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TRAINING IN INDUSTRY.

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THIS CHAPTER IN A LARGER WORK ON INDUSTRIAL PSYCHOLOGY DEALS LARGELY WITH THE NEED TO SPECIFY TRAINING OBJECTIVES THROUGH JOB ANALYSIS, USES OF TESTING IN TRAINEE SELECTION, TRAINING VARIABLES AND LEARNING PROCESSES, TRAINING TECHNOLOGY (MAINLY THE CHARACTERISTICS OF PROGRAMED INSTRUCTION), THE EVALUATION OF PROFICIENCY, THE VALUE OF EXPERIMENTATION, AND FACETS OF TRAINING (ORIENTATION AND INDOCTRINATION, VOCATIONAL AND JOB SKILL TRAINING, SUPERVISORY AND MAMAGEMENT EDUCATION, SPECIALIZED TRAINING). MAJOR CONSIDERATIONS IN THE TRAINING PROCESS ITSELF ARE THE PROPER AMOUNT OF REPETITION AND PRACTICE, TASK GUIDANCE BY THE TRAINER, PROMPT REINFORCEMENT (THAT IS, REWARDS CONTINGENT ON OR FOLLOWING FROM CORRECT TASK PERFORMANCE), CORRECT RESPONSE DISCRIMINATION AND GENERALIZATION BY THE TRAINEE, THE EXTINCTION (UNLEARNING) OF UNWANTED RESPONSES, EFFECTIVE TRAINING SEQUENCES, MEANINGFUL TRAINING MATERIALS, THE EFFORT AND THE DEGREE OF PRECISION REQUIRED, THE NATURE OF LEARNING PLATEAUS, THE ROLE OF NEGATIVE REINFORCEMENT, MOTIVATION, ACTIVE LEARNING, AND THE TRANSFER OF TRAINING TO NEW TASKS. THE DOCUMENT INCLUDES TWO TABLES, SUGGESTED READINGS, AND AN EXAMPLE OF A PROGRAMED TEXT. THIS DOCUMENT IS INCLUDED IN INDUSTRIAL PSYCHOLOGY, BY B. VONHALLER GILMER AND OTHERS. AVAILABLE FROM THE MCGRAW-HILL BOOK COMPANY, NEW YORK. (LY)

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7

Training in Industry

Robert Glaser

When we speak of the utilization of human resources in an industrial organization, or in a nation for that matter, we are almost inevitably led to think of training. We recognize that individuals need to be taught to perform in specific ways in order to accomplish certain aims. The aims must be specified, and the behavior of individuals must be shaped and modified so that they can perform the tasks required as members of an organization. "Shaping" and "modifying" are key words. They define the meaning of training and, indeed, of all education. This is what training is, and this is what training agencies and educational systems do: *they begin with individuals who behave in certain ways and modify this behavior so that these individuals behave in ways which are defined as the end products of the training program.*

An organization is fortunate if the skills it requires exist in adequate quantities in the manpower resources available. An industry is even more fortunate if all it needs to do is pick out the appropriately trained individuals on its own roster. However, the widespread and firmly established existence of training departments in industrial and governmental organizations attests to the fact that things are not so simple. With both machines and operating procedures becoming more complex, training within industry is becoming more and more essential.

With the passing of the Manpower Development and Training Act by Congress in the early sixties, interest in industrial training has expanded [21]. Researches from within military settings have also added many problems of relating training and the principles of learning [7, 18, 29]. More and varied people are becoming interested in training and retraining prob-

lems and in viewing their impact on society. In this chapter we shall give a background for understanding both the basic and applied aspects of training in industry.

THE SPECIFICATION OF TRAINING OBJECTIVES

The first step in establishing a training program is to state the objectives of the program in operational terms. The behaviors to be learned as a result of training should be specified in terms of the particular actions and operations that men must perform. It is not enough to state that the objective of a training program is to produce a good executive or supervisor, a good salesman, a proficient repairman, or a loyal employee. The particular skills and attitudes that make up these job performances need to be analyzed specifically and set down as training objectives. These then constitute the behaviors which are the goals, or end products, of the shaping and modifying learning processes involved in training. In specifying training objectives it is important to get answers to questions such as:

1 What are the requirements for proficient job performance?

2 What are the special characteristics of a job with respect to the organizational structure in which it is performed?

3 How can the job be engineered, or organized, so that it fits into the general system most effectively? Can it be simplified? Can it be combined with other jobs?

4 To what extent is a man being trained not only for skill in an immediate job but for possible conversion to other or future jobs?

5 What logistics problems are involved? That is, do we have the right number of people to be trained? Do we have equipment available for training?

Determination of the Requirements for Proficient Job Performance. Some ways of doing things are better than others, and certain ways in which people behave lead to more successful accomplishments than do other ways. In specifying the objectives of a training program, these behaviors must be identified. The ease with which they can be identified is, to a large extent, related to the ease with which they can be observed. This ease of observation is further related to the complexity of the behavior involved. Consider, for example, the differences between a training program for typists and a training program for first-line supervisors. The specific behaviors and skills of a proficient typist are relatively easy to define in terms of typing speed, accuracy, correct letter form, and neatness. Specification of a similar set of defining characteristics of supervisory proficiency in a particular organization is obviously more difficult, as we shall see in Chap-

ter 8. Even more complex is the difficulty of defining the objectives of a course designed to develop good company executives.

Job Analyses. Although the specification of training objectives for certain jobs is difficult, techniques for carrying out systematic job analyses can provide a basic tool for accomplishing this task. With specific reference to training, the essential aim of job analysis is to specify the ultimate and immediate objectives of the training program. More directly, the aim is to specify the knowledges and skills which constitute the behavior to be displayed by an individual at the end of a course of training. It is unsatisfactory to say that an individual is being trained so that sometime in the future he will be able to become an executive or an experienced technician. The subobjectives, or subgoals, of immediate training that are related to long-term and eventual job proficiency should be specified in detail as far as possible. Some of the best research in this area has been done by military psychologists. An example of the detail that is often required for

Table 2 / Sample Format for Describing a Maintenance Task

Operator: *Line Mechanic—Fire-control System*
Work Cycle: 1 *Adjust System Voltages.* Performed every 25 hours of aircraft operation
Task: 1.1 *Adjust Power-supply-regulated Voltages.* Requires 40 minutes. If any of the specified indications cannot be obtained, replace power-supply unit.

	Control	Action	Indication	Alternatives and/ or Precautions
J1.1.1	POWER switch	Turn to WARM UP.	Inverter hums, pilot light comes on.	Make sure covers are on high-voltage units before starting task.
1.1.2	AC VOLTAGE (screwdriver)	Turn as required.	AC voltmeter aligns to 117 ± 4 volts.	
1.1.3		Wait maximum of 5 minutes.	READY light comes on.	If READY light does not come on, use press to test button. If light is burned out, replace it.
1.1.4	METER SELECTOR switch	Turn to 300.		
1.1.5	+300 VOLTS ADJ. (screwdriver)	Turn as required.	Meter indicates within green area.	
1.1.6	METER SELECTOR switch	Turn to −150.		
1.1.7	−150 VOLTS ADJ. (screwdriver)	Turn as required.	Meter indicates within green area.	

specification of job characteristics, appears in job analyses of Air Force tasks carried out as a basis for equipment and job redesign, and for establishing training programs with appropriate course content, manuals, and training devices. Table 2 presents a segment of a task analysis for a maintenance task. Table 3 presents a similar description for a pilot task [51]. These tables are presented here merely to show the amount of detail required for the specification of the job characteristics for a single task. However, this detail is similar to that required for the more comprehensive time-and-motion studies in industrial engineering work. To the extent that the objectives of training (the end-product behaviors) are known, they should be stated so that we can have definite behaviors which we want our

Table 3 / Sample Format for Describing a Pilot Task

Operator: *Pilot F–100 Interceptor*
Work Cycle: 1 *Climbing to Altitude as Directed by Ground Control.*
Task: 1.1 *Accelerate to Climb Speed* (in shortest possible time and in most favorable position to intercept and destroy unidentified aircraft).

Job-element Variables

Inputs

Needed input information
1 Position, speed, and direction of unidentified aircraft (provided by Ground Control)
2 Friendly or unfriendly aircraft
3 Amount of fuel
4 Position, speed, and heating of interceptor

Disruptive or irrelevant inputs
1 Air turbulence
2 Background chatter from Ground Control
3 Radio static
4 Enemy jamming

Critical time characteristics of inputs
1 If fuel is limited, intercept may have to be made before the most favorable position for attack can be reached.

Decisions

1 Best course to follow in accelerating to climb speed
2 When climb speed has been reached

Required Control Actions

Controls	Actions
1 Control stick	Standard-power boost and artificial back pressure
2 Rudder pedals	Standard-power boost and artificial back pressure
3 Throttle	Standard

Table 3 (*Continued*)

Feedback

Indications of adequacy of actions
1 Airspeed indicator reads attained speed.
2 Direction indicator reads desired heading.
3 Attitude indicator shows level flight.

Delay action to indication
1 Airspeed indicator lags about 2 seconds during rapid acceleration.
2 Direction and attitude indicators have lag of less than 0.5 second.

Characteristic Errors and Malfunctions

Climb may be started later than is efficient because of airspeed-indicator lag.

Contingencies Which Will Affect Task

Contingencies	Effects on task
1 Ground Control loses target.	Pilot must decide whether to attempt unaided intercept or return to base.
2 Target changes course.	Acceleration course may have to be revised.
3 Ground Control detects target escorts.	Attack attitude revised, changing point at which climb to altitude is started.
4 Malfunction occurs.	Must decide whether or not to abort.

trainees to learn. To the extent that we do not or cannot specify these behaviors, we must *guess* about the content of a training program.

How to Describe a Job. The crucial problem is how to describe a job in a detailed manner which is meaningful for training. Many of the job-analysis schemes now in use in industry and elsewhere are not satisfactory for this purpose. One type of job-analysis procedure directly infers underlying abilities from observation of the job. According to this method, jobs are described in terms of abilities, such as numerical facility, verbal fluency, color vision, or ability to recall details. These terms, however, are ambiguous and are subject to different interpretations from job to job. For example, the presence of colored signals may not mean that color vision is involved. One should observe whether the operator must respond to the presence of a light regardless of its color or whether he must discriminate between differently colored signals. The specification of the kinds of discriminations an individual has to make among numerical, verbal, or other visual signals can help pinpoint the skills which must be learned. Another method of job description comes from time-and-motion study in which physical descriptions of movement are employed, such as "moves lever forward," "loads vehicle," "empties vehicle," and so forth. This kind of description is convenient to use and is unambiguous. However, it provides

no indication of the behavior involved in initiating or terminating the movement. Moving a lever to shift gears in a truck requires different kinds of discriminations from those involved in moving a lever to start a production line rolling.

What the training specialist requires is a set of descriptive categories which tell him how to proceed. For certain kinds of tasks, such categories as the following have been suggested by Gagné and Bolles [20].

Identifying. Examples are pointing to or locating objects and locations, naming them, or identifying what goes with what, either physically or in words or symbols. This includes much of what is meant by learning "facts."

Knowing Principles and Relationships. This means understanding a statement relationship, as shown by being able to state, illustrate, and recognize its implications. Often this is a statement that tells how a cause produces an effect or how a result can be predicted from several component factors. It may involve knowing arbitrary rules of contingent procedure; e.g., if such and such is observed, do thus and so.

Following Procedures. Examples are knowing how to perform a set of operations that must be carried out in a rather fixed sequence, such as a preflight check, starting a car, or making a well-defined type of calculation.

Making Decisions or Choosing Courses of Action. This involves the application of conceptual rules or principles as a basis for making the kinds of decisions that are involved in diagnosing or interpreting complex situations. However, sometimes it involves perceptual discriminations that are learned or acted on directly without reasoning.

Performing Skilled Perceptual-Motor Acts. These may be quite simple (using basic hand tools) or quite difficult (manipulating the controls of an airplane or performing a sensitive adjustment that requires precise timing). Often the simpler skills provide necessary steps in more complex tasks that require the following of lengthy procedures.

Six Job-analysis Methods. The advantages and limitations of various methods of obtaining task information for training purposes have been investigated. One study compared job practices with training-course content using six job-analysis methods. The different methods were *direct observation,* an activity *checklist* filled in by the job analyst and job supervisors, a job *questionnaire* filled out by the technician, investigation of maintenance *records* for each job, *reports* to the observer of jobs just completed, and *sorting* of descriptive task statements prepared by the observer [6].

These methods were compared in terms of the amount of observer time required, the amount of technician time required, the amount of time required for observer training, the amount of technical job knowledge required by the observer, the amount of total job coverage possible in one week, the type of data analysis required of the information obtained, and the difficulty of this analysis. The study showed that some combination of

routine checklist and questionnaire, supplemented with a large measure of concentrated on-the-spot observation, is valuable for getting information for training purposes. Many industrial training problems could be dealt with more economically if just a little more time were given to the problem of determining what information will be most useful.

Procedures for the specification of the behaviors to be developed in a training program are extremely important because on the basis of these specifications the entire program is established, as shown by Miller [39].

Determination of the Structure and Organization of a Job. Certain considerations about the nature of a job and its relation to an organization are of value for training. It is most important in industry that the distinction be made between training and education. Training is usually defined as the teaching of specific skills. Education usually refers to a broader type of teaching in which the objectives relate to proficiency in future situations by providing a basis for learning through experience or future training. It is often important for an organization to decide upon the goal of its training program. Within the limits of training time, is it more worthwhile to train individuals for a high proficiency level in a particular phase of a job, or is it more worthwhile to provide a higher degree of general training? Specific training gets people on the job faster and usually at a relatively high level of competence. Broad general training usually means that men will be more adaptable to fluctuations in job procedure and new equipment, but in any event, they require a period of specific on-the-job training. Each kind of training has its place. Instruction given the mechanic in running a new machine meets our definition of training. The instruction given in our graduate schools of business to young executive trainees we consider education.

Job Simplification. As jobs in industry and in the military become involved with increasingly complex equipment, it often appears that lengthy training is required. One way of managing such a situation is by job simplification, or *shredout*. Shredout refers to the breaking up of jobs, or tasks, into more easily trainable units. Such units will then require shorter training periods and less background for the people entering training. These units can be developed by training specialists in cooperation with the persons responsible for the utilization of the trainees. Shredout may require that a job be reorganized or redesigned so that it is performed in a new way. With appropriate job design a trainer may find that much less training time or fewer training demands are required. Industry has done little research in this area, but the military has done a great deal. An example of this research is reported for a control tracking situation where the task was redesigned to provide the operator with more immediate and direct knowl-

edge of the effects of his own motions. Subjects who performed without task redesign were incapable of controlling more than one dimension or coordinate. With task redesign, five out of six operators handled four coordinates with ease [3]. Studies of this kind highlight the principle that training should be considered in relation to equipment and job design. This will be exemplified in the chapter on human engineering factors.

INPUT CONTROL

A necessary aspect of the training process in industry is the selection of the raw material that is to be modified. Personnel for a training program are selected by a variety of procedures consisting of such devices as tests, interview judgments, personal history, previous training, and in some cases the whims of a supervisor or manager. Judgment based upon interview is an extensively used procedure, the effectiveness of which is not evaluated often enough. The more formal selection techniques, in comparison with other aspects of a training program, have quite a detailed body of methodology and relatively well-laid-out procedures, as was shown in the preceding chapter on personnel selection. However, some special considerations of these for training will be mentioned here.

Selection procedures and training methods are influenced by the adequacy of the manpower supply available. When there is a full manpower pool, less precise selection procedures can be employed in order to select the relatively small number of trainees with the desired qualifications. The precision of selection procedures becomes increasingly important as larger numbers need to be selected or as the amount of available manpower grows smaller [48].

Cost Considerations. Testing practice in industry is also related to the cost of training. If test scores are positively correlated with success in training and with subsequent job performance, then the selection of individuals with high test scores can decrease the average cost of training per satisfactory employee. However, setting too stringent a test score for acceptance into training may require the testing of a large number of applicants. Using such a procedure can increase testing costs so much that the combined cost for testing and training per satisfactory employee is higher than the average cost for training a group with a lower minimum test score. This is true because qualifying with a lower score would require fewer applicants from which selections could be made. In general, overall costs increase when very high test scores are demanded. Refined selection techniques are especially necessary if classification for input into a number of different training programs is required. Such a practice would take place, for example, if a large organization desired to select electrical engineers for placement in

various company training programs leading to administrative, research, managerial, sales, or production careers [50].

Another aspect of input control is the determination of specific *training needs.* Training-needs tests can be of particular value for refresher courses and for on-the-job training courses to increase proficiency. On the basis of job-oriented knowledge and skill tests, individuals can be selected for refresher courses or advanced training. The main job of the training specialists in this connection is to develop a series of tests which can diagnose these training needs and assess levels of proficiency. Input for a training program often comes from the work force already employed in a company, and the problem becomes one of selection from this group. This kind of program entails the selection of foremen and higher-level supervisors who can benefit from training.

Selection and training procedures cannot be considered as relatively independent problems. The manpower available can determine the extent and nature of a training program. Similarly the time and cost of training is influenced by the kind of personnel selected. Attention to the interaction between testing and training permits evaluation of the relative utility of each function. If only applicants of high ability are accepted for training, then training can be less costly and perhaps be continued to a high terminal level. If lower-ability applicants are accepted, a longer training period and appropriate job reorganization may be required to reduce the need for high-level personnel.

LEARNING PRINCIPLES AND TRAINING PROCEDURES

We come now to the heart of the training process—the actual procedures and techniques used in shaping and modifying behavior, including the teaching of certain skills, knowledges, and attitudes. The instructor or the supervisor must determine the best procedures to use, recognizing the caliber of the input population and the nature and objectives of the organization.

Scientific Findings and New Applications. An individual learns as a result of certain events that take place in his environment. Determination of the characteristics of these events and the relationships of these events to how behavior is acquired comprise a primary study of the science of psychology. As psychology advances, it will probably be possible to state the kinds of training procedures required for particular kinds of behaviors and for particular kinds of individuals. At this future time training and education will have become the applied psychology of learning. In furthering this end, psychologists spend much time working to discover the relevant considera-

tions and variables that make up the laws of learning. Applied practice often outruns cataloged knowledge, and so individuals are trained and educated on the basis of the informal knowledge gained by experience instead of on the basis of the more rigorous knowledge gained by formal experimentation. This is illustrated by the fact that bridges and steam engines were built before laws describing their underlying principles were formally specified. However, experience is neither an inexpensive nor an efficient guide, and it is likely that the individual who modifies traditional practice with available scientific knowledge can do a more effective job. It also may be that the individual who, on the basis of scientific findings, breaks with the practices built up from experience will discover new applications and techniques which far outdistance the old.

It seems clear that what is most needed for the advancement of training methods and the development of a psychology of training is fruitful and flexible interplay between the requirements of training programs in industry, government, and educational institutions and an experimental approach to the modification of behavior. To have "pure" and "applied" endeavors operating in close coordination is an important undertaking. An experimental and research approach to training may be in the long run as valuable to an organization as a research laboratory for product development. Within the past decade industry has shown quite a willingness to work with professional educators and psychologists in attacking the practical problems of human learning.

Variables in Learning. A number of psychologists have attempted to draw together the results of the accumulated knowledge about learning and to state general principles that apply to training. These principles should be regarded primarily as *relevant variables* to be considered in developing training methods. The specific application of these variables in relation to the behavioral modifications required is a matter of determining their particular value in a specific training situation. This may be no more unreasonable than saying that here are some important considerations for building a new piece of equipment, but the exact application for developing this equipment, with certain desired characteristics, must be determined by field tests. If a consideration or variable is found to influence learning in a training situation, then it is important to ensure its appropriate use.

Repetition and Practice. Repetition can facilitate the learning of a task. A training situation should be designed so that the repeated practice of skills is possible. The amount of practice required depends upon the kind of task involved, training techniques, and individual trainee differences. The influence of these variables in a practical situation should be determined by observation and investigation. Too often, in industry as well as

in college, time limits are set for training programs without knowledge of the amount and kind of repetition required for learning the tasks involved. Repetitions that are separated by a period of time are often more effective than repetitions that occur close together. Spaced repetitions, as compared with massed or concentrated repetitions, appear to result in rapid learning and increased retention. The trainer must determine the optimal schedule of practice for the particular activities with which he is concerned, and he must also consider the size of practice units.

7 **Task Guidance.** Learning is facilitated when the behavior of the learner is controlled through guidance. The word "guidance" here refers to any procedure employed to ensure that the trainee performs a task or works through a problem in a way which the trainer considers correct. In many instances one of the most important functions of a trainer is to aid the learner in performing correct responses, such as selecting the best movement, using the correct form, or choosing the alternatives which give maximum information in making a decision. Training is most efficient, it seems, when the trainee is allowed to make only a minimum of incorrect or ineffective responses. As a task becomes learned and the associated responses become finely differentiated in the presence of task cues, guidance should be shifted to these new, more precise responses.

In relation to guidance, industrial psychologists often discuss the problem of training for accuracy versus training for speed. In general, it appears that the answer depends upon the extent to which fast task responses differ from slower responses. If the difference is great, it is probably best to approximate the speeded task to be learned at the outset of training. It is often pointed out that information to the trainee concerning the outcome of his efforts and the nature of his errors aids learning; this, too, can be considered a form of guidance. The trainer needs to determine the kind of information which, in particular training situations, can be best used by the learner, and he must decide upon the best method of presenting this information to him.

Reinforcement. The learning of a task is facilitated when the learner is stimulated by the successful consequences of his behavior. Reinforcement refers to the fact that new behavior is learned and old behavior is changed when the individual's actions produce a consequent event such as a reward. Put another way, when an event that follows the learner's activity results in an increase in that activity, that event is said to be a reinforcer, and the process involved is called reinforcement.

Psychologists refer to the reward that is contingent upon or follows from, the performance of a task as reinforcement. Reinforcement can take many forms in training and education; it can be information about success-

ful results or achievement or about progress or improvement; it can be monetary reward, recognition, approval, or the feeling of accomplishment. In a particular training situation, it may be practical to make a survey of the events which are most reinforcing to the trainees. It is important that the trainee have realistic goals in the course of training. Unrealistic goals cause failure and are punishing rather than reinforcing. The appropriate establishment of realistic goals which are reinforcing is an important task of the trainer.

Positive and Negative Reinforcement. Another important task for the trainer is to determine the trainee's level of aspiration and to give the trainee practice in setting aspiration levels for himself which are reinforcing and contribute to learning. Certain training programs use permissive-discussion methods, which are designed to encourage the trainee to express his attitudes and viewpoints. Permissive discussion reinforces the trainee's behavior in expressing his views. The expression of these views is then reinforced by the acceptance or nonacceptance of the group and by the reaction of the instructor. Certain general classes of reinforcers are distinguished by psychologists—positive reinforcers and negative reinforcers. *Positive reinforcing events* are effective because they are presented as a consequence of a response. Familiar examples are a good test score, the praise of the instructor, or information that a task has been performed accurately. *Negative reinforcers* are effective because they are withdrawn as a consequence of task performance. Examples include removing a trainee from a job he dislikes as a result of the successful completion of a training course and transferring a trainee to a new task which is less monotonous than his former job.

Reinforcement Schedules. Reinforcement is most effective if it occurs immediately after a task has been performed. Waiting until the end of a training session to inform a trainee of his success may not be as effective as immediate reinforcement. Determination of how various techniques and conditions of reinforcement influence learning and task performance has long been an important area of study for psychologists. Of particular interest in training is the frequency and pattern of application of reinforcement. How often and according to what kind of schedule should reinforcement follow the tasks being learned? Different schedules yield different characteristics in the behavior acquired. The effects of various schedules or programs of reinforcement in training curricula is an interesting matter for investigation and application. Optimal schedules of reinforcement can be of much practical importance. Skinner, who developed the idea of reinforcement schedules, points out that one kind of schedule of reinforcement depends upon the behavior of the individual himself; that is, a reinforcement occurs only after a fixed number of responses. This is a common schedule in education, where the student is reinforced for completing a

project or a paper or some other specific amount of work. It is essentially the basis of selling on commission or of piecework pay. In industry such a schedule can result in very high rates of responding, which set unduly high standards of performance and result in excessive fatigue and so are dangerous to health. In view of these results, piecework pay is frequently strenuously opposed. Investigation of the effects of reinforcement schedules in industry, e.g., schedules of pay and the use of bonuses and incentive wages, could result in generating optimal productivity with the increased morale and happiness of the employee [33, 44].

Reinforcement is not only an important consideration in the early stages of learning a task; it is equally important in shaping and maintaining the fine discriminations and fine behavioral modifications required for the increased effectiveness of task performance. At this stage of training, when a high level of skill is being obtained, the task of the instructor becomes critical in ensuring that appropriate behaviors are reinforced in the presence of appropriate cues.

Learning to Discriminate. It is important for the trainee to learn to discriminate between those aspects of a situation to which he must behave *differently* and those aspects to which he must respond in a *similar* fashion. In other words, whether he is learning to perform a fine motor skill or to make executive decisions, the trainee must learn to discriminate between certain classes of behavior and to respond similarly within these classes. This may be compared to what a child does when he learns to discriminate between a dog and a horse and learns to respond in a similar fashion by calling them both animals. Bringing out this within-class similarity of responses is called *generalization training*. Here the individual learns to generalize his performance to cues other than those on which he was initially trained. Learning to discriminate between classes and to generalize within classes is considered a basic learning process involved in the formation of concepts. Perhaps writers of training manuals have this kind of underlying learning process in mind when they point out that a training situation must contain an adequate variety of practice materials, that situations to be discriminated should be as little alike as possible, and that response interference is a function of the degree of proficiency attained in task performance. Other considerations of learning also indicate the desirability of a variety of practice material.

Experience shows that without guidance and without appropriate arrangement of the training situation, reinforcement may not be effective in the right way. As a result, accidental connections may be established between certain task responses and the reinforcing event. In this way the operator of a machine may in a sequence of control manipulations give his controls some superfluous movements which are unrelated to the success

of the desired operation. A comparable situation exists in certain games and sports like bowling and billiards in which the trainee develops a response referred to as body English which accompanies the true movements that contribute to a successful throw of the ball or shot with the cue. In a similar fashion, accidental and wasteful behaviors may be learned in the course of learning to become a successful supervisor. Responses which are learned as a result of the accidental contingency of responses and reinforcement are often called "superstitious" responses. A trainer should be aware of this possibility in the course of training. Careful delineation and spacing of subtasks may avoid this situation.

Extinction. The modification of behavior through learning sometimes involves *removing* certain behaviors from a trainee's repertoire. In order to remove certain task responses from a learner's performance, reinforcement contingent upon the task can be withheld. When reinforcement is not forthcoming following a learned response, the response becomes less and less frequent and in effect becomes removed as a part of task performance. The process whereby a task response loses strength as a result of lack of reinforcement is called *response extinction*. Often the process of response extinction is slower than the process of acquiring a response through reinforcement.

Using the notion of extinction, trainers have often pointed out that bad habits, or incorrect responses, can be eliminated by practicing them in a situation where they are recognized as wrong and where reinforcement is withheld. It is also important to check on the growth and progress of trainees, because their falling behind may be the result of performing tasks for which they have not been appropriately reinforced. Lack of reinforcement may also lead to emotional behavior or frustration in the course of extinction. The trainer should be aware of this and make allowances for it; he should attempt to extinguish incorrect responses while at the same time reinforcing substitute behavior. Extreme lack of reinforcement which can lead to extreme discouragement and lack of will to continue is, of course, to be avoided. In the development of attitudes it is often advised that procedures be designed to permit trainees to express hostile attitudes, to let off steam. It is desirable in these procedures to permit no reinforcement to occur, so that these attitudes can undergo extinction. Otherwise, it may be that the release of the hostile expression is reinforcement enough to guarantee its continuance. This may be particularly true in an industrial climate where one's boss is excessively autocratic.

A trainee's present task performance is dependent upon his prior conditions of practice and reinforcement. The extent to which a task response will be resistant to extinction, i.e., persist in the face of little or no reinforcement, will be the result of past training procedures. It follows from

this that for certain job situations where the occurrence of failure is highly probable at times, tolerance for failure is best taught by providing a backlog of success or a history of reinforcement. Certain patterns or schedules of reinforcement, where success comes only intermittently in the course of practice, result in greater resistance of task performance to extinction.

Forgetting is not equivalent to extinction. Extinction occurs when a response occurs and reinforcement does not follow. Forgetting refers to a decrease in response proficiency as a result of the nonoccurrence or disuse of the response over the course of time. Some psychologists believe that forgetting is the result of learning competing responses which take place in the situation where the originally learned responses would have occurred. In general, as a result of forgetting, performance losses are greater soon after the cessation of practice than later on.

Training Sequences. In the learning of a task, certain sequences of task performance are more effective for the learner than others. In fact, one of the major problems of effective training is not that of making training tasks similar to job tasks, but of *arranging successive tasks* in such a way that the behavior is efficiently learned. The systematic arrangement of practice on particular components of a complex motor skill may often lead to far greater improvement than direct practice on the task in its actual complexity. One investigator [35] found that requiring practice *first* on certain difficult visual-motor discriminations and later on the task itself was an efficient learning sequence. For some time, psychologists have debated the question of whether the whole method of learning an entire task is superior to the part method in the acquisition of a skill. It appears now that the answer depends upon the nature of the task and that a good trainer will organize a task into the most effective sequence for learning. The determination of effective learning sequences may be accomplished by careful job analysis and experimentation with suggested procedures.

In the course of learning complex behavior, the learner's performance progresses from unskilled, coarse responses to skilled, carefully differentiated behavior. The job of the trainer is to reinforce the correct responses in the correct sequence in a way that will lead to the desired behavior. He does this by reinforcing those task responses which approximate the behavior eventually desired and then continuing to reinforce behavior which gets closer to the performance of a skilled employee. The procedure of successively reinforcing a sequence of behavior approximating the finally desired task performance is called *successive approximation.* Thus, a trainer should not expect perfection too soon from a beginner; early in learning, he should often concentrate upon actions rather than upon the quality of the end product. An analogy given by one writer [44] is that this procedure of shaping and modifying behavior is like shaping a lump of clay, where

the sculptor begins with gross approximations to the final figure. If the trainer waits for a complete task performance before reinforcing, he may not be effectively teaching the early basic responses required in the educational sequence.

Learning and Effort. It is important to point out that as a task response is learned and the learner becomes increasingly skillful, there is a *reduction in the amount of effort* required to perform it. In many tasks this occurs to such a degree that a skillful operator seems to work effortlessly with little apparent concentration upon or attention to what he is doing. A trainer should be aware of this stage of performance if it occurs in the tasks with which he is concerned, so that he can permit the learner to drop out unnecessary responses and cues which were required in early training. At this time the trainer may also find it desirable to introduce further tasks which the learner can now perform but which would have interfered with early task performance. A related consideration in training is what is called *response tolerance* or *response precision.* This refers to the range of precision that is permitted in responses during particular stages of training. Permitting practice on only the correct response restricts the range of tolerance so that the learner cannot make responses that are too fine or errors that are too gross. On the other hand, a wide range of response tolerances in the early stages of training allows the trainer to reinforce approximately correct responses and to refine his reinforcement through successive approximations. In deciding upon appropriate response tolerances, the trainer must consider the interacting influence of many of the variables previously described, such as guidance of the correct response, reinforcement, and extinction.

Meaningfulness of Material. Learning is facilitated when the tasks to be learned are meaningfully related. If some general principles which the learner understands (has previously learned) underlie a sequence of tasks, then these tasks will be learned more readily than tasks which are not meaningfully connected. Training sequences should therefore be organized around *connecting principles* whenever possible. The trainer should be aware of principles which do relate material meaningfully and those which do not. For example, the teaching of certain principles of basic electronics may assist a trainee in learning his job as a radio repairman. On the other hand, it may be that some principles which are traditionally a part of early training actually relate tasks only at more advanced job levels, e.g., at the level of radio-design engineer.

In attitude and morale training it appears that free exchange of opinion should be encouraged if such discussion helps develop meaningful relationships which facilitate future learning. One of the important characteristics

of learning sequences may be that effective sequences define meaningful relationships among the task responses to be learned.

Aversive Consequences. For efficient learning, stimulation by *unsuccessful,* or aversive, consequences of the learner's behavior appears to be less effective than positive reinforcement. A trainer can expect better results by stressing praise and offering a suitable incentive for correct or nearly correct performance than by stressing reproof or enforcing penalties for incorrect performance. Training under the control of rewarding consequences is preferable to training under the control of punishment. In training programs, aversive controls may take the form of docking pay, withdrawing privileges, discharge from the course, return to a lower-status job, or threats of these consequences. Research findings indicate that the immediate effect of aversive consequences is to eliminate the incorrect behavior. *However,* if the behavior is not removed by the process of extinction, the elimination may not be permanent. This may suggest that punishing consequences can be used to depress an incorrect behavior temporarily so that an incompatible correct response can be learned in its place. The term "incompatible" means that both responses cannot take place at the same time. An appropriate caution is that aversive consequences may often evoke emotional or defensive responses which are undesirable and which may be incorporated in the future job situation.

Plateaus. In many training situations involving complex behavior, the learner reaches a stage in which he exhibits no apparent learning progress or increase in task proficiency. Psychologists have called these stages plateaus because, in a curve showing learning progress, stages of no apparent learning result in flattened sections in the curve. An important function of the trainer is to analyze the characteristics of such stages of learning in his training program. The occurrence of a plateau may indicate both desirable and undesirable influences. With certain behaviors, a plateau or slowing down of learning may indicate that the learner is acquiring the responses and discriminations required for more proficient task performance. At the same time, early unskilled responses of the learner are undergoing extinction. These early responses may rely, for purposes of initial training, on certain training supports not required at advanced levels of proficiency. In such cases, learning and task proficiency following the plateau may increase at a greater rate than previously, since now a more efficient set of task responses is being learned and employed. In training circumstances of this kind, the trainer should be aware that learning is proceeding and that the apparent decrease in progress is temporary.

In some instances, stages of no learning may be quite real and may be influenced by a number of learning considerations, such as sequence, rein-

forcement, and motivation. A plateau may also indicate that the learner's limit of proficiency in the training situation has been reached. If there is a large discrepancy between this limit and the level of proficiency expected on the actual job, it is probable that the training situation has not adequately simulated the job conditions and the job equipment. If increased job simulation of the training task is not feasible, then it is necessary that the behaviors taught during training consist of responses that readily transfer to and provide a basis for increasing proficiency on the job.

Learning to Learn. Much can be gained in certain training programs if the learner is taught how to learn. Experimental studies indicate that when a trainee is presented with a series of different tasks, he often develops greater facility in learning the later tasks than he displayed in learning the earlier tasks. It has been pointed out that the training of a set to learn can be of important practical significance for job situations in which an individual must adjust rapidly to changing problems and changing equipment models [16, 30].

Factors in a training program which influence learning to learn may be an important consideration for the trainer. A significant influence appears to be systematic variations in the learning situations presented to the trainee. The variables that are important in establishing learning sets need to be determined. These may consist of such aspects of behavior as habits of attending to critical discriminative cues or habits of modifying behavior when learning difficulties are encountered.

Active Learning. Learning that takes place by active responding permits more effective control by the trainer than does that which takes place through passive observation. Guthrie [28] writes that "in order to make listening profitable . . . it is essential that the student be led to do what is to be learned. . . . A student does not learn what was in a lecture or a book. He learns only what a lecture or book caused him to do." In this regard athletic coaches have a great advantage over trainers concerned with other kinds of behaviors. Many of the skills with which an athletic coach is concerned consist of overt behaviors which can be readily observed and shaped by appropriate reinforcement and sequencing. He can see the results of his training procedures and modify them accordingly to produce the behavior desired. The critical point here is that an important part of a trainer's job is to make the behaviors with which he is concerned as overt as possible. Only in this way can he see what he is doing. In teaching problem-solving tasks, such as the troubleshooting of equipment, it is important to use techniques and performance measures which make the learner's behavior overt.

Specially developed training exercises which require reasoning and inte-

gration of knowledge are useful ways of making the performance of such behaviors more available to the trainer. Training procedures which require a trainee to respond actively by summarizing a problem in his own words may be effective learning procedures of this kind. Despite the apparent advantage for trainer control that active responding permits, many training programs rely almost exclusively on a lecture method, which does not make available to the trainer the behaviors he is interested in shaping.

Transfer of Training. The objective of a training program may not be to produce a highly skilled trainee capable of immediately performing the tasks required for a job. It may be, rather, to teach certain behaviors which will facilitate learning when the trainee is placed on the job. Often the aim of a training program is a dual one—to train for a specific task and also for transfer of training. Studies in the psychology of learning indicate that the validity of programs designed for transfer can never be taken for granted. It is necessary for the trainer to determine whether positive-transfer effects occur as a result of training procedures. This is an important endeavor because transfer effects can be positive or negative. They can either facilitate or hamper subsequent learning and performance. Furthermore, established behaviors which have an apparent similarity to subsequent task responses may show little if any positive-transfer value.

It is difficult to determine those training tasks which facilitate subsequent learning and performance. Nevertheless, the trainer has the job of investigating and checking on the transfer value of his training program. If he does this, he can identify the training tasks and training procedures which maximize transfer for the tasks with which he is concerned. It seems that the considerations which are important for learning in general are equally relevant for learning behaviors which facilitate positive transfer.

The necessity of establishing dual objectives for a training program is often a complicating factor. The military service, for example, recognizes the need to train men to operate and maintain certain specific pieces of equipment and at the same time to train them to adapt to frequent equipment changes. Training for a specific job requires certain kinds of input personnel and certain training procedures which demand a particular amount of time. Training for transfer and adaptability may require different considerations and usually requires a longer training time. Within the limits of a two-to-four-year service period for many military personnel, a compromise program is necessary. In industries which have a large personnel turnover the problem is similar.

Motivation and Motivating Conditions. The influence of the considerations for learning so far discussed are enhanced or depressed by motivating conditions. A good example is the way in which the effect of repetition or

reinforcement is influenced by such conditions. For the practical purpose of modifying behavior, a trainer may distinguish between the motivational possibilities that a trainee brings to the learning situation as a result of his past experience and the motivational conditions that can be built into the training program. It is good practice for the trainer to assess the motivational states with which trainees enter a training program. For example, trainees can differ with respect to their desire to learn and their need for achievement. Also trainees can enter a training program with different degrees of anxiety or apprehension about aversive consequences that may occur in the training situation. The influence of anxiety upon learning has received considerable study. It appears that the learning of tasks at different levels of complexity is influenced differentially by varying degrees of anxiety. Although some degree of anxiety may be motivating, too intense a degree may result in emotional states which distract from learning. This may be true in industry where, let us say, the trainee may have some feelings of insecurity anyway [47, 49].

It is even more important for the trainer to determine what motivating conditions he can introduce into his training program in order to enhance the effect of such variables as reinforcement. Trainers often suggest that this can be accomplished by setting up conditions of competition and cooperation in a training program. However, the long-range effects of motivating conditions during training which differ from the actual motivating conditions present in the future work situation need more study, particularly in the industrial setting. Some experimental results do indicate, however, that learning under one type of motivating condition facilitates, or generalizes to, performance under another type of motivating condition [4, 34].

Individual Differences. Learning takes place on the foundation of existing behavior which a trainee brings to the learning situation, and trainees differ in this respect. An effective trainer will carefully evaluate the initial behavior of his trainees, since this comprises the raw material with which he must work. He should be aware of differences that exist between individual trainees or groups of trainees. As far as possible, training practices should allow for such considerations as differences in the initial ability of individuals to make certain required sensory discriminations, individual differences in the speed of learning, age differences which facilitate or retard learning, and the enhancing or hampering influences of the personality of a given instructor upon different individuals.

Emotional and Attitudinal Conditioning. The paradigm of Pavlov's dog should be described here to point out that during training emotional and attitudinal conditioning may take place which can persist in later job behavior. It will be remembered that in Pavlov's experiments, meat powder

elicited salivation; then a tone was paired with the presentation of the meat powder over a number of repeated trials. After a time, the tone alone was sufficient to elicit salivation. Similarly, a pleasant instructor can elicit pleasant experiences. When the task to be learned is paired repeatedly with the instructor, then the training task alone can come to elicit pleasant experiences that will be elicited in the future job. In order, then, to contribute to good morale and to individual satisfaction, it is important for a trainer to be aware of this sort of conditioning.

TRAINING AIDS, TRAINING DEVICES, AND SIMULATORS

Training aids and devices are widely used in training programs, and psychologists have begun to study the characteristics of effective training aids. The military services, for example, have official policies which require the development of training devices to accompany the construction of new equipment. A major proportion of time in some training programs is spent using training devices. In industry, for example, commercial airlines have made sizable investments in flight simulators because they reduce costs greatly by keeping operational equipment in use and because they provide opportunity for training and proficiency checking under supervision and low-hazard conditions [16, 19, 36].

The task of the psychologist in this work is to ask and answer such questions as: What are the characteristics of a training device that result in effective transfer of training to the job situation? How can a training device be built which will provide reliable measures of proficiency level? To what extent does a device have to simulate actual job conditions in order to provide effective training? In addition, these questions are important: To what extent do actual job conditions have to be deliberately altered to provide effective learning and reliable proficiency measurement? Does the use of a particular training device result in better transfer skills than less expensive classroom training aids? How can present aids and devices be used more effectively? The answers to these questions can be found by application and concurrent experimental investigation. From the psychologist's point of view, a major attraction of training aids and devices is that they offer a means of automatically controlling many of the variables which facilitate learning and transfer.

PROGRAMMED INSTRUCTION AND TEACHING MACHINES

Recently the application of learning principles to training and instructional practice has been implemented through the concept of programmed in-

struction. This has been described by Hughes [32], by Lumsdaine and Glaser [38], and by Shoemaker and Holt [43]. Essentially, programmed instruction represents an attempt to organize the process of teaching according to what we know about human learning. Much research and development work is going on in this new field, and increasingly frequent application is being made in the military and in industry [1, 7, 9, 12]. Because this new field is developing rapidly, its principles and practices are constantly being refined. In its initial modern development, the basic principles involved have been described by Skinner [45]. Many of the principles that are incorporated in programmed instructional materials are those described earlier in this chapter.

The construction of programmed instructional materials takes very seriously the importance of the behavioral specification of training objectives and the significance of such learning variables as task guidance, immediate reinforcement, and active learning. An important principle is that of gradual progression; when teaching complex performance, the behavior the trainee brings to the situation is reinforced when it is only a slight approximation to the terminal behavior being taught. The program moves in graded steps, working from a simple level to higher and higher levels of complexity. This gradual progression serves to make the student correct as often as possible and helps maintain his motivation for learning. A short example of a programmed instructional sequence is shown in Figure 7.1. The student is exposed to material in the form of small steps which are designed in such a way as to encourage him to respond. Before beginning the program, the student is told to respond while he reads through the step, or frame, as it is called. He writes his answers either directly in the book where the frame appears, on a separate answer pad, or, if a teaching machine is used, on the exposed space. As soon as he has completed the response called for, the student can expose the correct answer either by turning the page or advancing the machine. In the example in Figure 7.1, you should begin with the top panel on page 1, i.e., step 1, respond to it, and turn to page 2 to get your answer confirmed in the top panel. You should then go on to the top panel of page 3 for step 2, respond to it, and confirm your answer by turning the page, and so on.

At the beginning of the program progression, the frames call for behavior which the student brings to the teaching situation, and this behavior is gradually developed in relation to new subject-matter content. In the course of constructing a program, each step is tested so that trainees can respond to it with a high probability of success. This maximizes the occurrence of positive reinforcement. The probability of success is increased by the use of prompting techniques which essentially are hinting and coaching procedures based upon what is known about the trainee's background. For example, consider a set of frames designed to teach the Greek number

AN EXAMPLE OF A PROGRAMMED TEXTBOOK; CONVERSION TO NUMBER BASES OTHER THAN 10—Page one

STEP 1: It has been said that the reason we use a **decimal** (from the Latin word for 10) system in our arithmetic is that primitive men probably counted on their fingers. The total number of fingers and thumbs on both hands is ____. This number is called the **base** of our ordinary arithmetic.

STEP 3: There is nothing magical or sacred about the base 10 system we employ. In fact, conversion to bases other than 10 often provides important advantages. Some people have suggested that a base 12 system would facilitate computation, since 5 numbers **less** than 12 divide into it **evenly.** These 5 numbers are ____, 2, ____, ____, ____. In our base 10 system, on the other hand, only the numbers ____, 2, and ____ are less than 10 and divide it evenly.

STEP 5: Since we are familiar with the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, we will use them as much as possible while converting to other bases. For example, if we wanted to convert to the base 3, we would use the digits 0, 1, 2. If we wish to convert to the base 5, we would use the digits 0, 1, 2, 3, 4. If we wished to convert to the base 7, we would use the digits, ____, ____, ____, ____, ____, ____, ____.

STEP 7: There is another base, the **binary** base, which is immensely important in the construction of modern high-speed computers. These computers use vacuum tubes and switches which can be either "ON" or "OFF." From this and from the word "binary," you might guess that the base of the binary system is ____.

Fig. 7.1. Reprinted from Glaser, R., Homme, L. E., and Evans, J. L. An evaluation of textbooks in terms of learning principles. In A. A. Lumsdaine and R. Glaser (Eds.). *Teaching machines and programmed learning.* Washington, D.C.: National Education Association, 1960.

AN EXAMPLE OF A PROGRAMMED TEXTBOOK: CONVERSION TO NUMBER BASES OTHER THAN 10—Page two

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STEP 1: Response Check

10

STEP 3: Response Check

1	1
3	5
4	
6	

STEP 5: Response Check

0
1
2
3
4
5
6

STEP 7: Response Check

2

AN EXAMPLE OF A PROGRAMMED TEXTBOOK: CONVERSION TO NUMBER BASES OTHER THAN 10—Page three

STEP 2: If our primitive computers had had a different number of fingers on their hands, they may very well have had an arithmetic with a base other than 10. For instance, if they had had six fingers on each hand they might have developed an arithmetic with base _____.

STEP 4: Since we use a base 10 system, we need 10 different numbers or symbols, which we will call digits, to write out our values. These digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Notice the 0 (zero). You will need to list the 0 when writing out the digits of **all** bases. We always need the **same** number of digits as the base we are using and one of these digits will alway be "0." If we use a base 5 system we would need _____ digits.

STEP 6: We have seen that conversion to the base 12 might provide some advantages in computation, especially in division. However, if we use base 12, we will need _____ different digits. Since the digits 0-9 provide only 10 digits we must make up 2 new ones. (We wouldn't want to use 10 and 11, since these are made up of other smaller digits and are therefore not distinct.) You could make these up yourself, but for convenience, let us use ⊘ for the digit after 9 and ⊗ for the digit after ⊘. Therefore, the digits for the base 12 are _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____.

STEP 8: The binary system is base 2; therefore the digits we might use would be _____, _____.

AN EXAMPLE OF A PROGRAMMED TEXTBOOK: CONVERSION TO NUMBER BASES OTHER THAN 10—Page four

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STEP 2: Response Check

12

Please return to Page One and go on to Step 3.

STEP 4: Response Check

5

Please return to Page One and go on to Step 5.

STEP 6: Response Check

12	6
0	7
1	8
2	9
3	~~9~~
4	~~9~~
5	

Please return to Page One and go on to Step 7.

STEP 8: Response Check

0

1

prefixes which might be used in teaching the technical vocabulary of chemistry [46]. The trainee must learn to correctly use such prefixes as *mono, di, tri, tetra,* and *penta* with respect to the subscripts in chemical notations. The background of the student can be exploited by using such a frame as "A *mono*cle is a lens for use in only _____ eye." Or, "The *five*-sided building in Washington used by the military is called the _____gon." Later in the program the trainee is transferred to a specific application when he is asked to compose the technical names for chemical compounds indicated with symbols; for example, "CF_4 is carbon _____fluoride." In the program progression prompting techniques are used to control error and to evoke relevant behavior so that it can be brought under the control of new subject-matter content. The immediate-answer feedback provided by a program can encourage careful attention to the material, since the student works to come up with the correct answer. Since prompts are learning crutches, they have to be removed so that by the time the lesson is completed the trainee is actually performing the real task. In the course of the program progression, prompts are gradually withdrawn so that eventually the trainee responds on his own. In a programmed sequence, provision is made for the appropriate scheduling of practice and review with a variety of subject-matter examples.

One of the most important aspects of programmed instruction is the way in which a program is constructed. It is tested and revised until proof can be given that it teaches the training objectives set for it. In the course of its construction, if a trainee does not learn, then the program is revised and modified. Each successive revision ensures that the student's performance is brought closer and closer to the training objectives of the program. Once it teaches satisfactorily, it can be used in operational training.

The relation between teaching machines and programmed instruction is similar to the relation between computers and computer programming. An instructional program must be developed which can be implemented by machine capability. Programmed instruction is being carried out in the form of programmed textbooks, as illustrated by Figure 7.1. However, the potential for the integration of instructional programming, computer processing, and machine display and response devices cannot be overlooked, says Coulson [10].

OUTPUT CONTROL THROUGH PROFICIENCY MEASUREMENT

At the end of a training program and during the course of training, it is important for the trainer to measure the performance of the trainee. In this way he can determine whether or not the trainee has learned the behaviors specified as training objectives to the level of proficiency required. For

training purposes, proficiency measures have three primary uses: (1) They provide information about the trainee's performance in the course of training which can be used to decide upon the subsequent course of learning. (2) They provide standards of proficiency which must be attained at the end of training. (3) They can be used to diagnose inadequacies in training procedures so that training can be improved.

TESTS OF PROFICIENCY

The main concern of the trainer in the development of proficiency tests is to measure those behaviors which have been specified as the objectives of training. This assumes that the specification of objectives adequately describes the behaviors necessary for job performance and for transfer of training on the job.

The validity of a measure is determined by how well the training objectives have been built into the proficiency test. The type of validity required for proficiency measures of this kind is called *content validity*. In evaluating the content validity of a training-achievement test, one asks, "To what extent does this test require performance by the trainee of the behaviors which constitute the objectives of the training program?" The more completely and reliably a test measures the attainment of these objectives, the greater is its content validity [13].

The determination of content validity is usually, like job analysis, a qualitative matter in which an essentially qualitative comparison is made of training objectives and the behavior elicited by the test. One use of training-achievement tests should be to set standards of performance which most trainees can achieve by appropriate training. This could be accomplished by varying training procedures when necessary, for example, by repeating certain aspects of the course or by employing different-sized learning units for different individuals. Most trainees should then eventually perform satisfactorily on the established proficiency measures. In practice, however, training procedures and training time are relatively uniform, with the result that trainees perform with varying degrees of proficiency. A cutoff score is often decided upon below which achievement is unsatisfactory. This situation may require the estimation of predictive validity for appropriate use of the proficiency test. The predictive validity of a test refers to the extent to which it predicts future measures of behavior. This kind of validity is usually determined by correlating test scores with subsequent performance measures. With adequate validity of this kind, end-of-course--proficiency measures can be used to estimate future job proficiency, and job assignment can be made accordingly.

Much of the work relating to the construction and interpretation of pro-

ficiency measures has developed out of general test theory, which has emphasized individual differences. One emphasis in test interpretation in this context has been on relative measures, such as standard scores and percentiles which indicate the relative standing of an individual in a given group. In training, the emphasis is somewhat different. What is required is an indication of the level of attainment of training objectives. For example, a percentile or standard score on a test of a job skill would not indicate whether the trainee was highly competent or had little skill. The determination of proficiency attainment must be made in terms of training objectives. Levels of proficiency or achievement should be made by the training specialist and subject-matter experts on the basis of their judgments of observed performance and specified in terms of proficiency-test performance. Scores on such proficiency tests should indicate the degree to which training objectives have been attained by the trainee. These scores can then tell the trainer whether or not it is necessary to make changes in the training program in order to produce trainees with the desired proficiency levels.

THE ORGANIZATION OF TRAINING

This chapter has been concerned primarily with the principles which underlie training. In practice these principles need to be applied to many different types of training programs. Industrial training in general involves both on-the-job training and off-the-job training. In the former, a training program is organized to fit in with working operations and is carried out by experienced operators, foremen and supervisors, or special job trainers. Off-the-job training is carried on in a company school or by arrangement with outside technical schools and universities. Depending upon the job involved and the lines of employee development in an organization, training of many kinds can take place [15].

Training occurs at various levels in an organization and is concerned with shaping different areas of job behavior. For purposes of description, these areas can be classified in a meaningful way.

Orientation and Indoctrination Training. This training is concerned with new employees or employees who enter new job situations within a company. The objective is to provide information about the policies and goals of the organization and to develop attitudes such as pride, respect, and loyalty.

Vocational and Job-skill Training. Here the concern is to train novices or semiskilled individuals in the specific tasks required for skilled job performance. Many organizations have centralized training groups and well-defined procedures for accomplishing this.

Professional and Technical Training. In contrast to the vocational train-

ing just described, professional and technical training is primarily concerned with the acquisition of advanced job techniques and the learning of recent technological and scientific developments which are of direct or indirect benefit to the organization.

Managerial, Supervisory, and Executive Training. Although the special skills which contribute to success in jobs in this area are less well known than those in other areas, an increasing amount of training in industry is concerned with the development of executive skill. Training in human relations, supervisory procedures, and principles of scientific management takes place both on and off the job.

Specialized Training. An organization continuously requires a variety of specialized training programs such as job-rotation training, training in work simplification, salesmanship training, training in labor relations, safety training, training in employee evaluation, programs of general cultural and civic development, and so forth. As an individual and organization evolve, the need for specialized training appears to be ever present.

TRAINING AND EXPERIMENTATION

A training program in an organization has features throughout it which can be investigated by experimental study. The industrial psychologist can bring to it hypotheses based on research findings, as indicated in the section on training procedures. Training personnel involved in day-to-day training operations can bring to it the results of their experience. From whatever source the problems or hypotheses come, they should be set up to give an adequate test of the practical alternatives and the general training variables being studied. This requires close cooperation between psychologists and training personnel. The psychologist may require experience in an organization's training programs. At the same time, training personnel may require indoctrination in a research point of view toward the training process. This interplay can contribute to improved programs of training for specific organizations and to the further development of training as an applied discipline based upon a science of learning [52].

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