of learning and degree of physical simulation, (4) knowledge of results and scoring, (5) recording procedures, (6) proficiency measurement, (7) the design of the instructor's station, (8) the trainer as a demonstrator of principles, and (9) outline of steps in designing a training device.

356. Miller, Robert B. *Task and Part-Task Trainers and Training*, WADD Technical Report 60-469, Behavioral Sciences Laboratory, Aerospace Medical Division, Wright Air Development Division, Air Research and Development Command, Wright-Patterson AFB, Ohio, June 1960 (Contractor: American Institute for Research).

The factors to be considered in designing and using whole-task and part-task trainers are described. Rules are given for identifying parts of tasks and relating them to requirements for certain kinds of part-task trainers. Tasks or parts of tasks are classified as follows: (1) standard, routine procedures, (2) nonstandard procedures abstracted from work contexts, (3) tracking tasks, and (4) knowledges. Major classifications for trainers are the familiarization trainer, the instructed-response trainer, and the automatized-skill trainer.

357. Muckler, F.A., Nygaard, J.E., O'Kelly, L.I., and Williams, A.C., Jr. *Psychological Variables in the Design of Flight Simulators for Training*, WADC Technical Report 56-369, Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, January 1959.

This is a review of the literature and analysis of the problem of use of simulators for flight training.

358. Murnin, Joseph A. *Comparison of Training Media: Transfer of Principles Involved in a Manipulative Skill; Operation of Aircraft Load Adjuster Slide Rule*, Technical Report SPECDEVCEEN 269-7-103, Special Devices Center, Port Washington, N.Y., September 1955 (Contractor: Pennsylvania State University).

This study was performed to give evidence on the value of a transparency, a trainer, and actual equipment for teaching the manipulative skill of operating the aircraft adjuster slide rule. For teaching the transfer of weight and balance principles from one aircraft to another, the individual load adjuster slide rule was as effective as the Multi-Engine Weight-and-Balance Trainer. Transparencies of the aircraft models were not as effective as the Multi-Engine Weight-and-Balance Trainer.

359. Ornstein, George N., Nichols, Irwin A., and Flexman, Ralph 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*, Technical Report AFPTRC-TR-54-110, Basic Pilot Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Goodfellow AFB, Tex., December 1954.

A study was made of the effectiveness of the P-1 simulator in teaching specific components of contact and instrument flying skills. The simulator was generally effective, but it is most effective for those maneuvers not exceeding the design limitations of the trainer and those that are heavily loaded with procedural components.

360. Poe, Arthur C., and Lyon, Verne W. *The Effectiveness of the Cycloramic Link Trainer in the U.S. Naval School, Pre-Flight*, Project Report No. NM 001 058.07.01, U.S. Naval School of Aviation Medicine, Naval Air Station, Pensacola, Fla., 1952.

The purpose of the study was to determine the contribution of instruction in the SNJ Cycloramic Link during preflight school to flight proficiency in the initial stages of flight training. The Link group had five periods of Link instruction. The control group had regular preflight instruction. The criteria used were number of flight attritions, number of board proceedings to consider flight deficiencies, number of extra flights required to meet proficiency standards, instructional flight grades, and check flight grades. No statistically significant differences were found.

361. Siskel, Maurice, Jr., and Smith, Wayne D. *A Preliminary Training Study of the H-34 Cockpit Procedures Trainer*, Research Memorandum, HumRRO Division No. 6 (Aviation), Fort Rucker, Ala., October 1960.

Practice of Performance

Subjects were given 6, 3, and 0 hours in the H-34 Cockpit Procedures Trainer prior to actual practice in the H-34 helicopter. Procedures were learned satisfactorily in three hours of practice in the trainer. Practice in the trainer led to reduced errors and less time required to reach satisfactory performance in the helicopter.

362. Wilcoxon, Hardy C., Davy, Earl, and Webster, James C. *Evaluation of the SNJ Operational Flight Trainer*, Technical Report SPECDEVCEM 999-2-1, Special Devices Center, Port Washington, N.Y., March 1954 (Contractor: Psychological Corporation).

A study was conducted of the value of the SNJ operational flight trainer (OFT). Both the SNJOFT and the simpler device NavBIT were effective aids to training. The NavBIT was equal in effectiveness to the SNJOFT in basic instrument training and slightly superior for radio range work. Synthetic training should be given in a block prior to actual flying, rather than interspersed with flight. A progress-at-own rate flight schedule plus a rigorous block of ground training saved an average of 1.3 hours of flight time during the basic instrument phase. The SNJOFT was only as effective as the combination SNJ cockpit mockup and Cycloramic Link Trainer in providing cockpit familiarization, despite its higher sophistication and cost.

363. Willard, Norman, Jr., Bancroft, Charles A., and Reddon, John C. *The Training Effectiveness of a Stereoscopic Range-Finder Trainer*, Technical Report 12, Human Resources Research Office, October 1954.

The range-finder training instrument OROPT-T1 was evaluated in comparison with training on the range finder itself. The trainer assisted in distinguishing operators who will make normal progress from those who will require special training. It had no special value for training poor students. There was positive transfer to the range finder itself. The trainer was useful as a familiarization device.

K. MISCELLANEOUS

364. Adams, Henry L. "The Comparative Effectiveness of Electric and Manual Typewriters in the Acquisition of Typing Skill in a Navy Radioman School," *J. Appl. Psychol.*, vol. 41, no. 4, 1957, pp. 227-230.

An experimental group was trained on electric typewriters but switched to manual typewriters for the last fourth of the training. A control group practiced on the manual typewriter entirely. As measured by tests composed of cipher groups, there was no difference between the groups.

365. Baker, Robert A., Mathers, Boyd L., and Roach, Eugene C. *The Effects of Increasing and Decreasing Training Time on Proficiency in the Critical Armor Skills*, Technical Report 55, Human Resources Research Office, June 1959.

Halving, doubling, and tripling training time were compared to determine the effects of training time on proficiency. Forty-one Armor instructional units were used for the study. With increased training time proficiency increased, but not at the desired rate. It was concluded that changes in training method, rather than lengthening the training program, were called for.

366. Bell, A. Howard. "Effects of Experimentally-Induced Muscular Tension and Frequency of Motivational Instructions on Pursuit Rotor Performance," *Percept. Mot. Skills*, vol. 9, no. 2, June 1959, pp. 111-115.

The variables in this study of pursuit rotor learning were induced muscular tension and instructions to improve. The variables were not effective.

367. Briggs, George E., Fitts, Paul M., and Bahrick, Harry P. *Learning and Performance in a Complex Tracking Task as a Function of Visual Noise*, Research Report AFPTRC-TN-56-67, Interceptor Pilot Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Tyndall AFB, Fla., June 1956.

Four groups practiced tracking in an F-86D simulator. In preliminary training the groups practiced with different degrees of noise. The final task involved a varying noise level. There was no significant difference between the groups.

368. Christensen, J.M., and Crannell, C.W. *The Effect of Selected Visual Training Procedures on the Visual Form Field*, WADC Technical Report 54-239, Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, April 1955 (Contractor: Miami University).

An attempt was made to increase the area of the visual form field through certain training procedures--reading groups of digits exposed tachistoscopically, and perceiving single digits exposed to the periphery of the retina. Criteria were pretests and posttests of (1) reading speed and accuracy, (2) ability to check read a panel of simulated aircraft instrument dials exposed tachistoscopically, (3) ability to perceive digits in peripheral areas, and (4) ability to perceive other peripherally exposed symbols. Results were negative except for some transfer from training with peripherally exposed digits to the perception of Landolt rings. It is concluded that training with extremely simple stimuli is unlikely to result in a general improvement in form vision or reading proficiency.

Practice of Performance

369. Clark, L. Verdelle. "Effect of Mental Practice on the Development of a Certain Motor Skill," *Res. Quart. Amer. Ass. Hlth. Phys. Educ. Recr.*, vol. 31, no. 4, 1960, pp. 560-569.

Mental practice was compared with physical practice in the one-hand basketball foul shot. Mental practice was nearly as effective as physical practice.

370. Crannell, C.W., and Christensen, J.M. *Expansion of the Visual Form Field by Perimeter Training*, WADC Technical Report 55-368, Wright Air Development Center, Wright-Patterson AFB, Ohio, 1955.

The effect of various types of perimetric training on the visual form field was studied. In addition to a control group that received no training, other groups received, respectively, 10, 20, 30, and 40 half-hour sessions of training. As in a previous study, there was much improvement in ability to identify familiar stimuli presented farther and farther from the foveal area, but no evidence of transfer to other stimuli.

371. Fitts, Paul M. "Factors in Complex Skill Training," in *Training Research and Education*, Robert Glaser (ed.), University of Pittsburgh Press, 1962, pp. 177-198.

This chapter provides a review of significant factors in complex skill training. Topics discussed include task taxonomy, instructor opinions on the problems of skill training, phases in complex skill learning (cognition, fixation, and automation), the learning of subroutines, absence of plateaus and asymptotes, and implications for training.

372. Fitts, Paul M. "Perceptual-Motor Skill Learning," in *Categories of Human Learning*, Arthur W. Melton (ed.), Academic Press, New York, 1964, pp. 243-285.

This article reviews the learning of perceptual-motor skills. Major topics include definitions and taxonomy, theoretical models, the continuity-discontinuity issue in skill learning, phases characteristic of skill learning, cognitive aspects of skill learning, some cross-category problems of skill learning, and some relatively unique aspects of skill learning.

373. Gibson, Eleanor J. *A Survey of Research on Improvement in Perceptual Judgments as a Function of Controlled Practice and Training*, Research Bulletin 53-45, Perceptual and Motor Skills Research Laboratory, Human Resources Research Center, Air Research and Development Command, Lackland AFB, Tex., November 1953.

An extensive review of research on the training of perceptual judgments is presented. Generally, perceptual judgment, where it can be trained, can be treated as identification learning.

374. Gibson, Eleanor J., and Bergman, Richard. *The Effect of Training on Absolute Estimation of Distance Over the Ground*, Research Bulletin AFPTRC-TR-54-95, Skill Components Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Lackland AFB, Tex., December 1954.

Subjects estimated the distance of targets over a level field. Improvement of absolute judgment of distance occurred as a result of training, even though none of the distances presented were repeated. Training corrected errors of both under- and over-estimation very quickly. The function related true to estimated error was linear.

375. Goldstein, Myron, and Ellis, Douglas S. *Pedestal Sight Gunnery Skills: a Review of Research*, Research Report AFPTRC-TN-56-31, Armament Systems Personnel Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Lowry AFB, Colo., February 1956.

A review is presented of the literature on pedestal sight gunnery skills covering the period 1944-1955. Topics include performance measurement, devices and reliabilities, task analysis, training and selection.

376. HumRRO Division No. 4 (Infantry). *Extension of Research in TRAINFIRE I Rifle Marksmanship Course*, Research Memorandum, Fort Benning, Ga., December 1959.

The purpose of the study was to evaluate the effect of additional practice on areas of the TRAINFIRE Range. Repetition of the proficiency test was the most effective method for obtaining higher proficiency.

377. Jones, Francis E., and Odom, CWO William F. *MOONLIGHT II: Training the Infantry Soldier to Fire the M1 Rifle at Night*, Technical Report 15, Human Resources Research Office, December 1954.

Against dark and flashing targets, veterans of Korea were no more proficient than men who had just completed basic training. Use of aids, such as a flash hider or waxed white string, did not increase proficiency. A special training method increased proficiency from 60% to 210% depending on the type of target, with the exception of moonlight conditions. The general method of showing the soldier what he cannot do and why not, to show him how he can and why, and to let him prove he can is stressed.

378. Kidd, J.S. *A Comparison of Two Methods of Controller Training in Simulated Air Traffic Control Task: A Study in Human Engineering Aspects of Radar Air Traffic Control*, WADC Technical Report 58-449, Aero Medical Laboratory, Wright Air Development Center, Air Research and Development Command, Wright-Patterson AFB, Ohio, January 1959 (Contractor: Ohio State University).

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Two conditions were compared in training of a complex task of radar air traffic control: (1) constant high input load during training, and (2) graduated input load during training. Controllers trained under constant high input load were superior to the others on several criteria. An explanation was proposed in terms of increased frequency of knowledge of performance for the first group.

379. Lichte, William H., Eason, Robert G., Miller, John G., Borreson, Clarence R., and Wist, Eugene. *A Review of the Literature Relating to the Scope-Interpretation and Map-Reading Tasks of the Aircraft Observer*, Research Report AFPTRC-TN-57-110, Operator Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Randolph AFB, Tex., August 1957.

This report is a review of the literature on perception, scope reading, geographical orientation, and charts and their use. A 67-item bibliography is included.

380. Mayer, Sylvia R. "The Effect of Induced Tension During Training on Visual Form Recognition," *J. Educ. Psychol.*, vol. 48, 1957, pp. 11-17.

The effect of induced tension during learning was studied. Varying degrees of dynamometer tension were used. The task required subjects to learn forms that must later be recognized from among similar ones. Recognition frequency was at a maximum with drawing, at a minimum with tracing, and decreased systematically with increases in dynamometer tension.

381. McGuigan, F.J., and Grubb, James W. *Several Methods of Teaching Contour Interpretation*, Technical Report 35, Human Resources Research Office, January 1957.

Several methods are compared to select the best for teaching map contour interpretation. The best method was one in which soldiers associated terrain features as pictured on two-dimensional slides with contour lines as represented on three-dimensional relief maps.

382. Miller, James W., and Ludvigh, Elek. *An Analysis of Certain Factors Involved in the Learning Process of Dynamic Visual Acuity for 1000 Naval Aviation Cadets*, Project No. NM 17 01 99, Subtask 2, Report 13, U.S. Naval School of Aviation Medicine, Naval Air Station, Pensacola, Fla., April 1957 (Contractor: Kresge Eye Institute).

A majority of subjects who practiced dynamic visual acuity improved with practice. A substantial minority failed to show any improvement, however. An equation was developed to express the results.

383. Naylor, James C., and Briggs, George E. *Long-Term Retention of Learned Skills: A Review of the Literature*, ASD Technical

Report 61-390, Behavioral Sciences Laboratory, Aerospace Medical Laboratory, Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, Ohio, August 1961 (Contractor: Ohio State University).

An extensive review of the literature on the long-term retention of learned skills is presented. While many variables may be important, only limited research has been conducted with any one. Variables seem to fall into categories of type of task, learning parameters, retention interval parameters, and recall parameters. Task organization and scoring criteria are considered key variables in research on long-term retention.

384. Naylor, James C., Briggs, George E., and Reed, Walter G. *The Effects of Task Organization, Training Time, and Retention Interval on the Retention of Skill*, Technical Documentary Report No. AMRL-TDR-62-107, Behavioral Sciences Laboratory, Aerospace Medical Division, Air Force Systems Command, Wright-Patterson AFB, Ohio, September 1962 (Contractor: Ohio State University).

The effect of amount of training, task organization, and length of retention interval on long-term retention of a discrete and a continuous task were studied. Conclusions were that (1) amount of training is a highly important variable, and (2) under lesser training conditions, task organization becomes important.

385. Parker, James F., Jr., and Fleishman, Edwin A. *Use of Analytical Information Concerning Task Requirements To Increase the Effectiveness of Skill Training*, Psychological Research Associates, Arlington, Va., December 1959.

Prior analysis had revealed factor analysis information about the importance of task components at various stages of practice of a complex tracking skill. This provided the basis for special instructions to students. Learning by students who received this information was superior to that by students who had not.

386. Parker, James F., Jr., and Fleishman, Edwin A. "Use of Analytical Information Concerning Task Requirements To Increase the Effectiveness of Skill Training," *J. Appl. Psychol.*, vol. 45, no. 5, October 1961, pp. 295-302.

Factor analysis of a tracking task yielded information concerning abilities important at different stages of practice. One group received no formal training. A second group had a "common sense" training program. A third group had additional instruction derived from the task analysis. The third group showed higher proficiency than the others.

387. Stevenson, Harold W., and Moushegian, George. "The Effect of Instruction and Degree of Training on Shifts of Discriminative Responses," *Amer. J. Psychol.*, vol. 69, 1956, pp. 281-284.

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Three groups of subjects were trained to make a size discrimination, and then, without knowledge of the shift, a position discrimination. A fourth group was instructed that the problem would change. The results were: (1) The degree of training in the first discrimination was positively related to the ease of solving the second; (2) perseveration of responses was not a function of the degree of training; and (3) instruction significantly increased the ease of making a change.

388. Straha, Carolyn L. "The Influence of Instruction on Performance of a Complex Perceptual Motor Task," *Can. J. Psychol.*, vol. 9, no. 3, 1955, pp. 168-172.

Subjects were informed that errors made on the Toronto Complex Coordinator were being recorded. It was hypothesized that the following results would be obtained: (1) A decrease in the number of matches and in the number of total errors, and (2) an increase in the latency-match, initial error-match, and error persistence-total error ratios. Hypotheses were found to be tenable.

389. West, Leonard J. "An Experimental Comparison of Nonsense, Word, and Sentence Materials in Early Typing Training," *J. Educ. Psychol.*, vol. 47, 1956, pp. 481-489.

The following types of early keyboard practice materials were compared: single finger nonsense sequences, short words, long words, and sentences. The word and sentence typists were generally superior to those who used traditional drill sequences.

390. West, Leonard J. *Recommendations for Typewriting Training*, Development Report AFPTRC-57-68, Air Force Personnel and Training Research Center, Lackland AFB, Tex., 1957.

This report presents a set of recommendations for conducting training in typewriting, organized around 11 general principles.

391. West, Leonard J. *Review of Research in Typewriting Learning With Recommendations for Training*, Research Report AFPTRC-TN-57-69, Air Force Personnel and Training Research Center, Lackland AFB, Tex., June 1957.

This is an extensive review of research on learning to type-write, with many recommendations for more effective training.

Section VI

MANAGEMENT OF STUDENTS

392. Ausubel, David P., Schpoont, Seymour H., and Cukier, Lillian. "The Influence of Intention on the Retention of School Materials," *J. Educ. Psychol.*, vol. 48, 1957, pp. 87-92.

An experimental group and a control group studied an historical passage and were tested immediately afterwards. Then the experimental subjects were informed that they would be tested again in two weeks. The control group was not so informed but received a surprise test. There was no significant difference in retention between the groups.

393. Azrin, N.H. "Use of Rests as Reinforcers," *Psychol. Rep.*, vol. 7, no. 2, October 1960, p. 240.

A description is presented of the performance of one subject, under Fixed Interval and Fixed Ratio schedules, using rest as a reinforcer for a handwheel turning task. Fixed Ratio resulted in higher levels of performance than Fixed Interval reinforcement.

394. Bayton, James A., and Conley, Harold W. "Duration of Success Background and the Effect of Failure Upon Performance," *J. Gen. Psychol.*, vol. 56, Second Half, April 1957, pp. 179-185.

Three groups of subjects had, respectively, 5, 10, and 15 trials of "success" in the Minnesota Rate of Manipulation test before experiencing "failure." For the 10 and 15 success groups, failure resulted in an increase in the level of performance. This did not occur after 5 success trials. It is concluded that when failure is the first or early experience, the effect is inhibitory, but that when failure follows extensive success, it facilitates performance.

395. Binder, Arnold, McConnell, David, and Sjöholm, Nancy A. "Verbal Conditioning as a Function of Experimenter Characteristics," *J. Abnorm. Soc. Psychol.*, vol. 55, no. 3, November 1957, pp. 309-314.

A male and a female experimenter conducted verbal conditioning, reinforcing the use of hostile words by saying "good." Significant differences were found by different experimenters, with the female experimenter producing a steeper slope when the number of hostile words was related to blocks of trials.

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396. Buss, Arnold H., Gerjuoy, Irma R., and Zusman, Jack. "Verbal Conditioning and Extinction With Verbal and Nonverbal Reinforcers," *J. Exp. Psychol.*, vol. 56, no. 2, August 1958, pp. 139-145.

Cigarettes, candy, poker chips, and the word "good" were used as reinforcers in verbal operant conditioning and extinction. Poker chips were ineffective as a reinforcer, but "good" and cigarettes and candy were effective. Acquisition slope was related to extinction slope. The nonverbal reinforcer did not yield significantly faster extinction than the verbal reinforcement.

397. Caro, Paul W., Jr. "The Effect of Class Attendance and 'Time Structured' Content on Achievement in General Psychology," *J. Educ. Psychol.*, vol. 53, no. 2, April 1962, pp. 76-80.

"The effects of attending class and of structuring an introductory psychology course with respect to time and content were studied, using 335 undergraduates in a 2x3 factorial design. Time structuring was accomplished through schedules of testing. Using end-of-course achievement test scores as the criterion, F ratios for neither the class attendance variable, the time structure variable, nor the treatment interaction were significant at the .10 level. It was concluded that students performed as well through independent study as in the conventional class situation, and time structured content was ineffective as a determiner of student achievement. Student dropouts and the number of students seeking individual assistance were unrelated to the experimental treatments."

398. Cline, Victor E., Beals, Alan, and Seidman, Dennis. *Evaluation of Four-Week and Eight-Week Basic Training for Men of Various Intelligence Levels*, Technical Report 32, Human Resources Research Office, November 1956.

The performance of high-, low-, and medium-aptitude trainees was compared after four and eight weeks of basic training. The high-aptitude personnel in the four-week group learned as much military information and performed as well on performance tests as high-aptitude personnel in the eight-week course. Personnel in the high-aptitude four-week companies were superior to the normal eight-week trainees in military knowledge and performance tests, but slightly lower in rifle marksmanship and physical fitness. Personnel of the four-week normal-input companies learned as much military information as personnel of the eight-week normal companies, but did not do as well as the eight-week trainees on the performance tests, rifle marksmanship, and physical fitness.

399. Cohen, Bertram D., Kalish, Harry I., Thurston, John R., and Cohen, Edwin. "Experimental Manipulation of Verbal Behavior," *J. Exp. Psychol.*, vol. 47, no. 2, 1954, pp. 106-110.

The use of certain words in sentences was reinforced by the experimenter saying "good" in a flat tone of voice. Standard

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acquisition and extinction curves generally resulted. The subjects were not aware of the reinforcer.

400. **Duel, Henry J.** "Effect of Periodical Self-Evaluation on Student Achievement," *J. Educ. Psychol.*, vol. 49, 1958, pp. 197-199.

Using a rating scale of proficiency, students rated their proficiency on various tasks at the beginning and end of each test point for the task. In two experiments significant results were obtained favoring the use of self-evaluation to raise achievement.

401. **Fattu, Nicholas, and Mech, Edmund V.** "Resistance to Extinction of Verbal Responses Following Two Patterns of Reinforcement," *J. Gen. Psychol.*, vol. 53, Second Half, October 1955, pp. 193-198.

Subjects were required to say numbers. They were reinforced by the experimenter saying "mmm-hmmm" whenever the proper number class was given. A comparison of 100% vs. 50% reinforcement was made and the 50% group showed more resistance to extinction.

402. **Findlay, Donald C., Matyas, Seymour M., and Rogge, Hermann III.** *Training Achievement in Basic Combat Squads With Controlled Aptitude*, Technical Report 16, Human Resources Research Office, January 1955.

This study was designed to test a method of raising the performance of low-aptitude basic trainees by placing them in squads containing more high-aptitude trainees than normal; raising motivation was also tested by rewarding squads on the basis of test averages. Low-aptitude men did not benefit from training with high-aptitude men. Squad competition and reward increased proficiency by about 28%.

403. **Fiske, Donald W., and Maddi, Salvatore R.** *Functions of Varied Experience*, Dorsey Press, Inc., Homewood, Ill., 1961.

An analysis of the effects of varied experience on behavior is presented, along with a conceptual framework by the principal authors. Several chapters by different writers follow, after which the conceptual framework is evaluated.

404. **Fleishman, Edwin A.** "A Relationship Between Incentive Motivation and Ability Level in Psychomotor Performance," *J. Exp. Psychol.*, vol. 56, no. 1, July 1958, pp. 78-81.

Supplementary verbal motive-incentive instructions were given to half of the subjects, divided into high- and low-ability groups. The subjects practiced a complex self-paced psychomotor task for 20 one-minute trials. The high-ability group was favorably affected by the instructions, while the low-ability group was not.

405. **Gloye, Eugene.** "Learning as a Function of Contexts Differentiated Through Antecedent Value Experience," *J. Exp. Psychol.*, vol. 50, no. 4, 1955, pp. 261-264.

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Numbers were learned in contexts that had previously been given affective value (positive, neutral, or negative). Fewer trials were required to learn numbers in a neutral context than in either a positive or negative one.

406. Grosslight, Joseph H., Hall, John F., and Murnin, Joseph. "Patterning Effect in Partial Reinforcement," *J. Exp. Psychol.*, vol. 46, no. 2, August 1953, pp. 103-106.

Using a modification of the Humphreys light expectancy procedure, three patterns of reinforcement were studied: (1) continuous reinforcement, (2) partial reinforcement with nonreinforcement termination, and (3) partial reinforcement with reinforcement termination. Condition (3) leads to the greatest resistance to extinction.

407. Hoehn, Arthur J., and Saltz, Eli. "Effect of Teacher-Student Interviews on Classroom Achievement," *J. Educ. Psychol.*, vol. 47, 1956, pp. 424-435.

The effect of teacher-conducted interviews was studied in an Air Force technical school. The results suggest that the average teacher cannot improve grade averages by means of interviews. Interviews may be harmful for some borderline students.

408. Jensen, Barry T. "Instruction and Personality as Factors in Student Performance," *J. Educ. Res.*, vol. 47, March 1954, pp. 529-535.

Independent study vs. class attendance were compared in a college course in adolescent development. It was concluded that students not attending class can achieve as much as those attending class regularly if the course is not rigidly outlined and students have to work somewhat independently. Those attending class learned more when the criterion was acquisition of knowledge about the course content.

409. Kaess, Walter, and Gosette, Robert. "Effectiveness of Individual Conferences With Students Failing Introductory Psychology," *J. Psychol.*, vol. 48, First Half, July 1959, pp. 141-145.

Laboratory instructors in psychology invited failing students for individual conferences. Compared to a control group, there was no evidence that conferences improved a student's later performance in the course.

410. Kanfer, Frederick H. "Verbal Conditioning: Reinforcement Schedules and Experimenter Influence," *Psychol. Rep.*, vol. 4, no. 3, September 1958, pp. 443-452.

Subjects were assigned to a Fixed Ratio group, a modified Fixed Interval group, and a modified Variable Interval group. Two experimenters administered the same procedures to half the subjects in each group. Reinforcement was a flashing light that represented a point score. Verbs were reinforced. The Fixed

Ratio group yielded the highest ratio of verbs to reinforcement, and the greatest resistance to extinction. The experimenters differed in their effect on rate of verbs during extinction.

411. Kanfer, Frederick H., and Marston, Albert R. "Human Reinforcement: Vicarious and Direct," *J. Exp. Psychol.*, vol. 65, no. 3, March 1963, pp. 292-296.

Subjects said words intermittently with a taped simulated group performing a verbal conditioning task. Groups were provided vicarious reinforcement, direct reinforcement, both, or neither. Vicarious reinforcement involved a subject's listening to the experimenter say "good" when a taped subject gave a critical response. Direct reinforcement involving saying "good" directly to each subject. Vicarious reinforcement significantly facilitated learning, with direct reinforcement showing no additional effects. Extinction differences were due to differences in acquisition levels.

412. Kostick, Max Martin. "An Experiment in Group Decision," *J. Teach. Educ.*, vol. 8, 1957, pp. 67-72.

The technique of group decision to raise grades resulted in an increase of approximately seven percentage points on an objective test. The decision was to try to raise scores five percentage points.

413. Krasner, Leonard. "Studies of the Conditioning of Verbal Behavior," *Psychol. Bull.*, vol. 55, no. 3, May 1958, pp. 148-170.

The majority of 31 articles reviewed report positive results with the use of reinforcers such as "good" or "mmm-hmmm."

414. Levine, Jacob, and Butler, John. "Lecture vs. Group Decision in Changing Behavior," *J. Appl. Psychol.*, vol. 36, no. 1, February 1952, pp. 29-33.

Previous analysis of the ratings of 395 factory workers by 29 supervisors had shown them to be biased in favor of men holding high-level jobs. Group discussion was effective in changing rating behavior, while formal lecture was not.

415. Lewis, Donald J., and Duncan, Carl P. "The Effect of Partial Reinforcement and Length of Acquisition-Series Upon Resistance to Extinction of a Motor and a Verbal Response," *Amer. J. Psychol.*, vol. 69, 1956, pp. 644-646.

Subjects played a card game with money as a reinforcer. Subgroups were given 4, 8, and 16 acquisition trials and 50% and 100% reinforcement. They were then given extinction trials. There was no significant difference between reinforcement groups.

416. Mandler, George, and Kaplan, Warren K. "Subjective Evaluation and Reinforcing Effect of a Verbal Stimulus," *Science*, vol. 124, September 1956, pp. 582-583.

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The subjects responded with words and were reinforced by the experimenter saying "mmm-hmmm" when they said a plural noun. Those who thought the experimenter's response was positive increased and then decreased their production of plural nouns. Those who thought the experimenter's response was a negative indication decreased their production.

417. Mayo, George Douglas. "Effect of Temperature Upon Technical Training," *J. Appl. Psychol.*, vol. 39, no. 4, 1955, pp. 244-246.

The effect of summer temperature in the mid-South on performance in training was studied. One group attended air-conditioned classes, while the other used exhaust fans. Subjects working under the higher temperatures thought their learning was impaired, but it was not. Temperatures at least as high as the low eighties Fahrenheit do not result in an appreciable decrement in achievement in U.S. Navy technical school courses of a sedentary nature.

418. McIntire, Roger W. "Reinforcement and Verbal Learning: A Test of the Premack Hypothesis," *Psychol. Rep.*, vol. 12, no. 1, February 1963, pp. 99-102.

In order to test Premack's hypothesis of reinforcement, a paired-associate task was presented to three different groups: (1) A word of high occurrence frequency followed each paired associate, (2) a word of low occurrence frequency followed each paired associate, and (3) no word followed. Premack's hypothesis was supported in that (1) was superior to (2). It was concluded that the relatively high scores of (3) are due to practice during the intertrial interval.

419. Mech, E. Victor. "'Resistance to Extinction' of Two Patterns of Verbal Reinforcement," *J. Exp. Educ.*, vol. 22, December 1953, pp. 155-163.

Students were reinforced under either a partial or continuous reinforcement schedule. Partial reinforcement resulted in greater resistance to extinction.

420. Milton, Ohmer. "Two-Year Follow-Up: Objective Data After Learning Without Class Attendance," *Psychol. Rep.*, vol. 11, no. 3, December 1962, pp. 833-836.

An experimental group did not attend class, while a control group did. There were no significant differences in achievement. The experimental group did more outside reading and other work in learning. On follow-up there were no differences between the groups in number of drop-outs or number taking later courses in psychology.

421. Mullin, Daniel W. "An Experimental Study of Retention in Educational Television," *Speech Monogr.*, vol. 24, 1957, pp. 31-38.

Groups of subjects viewed TV in the home and in a classroom. Subgroups of each were motivated and not motivated, the motivated

subjects being told they would be tested and paid for high scores. Motivation was a significantly effective variable, while location was not.

422. Noble, Clyde E., and Noble, Janet L. "Human Trial-and-Error Learning Under Joint Variation of Locus of Reward and Type of Pacing," *J. Exp. Psychol.*, vol. 56, no 2, August 1958, pp. 103-109.

This study compared reinforcement after each correct response to reinforcement after a group of correct responses. The serial reinforcement was superior to terminal reinforcement.

423. Page, Ellis Batten. "Teacher Comments and Student Performance: A Seventy-Four Classroom Experiment in School Motivation," *J. Educ. Psychol.*, vol. 49, no. 4, August 1958, pp. 173-181.

Teachers in 74 classrooms, using 2139 unaware students, gave normal tests. Random selection of the following types of teacher comments were added to the scores: (1) No comment group received no marks beyond those necessary for grading, (2) free comment group received whatever comment the teacher felt was appropriate, and (3) specified comment group received uniform comments designated by the instructor as standard for each letter grade and thought to be encouraging. Free and specified comments led to higher grades than no comments.

424. Premack, David. "Toward Empirical Behavior Laws: I. Positive Reinforcement," *Psychol. Rev.*, vol. 66, no. 4, July 1959, pp. 219-233.

This is a discussion of the hypothesis that: "Any response A will reinforce any other response B, if and only if the independent rate of A is greater than B."

425. Rudd, W.G.A. "The Psychological Effects of Streaming by Attainment," *Brit. J. Educ. Psychol.*, vol. 28, 1958, pp. 47-60.

The control group of 90 pupils was organized into three classes whose membership did not change for two years. The experimental group was divided into three ability groups, with transfers between groups, or streams, after each half-year. There were no significant differences in ability, achievement, or attitude toward school attributable to streaming. In the streaming groups there were fewer social contributions to lessons made by pupils, more aggressive behavior, and less attention to work. Pupils' self-estimates of personality showed an extensive, but probably temporary, deterioration in personality following regrouping.

426. Salzinger, Kurt. "Experimental Manipulation of Verbal Behavior: A Review," *J. Gen. Psychol.*, vol. 61, First Half, July 1959, pp. 65-94.

Management of Students

This article is a comprehensive review of the literature on experimental manipulation of verbal behavior.

427. Sessions, Frank Q., and Carruth, Max L. "Student Performance in Morning and Afternoon Classes," *Personnel Guid. J.*, vol. 41, no. 2, 1962, pp. 144-146.

Performance of students in afternoon and morning classes were compared. There was no significant difference.

428. Ugelow, Alvin. *Motivation and the Automation of Training: A Literature Review*, Technical Documentary Report MRL-TDR-62-15, Behavioral Sciences Laboratory, Aerospace Medical Division, Air Force Systems Command, Wright-Patterson AFB, Ohio, March 1962.

A review is presented of the literature considered relevant to motivating students to participate in automated training. Topics reviewed include (1) teaching machines and the motivation problem, (2) knowledge of results, (3) praise and reproof, (4) competition, (5) task interruption, and (6) some contextual factors.

429. Williams, D.C.S. "Effects of Competition Between Groups in a Training Situation," *Occupational Psychol.*, vol. 30, 1956, pp. 85-93.

An experiment was carried out to test the hypothesis that during training in relay adjusting, the introduction of competition would lead to increase in quality and quantity of work. There was no significant difference in quality, but a significant increase in quantity as a result of competition.

430. Wilson, William Cody, and Verplanck, William S. "Some Observations on the Reinforcement of Verbal Operants," *Amer. J. Psychol.*, vol. 69, 1956, pp. 448-451.

The reinforcers "mmm-hmmm," "good," and writing down the word were effective in changing verbal behavior. Most subjects reported the response conditioned. Saying adverbs is a form of verbal behavior that has a very low operant level.

Section VII

ADDITIONAL MATERIAL

431. Bowers, Norman D. "Meaningful Learning and Retention: Task and Method Variables," *Rev. Educ. Res.*, vol. XXXI, no. 5, December 1961, pp. 522-534.

This is a review of recent research on task and method variables, as related to meaningful learning and retention. Major topics covered are (1) task variables, (2) method variables, including classroom organization, presentation procedures, and evaluation techniques, (3) teacher factors, and (4) task-method emphases.

432. Finch, G. (ed.). *Educational and Training Media: A Symposium*, National Academy of Sciences-National Research Council, Washington, 1960.

In a symposium on educational and training media, titles of papers presented were "Role of Media in Education and Training"; "The Instructor"; "Textbooks and Methodology"; "The Job as a Medium for Training"; "Graphic aids, Models, and Mockups"; "The Instructional Film"; "Teaching by Television"; "Part Trainers"; "Teaching Machines."

433. Fryer, Douglas H., and Edgerton, Harold A. "Research Concerning 'Off-the-Job Training'," *Personnel Psychol.*, vol. 3, no. 3, Autumn 1950.

The implications of training research conducted during World War II are summarized. Topics described are instructor training, selection, and evaluation; training surveys and methods; training films; and testing.

434. Gage, N.L. (ed.). *Handbook of Research on Teaching*, Rand McNally & Company, Chicago, 1963.

This handbook is a comprehensive review of topics relevant to research in teaching. Part I, Theoretical Orientations, includes (1) Historic Exemplars of Teaching Method, (2) Logic and Scientific Method in Research on Teaching, and (3) Paradigms for Research on Teaching. Part II, Methodologies in Research on Teaching, includes (4) Statics as an Aspect of Scientific Method in Research on Teaching, (5) Experimental and Quasi-Experimental Designs for Research on Teaching, (6) Measuring Classroom Behavior by Systematic Observation, (7) Rating Methods in Research on Teaching, (8) Testing Cognitive Ability and Achievement, and (9) Measuring Noncognitive Variables in Research

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on Teaching. Part III, Major Variables and Areas of Research on Teaching, includes (10) Analysis and Investigation of Teaching Methods, (11) The Teacher's Personality and Characteristics, (12) Instruments and Media of Instruction, (13) Social Interaction in the Classroom, and (14) The Social Background of Teaching. Part IV, Research on Teaching Various Grade Levels and Subject Matters, includes the following research on teaching: (15) In the Nursery School, (16) Reading, (17) The Social Studies, (18) Composition and Literature, (19) Secondary School Mathematics, (20) Science, (21) Foreign Languages, (22) The Visual Arts, and (23) At the College and University Level.

435. Gagné, Robert M., and Bolles, Robert C. "A Review of Factors in Learning Efficiency," in *Automatic Teaching: The State of the Art*, E. Galanter (ed.), John Wiley & Sons, Inc., New York, 1959, pp. 13-54.

In this discussion of factors contributing to learning efficiency, two broad classes of factors are described--readiness and associative. Under readiness factors are included motivation, reinforcement, set, and attention. Under associative factors are included nature of associations, intratrial factors, and inter-trial factors.

436. Hoehn, Arthur J. *The Development of Training Programs for First Enlistment Personnel in Electronics Maintenance MOS's: IV. How to Design Training Methods and Materials*, Research Memorandum, HumRRO Division No. 1 (System Operations), Alexandria, Va., February 1960.

A discussion of 70 guidelines for designing training methods and materials is presented. Major topics cover (1) training activity interpreted in terms of cue displays, trainee responses, and feedback, (2) general concepts related to programing, (3) programing in relation to content and task characteristics, (4) motivation, (5) training media, and (6) the outline of a procedure for the design of methods and materials.

437. Krumboltz, John D. "Meaningful Learning and Retention: Practice and Reinforcement Variables," *Rev. Educ. Res.*, vol. XXXI, no. 5, December 1961, pp. 535-546.

This is a review of recent research on practice and reinforcement variables as related to meaningful learning and retention. Major headings are (1) Evoking the Desired Response--Use of Prompts, Construction vs. Selection of Responses, and Overtness of Response; (2) Reinforcing the Desired Response--Effectiveness of Reinforcers, Immediate vs. Delayed Reinforcement, and Schedules of Reinforcement; (3) Maintaining and Improving the Desired Response; and (4) Eliminating the Undesired Response--Optimal Error Rate, and Procedures for Dealing with Errors.

438. Lumsdaine, Arthur A. "Design of Training Aids and Devices," in *Human Factors Methods for System Design*, John D. Folley, Jr. (ed.), American Institute for Research, Pittsburgh, 1960.

A general treatment of the design of training aids and devices for effective training is presented. Major topics considered are (1) some basic considerations in training device design, (2) identifying the requirements for training, (3) types of training devices particularly suitable for various classes of training objectives, (4) classroom training aids, (5) some special factors in design and use of training devices, and (6) procedures in the design of training devices.

439. McGehee, William. "Are We Using What We Know About Training?-- Learning Theory and Training," *Personnel Psychol.*, vol. 11, no. 1, Spring 1958, pp. 1-12.

Several general statements and their implications for industrial training are discussed. The statements are (1) the learner has a goal or goals, (2) the learner makes a response, (3) the learner's responses are limited by his past responses and abilities, his interpretation of the goal situation, and the feedback from his responses, and (4) the learner has achieved his goal, that is, he has learned.

440. McKeachie, W.J. "Understanding the Learning Process," *J. Eng. Educ.*, vol. 51, no. 5, February 1961, pp. 405-408.

This is a discussion of several principles and aspects of effective learning: practice, knowledge of results, activity, organization, and transfer.

441. Meierhenry, Wesley C. (ed.). "Learning Theory and AV Utilization," *AV Communication Rev.*, vol. 9, no. 5, Supplement 4, September-October 1961.

A collection of papers on learning theory and the utilization of audiovisual devices. Papers include "Implications of Gestalt Psychology for AV Learning," by A.S. Luchins; "Stimulus-Response Psychology and Audiovisual Education," by H.H. Kendler; "Learning and the Technology of Instruction," by R. Glaser; "Motivation and the Communication Processes," by F.J. McDonald; "Human Learning and Audiovisual Education," by L. Postman; and "Comment and Summary: A Mine of Possible Applications," by J. Deese.

442. Root, Robert T. *An Annotated Bibliography of Research on Training Aids and Training Devices*, Staff Memorandum, HumRRO Division No. 1 (System Operations), Alexandria, Va., August 1957.

A survey of the literature up to December 1956 forms the basis for an annotated bibliography of approximately 350 titles. The major topics are training devices, training aids, requirement and evaluation methodology, and basic research and its applications.

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443. Stiles, Helen J., and Demaree, Robert G. *Maintenance Personnel and Training Research: A Bibliography*, Staff Memorandum, HumRRO Division No. 5 (Air Defense), Fort Bliss, Tex., March 1958.

This is predominantly an annotated bibliography of maintenance personnel and training research. Topics include (1) maintenance research programs and their management, (2) design of equipment and work situations for maintainability, (3) job description and forecasting, (4) selection, (5) training, (6) training equipment, (7) proficiency measurement and criteria of job performance, (8) job aids and handbooks, and (9) collected works.

444. Townsend, John C., and Flexman, Ralph E. *Suggested Ways of Improving Instruction in the Primary Pilot Training Program*, Research Review AFPTRC-TR-54-126, Basic Pilot Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Goodfellow AFB, Tex., December 1954.

The primary pilot training program was changed by application of the following methods: distributed practice, over-learning, intellectualization of maneuvers, talking the students through, part-task and whole-task learning, creation of a proper set, training for transfer, and student participation. New training materials and procedures were developed. A significant improvement in proficiency resulted.

445. Trafton, Clinton S. *An Annotated Bibliography on the Troubleshooting of Electronic Equipment*, Research Memorandum, HumRRO Division No. 5 (Air Defense), Fort Bliss, Tex., March 1962.

This is an annotated bibliography of 74 items on the troubleshooting of electronic equipment.

446. Tyler, Ralph W. "Conditions for Effective Learning," *NEA J.*, vol. 48, no. 6, pp. 47-49, May 1957.

The following conditions for effective learning are described: (1) motivating the learner, (2) the learner finds his previous ways of reacting unsatisfactory, (3) guiding the learner's activities when the behavior is not simply acquired, (4) providing materials for the student to use in his efforts to learn, (5) providing time to carry on the desired behavior, (6) the learner gets satisfaction from his behavior, (7) sequential practice, (8) encouraging pupils to keep setting their sights higher and higher, (9) helping the learner get some means of judging his own performance.

447. Underwood, Benton J. "Verbal Learning in the Educative Processes," *Harvard Educ. Rev.*, vol. 29, 1959, pp. 107-117.

A description is presented of significant variables established in laboratory studies that may affect verbal learning in

Additional Material

schools. This includes meaningfulness, intratask and intertask similarity, and active recitation vs. passive study.

448. Wolfle, Dael. "Training," in *Handbook of Experimental Psychology*, S.S. Stevens (ed.), John Wiley & Sons, Inc., New York, 1951, pp. 1267-1286.

Six principles concerned with variables that can be manipulated under practical training conditions are described. These are knowledge of results, avoidance of habit interference, variety of practice materials, methods used in training, knowledge of principles involved, and effectiveness of guidance.

449. Woodworth, Robert S., and Schlosberg, Harold. *Experimental Psychology*, (rev. ed.), Holt, Rinehart, & Winston, New York, 1954.

This book covers experimental psychology in general. Chapters on learning include the following titles: (1) Learning: Introductory Survey, (2) Conditioning, (3) Discrimination Learning, (4) Maze Learning, (5) Motivation in Learning and Performance, (6) Transfer and Interference, and (7) Economy in Learning and Performance.

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DESCRIPTION OF THE KWIC INDEX

A key-word-in-context (KWIC) index has been prepared as an aid to the user of this bibliography. It has been constructed by alphabetizing bibliographic titles according to key words--those words presenting the greatest amount of subject-oriented content. Each title is listed separately for each key word it contains; therefore, if a title contains four key words it will appear four times in the KWIC, alphabetically by key word. The key words are aligned down the middle of the page, with the remainder of the title "wrapped around" the key word. Virgules (//) mark the end of a title.

Example: (each key word is underlined)

Title: Procedures for Giving Immediate Reinforcement in
Programmed Instruction

KWIC index entries:

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INSTRUCTION// PROCEDURES FOR GIVING IMMEDIATE REINFORCEMENT IN PROGRAMMED I
MEDIATE REINFORCEMENT IN PROGRAMMED INSTRUCTION// PROCEDURES FOR GIVING IM
CEMENT IN PROGRAMMED INSTRUCTION// PROCEDURES FOR GIVING IMMEDIATE REINFOR
R GIVING IMMEDIATE REINFORCEMENT IN PROGRAMMED INSTRUCTION// PROCEDURES FO
// PROCEDURES FOR GIVING IMMEDIATE REINFORCEMENT IN PROGRAMMED INSTRUCTION
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To search the index, the user should frame a question and select key words from it. If first-selected key words do not yield the desired information, the user should search related topics or synonymous words. For example, if the user is interested in "Knowledge of Results," but the information under the key word "knowledge" is insufficient, he might look under "results," "reinforcement," or "feedback." Used in this manner, the KWIC should provide to the user all the information available in the bibliography pertaining to the topic.

When the searcher has found a title which interest him, the reference code provides location and other information. This reference code is aligned down the right column of the page and is in three parts. The first segment is the item number of the entry, and can be used to locate the item in the report; the next segment is the section of the report in which the entry appears, and indicates the major topical emphasis; and the last segment is the year in which the item was written. For example, the code 209/IV/62 indicates the title is entry number 209, appears in Section IV (Practice of Knowledge), and was written in 1962.

Because of space limitations of the computer printout, some long titles had to be truncated and do not appear in exactly the same form as in the report. However, every effort was made to retain the original context and key words. Titles that were shortened in this manner are indicated by an asterisk at the end of the reference code.

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13. ABSTRACT The bibliography is divided into seven major areas, each dealing with a different aspect of instructional system design: I, Systems--General; II, Training Systems; III, Presentation of Knowledge; IV, Practice of Knowledge; V, Practice of Performance; VI, Management of Students; and VII, Additional Material. The major areas are further divided into sub-topics where appropriate. There are 442 annotated entries in the bibliography, dating from 1870 to 1965. Key-word-in-context (KWIC) and author indexes are included.		

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