UNCLASSIFIED

AD 419122

DEFENSE DOCUMENTATION CENTER

FOR

SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION, ALEXANDRIA, VIRGINIA

UNCLASSIFIED

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

CATALOGED BY DDC 419122
AS AD No.

AMRL-TDR-63-74

64-5

A CLASSIFICATION OF LEARNING TASKS IN CONVENTIONAL LANGUAGE

TECHNICAL DOCUMENTARY REPORT No. AMRL-TDR-63-74

JULY 1963

419122

BEHAVIORAL SCIENCES LABORATORY
6570th AEROSPACE MEDICAL RESEARCH LABORATORIES
AEROSPACE MEDICAL DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

Contract Monitor: T. E. Cotterman
Project No. 7183, Task No. 718306

(Prepared under Contract No. AF 33(616)-5965 by
Elmo E. Miller
University of Illinois, Urbana, Illinois)

NOTICES

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related government procurement operation, the government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Qualified requesters may obtain copies from the Defense Documentation Center (DDC), Cameron Station, Alexandria, Virginia. Orders will be expedited if placed through the librarian or other person designated to request documents from DDC formerly ASTIA).

Do not return this copy. Retain or destroy.

Stock quantities available at Office of Technical Services, Department of Commerce, Washington 25, D. C. Price per copy is $0.75.

Change of Address

Organizations receiving reports via the 6570th Aerospace Medical Research Laboratories automatic mailing lists should submit the addressograph plate stamp on the report envelope or refer to the code number when corresponding about change of address.

700 - October 1963 - 8-149-162

FOREWORD

This report was prepared as a portion of the work carried out under Contract AF33(616)-5965 by the Training Research Laboratory of the University of Illinois, Urbana, Illinois, with Prof. L. M. Stolurow serving as principal investigator. The contract was initiated in support of Project 7183, "Psychological Research on Human Performance," Task 718306, "Research on Human Learning and Related Methodology," and was continued in support of Project 1710, "Training Personnel and Psychological Stress Aspects of Bioastronautics," Task 171003, "Human Factors in the Design of Systems for Operator Training and Evaluation," with Dr. T. E. Cotterman acting as contract monitor. This work was previously described briefly at an American Psychological Association Symposium, "Psychological Classification of Tasks," 6 September 1960 at Chicago, Illinois. Dr. Elmo E. Miller is now with the U. S. Army Armor Human Research Unit, Fort Knox, Kentucky.

The author gratefully acknowledges suggestions and guidance from Prof. Stolurow, Dr. Cotterman, and Mr. Roger Fisher, then of the University of Illinois.

ABSTRACT

Classifying learning tasks may aid in analyzing training requirements and applying learning principles. To this end the term "learning task" is defined for purposes of the classification, and a descriptive system is introduced for analyzing training requirements and for relating various practice conditions.

A logically exhaustive classification is presented. Learning tasks are categorized by applying the definitional criteria sequentially. Major categories are "perceptual-motor," "discovery," "understanding," "perceptual judgment," and "memorizing," corresponding roughly with common usage of the terms. The criteria for class membership are of three kinds: (a) discrepancies between criterion performance and initial skills of trainees, (b) restrictions on practice conditions considered legitimate in meeting the particular performance test, and (c) the kind of overt behavior constituting criterion performance and the allowable alternatives in such performance. The restricted applicability of generalizations about learning to certain categories is discussed.

PUBLICATION REVIEW

This technical documentary report has been reviewed and is approved.

Walter F. Grether

WALTER F. GRETHER
Technical Director
Behavioral Sciences Laboratory

TABLE OF CONTENTS

	Page
INTRODUCTION	1
METHOD	1
Definitions and Other General Considerations	1
Conditions the Classification Should Satisfy	5
Procedure.	6
THE RESULTING CLASSIFICATION	6
Perceptual-Motor Learning Tasks	7
Discovery or Understanding Tasks	8
Perceptual Judgment Tasks	11
Memorizing Tasks	11
A STEP BY STEP PROCEDURE	12
CLASSIFICATION OF GENERALIZATIONS ABOUT LEARNING	13
SUMMARY	14
LIST OF REFERENCES	15

A CLASSIFICATION OF LEARNING TASKS IN CONVENTIONAL LANGUAGE

INTRODUCTION

Currently, the design of training programs tends to be an art rather than a systematic application of knowledge. Not only is more knowledge needed, but the knowledge which does exist is not organized so that it may be obtained and applied easily. Often there is doubt about the generality of findings when particular training problems are considered. Organization of training principles would facilitate the application of scientific information and the planning of efficient research.

One way to organize training principles is to develop a classification of the tasks confronting individuals during training. The categories or classes would be distinguished in such a way as to make separately listed training principles differentially applicable to the various categories. In this way, information on training would be organized according to different kinds of training objectives. The organization of training objectives would facilitate the analysis of training problems even if little attention is devoted to the application of principles. The logic of such an approach, the general requirements which it must satisfy, and some general methods of implementing it have been presented and discussed at length by Cotterman (ref. 1).

The present report is devoted to a description of one of the efforts to develop such a task classification. The purpose of the endeavor is very similar to that of Cotterman, but there is a rather basic difference in conception of the tasks being classified. Cotterman attempts to classify behavior which must be mastered by the end of practice. The present endeavor is an attempt to classify the desired change in behavior which practice is to produce.

The specific method used to develop categories will be given and the resulting classification will be presented. No attempt was made to work out a detailed listing of particular principles or practice conditions or to show in detail how they apply differentially to the various classes. However, some speculations of this nature are given in later portions of the report.

METHOD

The approach may be characterized as a process of proposing suitable categories, expressed in terms of precisely-defined conventional task distinctions, by examining training principles and grouping these in terms of common relationships among independent and dependent variables. This process is facilitated by establishing certain ancillary language conventions.

Definitions and Other General Considerations

Achievement language and dependent variables: In analyzing and classifying learning tasks, one may choose among various language systems of comparably

direct operational reference. The choice of an appropriate language system depends upon the ease of description in analysis and classification, and an unfortunate choice can result in awkward circumlocutions. In the present discussion, an achievement language will be used, one which MacCorquodale and Meehl (ref. 6, p. 238) distinguish as requiring "an explicit reference to the stimulus side in its characterization of the response." Such an achievement conception of the response, generally characteristic of cognitive theorists, seems implicit in conventional task language.

The objective of training is to enable an individual to exhibit criterion performance. The specification of criterion performance must include any restrictions over techniques permitted in exhibiting the performance (e.g., "assembling an M-1 rifle" is not the same criterion performance as "assembling an M-1 rifle blindfolded".)

Various types of criterion measurement are possible, involving correctness, frequency, latency, and amplitude of the required response. Various combinations of these as well as many others are commonly used to specify criterion performance in training. The classification to be discussed is general in that any reliable criterion measures may be used to specify learning tasks.

Task and learning task: "Task" is defined as a change to be effected by a person. In exhibiting criterion performance, an individual is required to change his environment in a specified manner, whether it be through language or by manipulation of objects. The tasks which constitute criterion performance may be called the criterion task.

Criterion performance is construed as evidence of another sort of change, namely, learning. "Learning" is defined as an improvement in ability to perform a criterion task. By substituting the definition of "learning" for the word "change" in the definition of "task", we define "learning tasks" (the subject of the present paper). A "learning task" is an improvement (in ability to perform a criterion task) to be effected by an individual.

Subtasks: Practice conditions sometimes are related only indirectly to the criterion task. We shall differentiate among alternative kinds of practice on the basis of the behavior that is considered "correct" ("rewarded" or "reinforced"). The most direct practice (referred to as practice of the major tasks) is practice in which the "correct" behavior has the same characteristics as that demanded in the criterion task.

Often, practice is not direct. The behavior considered correct during practice may be different in character from that constituting criterion performance. Presumably such indirect practice bears a positive transfer relationship to criterion performance and will be referred to as practice of a subtask. A subtask may be used in training because of difficulties involved in practicing the major task or because practice of the subtask is supposed to be even more efficient for the eventual accomplishment of the major task than a comparable amount of practice of the major task itself. There may be proposed subtasks for subtasks, etc. It should be understood that major tasks and subtasks are learning tasks, i.e., the major task or subtask for the trainee is

the obligation to learn to perform in such a way as to produce changes in his external environment, rather than an obligation to merely accomplish these changes.

There should be some amplification of what is meant by a change in the characteristics of behavior which is considered correct, since the idea of such changes is crucial to the concept of subtasks. The behavior considered correct consists of the response requirements of the task under consideration. The use of an achievement language in the present paper implies explicit reference to the stimulus side in the characterization of the response. Cues which are used to designate responses cannot be eliminated without changing the responses. The mere addition of stimuli will not be considered a change in the behavior (response) required as long as the cues to be used in criterion performance are replaced, then the responses are no longer the same because the stimuli by which the responses are designated are no longer present. Therefore, a major task is not converted to a subtask by merely adding stimuli, but only when there is a change in the responses considered correct, and responses are changed if the stimuli by which they are designated are replaced. For example, if the task is to memorize paired associates material, practice in the presence of both stimulus and response terms in printed form does not constitute a subtask even though the printed response terms are not allowed during criterion performance. On the other hand, practice of the response terms alone without any presentation of the stimulus terms would constitute a subtask because the cues by which responses are designated are absent.

It should <u>not</u> be inferred that a learner is responding to the cues which are used to designate responses just because the cues are present. If cues other than those designating responses are added in order to elicit the desired movements during practice, there is an opportunity for the learner to shift his responses to the utilization of the correct cues; the possibility of such a response shift is eliminated if the correct cues are actually replaced by the extra stimuli. Even though the practice may be designed inefficiently, the objective in adding extra cues during practice is to allow the learner to make the desired movements and then to shift the movements to the correct cues. The "correct cues" are those to which the individual must respond in order to satisfy the particular specifications of criterion performance; such "correct cues" are the appropriate ones for designating responses. After practice, the function of the test for criterion performance is to determine whether or not the learner successfully shifted the desired movements to the correct cues. If the learner meets criterion performance by utilizing cues other than the correct ones, it is simply a case of poor experimental control over the criterion test, and it is not the function of definitions to remedy the situation.

A major task <u>is</u> converted to a subtask when the response requirements are changed. Strictly speaking, even practice of only one section of a long performance must be considered a subtask because the response requirements are different from the total performance, but as a rule such designation as subtask will be trivial because both major task and subtask would be handled in the same manner. On the other hand, if a subtask involves only particular responses of a major task or a distinct change in emphasis for desired

performance, it may have distinctly different characteristics from its major task, and, therefore, may be handled differently.

If we designate certain principles as inapplicable or not valid for certain kinds of learning tasks, this designation applies only to practice of the major task. We can never be sure that no subtask exists from other task categories to which the principles do apply. A principle may apply to practice of a major task directly or it may suggest efficient subtasks. If the learning principles collected for the present paper are representative, then the majority of learning principles suggest efficient subtasks. A learning principle would be classified according to major tasks rather than by subtasks suggested. The reason for extended discussion of establishing subtasks is the prevalence of learning principles suggesting efficient subtasks.

Irrelevant Learning: This paper is concerned with classifying learning which is relevant to a particular purpose; i.e., improvement in ability to perform the criterion task. Two types of learning are irrelevant to such classification. First, the student may learn things not required by the criterion test or by practice tests. Secondly, practice may be designed inefficiently and thus make demands upon the subject which are unnecessary for improvement in ability to perform the criterion task. The present classification imposes no special restrictions on how practice conditions can be varied to induce efficient mastery of the criterion task.

Composite Learning Activity: A group of related learning tasks often is considered as one task, e.g., learning to play the piano may be considered a skill consisting of learning to play several individual pieces. It does not make sense to speak of the larger skill independently of the component skills. When a group of learning tasks is considered as one activity it is assumed that they are highly related activities among which there are high degrees of positive transfer; the term "composite learning activity" refers to such a group of related learning tasks.

Composite learning activities are roughly co-extensive with those commonly referred to as "learning to learn". With composite learning activities one should not necessarily infer that there is an equal amount of transfer among the constituent tasks. The constituent tasks will have roughly the same form but the content will vary. Composite learning activities are formed on the basis of similarity of their constituent tasks, not on the basis of being encountered together and considered one activity, they will be called a conglomerate learning requirement; e.g., learning to play baseball. An example of a true composite learning activity is learning to solve wire puzzles; each puzzle represents a separate learning task, but the high degree of similarity among them makes solving one of them easier if one previously has solved others. The inclusion of learning tasks in a particular composite learning activity is a matter of the degree to which they promote a skill common to all of them. The idea of composite learning activities has been introduced because they are easily confused with other sorts of tasks and because they represent a special kind of problem for task analysis and classification. A rigorous definition of what learning tasks to include in particular composite learning

activities is not necessary for purposes of classifying the constituent tasks.

Conglomerate Learning Requirements: As we commonly encounter them, things which are called learning tasks might more appropriately be called conglomerate learning requirements. A conglomerate learning requirement is an aggregate of disparate things which are to be performed in one situation and which an individual is required to learn. A task classification system could not be expected to enable one to categorize readily conglomerate learning requirements because of the disparity of the elements involved. The term "learning task" will be reserved for relatively homogeneous learning pursuits, although such a restriction is not evident in the definition of a learning task.

The analysis of conglomerate learning requirements into relatively homogeneous learning tasks is a process of establishing subtasks. In this process, the conglomerate learning requirement is considered as the major task and the individual learning tasks are considered as subtasks.

This process introduces a dilemma. A conglomerate learning requirement must be analyzed into learning tasks for purposes of classification and consideration of practice conditions. However, the analysis is a process of establishing subtasks, and there is a risk that the subtasks may not transfer effectively to the conglomerate learning requirement. Therefore, the way conglomerate learning requirements are analyzed has implications for the effectiveness of practice conditions. Different classification systems may analyze conglomerate requirements in different ways, and the effectiveness of such analysis in establishing effective practice is a method of evaluating classification systems.

Conditions the Classification Should Satisfy

There are characteristics which are desirable generally in a learning task classification system.

1. It should be exhaustive of all learning tasks.

2. The categories should be independent. Things to be classified should fall into only one category because instances which fall into more than one category tend to defeat the purposes of classification.

3. The assignment into categories should be reliable.

4. Classification should be independent of practice conditions. The classification may suggest effective practice conditions, but should not restrict practice to particular conditions. The only way to improve practice is to change practice conditions, so classification of learning tasks should introduce no restrictions upon practice conditions other than those restrictions intrinsic to task goals.

5. One should be able to classify learning tasks reliably while seldom or never resorting to special experimental determination.

Procedure

Assembly of Principles: The first step was to gather a large sample of principles of learning from standard references. Briefly stated generalizations which appeared directly applicable to human training problems were sought. Over three hundred generalizations were collected from McGeoch and Irion (ref. 7), Hovland (ref. 4), Hilgard (ref. 3), Deese (ref. 2), and Keller and Schoenfeld (ref. 5), and each generalization was typed on a separate sheet of paper.

In most cases, the wording of a principle or the situation from which it was developed seemed to restrict its range of application. The limitations on applicability common to various generalizations were used as a basis for a set of definitional points which in turn were organized into a classification. The task categories developed by this process closely resembled conventional concepts, which is not surprising in view of the fact that the generalizations were stated and perhaps conceived in common language.

THE RESULTING CLASSIFICATION

The complete classification resulting is given in table 1. Conventional terms are used even though their common meanings are not precise. Some persons might apply the conventional terms to conglomerate learning requirements, only part of which would be covered by the corresponding categories as defined here. The choice of using conventional terms rather than neologisms is admittedly somewhat arbitrary.

TABLE 1

THE CLASSIFICATION OF LEARNING TASKS

1. Perceptual-motor skill learning
2. Discovery or understanding
   a. Discovery
      (1) Type I
      (2) Type II
   b. Understanding
3. Perceptual learning
4. Memorizing
   a. Motor
   b. Verbal
      (1) Rote
      (2) Substance

Perceptual-Motor Learning Tasks

A perceptual-motor learning task is the task of learning to perform the overt (muscular) responses that are involved in criterion performance. Operationally, one may determine that a subject is faced with this kind of task by showing that he cannot make the required responses even when they are indicated in the most efficient manner available. The operational definition may seem vague, but if an instructor cannot get the required responses to occur satisfactorily at the start of practice, then it follows that training must proceed by means other than repetition of the correct overt behavior. The desired overt behavior must be formed from other overt behavior which does not meet the criterion. When determining whether or not the subject can make the desired responses, the responses must not be removed from the to-be-used pattern reduced in speed, since these factors constitute part of the response requirements.

Generally it is not necessary to determine experimentally whether or not a learning task is a perceptual-motor learning task. When learning tasks were defined and discussed previously in this paper, it was noted that specification of a learning task includes determination of the fact that the individual cannot perform satisfactorily before practice; such determination must be made before it can be said that there is a learning task to classify. By the time it is determined that there is a learning task (either experimentally or by information given about the situation), it usually is apparent whether or not the overt responses must be learned. In learning pursuit rotor skill, for example, if the individual cannot perform satisfactorily, then there is no method available for indicating the overt responses required so that he can perform the overt responses satisfactorily without practice. It is taken for granted that a person is not making satisfactory overt responses if his hand must be literally forced into the desired movement pattern.

Use of an achievement language implies that "responses" are to be designated by explicit reference to the stimulus side. This consideration places a certain limitation upon the stimuli which may be introduced to elicit the desired movements in the testing for perceptual-motor learning tasks. Since the responses are to be designated by reference to their cues, stimuli which replace these cues change the responses even though the movements are unchanged; e.g., in baseball, the response of hitting the ball is not the same if the ball is not thrown (the ball being replaced by a verbal command to swing). For example, consider the case of quickening as used in human engineering studies; although the required movements are the same, the responses are not the same because the cues to which the subject ordinarily must respond are replaced by a quickened display. If some way could be found to integrate a quickened display with the corresponding conventional display, then the responses would be considered the same as if no quickened display were present. This point suggests that such a situation might lead to efficient training if the stimuli from the quickened display were gradually withdrawn as practice proceeded.

The foregoing discussion of responses is closely related to feedback processes. "Feedback" may be defined as stimulus functions whose values depend

upon the responses which the subject makes. Two functions of feedback processes may be distinguished. First, feedback may operate by giving the learner information about the quality of his response so that he may perform more effectively upon the next presentation of the same stimulus conditions; we will not be concerned especially with this process. On the other hand, feedback may operate by giving the subject information concerning the next responses he is to make in the series of required responses; a change in such processes commonly constitutes a replacement of the cues which are used to designate the responses. In tracking tasks, for example, information about the current deviation from the desired course is relevant not only to past performance but also to the immediate correction desired. If feedback of the second type (relevant to the next reactions required in the series) is changed, it is not a sure indication that the response requirements have changed, but such changes frequently do involve a replacement of cues which should be construed as a change in responses required.

Discovery or Understanding Tasks

If there are any restrictions concerning the practice that is considered legitimate in meeting the particular criterion performance test to be used, the task is one of discovery or understanding. The restrictions relating to practice of discovery tasks and understanding tasks apply not only to practice of the major task involved, but also to any subtask which may be set up to foster task mastery. Such restrictions do not include the normal restrictions on "cheating" by responding to chance stimuli totally irrelevant to the criterion tasks.

Discovery Tasks: A discovery task is one in which a person must learn specified behavior by utilizing knowledge contingent upon his performance during practice (assuming the required overt responses can be made before practice). The requirement of utilizing information contingent upon performance is insured by restricting other kinds of information during practice. Operationally, one determines whether or not someone has mastered a discovery task by testing for consistently correct behavior and by checking to see that during practice direct information about the behavior required was restricted. Learning to put together a jig-saw puzzle is an example of a discovery task.

As they are commonly encountered outside the laboratory, discovery tasks are constituents of composite learning activities. (A composite learning activity has been defined as a group of highly similar, related activities among which there are high degrees of positive transfer). In trouble shooting, for example, locating a particular malfunction represents a discovery task, but the trouble shooting performed in a particular field is a composite learning activity composed of several discovery tasks.

Discovery tasks require the learner to respond and to use information resulting from his responses to modify his behavior; the responses which produce such information sometimes may be covert or perceptual, as in discovery of a camouflaged object. Sometimes understanding is intrinsic to a relationship to be discovered, as when a person discovers that the next number in a series is the

square of the previous number, and in such cases, the required learning would be a discovery task, not an understanding task. Sometimes a discovery task does not entail understanding, as when a child discovers cookies are kept in a cookie jar.

The learning involved in discovery tasks, by definition, is absolutely dependent upon knowledge of results given. This unique characteristic of discovery tasks makes possible a subdivision of the category on the basis of the kind of knowledge of results given. The particular subdivision is not possible with other categories because information other than knowledge of results may be used to promote learning.

Discovery, Type I: Discovery of Type I is discovery in which the knowledge following correct performance is designed to give the learner sure knowledge of what is expected of him on his next encounter with that problem (although he may forget or perceive incorrectly sometimes). Common puzzle solutions are examples of Type I discovery. An individual who solves a puzzle has no doubt he has performed the required responses, and that if he can repeat his actions on the next occasion, his performance will again be correct. Another example of Type I discovery is finding a "hidden face" in a drawing; one may assume that either the learner may receive direct confirmation from the person administering the task or the "hidden face" forms a strong enough Gestalt to make further confirmation superfluous.

Discovery, Type II: Discovery of Type II is discovery in which knowledge presented following correct performance gives a subject only probabilistic knowledge concerning what will be correct on his next encounter with the problem. The common extinction paradigm, when applied to the case of human learning, is an example of probabilistic discovery (Type II); when reinforcement is withdrawn, the first nonreinforcement does not give the learner sufficient information to conclude that no more reward is forthcoming. An example of probabilistic discovery is any concept formation task in which the subject must guess on each trial which of the stimuli presented exemplifies the concept in question; the experimenter's words "that's right" do not give the subject sure knowledge of what is expected of him on the next trial.

The distinction between discovery tasks of Type I and Type II allows for no gradations between the two types. Because of the restrictions on direct information about the relationships involved, the learning of discovery tasks is peculiarly dependent upon the knowledge of correctness following actual performance. Consider what may happen after the learner emits the first response pattern which meets the task performance criterion; if the next trial would be the same situation with the same behavior considered correct and the task administrator is allowed to communicate that fact to the learner, then it is a Type I discovery. In Type I discovery tasks, hunches may be tried out and confirmed quite directly. Type II discovery tasks require repetitions of criterion performance in the demonstration of task mastery. In either type of discovery task, there may be approaches to solutions about which the learner may be given information concerning correctness, but it is not such knowledge of results by which discovery tasks are classified into Types I or II. If some portions of the behavior required by discovery criterion tests involve probabilistic knowledge of results and others involve sure knowledge of results, the learning requirements should be divided accordingly into two tasks.

A rather puzzling case is presented by problems in which the learner receives probabilistic information on particular trials, but when he thinks he conceives the "correct" relationship, he may state his hypothesis and receive direct confirmation. Such cases will be viewed as probabilistic discovery, since the stating of the hypothesis may be viewed as a substitute for trying out the hypothesis through action over several trials.

Understanding Tasks: Understanding tasks are those in which individuals must learn to use a relationship in more than one way ("relationship" here is to be construed broadly to include any consistent pattern). Operationally, one determines that a person has mastered an understanding task by testing him in a situation in which the relationship in question is embodied in a novel fashion. For example, a child learns to use the term "triangle" appropriately; any sort of practice and instruction is allowed, but in a test for understanding of triangularity, a particular triangle must be used which did not constitute a large part of the training. Often a learner may be tested for understanding by being asked to describe abstractly the relationship to be understood. Such a procedure may be viewed as a substitute for testing in a novel situation, and the ability to respond appropriately in a novel situation may be inferred from the individual's abstract description. Thus the defining of "sonnet" as a fourteen line poem generally would be considered sufficient evidence of ability to apply the term appropriately. Sometimes the novelty of the criterion test for understanding does not consist of a different physical situation, but rather of requiring the learner to use the relationship in a novel fashion; e.g., a person may demonstrate understanding of a prose passage by explaining it in his own words although the physical situation (presence of the printed prose passage) may remain the same as during practice (when it was read and explained to him).

Care should be taken not to confuse understanding tasks with the composite learning activities discussed previously. A composite learning activity may consist of tasks from any of the task categories. To say that a person has achieved in a composite learning activity is merely to assert that several of the constituent tasks have been mastered. It is not expected normally that a person who has achieved in a composite learning activity can perform all constituent tasks without further practice, but understanding a relationship implies ability to perform appropriately in the many situations in which the relationship might be embodied. It is characteristic of composite learning activities that the learning factors which the constituent tasks have in common are not so clearly formulated as the relationship underlying an understanding task. The inclusion of tasks in a particular composite learning activity is more arbitrary than the choice of situations which may be used to test for understanding of a particular relationship.

Understanding tasks really do not involve restrictions on practice, but the task administrator must find a criterion test which embodies in a novel way the relationship to be understood (one with which the learner has not practiced). With discovery tasks, the restrictions actually apply to practice; information about the relationship to be discovered must be restricted during practice, except as the learner's activities reveal the relationship to him.

Perceptual Judgment Tasks

Perceptual judgment learning tasks are those in which (1) the overt responses can be made before practice, (2) there is no restriction on the type of practice legitimate in relation to criterion performance, (3) the stimuli of the criterion task cannot be discriminated. Operationally, one tests an individual's perceptual judgment by asking him to indicate in the simplest fashion available the stimulus property in question. This category includes improvement in the sorts of judgments required in psychophysical experiments. It should be noted that many tasks which involve some perceptual judgment would not be classified in this category simply because they would be classified as a perceptual-motor, discovery, or understanding tasks.

An example of a perceptual judgment learning task is improvement in the ability to tell whether two tones falling within a specified range of pitches are the same or different. Another example is improvement in the ability to tell whether one lifted weight is more than or less than three times as heavy as another (the weights falling within a specified range). This kind of task may seem akin to an understanding task in that such judgments are often required in new situations, but the two kinds of tasks are not to be considered the same. With perceptual judgment learning tasks the task administrator is allowed to institute intensive practice on the criterion test situation.

Memorizing Tasks

Memorizing tasks are those learning tasks in which the subject can make the required overt responses and perceptual judgments before practice and there is no restriction of the kinds of practice in relation to criterion performance. The thing required of a person in memorizing is to associate directly overt responses he can make with stimuli he can discriminate. The learner should have no difficulty with either the stimuli or overt responses separately, and the relationships between stimuli and responses are quite direct, but the number and difficulty of associations which must be formed constitute the learning task.

Memorizing tasks may be subdivided into verbal memorizing and motor memorizing tasks, depending upon whether the required overt criterion responses are verbal or not. "Response" is a class concept (there may be measurable differences between two instances of what is considered the same response) so that in some cases either verbal or motor responses sometimes may be considered acceptable criterion performance; in such cases, we will consider the task a verbal memorizing task. Procedural learning for aircraft pilots is an example of motor memorizing. Another example of motor memorizing is learning to play a piece on the piano without sheet music (assuming that the piece can be played satisfactorily with music at the start of practice).

The distinction between verbal and motor memorizing tasks is not crucial, but it may serve to remind one that verbal memorizing task should not be equated readily with an analogous motor memorizing task. In motor memorizing tasks the motor aspects constitute an additional demand, but on the other hand, such

overt action may aid the process of remembering the appropriate steps. The verbal memorizing category may be further divided into rote and substance learning. In rote learning, a particular wording of the material is the only acceptable version, but in substance learning alternate forms are acceptable (but not required). Memorizing a poem or speech word for word are examples of rote verbal memorizing. Reciting the plot of a story or repeating the gist of a conversation are examples of substance verbal memorizing.

It may seem difficult to distinguish between motor memorizing and perceptual motor skill learning. Perceptual-motor skill learning must be developed by starting with overt responses which only approximate the correct responses and transforming them into the desired responses. By the definition of "perceptual-motor skill," any task which fits this category entails responses which cannot be elicited merely by adding supplementary cues. Conversely, the definition of "motor memorizing" logically implies that the overt responses of such tasks can be performed without practice if supplementary cues are provided. Motor memorizing may proceed by gradual withdrawal of the supplementary cues until the responses depend upon correct task cues alone.

A STEP BY STEP PROCEDURE

The classification is designed to augment the division of conglomerate learning requirements into relatively homogeneous learning tasks. The definitions were designed, in part, to allow the categories to be considered sequentially in the order in which they were introduced and defined in the present paper.

In dividing a conglomerate learning requirement, it must be determined first whether or not the overt responses involved in criterion task can be performed before practice. If the learning task to be classified cannot be fitted completely into the perceptual-motor category and yet some learning of overt responses is required, then the task should be divided accordingly. It is assumed that learning requirements as commonly encountered may be divided realistically into perceptual-motor tasks of learning overt responses and other types of tasks involving learning to utilize the responses. Division of practice along these lines should yield efficient training if the classification is to be fruitful.

Any restrictions over practice relative to criterion performance (as used to define discovery and understanding tasks operationally) should cover all the behavior required by the task; if this condition is not fulfilled, the task should be broken down accordingly until it is satisfied. If the restrictions apply only to the practice of part of the behavior demanded, it seems reasonable that such behavior is separable from the rest. Within the discovery category, if both probabilistic knowledge and sure knowledge of correctness follow instances of criterion performance, the behavior required should be divided into different aspects on the basis of such knowledge of results. The feasibility of dividing "discovery" into two subcategories

stems from the complete dependence upon knowledge of results of any learning task conforming to the definition of "discovery." Understanding tasks do not involve response differentiation or restrictions over practice, but a novel criterion test must be employed.

Perceptual judgment tasks, by definition, rule out tasks which would fit into previously considered categories. "Memorizing" is defined so as to include every learning task not classified in other categories, and this feature insures a logically exhaustive system. The sub-division of the memorizing class may be accomplished by applying the definitions of the subcategories to the overt behavior required in the criterion test.

CLASSIFICATION OF GENERALIZATIONS ABOUT LEARNING

The classification must differentiate among learning principles as well as among learning tasks if it is to aid in the application of the principles. The next step would be a formal categorization of a great number of generalizations about learning, but such an effort is beyond the scope of this paper. However, the methods of classification of principles may be indicated.

Many principles explicitly state the context in which they may be applied. A generalization which begins "In memorizing verbal material, the whole method...." would be applied only to the verbal memorizing category, providing that it is apparent that "verbal memorizing" was not used in a different sense from the definition used in the classification.

In other cases, the type of experimental controls implied by a term may determine classification. In the application of operant conditioning and extinction principles to humans, it is understood that the subject is not told that no more reward is forthcoming and that any further responding will count against him, his response frequency is likely to be affected by such information and one would not be likely to call this operant extinction. Thus, operant conditioning principles would be limited to the "discovery" category because of the restriction of information about what responses are considered correct. Furthermore, "operant conditioning," as the term is generally understood, involves a series of responses rather than a single response which completely reveals the state of affairs to the subject, so operant laws are restricted to Type II Discovery tasks. Of course, it should be emphasized that a subtask may be established for any learning task, and the subtask may belong to a different category than the major task. Thus the operant conditioning laws could apply to a subtask of the Type II Discovery category even though inapplicable to the major task.

Finally, some generalizations about learning are established on a sharply restricted set of situations and may prove to be false empirically in some of the categories. If so, the classification may aid in resolving some apparent conflicts in empirical results.

SUMMARY

The objectives in classifying learning tasks are to provide a conceptual basis for analyzing training requirements and to facilitate application of learning principles to training problems. The problems of analyzing and classifying learning tasks were approached by explication of concepts used in common language and in generalizations about learning.

The definition of "learning task" involved a requirement to improve performance capabilities. The criterion test is the operational measure of such improvement, but the test is not the learning task. The idea of subtasks was introduced to clarify the situation which occurs when gross learning requirements are analyzed into more teachable units. Generally, the learning requirements in training programs are not specified in neat homogeneous units, but rather involve conglomerations of disparate behaviors. Another common practice is to learn a group of activities in preparation for other similar learning tasks, i.e., learning to learn.

The above considerations were introduced as a basis for presenting a logically exhaustive system for categorizing learning tasks. It was developed from distinctions implied in authoritative generalizations about learning. Major categories are "perceptual-motor," "discovery," "understanding," "perceptual judgment," and "memorizing." The definitions of categories correspond roughly with common usage of the terms. Learning tasks are classified by sequential application of definitional criteria. Many generalizations about learning may be applied only to learning tasks of certain categories.

LIST OF REFERENCES

1. Cotterman, T. E., Task Classification: An Approach to Partially Ordering Information on Human Learning, WADC Technical Note 58-374, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, January 1959.

2. Deese, J., The Psychology of Learning, McGraw-Hill, New York, 1952.

3. Hilgard, E. R., Theories of Learning, Appleton-Century-Crofts, New York, 1948.

4. Hovland, C. I., "Human Learning and Retention," In Handbook of Experimental Psychology, S. S. Stevens, Ed., J. Wiley & Sons, New York, 1951.

5. Keller, F. S., and W. N. Shoenfeld, Principles of Psychology, Appleton-Century-Crofts, New York, 1950.

6. MacCorquodale, K., and P. E. Meehl, "Edward C. Tolman," In W. K. Estes and others, Modern Learning Theory, Appleton-Century-Crofts, New York, 1954.

7. McGeoch, J. A., and A. L. Irion, The Psychology of Human Learning, Longmans, Green, New York, 1952.

Aerospace Medical Division, 6570th Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio. Rpt. No. AMRL-TDR-63-74, A CLASSIFICATION OF LEARNING TASKS IN CONVENTIONAL LANGUAGE. Final report, Jul 63, iv + 15 pp., table, 7 refs. Unclassified report

Classifying learning tasks may aid in analyzing training requirements and applying learning principles. To this end the term "learning task" is defined for purposes of the classification, and a descriptive system is introduced for analyzing training requirements and for relating various practice conditions. A logically exhaustive classification is presented. Learning tasks are categorized by applying the definitional criteria sequentially. Major categories are "perceptual-motor,"

(over)

UNCLASSIFIED

1. Learning (Psychology)
2. Training and Training Aids
3. Human Engineering

I. AFSC Project 7183, Task 718306
II. Behavioral Sciences Laboratory
III. Contract AF 33(616)-5965
IV. University of Illinois, Urbana, Illinois

UNCLASSIFIED

"discovery," "understanding," "perceptual judgment," and "memorizing," corresponding roughly with common usage of the terms. The criteria for class membership are of three kinds: (a) discrepancies between criterion performance and initial skills of trainees, (b) restrictions on practice conditions considered legitimate in meeting the particular performance test, and (c) the kind of overt behavior constituting criterion performance and the allowable alternatives in such performance. The restricted applicability of generalizations about learning to certain categories is discussed.

UNCLASSIFIED

V. Miller, E. E.
VI. In DDC collection
VII. Aval fr OTS $0.75

UNCLASSIFIED

Aerospace Medical Division, 6570th Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio. Rpt. No. AMRL-TDR-63-74, A CLASSIFICATION OF LEARNING TASKS IN CONVENTIONAL LANGUAGE. Final report, Jul 63, iv + 15 pp., table, 7 refs. Unclassified report

Classifying learning tasks may aid in analyzing training requirements and applying learning principles. To this end the term "learning task" is defined for purposes of the classification, and a descriptive system is introduced for analyzing training requirements and for relating various practice conditions. A logically exhaustive classification is presented. Learning tasks are categorized by applying the definitional criteria sequentially. Major categories are "perceptual-motor,"

(over)

UNCLASSIFIED

1. Learning (Psychology)
2. Training and Training Aids
3. Human Engineering

I. AFSC Project 7183, Task 718306
II. Behavioral Sciences Laboratory
III. Contract AF 33(616)-5965
IV. University of Illinois, Urbana, Illinois

UNCLASSIFIED

"discovery," "understanding," "perceptual judgment," and "memorizing," corresponding roughly with common usage of the terms. The criteria for class membership are of three kinds: (a) discrepancies between criterion performance and initial skills of trainees, (b) restrictions on practice conditions considered legitimate in meeting the particular performance test, and (c) the kind of overt behavior constituting criterion performance and the allowable alternatives in such performance. The restricted applicability of generalizations about learning to certain categories is discussed.

UNCLASSIFIED

V. Miller, E. E.
VI. In DDC collection
VII. Aval fr OTS $0.75

UNCLASSIFIED

AF-WP-B-JUN 63 1M