3

What Is Learned—Varieties

Now that we have seen what the basic prototypes of learning can accomplish in terms of associations and chains, we need to examine some more complex forms of human performance. We shall look at some major categories of learned human capabilities as they occur in everyday life and in educational settings. In addressing the question of how such complex forms of behavior are learned, we shall return in Chapter 4 to the ideas of *information processing* as a model for learning. As an essential piece of background knowledge, however, we must begin in this chapter with the question "What kinds of things do people learn?"

During their lifetimes, people learn many things. In early childhood they learn to interact with their environment in basic patterns of sensorimotor coordination: to move their bodies and limbs, to manipulate objects, and to respond appropriately to their protectors. Quite early, children learn to speak and to use language, an enormously powerful set of skills that will have the most profound effect on all their subsequent learning and that will set them apart from all other animals for the remainder of life.

As beginning schoolchildren people face two major learning tasks. One is to continue their socialization by learning to interact with other children and adults in ways that will achieve moment-to-moment goals without conflict and that will support the needs of others with kindness and consideration. A second task is to learn to respond appropriately to symbols that represent the environment in miniaturized fashion: pictures, diagrams, printed words, and numerals. This last is the intellectual task of reading, writing, and manipulating numbers. While children continue to elaborate and supplement what they have learned of oral language, this distinctly new form of symbol use adds another dimension to their capabilities as human beings.

Once these basic language and symbol-using skills are acquired, schoolchildren are capable of learning many things. They learn about the earth, its peoples, and its geographic and physical properties. They learn about human society and its institutions. They learn how to deal with the environment not only by direct interaction with things and people but by solving problems constructed in imagination. As they continue to acquire competence in symbol-using activities, children learn skills which prepare them

for adult life: comprehending passages of printed language, composing communications in both oral and written form, solving practical quantitative problems with numbers.

As education continues, individuals learn more and more specialized knowledge and more highly complex skills. They may learn things that will be useful in pursuing an occupation, such as typing or drawing or the procedures of real-estate transfer. They may learn knowledge and skills that pertain to the role of a citizen, such as the structure of local government, the rules of jury trial, and the laws of voter registration. And the chances are that they will learn things that give them pleasure, such as listening to music, reading fiction, and participating in sports.

FIVE VARIETIES OF CAPABILITIES

How is it possible to think about learning in all the varieties in which it occurs during the lifetime of the individual? How can we find common ground among the many instances of learning, considering the vast array of differences that are so apparent in what is learned?

As a first step, we must focus on *what is learned,* rather than upon the conditions that exist when learning occurs. Learning conditions are not the same for different varieties of what is learned. Therefore, it is first necessary to distinguish as clearly as possible the *types* of outcomes that learning has—the *varieties of learned capabilities.* These capabilities, as we have seen in Chapter 1, must be observed as human performances. What must be looked for, then, are types of human performances that have common characteristics, even though their specific details vary. From these performances inferences can be made about the learned capabilities that make them possible.

Consider, then, what major categories of human performance may be established by learning. The following list will be expanded upon in the remainder of this chapter.

1. **Intellectual skills.** An individual may learn to interact with the environment by *using symbols.* The child uses oral language to deal with the environment symbolically, for example when saying "Open!" as a request to a parent to open a door or as a response to such a parental request. Reading and writing and using numbers are basic kinds of symbol use learned in early grades. As school learning continues, symbols are used in more complex ways: for distinguishing, combining, tabulating, classifying, analyzing, and quantifying objects, events, and even other symbols. Mentally converting 24 ounces into pounds is a simple example; making a singular verb agree with a singular subject in a written sentence is

another. This kind of learned capability is given the name *intellectual skill.* It is "knowing how," or *procedural knowledge.*

2. **Verbal information.** A person may learn to *state* or *tell* a fact or set of events by using oral speech or by using writing, typewriting, or even drawing a picture. Obviously, a person must *have* some intellectual skills in order to posit statements. In other words, the person must know how to construct at least a simple sentence. But the purpose of the learner's act is to *tell information,* not merely to display the intellectual skill of sentence construction. A simple statement may vary in its skill from one person to another, yet the information (the ideas) conveyed may be indistinguishable. What is stated may be a single idea or a set of ideas that are ordered in some way (as in recounting a set of events). Being able to *state* ideas is a learned capability called *verbal information* ("knowing that," or *declarative knowledge*).

3. **Cognitive strategies.** The individual (in this case, a young woman) has learned *skills that manage her own learning, remembering, and thinking.* She has learned certain ways of reading different parts of a text, for example. When asked to learn a set of apparently unrelated object names, she approaches the task by searching for relationships among the names, or relationships with other more familiar names. Perhaps the learner has acquired a particular skill that enables her to recapture the details of a scene she has witnessed, or to remember the main points of a lecture she has heard. She has also learned certain techniques of thinking, ways of analyzing problems, and approaches to the solving of problems. These skills, which control the learner's own internal processes, are given the general name of *cognitive strategies.*

4. **Motor skills.** The learner has learned to *execute movements* in a number of organized motor acts, for example in threading a needle or throwing a ball. Often these individually coherent acts form a part of more comprehensive activities such as playing tennis or driving an automobile. The unitary acts are referred to as *motor skills.*

5. **Attitudes.** A learner acquires mental states that *influence the choices of personal actions.* One person may tend to choose actions that increase the likelihood of selecting golf, for example, as a preferred recreation. Another may choose to study physics rather than English literature during the time available for study. Such "tendencies," which are seen as *choices* to the learner rather than as specific performances, are called *attitudes.*

Here, then, are the five main categories of capabilities that human beings learn. These categories are comprehensive. Any learned capability, regardless of how it is otherwise described (whether mathematics, history, economics, or whatever), has the characteristics of one or another of these varieties.

How are these organized outcomes of learning related to the learned associations discussed in Chapter 2? The answer is that they are more complex units which, according to theory, are held together by learned associations. As we saw in the previous chapter, isolating a single association for study is very difficult, if not impossible. What gets learned and stored in memory are these complexes called *capabilities.* We shall see in later chapters what conditions support the learning of each of these capabilities. First, though, we shall give some additional examples of each type.

INTELLECTUAL SKILLS

A person who takes a saw and cuts a piece from the end of a board is, of course, interacting with the environment in a *direct* manner. This action, however, may have been preceded by other actions, for example planning that involved measuring a length like $22\frac{3}{16}$ inches, finding the difference between that distance and $24\frac{1}{8}$ inches, and perhaps using a tool with a straight edge to draw a line at a right angle to the board's edge. Many of the activities involved in this type of planning require the individual to interact with the environment *indirectly* through the use of symbols. The learner represents linear measurements by the symbols "$22\frac{3}{16}$" and "$24\frac{1}{8}$" and proceeds to operate on these symbols rather than directly on the lumber itself. Some symbolic operations are done "in the learner's head"; others may need to be worked out on a small writing surface. But these operations are very different from the actions that would need to be done directly to the wood, were such symbolic activity not possible. The capabilities that make symbol use possible are what we mean by *intellectual skills.*

An individual learns many simple and complex intellectual skills. The content of school mathematics, for example, is virtually all intellectual skills. However, intellectual skills pertain also to symbols other than numerals and number operations. In a larger sense, the symbols used to represent the environment to the learner constitute *language.* A relatively simple intellectual skill in the use of language symbols is the grammatical rule of the objective form of a pronoun following a preposition ("from her"). A more complex skill is involved in using a metaphor ("seeking the bubble reputation"). Since language is used to record and communicate the relationships (concepts, rules) that exist in any subject, the learning of such relationships can be expected to involve the learning of intellectual skills. It may be seen, therefore, that such skills are in many ways the most important types of capability learned by human beings and the essence of what is meant by "being educated."

Conditions of Learning

How do individuals learn to use symbols in an intellectual skill? It is apparent that some conditions for this learning must exist within the learners (*internal* conditions), while others are *external* to the learners and may be arranged for in instruction. These conditions will be described in subsequent chapters. Here, we shall give a few examples to illustrate what is meant by the conditions of learning.

Suppose that some youngsters are expected to learn how to find the difference between a linear extent measured as $22\frac{3}{16}$ and another measured at $24\frac{1}{8}$, and assume that they don't already know how to compute this. They can learn this particular skill (applicable to all mixed numbers containing eighths and sixteenths) quite readily, provided certain internal conditions are present. Particularly significant among these conditions is the availability of certain *component* or *subordinate skills,* which may be identified as "forming equivalent fractions by multiplying numerator and denominator by the same (small) number" ($1/8 \times 2 = 2/16$), "forming equivalent fractions by dividing numerator and denominator by the same (small) number" ($6/16 \div 2 = 3/8$), and "finding a difference by subtracting fractions having common denominators" ($4/8 - 1/8 = 3/8$). Of course, if these subordinate intellectual skills have not been previously learned and stored in memory, they will not be available to the learners and must therefore be learned. But if they are present as internal conditions, learning of the new skill can proceed with little difficulty or delay.

The external conditions for acquiring the new skill may begin with a reminder that the subordinate skills will need to be recalled. Often this is done by means of verbal communications, such as "Remember how to subtract fractions like $\frac{3}{16}$ from $\frac{4}{16}$." A second kind of verbal communication may be used to inform the learners of the learning objective, that is, of what the specific purpose of the performance will be after it has been learned. This may be represented by some such statement as "The distances $22\frac{3}{16}$ and $24\frac{1}{8}$ are different; what you want to do is to find the amount of this difference." A picture and an example might also be used to convey this objective.

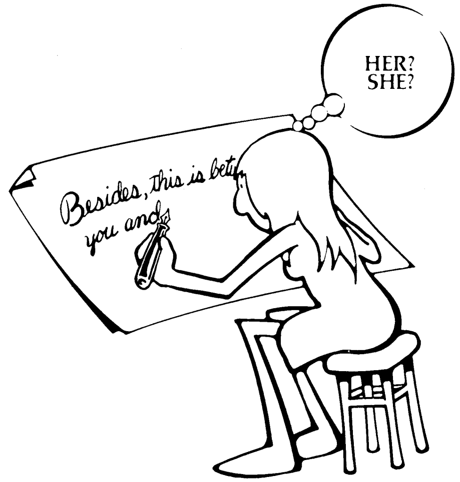
The next event that makes up the external conditions of learning for this skill is a communication that suggests "putting things together," that is, combining subordinate skills to make the new one. Actually, the learners may already see how to do this or may be able to "discover" it themselves, in which cases no additional stimulation is needed. Often, though, some statement or hint may be valuable, such as "If you change $\frac{1}{8}$ to $\frac{2}{16}$, can you then find the difference?" Then, if the learners state the difference they seek as "$\frac{1}{16}$," only one more step is needed. This is the provision of a new example (such as the distances $1\frac{7}{8}$ and $1\frac{1}{4}$) on which the learners can demonstrate the application of their newly learned skill.

Thus, the *internal conditions* for learning an intellectual skill consist of (1) the previously learned skills that are components of the new skill and (2) the processes that will be used to recall them and put them together in a new form. Several distinct events make up the *external conditions,* and some of the most important have been mentioned in the example described. Notice that these external events have the purposes of (1) stimulating recall of the subordinate skills; (2) informing the learner of the performance objective; (3) "guiding" the new learning by a statement, question, or hint; and (4) providing an occasion for the performance of the just-learned skill in connection with a new example. These events are perhaps the most obvious features of the external conditions of learning; they serve to illustrate a set that will be described more fully in later chapters.

The Nature of Intellectual Skill

The most typical form of an intellectual skill, exemplified by the instance just described, is called a *rule.* When learners have acquired a rule, they are able to exhibit behavior that is *rule-governed.* Such behavior does not mean that the learners are able to formulate or state the rule. Quite the contrary is often the case; young children evidence rule-governed behavior in their use of oral language and in many other ways. The external observer of behavior (the learning investigator, for example) is able to draw the conclusion that a rule has been learned.

Performance is rule-governed when its regularity can be described only by a rule statement rather than by the relation of a particular stimulus to a particular response. A rule statement relates *classes* of stimuli to *classes* of responses. In the fraction example mentioned previously, the learners acquired a capability which does not relate to the *particular* stimulus situation ($22\frac{3}{16}$, $24\frac{1}{8}$), but to a *class* of situations having certain characteristics (mixed numbers including eighths and sixteenths). Accordingly, the performance of which the learners become capable does not consist of a *particular* response ($\frac{1}{16}$), but of an entire class of responses (any differences of the mixed numbers presented, expressed as eighths or sixteenths). Thus the performance made possible by learning is perfectly regular, and it can be described by a rule statement ("finding the differences in mixed numbers containing eighths and sixteenths as fractional parts"), which relates an entire class of stimuli (any mixed number of the sort described) to a class of



Applying a rule: A performance involving an *intellectual skill.*

performances (any difference obtained). This is what is meant by rule-governed behavior. The individuals, then, can be said to have *learned a rule.*

It should be emphasized that when learners have acquired a rule (as shown by its use), they may be quite incapable of describing what has been learned, in other words, of *stating* the rule. In fact, learners are likely to think that stating the rule is a rather silly thing to do. It may also be a very difficult thing to do, because rule statements can quickly become enormously complicated in a linguistic sense. The most straightforward way of determining whether learners have learned a rule is to simply ask them to perform on an instance of the rule not previously encountered during learning. If the rule is one of finding differences in mixed numbers of the sort described, then a new instance such as $3\frac{1}{16}$ and $3\frac{5}{8}$ may be given. If the rule is one of using pronouns in the objective case following prepositions, an example might be "The captain was silent, and I waited to receive a signal from ________."

Subcategories of Intellectual Skills

We have seen that when component skills are already available in the learner's memory, rule learning is typically a matter of *combining* simpler component skills into a new pattern. Are these component skills also rules that are analyzable into even simpler skills? In general, the answer to this question is yes. A complex rule may usually be shown to be composed of simpler rules, each of which in turn may be further analyzed into previously learned components. However, as this process continues, the nature of the components changes somewhat, and they need therefore to be separately identified and described.

Concepts. A fairly simple rule is represented by the statement "A gallon of liquid consists of four quarts." It can be seen that a rule is a *relation* between two or more *things.* In this case, there are three *thing-concepts:* gallon, liquid, and quart. The primary *relational concept* is the verb "consists of," with a secondary relation represented by the quantity "four." Thus, an initial step in the further analysis of a *rule* produces the new category of intellectual skill called a *concept*. The concept is a component of a rule and is thus subordinate to it. Learning the simplest rule is a matter of combining some previously learned concepts in a particular way. If the learner has previously learned the concepts *gallon, liquid, quart, four,* and *consists of,* learning the new rule "A gallon consists of four quarts" may be readily accomplished. (Note particularly, however, that learning the new rule does not mean learning to state the rule, which is not the same capability. Rather than stating it, the learner who has acquired this rule will be able to show that four quarts of liquid make up a gallon.)

Discriminations. Intellectual skills can be analyzed still further. Concepts can be seen to require even simpler skills called *discriminations.* The things concepts represent have characteristics that may be described (in the ultimate sense) in physical terms. For example, a dime possesses certain object properties: it is round, of a certain thickness and diameter, a particular weight, silver in color, and metallic in its "feel." (As we shall see in a later chapter, these object properties are themselves concepts of a basic sort called *concrete concepts.*) In order to learn to identify a dime, that is, to learn "dime" as a concept, these object properties must be distinguished from each other and from those of other objects. The learner must be able to *tell the difference* between objects varying in these particular qualities: between a color that is silver and one that is not silver, between a shape that is small and round and one that is not, and so on. Telling the difference between variations in some particular object-property is called a *discrimination.*

Obviously, colors, shapes, sizes, texture, and most other discriminations important for further learning are learned very early in our lives. Kindergarten children are likely to have learned to tell the difference between the color red and some other color, as shown by an exercise in which they match the reds in an array of various colors with a red sample. But not all the necessary discriminations have been learned; the children may need to learn to tell the difference between tones of nearby pitch or letter-sounds that are similar (such as the short vowels "e" and "i"). Quite a few children must learn discriminations of printed letter patterns (for example, L and J) as prerequisite capabilities for learning the letter concepts *d* and *b.* The necessity for learning additional discriminations sometimes becomes apparent in later school grades and in adult learning. For example, the pronunciation of certain sounds in a foreign language may need to be preceded by discrimination learning so that the students first learn to hear the differences between the new sounds and sounds more familiar to their native languages. Consider also how many fine discriminations must be learned by a tea taster or a wine taster!

Higher-order rules. Just as rules may be analyzed to reveal the necessity for simpler skills (concepts, discriminations), the reverse process also occurs. Rules may be combined by learning into more complex rules, which may be called *higher-order* rules. Such rules have greater generality, that is, they apply to a greater variety of situations than do any of the component rules of which they are composed. Higher-order rules may be learned under conditions similar to those for other rules. It is often true, however, that higher-order rules result from the learner's *thinking* in a *problem-solving* situation. In attempting to solve a particular problem, the learner may put together two or more rules from very different content domains in order to form a higher-order rule that solves the problem.

Procedures. Another way that rules get more complex is simply by becoming longer. The rule for long division, for example, is relatively lengthy and deserves to be called a *procedural rule* or simply a *procedure*. Just as is the case with other rules, the long division procedure may be analyzed into simpler subordinate rules, including those of multiplying whole numbers, estimating a quotient, subtracting whole numbers, and others. Additionally, though, the procedure is a chain of simpler rules that must be applied in a particular sequence in order for division to be done correctly. This means that in addition to knowing each of the simpler rules (and the concepts of which they in turn are composed) the learner must be able to reinstate a *sequence of action steps*. Often, as in the case of long division, remembering the sequence is not too difficult following practice because the steps repeat themselves as the performance proceeds. When procedures become very long and nonrepetitive, they usually require an external checklist, or something similar, as an external aid to remembering the sequence of steps.

Prerequisites in the Learning of Intellectual Skills

The very important learned capability called *intellectual skill* has a number of forms, some simple and some more complex. Distinguishing these forms of intellectual skill is important for two reasons. First, a significant characteristic of intellectual skills is that the learning of any one skill depends upon the prior learning of one or more simpler skills. Second, as we shall see in later chapters, certain notable differences exist in the conditions of learning required for each type of intellectual skill.

A summary of the interdependence of intellectual skills, and their dependence upon basic forms of learning, may be given as follows:

Higher-order Rules
require as prerequisites

Rules
that require as prerequisites

Concepts
that require as prerequisites

Discriminations
that require as prerequisites

Basic forms of learning:
Associations and Chains

Subsequent chapters will devote attention to conditions for learning the following forms of intellectual skill: discriminations, concepts, rules, and higher-order rules. The significance of the internal conditions brought about by prior learning of prerequisite skills will again be emphasized in these descriptions.

COGNITIVE STRATEGIES

A second and most important kind of capability learned by human beings is called a *cognitive strategy*. These are the skills by means of which learners regulate their own internal processes of attending, learning, remembering, and thinking. These internally organized skills have been given different names by various authors. Bruner (1971) refers to them as "cognitive strategies," which he relates primarily to processes used in finding and solving novel problems. These strategies appear to be related to the "mathemagenic activities" described by Rothkopf (1971) and to the "self-management behaviors" referred to by Skinner (1968). They are called "executive control processes" by a number of learning theorists who favor information-processing conceptions (Greeno and Bjork, 1973).

Besides the increasing repertoire of competencies for dealing with their environment (intellectual skills), learners acquire increasingly skillful strategies that they use to activate and regulate the learning, retention, and use of their own skills. Rather than being oriented to specific kinds of external content, such as language or numbers, cognitive strategies are largely independent of content and generally apply to all kinds. If learners have improved their strategies of attending (one kind of cognitive strategy), this strategy will apply to the learning of any subject, regardless of content. Similar generality of application would be true of strategies of encoding, strategies of memory search, strategies of retrieval, and strategies of thinking.

A "mnemonic system" for remembering the sequence of ideas in a speech is an example of a cognitive strategy for retrieval. Such a system is of limited usefulness and is not advocated here as something to be learned. Nevertheless, mnemonic systems of this sort have been used by prominent orators for a great many years. One strategy is to create an imaginary position for each point to be made somewhere in a highly familiar room. For example, the speaker might begin with the high cost of oil, imagining that this idea is located at the left of the doorway to the room. Then, proceeding clockwise, the speaker might locate the next point (say, the scarcity of food supplies) as the closet door along the lefthand wall. If the next item is about the incidence of starvation, this might be located in the left corner of the room. Thus, the speaker would continue this process until all the main points have been located in the room. The imagined locations become cues for the retrieval of the main points of the speech in the proper order. In using this method of cueing to remember a speech, the speaker has deliberately chosen a cognitive strategy, in this case a strategy for retrieval.

This particular cognitive strategy for remembering a sequence of ideas appears to have limited usefulness. The cognitive strategies that apply to

Originating an interpretation of unfamiliar data: a performance using a *cognitive strategy.*

remembering in a more general sense are undoubtedly more complex and subtle in their operation. It is likely, though, that everyone has learned *some* strategies for remembering, as well as some for attending, learning, and thinking. The strategies that some people possess appear to be better than those of others, because the *quality* of their learning and thinking is better or faster or more profound. How to bring about improvement in cognitive strategies, so that every learner is "working up to potential" is one of the challenging problems of education.

Cognitive strategies may be fairly simple and easy to understand. For example, children who are given the task of learning a set of objects shown in pictures may be told to commit them to memory in terms of categories. Likewise, children who are learning pairs of words (BOY-COW) may be told to think of a sentence connecting the words ("The BOY rode the COW"). Strategies of this sort can readily be acquired and used so as to improve the performance of remembering (Brown, 1978; Rohwer, 1975). There are also cognitive strategies that are more abstractly described, such as those applicable to the solution of mathematical puzzles, which are obviously more difficult to acquire and use (see Wickelgren, 1974). It seems probable that many of a learner's cognitive strategies improve in increments over long periods of time, rather than being totally learned in a few days, weeks, or months.

Internal conditions. Since cognitive strategies are internally organized skills, they must have something internal to work on. Thus, it is reasonable to suppose that if an encoding strategy for the learning of facts is being learned, and if the strategy involves putting the facts in familiar categories, the learner must have a repertoire of convenient categories, previously learned and recallable for use. Similarly, if what is being learned is a strategy of thinking that can be used to solve problems of light refraction, the learner needs to have available some previously learned rules relevant to light refraction. Thus, although cognitive strategies are themselves free of specific content they cannot be learned or applied without some specific content. These mental operations, in other words, must have something to work on—they cannot be exercised in a vacuum.

The capabilities that need to be recalled from previous learning in support of the learning and refinement of cognitive strategies are usually intellectual skills. This necessity is illustrated in the previous examples: in one instance concepts (such as categories) must be recalled by the learner, in the other rules of light refraction. In addition, information is sometimes the kind of capability that must be recalled. For example, the exercise of cognitive strategies in composing an original essay on the distribution of electric power obviously requires the recall of a great deal of information about the subject. The effectiveness of the learner's cognitive strategies may be indicated by the originality of the essay, but the facts must be available in any case.

External conditions. The identification of specific external conditions affecting the learning of cognitive strategies is perhaps least well known. In view of the absence of exact knowledge of what these strategies are and how they operate internally it is perhaps not too surprising that our knowledge of these external factors is limited. Arranging external conditions to establish and improve cognitive strategies is, after all, an attempt to exercise external control in an indirect fashion over the learning of capabilities that are internally managed.

Practical means of arranging optimal external events for learning cognitive strategies usually come down to encouraging the learners to practice the use of cognitive strategies in a variety of novel situations. For example, various kinds of learning materials may be presented, so that the learners are faced with decisions about strategies for attending, strategies for encoding, or strategies for retrieving. A succession of extremely varied, novel problem-solving situations may confront the learners, requiring them to select and use different strategies in solution. The educational implications of these approaches call for the inclusion in courses of instruction of frequent occasions on which the students are challenged to discover new ways of managing their own learning and thinking (see Bruner, 1961, 1971).

VERBAL INFORMATION

A third major category of learned capability is verbal information. We expect individuals to learn verbal information during the course of their lives and to retain a great deal of such information so that it is immediately accessible.

We know that individuals have learned some verbal information when they are able to "tell about it" or state it. What they state, of course, is basically in the form of one or more sentences (or propositions) having a subject and a predicate. Information is thought of as verbal, or more precisely, capable of being verbalized, because we know it in sentence form. Learners' statements often have the purpose of "telling" some other person or persons. However, learners often may be "telling" themselves.

Information is an important capability for a number of reasons (see Gagné and Briggs, 1979, pp. 78–84). First, the individual may need to know certain facts, such as the days of the week, months of the year, names and locations of cities, states, and countries, simply because they are "common knowledge" that every adult is expected to have. Second, verbal information functions as an aid and accompaniment to learning. The study of the principles of economics, for example, requires that the learner make use of a broad

base of organized information about production, markets, banking, and so forth. And third, information is important as specialized knowledge, which must be possessed by experts in any field. A trained chemist, in addition to knowing how to use the rules of chemistry, also knows a great deal of information about the subject.

Conditions of Learning: Verbal Information

The learning of verbal information requires its own set of internal and external conditions. Consider the following passage as containing information to be learned:

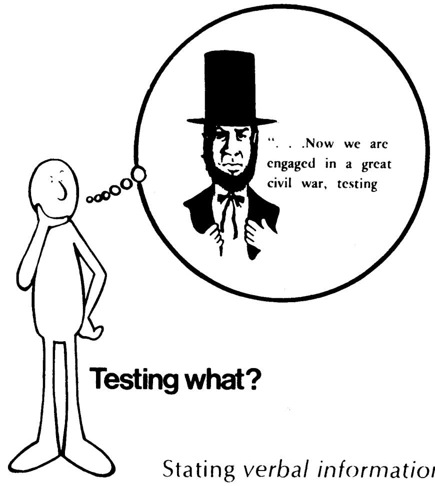
> The action of a volcano consists of the expulsion of heated materials to the surface of the earth from the interior. A volcano is a conical hill composed mainly of materials which have been thrown up from underground, and have built up around a central vent of eruption. The volcano has a truncated summit, and a cup-shaped cavity called a crater. In large volcanoes, rents appear on the sides of the cone, from which steam, hot vapors, and streams of molten lava are poured out.

This passage may be perceived as being composed of several propositions, which may be listed as follows:

Proposition 1:	Function of volcanic action (expulsion of heated materials, etc.)
Proposition 2:	Characteristics of a volcano (conical hill)
Proposition 3:	Function of volcanic hill materials (thrown up from underground, etc.)
Proposition 4:	Characteristics of conical hill (truncated summit, cup-shaped crater)
Proposition 5:	Relation of cone to rents (rents form on sides of cone)
Proposition 6:	Function of rents (hot vapors and lava pour out from them)

Let us assume that we are not immediately concerned with how the previous passage is presented—whether in print or by some auditory source. How are these propositions learned? What conditions must be present in order for the learner to "tell" someone what the passage contains?

Internal conditions. Certain internal conditions for learning this material are immediately apparent. The learner must have available, from previous learning, linguistic rules (intellectual skills) that make possible the comprehension of a sentence as a structure composed of agent, action, location, object, and so on. If the passage itself has a complex syntactic structure, the learner must be able to interpret it as a proposition with conjunctions, dependent clauses, modifiers, and other elements. Apparently, the learner must also "know the meaning" of at least some of the words, although the



Stating *verbal information.*

extent of this requirement cannot be clearly specified. For example, the sentence "Tilgem reduces gorbil" is readily learnable as information even though the thing-concepts "tilgem" and "gorbil" are not known from previous learning.

Still another internal condition influencing the learning of information has been emphasized by a number of learning theorists (Ausubel, Novak, and Hanesian, 1978). This is the availability to the learner of cognitive structures of meaningfully organized information. Such structures of organized knowledge are considered to have been previously learned. They are related in some meaningful sense to the new information to be learned. For example, the passage about volcanoes would, according to Ausubel (1978), be related to a more inclusive cognitive structure, previously learned, probably pertaining to hills, mountains, and other geographical features of the earth, including those having the name "volcano." The new information is conceived as being acquired when it is subsumed in this larger meaningful structure.

External conditions. Two sets of conditions are of particular importance to the learning of information. The first is stimulation that makes a cognitive structure readily accessible to the learner—that reminds one of the larger meaningful context into which the new information will fit. Studies by Ausubel and his associates (Ausubel, 1960; Ausubel and Fitzgerald, 1962) and more recently by Mayer (1976, 1978) have shown the effectiveness of what is called an *advance organizer* in accomplishing this purpose and thus improving learning and retention of information. The advance organizer is a communication given to the learner prior to the encounter with the set of information to be learned. Its purpose is to remind the learner of the meaningful context already available in memory and relevant to the new learning.

A second condition which may be externally arranged is that of *informing the learner of the objective* of the learning. In any passage of meaningful propositions, certain features of the information may represent the desired goal of learning while others may be incidental. For instance the objective may be to learn definitions of new technical terms, to learn the dates of the events described, or to learn new names for familiar things. The particular objective chosen, of course, will be reflected in the test given to assess the learning of the information. Informing the learner of the objective may be done in a number of ways, including a directly informing statement. A way that has been much investigated is to include within a passage of text the type of questions the learner will be expected to answer once the learning is completed (Frase, 1970; Rothkopf, 1970, 1971).

What about repetition as an external condition? Will not the information be better learned and retained if it is gone over several times? Practically speaking, repeated hearing or reading of an informational passage does ir[illegible]e its learning. The weight of evidence, however, attributes this result tc [illegible]ions in the internal processing of the information from one occas[illegible] another. Certain facts within a total paragraph may be processed when it is read the first time, certain others when it is read a second time, and so on. But the reading of the *same* fact more than once does not make it "stronger" in memory. Thus if a learner is asked to learn ten disconnected facts, repetition of the list increases the number of facts learned. It does so, according to most modern theories, because additional facts are taken in with additional repetitions.

Varieties of Information Learning

Just as intellectual skills come in varieties that are more or less complex, one might expect similar degrees of complexity among sets of information. It is true that certain distinctions can be made along this dimension of information, although the categories are primarily for convenience of description.

The simplest kind of information is a *label* or *name.* This elemental form of information probably should be conceived as a *verbal chain* in which an instance of the object is associated with its name. The verbal response itself may be of any variety. It is important to note that learning the *name* of an object is not the same as learning the *concept* that the object represents.

The most typical form of unitary information is the *fact,* which is expressed as a simple proposition such as "Jet engines generate noise," or "The boy captured the model airplane." Single facts appear to depend for their learning on the internal presence of the "larger meaningful structure." Their learning may also be strongly influenced by the simultaneous presentation of other related facts. Information may also be learned sets of interrelated facts, or *bodies of knowledge.* The organization of these sets of facts, the ways in which the individual components are related to each other, may have a considerable effect on learning and retention. Organized knowledge often takes the form of a *schema,* having interesting properties to be described later.

MOTOR SKILLS

We turn now to a different and familiar kind of capability usually easy to distinguish in human performance: a motor skill. (Note that there is no particular reason for considering this type of learning outcome, or any other type, in a particular order; each type is different.) Many examples of motor skills come to mind. In the young child, there are motor skills involved in such activities as dressing and eating. At the start of school, if not before, the child learns to make particular kinds of designs, including letters, with pencil and paper. Throughout the years of school, the individual learns the various motor skills involved in games and sports: throwing a ball, hitting a ball, jumping over hurdles, climbing. In many different kinds of courses, the student is likely to learn a number of tool-manipulation procedures that include motor skills. While not often given a central place in the curriculum, a variety of motor skills are involved in school learning.

We say that individuals have acquired motor skills not simply when they can perform certain prescribed movements but when these movements are organized to constitute a total action that is smooth, regular, and precisely timed. The smoothness and timing of performances reflecting motor skills indicates that these performances have a high degree of internal organization. As a consequence, it is typical for a motor skill to improve in precision and smoothness with continued practice over long periods of time (Fitts and Posner, 1967).

Internal conditions. Motor skills are usually composed of a sequence of movements. Thus, the action of driving a golf ball consists of the sequence of (1) positioning the body and the club, (2) raising the club over the shoulder, (3) aiming the club at the ball, and (4) making a full swing with involvement of arms and body. Printing the letter E requires a sequence of movements in which each of the four lines composing a letter is first (a) positioned and then (b) drawn to a particular length. The *procedural sequence* of a motor skill must be learned. Often, it is learned along with the motor skill itself. This procedure, which has been called the "executive subroutine" (Fitts and Posner, 1967), has the character of a rule by which the learner knows "what comes after what." A procedural rule of this sort must be available to the learner as improvement in motor performance with practice continues.

The separate parts of a motor act can often be learned and practiced separately as *part-skills.* These too may be prerequisites established by previous learning. Swimmers, for example, sometimes practice separately the

Planing the edge of a board: a *motor skill.*

part-skills involving leg movements and those involving arms and head. A child who is learning to draw a square may "put together" the previously learned part-skills of line drawing and corner drawing.

External conditions. The most important set of external conditions for motor skill learning is provided by periods of practice. The sequence of motor acts gets repeated again and again in a situation that provides *feedback,* or *knowledge of results.* Sometimes, the feedback is an inherent part of the act being performed, as is the case when a musical instrument is being played. In other instances, additional feedback may be provided by a coach or instructor. In any case, an important part of the stimulus situation for motor skill learning is provided by internal feedback from the muscles. Apparently, it is this system of kinesthetic sensing over successive periods of practice that brings about the gradual improvement in smoothness and timing of motor skills.

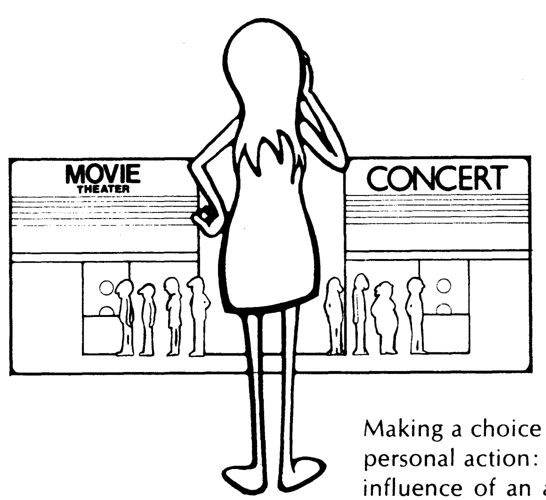
ATTITUDES

The final kind of learned capability to be introduced in this chapter is attitude. We define attitude as an internal state that influences (moderates) the choices of personal action made by the individual. Attitudes are generally considered to have affective (emotional) components, cognitive aspects, and behavioral consequences (Triandis, 1971). Some investigators consider attitudes to have their origin in discrepancies of beliefs and ideas; others presume that attitudes arise from emotional states. Here, we emphasize the effects of attitudes upon behavior, that is, upon the choices of action made by the individual. The internal states that influence these actions may well possess both intellectual and emotional aspects. However, it is their outcomes in human performance that provide the point of reference for our description of attitudes as learned dispositions.

The kinds of actions taken by human beings are obviously influenced greatly by attitudes. Whether one listens to classical music or rock, whether one obeys the posted speed limit while driving, whether one encourages one's spouse to express independent ideas, whether one votes for candidates who demonstrate concern for the public good—all are influenced by attitudes. These internal moderating states are acquired throughout life from situations encountered in the home, in the streets, in the church, and in the school.

Of course, the course of action chosen by an individual in any particular situation will be largely determined by the specifics of that situation. An individual who has a strong attitude of obedience to laws may nevertheless exceed the highway speed limit when in a hurry and no patrol cars are in sight. A child who has a strong attitude of honesty may steal a penny when no one is paying attention (Hartshorne and May, 1928). But the moderating tendency that persists over a period of time and that tends to make the individual's behavior consistent in a variety of specific situations is what is meant by an attitude. Obviously, observing and measuring the strengths of such tendencies is not an easy matter, since the effects of specific situational variables must be ruled out.

Attitudes are learned in a variety of ways. They can result from single incidents, as when an attitude toward snakes is acquired because of an instance of fright experienced in childhood. They can result from the individual's experiences of success and pleasure, as when children acquire strong positive attitudes toward video games by experiencing increasing success at them. And frequently, they are learned by imitation of other people's behavior, as when a child learns how to behave toward strangers by observing the actions of a parent. Regardless of these variations, there are some common factors in the learning and modification of attitudes.



Making a choice of personal action: the influence of an *attitude*.

Internal conditions. Attitudes must have some behavioral means of expression; this implies that certain capabilities appropriate to that behavior must be available to the learner. If the personal action to be influenced involves intellectual skills, these skills obviously must have previously been learned. For example, if an attitude of liking to solve mathematical puzzles is to be acquired, the learner must have some previously learned skills of numerical computation. If someone is to develop a strong attitude toward avoiding harmful drugs, some information about the drugs (such as their appearance and names) is a prerequisite. The learner who is to learn to like playing the piano must already have the motor skills to make such a choice of action possible.

When attitudes are acquired by imitation (or human modeling) it is necessary that the learner have respect or admiration for the person whose behavior is being imitated. This condition often exists between child and parent or between child and teacher. As is well known, the imitation of peers is likely to replace the imitation of parents during the preadolescent and adolescent periods, when the earlier unquestioning admiration for parents is replaced by a kind of rejection. In adults, attitudes are often established by modeling of people who are respected or admired for various qualities: physical attractiveness, virtuosity in sports, moral probity. But admiration for the model must exist, if the attitude exhibited in his or her behavior is to be acquired by the learner.

External conditions. Since a variety of situations may lead to the modification of attitudes, their common features are not easy to identify. Apparently, there must either be (1) an emotionally toned experience on the part of the learner in following a course of action or (2) the observation of a "good" or "bad" effect of the behavior of a human model. The latter condition leads to the presumption that the success (or, alternatively, the failure) of the model is vicariously experienced, that is, the learner is vicariously reinforced (Bandura, 1971).

A word should be said here about the inadequacy of certain external conditions in bringing about changes in attitudes. It has frequently been found that verbal statements intended to persuade are quite ineffective in changing listeners' attitudes (Hovland, Lumsdaine, and Sheffield, 1949). Whether based upon appeals to moral principles, to emotional states, or to rational arguments, these statements appear to be equally ineffective. Thus, it seems that a frequently important condition for attitude change is the presence of a human being who can serve as a model, whether in actuality or in the learner's imagination. When the persuasion is attempted by a respected model, a change in the learner's attitude is likely; persuasive statements without such a model are notoriously ineffective.

As is true for other learned states, the feedback of accomplishment, reward, or success is also an important condition for the learning of attitudes. The learner who succeeds at ice skating will very likely acquire a positive attitude toward that activity. The learner who has modeled an attitude of kindness toward animals will be more likely to maintain this attitude if his own acts of kindness to animals are rewarded in some fashion.

A SUMMARY OF TYPES OF LEARNING OUTCOMES

The five major categories of learning outcomes have now been described and exemplified. As a summary, we include Table 3.1, which lists these learned capabilities and gives a single example of each. The first category, intellectual skill, contains a number of subordinate categories, listed in order of their increasing complexity. The five major categories, however, are arbitrarily ordered in the table. They are simply different capabilities (Gagné, 1984).

Subsequent chapters of this book describe conditions of learning for the categories of human capabilities shown in Table 3.1. Chapters 5 and 6 are devoted to *intellectual skills,* from discriminations to rules. Chapter 7 considers the higher-order rules involved in human problem solving and goes on to discuss the category of *cognitive strategies* as it applies to the control of various learning processes. The learning of *verbal information*—the stating or "telling" of names, facts, and ideas—is taken up in Chapter 8 and followed in Chapter 9 by an account of the capabilities involved in *problem solving.* Next we consider the learning of the class of capabilities called *motor skills,* in Chapter 10. The category of *attitudes,* in Chapter 11, completes the roster of major classes of learning outcomes.

EDUCATIONAL IMPLICATIONS

Human beings learn many different things during their lifetimes. One way to make sense of the enormous variety of outcomes learning produces is to consider them as *performance categories.* Although these categories cut across the subject matter (content) of what is learned, they possess certain distinguishing features. Each category implies that a different kind of capability has been learned.

When viewed in this manner, there are five major categories of learned

TABLE 3.1 Five Major Categories of Learned Capabilities, Including Subordinate Types, and Examples of Each

Capability (Learning Outcome)	*Examples of Performance Made Possible*
Intellectual Skill	Demonstrating symbol use, as in the following:
Discrimination	Distinguishing printed *m*'s and *n*'s
Concrete Concept	Identifying the spatial relation "underneath"; identifying a "side" of an object
Defined Concept	Classifying a "family," using a definition
Rule	Demonstrating the agreement in number of subject and verb in sentences
Higher-order Rule	Generating a rule for predicting the size of an image, given the distance of a light source and the curvature of a lens
Cognitive Strategy	Using an efficient method for recalling names; originating a solution for the problem of conserving gasoline
Verbal Information	Stating the provisions of the First Amendment to the U.S. Constitution
Motor Skill	Printing the letter *R;* skating a figure eight
Attitude	Choosing to listen to classical music

capabilities: intellectual skills, verbal information, cognitive strategies, motor skills, and attitudes. Not only do these differ in the performances they make possible; they also differ in the conditions most favorable for their learning. These learning conditions are partly *internal,* arising from the memory of the learner as a consequence of previous learning. In addition, some learning conditions are *external* to the learner and may be deliberately arranged as aspects of *instruction.* In the following paragraphs we summarize some of the main points made in this chapter that apply to the planning of instruction.

For the learning of *intellectual skills* (procedural knowledge) the most important internal condition is the recall of prerequisite skills that are components of the new skill to be learned. External conditions, often in the form of verbal directions, guide the combining of these simpler skills. Intellectual skills have several varieties, increasing in complexity from *discriminations* to *concepts, rules,* and *higher-order rules.* Rules with many steps are called *procedures.*

The learning of *verbal information* (declarative knowledge) depends upon the recall of internally stored complexes of ideas that constitute "meaningfully organized" structures. In addition, certain basic linguistic skills must be present so that information can be stored in propositional form. Externally, the conditions of learning operate to relate the information to be learned to these previously learned structures, which serve as cues for retrieval and as organizing schemas.

Cognitive strategies are internally organized skills that learners use to manage their own processes of attending, learning, remembering, and thinking. They require as internal conditions the recall of intellectual skills and information relevant to the specific learning tasks being undertaken. Externally, what is apparently required is frequent opportunity to practice these strategies; over the course of practice, their use is refined and improved.

The learning of *motor skills* is attended by the recall (or prior learning) of an executive subroutine that provides the sequence and pattern for the performance and often by the recall of part-skills that are combined into the total motor act. External conditions are mainly provided by repetition of the performance, that is, by practice.

Attitudes are internal states that modify choices of personal action toward objects, persons, or events. They are learned in a variety of ways. One of the most dependable is by modeling, which requires a preexisting or previously learned respect for a real or imagined person. When this method of attitude change is employed, the external conditions consist of display of the desired behavior by the model and the observation of a successful outcome (or reward). The experience of success following a behavior choice usually has a direct positive effect upon the learner's attitude.

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