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Are Pschological Principles Useful?(A Guid to the Study of Human Learning)

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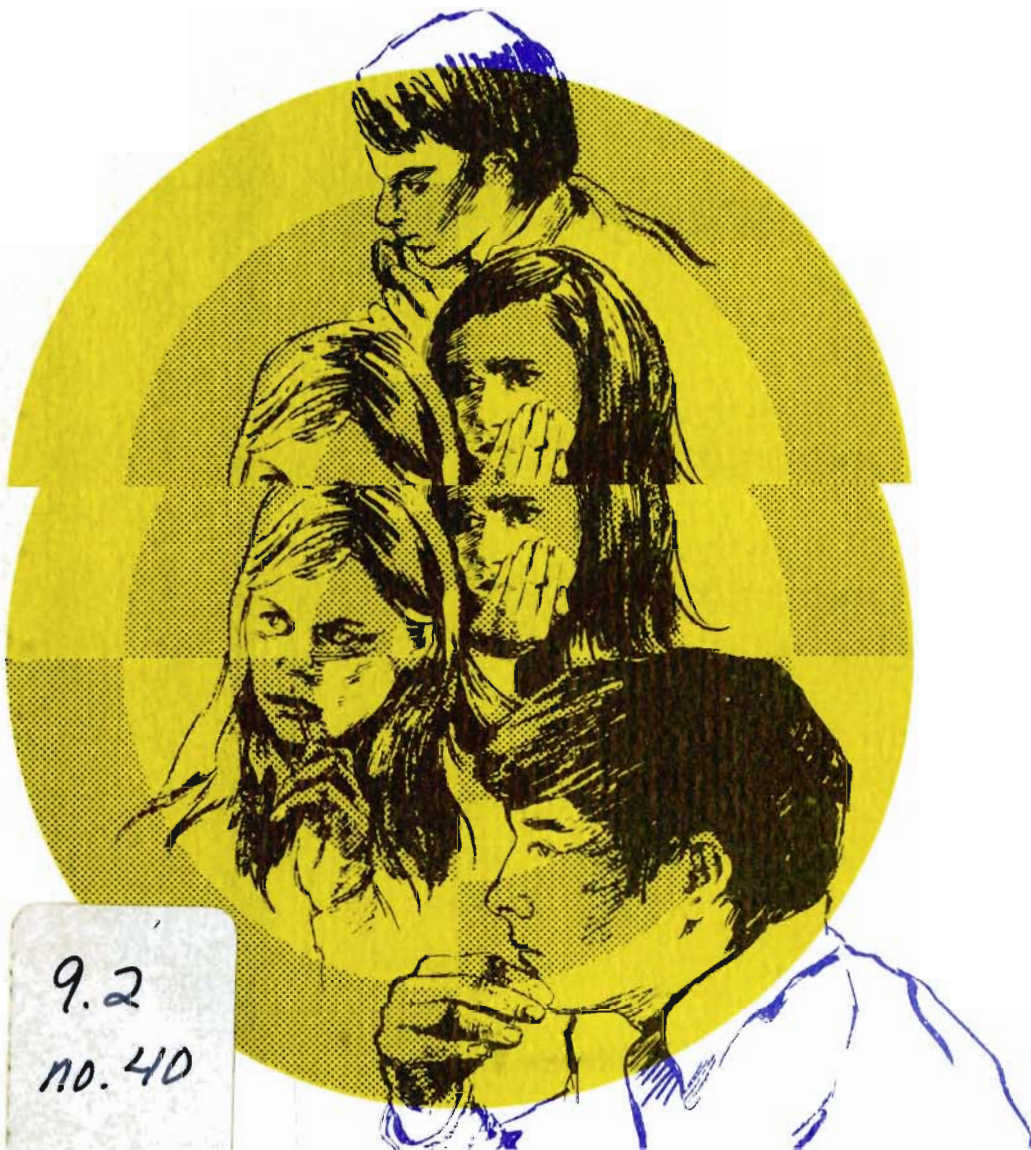
40th FACULTY HONOR LECTURE

ARE PSYCHOLOGICAL PRINCIPLES USEFUL?

(A Guide to the Study of Human Learning)

DAVID R. STONE
November 17, 1969

Utah State University

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FORTIETH HONOR LECTURE
FALL 1969
THE FACULTY ASSOCIATION

FORTIETH ANNUAL HONOR LECTURE

DELIVERED AT THE UNIVERSITY

A basic objective of The Faculty Association of Utah State University, in the words of its constitution, is:

> to encourage intellectual growth and development of its members by sponsoring and arranging for the publication of two annual faculty research lectures in the fields of (1) the biological and exact sciences, including engineering, called the Annual Faculty Honor Lecture in the Natural Sciences; and (2) the humanities and social sciences, including education and business administration, called the Annual Faculty Honor Lecture in the Humanities.

The administration of the University is sympathetic with these aims and shares, through the Scholarly Publications Committee, the costs of publishing and distributing these lectures.

Lecturers are chosen by a standing committee of the Faculty Association. Among the factors considered by the committee in choosing lecturers are, in the words of the constitution:

> (1) creative activity in the field of the proposed lecture; (2) publication of research through recognized channels in the field of the proposed lecture; (3) outstanding teaching over an extended period of years; (4) personal influence in developing the character of the students.

David R. Stone was selected by the committee to delivered the Annual Faculty Honor Lecture in the Humanities. On behalf of the members of the Association we are happy to present Dr. Stone's paper.

ARE PSYCHOLOGICAL PRINCIPLES USEFUL?
(A Guide to the Study of Human Learning)

Committee on Faculty Honor Lecture

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ACKNOWLEDGMENT

ARE PSYCHOLOGICAL PRINCIPLES USEFUL?

(A Guide to the Study of Human Learning)

DAVID R. STONE

To some extent, each person is his own doctor, his own economist, his own historian, his own counselor, his own psychologist, and his own teacher.

It is said that a man who is his own lawyer has a fool for a client. Can the same be said of a man's other roles? At least for learning (which professionally intersects education and psychology) any person may have the goal of helping himself to appreciate and evaluate the role of the learning professional.

A knowledge explosion has taken place in the area of learning, as in the many fields of science in the university. It is not now a sufficient answer to teach a person "how to think" or "how to learn." We must give a guide to his selective attenion for continued study. In this way the fantastic expansion of detail may be related to "sets or structures of basic knowledge," so that the subsumptive organized pattern may give a sufficient context for adequate comprehension and evaluation.

In this presentation, we would like to name and illustrate *five* "clusters" of factors which are now known to influence learning behavior. Within these clusters are to be found specific independent variables now proven to affect behavior in measurable ways. These clusters include current material on environment stimulus control, readiness, aptitude, self-concept, perception, cognition, mode of attack, transfer, reinforcement, and feedback. the concept of thinking as a particularly important human behavior will be stressed.

Someone said that if fishes were scientists, the last thing they would study is water. So it has been in the area of learning and thinking in psychology. Scientific work in the study of human thought has been of relatively recent origin. While early philosophers discuss thinking, only in our century has emerged the monumental work of Bruner at Harvard, Luria and Vygotsky in Russia, and Piaget in Switzerland.

In studying cognition, and the new emphasis of perception, upon which cognitive behavior rests, we are studying on the frontiers of the science of learning.

THE OBVIOUS AND THE COMPLEX

How are the concepts of "photosynthesis," "vector and valence," "gross national product" made understandable for an interested layman? The same problem exists in psychology for such terms as "transfer," "cognitive transformation," "stimulus equivalence," and "information processing."

In any science, we may look grossly or minutely at the available data. Gross aspects are more easily put into lay terms. Data also has dynamic and static qualities. We may study behavior "in motion," or as "abstraction." It is the assumption here that an active checking process is required to maintain a flexible balance between our symbolic representation of reality, and reality itself. Language as a tool can be used to discover truth, to capture it, but also to distort it.

The interested person cannot expect to understand any science without the effort needed to master some basic terms. After you have simplified "photosynthesis" or "cognition" by description or in simple terms, it is then both economical and an intellectual necessity to use the terms correctly to relate them to the context of a body of scientific knowledge. Space-flight language, while jargon in a sense is highly critical jargon. Such learning is not for mere entertainment.

We are not here referring to the overly-detailed use of a technical term to impress others as in *lilium* for lily (*although* this is sometimes appropriate). Nor are we talking about substituting *wee wee* for urinate. We are saying that a genuine desire to learn about learning is going to require the mastery of some "clusters" of technical terms, which then can be used to define principles of behavior in five process-areas.

These will be defined as needed in the discussion to follow. It should be clear that an area of science can be as simple as its name, or as complex as its discoveries. It depends on how much interest we can cultivate and how much effort we are

willing to give to its mastery. Too often the apathetic will say: "What I understand is so simple I don't need to study," or "What I don't know is so complex I won't even start to learn it."

Learning theory, for example, can be so expressed that the most simple and powerful means of teaching and learning can be clearly revealed. At the same time, issues so complex as to challenge the ingenuity of the most profound and rigorous scientific endeavor can also be set up for study. The era of conflicting theory is disappearing, and it is being supplanted with an "it depends" approach which matches a theory to a given kind or degree of complexity in the learning task (Gagne, 1968).

The same has been true in all areas of science. For example, Slater points out that:

> Physicists realized, during the years from 1924 to 1926, that something new was in the air. Wave mechanics was discovered by Schrodinger in 1926, and it was a great and startling achievement; but the time was ripe for it, and other developments had foreshadowed it.
>
> . . . The more direct line of attack which led to wave mechanics, however, went far back in the quantum theory, to the early puzzle as to whether light was a wave motion or a motion of corpuscles. Einstein's explanation . . . failed to appeal to a good many physicists . . . It obviously carried no explanation of all the phenomena of interference and diffraction, on which the wave theory of light had been solidly based for a hundred years. The feeling gradually grew up that somehow both theories must be simultaneously right: that there must be some sort of radiation field, governed by electromagnetic theory, and showing the properties of interference and diffraction, but which did not itself carry energy, but merely served in some way to guide the photons '(p. 164).

We will propose that a variety of theories are necessary to explain learning phenomena, and that rather than being termed "eclectic" this approach can now be called "neo-behavioristic," "functionalistic," or "comprehensive integrated."

---

[1] *Modern Physics* by John C. Slater, McGraw-Hill Book Company, Inc., 1935, pp. 163, 164.

SCIENTIFIC METHODS IN THE STUDY
OF LEARNING BEHAVIOR

The discoveries to be reported here are based on one of four methods:

(1) Observational
(2) Direct Action
(3) Correlational, and
(4) Experimental

OBSERVATIONAL

In a series of classical observations, Piaget (1952)[2] has developed a challenging theory of cognitive growth. His carefully documented observations, together with a unifying theory has merited extensive professional praise. In going beyond the persuasive theoretical constructs of Erickson (1950) who has described stages of maturity, and Maslow (1954), who has a hierarchic theory of motivation, Piaget particulary has shown how careful observational support can strengthen and elaborate the best theory.

DIRECT ACTION

Scientists such as Skinner working in some areas of operant conditioning, view the hypothesis as only a possible afterthought rather than a guide. These scientists have made important contributions to the understanding of learning behavior by their insistence; that is, you can define the required behavior, you can "shape" it by appropriate reinforcement.

CORRELATIONAL

Much of the work of learning scientists is based on a discovery technique which takes an extensive sample of tested behavior and compares it part by part, in a way that allows the appearance of "factors." If a new test is correlated with an old, it merely supports the previous factor, but it is as exciting as

[2] References in (   ) will be given later.

finding a new star to find some aspect of intelligence or personality which does *not* correlate with previously tested behavior. Factor analysis techniques by Guilford (1959) now suggest, for example, that the IQ concept is obsolete, for at least 120 varieties of mental aptitute are implied in his matrix model.

Obviously a year's time could easily be devoted to this small area alone. Psychologically defined behavior is now so documented as to reguire over 20 sub-area specialities.

The fascinating work of Kagan and Wallach (1965) is an excellent example of how the correlation method can tease out the concepts of "creativity" in a measurable way. This kind of ingenuity compares favorably in our field with the magnificent work of Ramsay (1889) who discovered neon. Psychology is now rapidly developing such a history of discoveries as we have found in the exact sciences.

EXPERIMENTAL

Much of the work of science requires the setting up of an "educated guess" or "hunch" which is an hypothesis regarding the classic independent variable of the controlled scientific experiment. In this case a new procedure is compared under strict control with other groups who get no treatment or varied treatments.

In the following discussion of the now secure principles in the applied learning area, we will be referring to scientific work based on these four methods.

ARE PSYCHOLOGICAL PRINCIPLES OBVIOUS?

While it is true that a wave of genuine interest in psychology is apparent, it is equally true that many trite, shallow, and even dangerous misconceptions exist which lag far behind the now available data.

Cronback (1963) said:

To some beginners in . . . psychology, all its principles seem obvious. When the professor enunciates a principle and reports the evidence to back it up, the student may think, "That's just common sense." And sometimes mutters, "Why do I need to study what anyone can see?" If psychology principles were not in accord with everyday experience, however, they would be suspect, since psychology claims to account for the behavior of normal people. A formal science of psychology with experiments, special vocabulary, professors, and textbooks is necessary because on some matters the long-accepted common-sense view is wrong. Only after careful investigation do we know whether a common-sense statement is true or merely persuasive."

(For example) Despite its unfinished business, research on reading has turned up sensible facts that contradict what everybody once knew to be "obviously" true. The major task of . . . psychology is to help . . . discard "sensible" views that are too limited or based on inaccurate observations. The principles of . . . psychology should be acceptable both by rigorous scientific standards and by those of common sense.

In this writer's opinion, it is unfortunate that a wider segment of our citizenry cannot, as yet, benefit from training in general psychology which would tend to protect them from naive beliefs regarding some kinds of parlor personality analysis, sleep learning, telepathy, improving genetic intelligence, some application of hypnosis, speed reading, and mind distortion as a substitute for true development and maturity.

ARE PSYCHOLOGICAL PRINCIPLES USEFUL?

My particular interest in educational psychology has been based on appreciation of general psychology. It is apparent to me that the educational process does not take place in the schools alone, as basic as they are, but exists in the broad field called behavior. Principles of applied learning can be helpful to parents, politicians, business leaders, farmers, engineers, child and family specialists, economists, historians, and ecologists — to name a few.

But, there are degrees of usefulness. There is an implied "so what?" to all theory or statements of principles.

David P. Ausubel and Floyd G. Robinson (1969) reviewed three viewpoints related to the application problem.

Three Views

The extrapolation view

This view holds that pure psychology can be projected from the lab to an educational setting. B. F. Skinner who has worked extensively with animals makes this assumption. Evidence indicates that powerful projections from animal behavior can be made to certain kinds of human learning. But, extrapolation has dangers as well.

The translation view

This view cautiously takes experimental findings from which tentative hypotheses are formulated.

> An example of this approach can be found in current attempts to apply theories of "arousal" (Berlyne, 1960) to educational pratice. It has been found . . . that conflicting responses . . . (arouse) curiosity . . . and the organism will seek further information to reduce their conflict . . . "(Ausubel and Robinson, 1969, p. 14)

This experiment suggests certain classroom procedures which could be tried based on arousal techniques.

William James (1899) favored the idea of relative freedom for the "so what" question.

> . . . you make a great, a very great mistake, if you think that psychology, being the science of the mind's laws, is something from which you can deduce definite programmes and schemes and methods of instruction of immediate schoolroom use. Psychology is a science, and teaching is an art; and sciences never generate arts directly out of themselves. An intermediary inventive mind must make the application, by using its originality.

This kind of statement implies a high degree of confidence in the ability of a given student to use what is called discovery learning. We only wish it were more generally true.

The first principles view

In this view the psychologist focuses directly on a problem.

It recognizes that the complexity of . . . learning will propose many problems in designing experiments from which clear-cut results may be obtained, but it maintains that such experiments are possible, provided that sufficient ingenuity is brought to bear on them. (Ausubel and Robinson, 1969, p. 15.)

The educational psychologist is sometimes disappointed in the difference in extent and quality of the applications made by his student and colleagues from those which would seem to be powerful and obvious. Yet expectation for application can be unrealistic, similar to asking an economist, "How do I get rich," or an historian, "What is the true account," or to an agriculturist, "Give me a guaranteed yield."

James' position calls for creative discovery. This would be ideal, for citizens and colleagues would learn and use the material we have refined. Research done by the basic psychologist is refined into wholesale segments by the educational psychologist. This refined product is the substance of this paper. We have then traditionally left it up to students or educators to use this material in a creative particular way. This can be a highly satisfying way to use known principles, but anxious students often spoil it for themselves by their need to be told how to do it. The first principles view, however, is now being more widely adapted by the educational psychologist particularly for a consultant's fee.

"Learning how to learn" as an answer emphasizes the process of learning, but we will point out that content as well as process is required to make the study of learning more useful to the individual.

We would challenge each person to try to find his own applications for each of the general principles and corollaries to be presented.

Each in its own way is a fascinating novel of discovery. Psychology can no longer be covered in a course on " contemporary views," although a full general psychology course is the best starting point.

Unfortunately, we cannot yet begin to match chemistry in

numbers of verified principles. In the introductory chemistry course, for example, over 215 separate principles are covered (depending) while in general psychology it is more like 150.

It will be the plan, from here, to look at the five "clusters" of factors, then the 14 factors will be defined and illustrated. We have designed the paper to include exact references to representative literature for each factor. These are what the educational psychologist makes his stock and trade. We would like you to see what these researchers are doing. The range of titles is startling.

THE FIVE CLUSTERS

For the purpose of analysis, and in order to make the principles easier to understand, an audio-visual communication device is used here in the form of a model. It will be presented in two phases. The first shows five major clusters of factors which have an effect on learning behavior, and the second includes the separate factors.

Taking the person as the focus, Gestalt field-theory suggests that "psychological space" includes the person *and* his environment. So, we have *situational* factors. Anything "outside the skin" of the learner is included; such as other people, physical elements, cultural aims, and incoming stimuli.

If the person has *readiness*, the input is supported by the psychological sensory and brain processes. Also, a kind of filtering of experience has been related to the person's apitudes (mental, motor, and emotional). The residue of experience is called self. The self is the present status of actualized potential. Self is the core of the dynamic systems we refer to as a person. It consists of systems of knowledge, attitudes, and skills.

When an active state of readiness has assured that incoming data information will be supported in the person, we may then refer to the next stage of *interpretation*. There are two sub-stages. The first is perception. This process is periodically being rediscovered. Currently work in teaching discrimination to mentally retarded children has been productive, both in sensory and in symbolic systems. For example, the child is
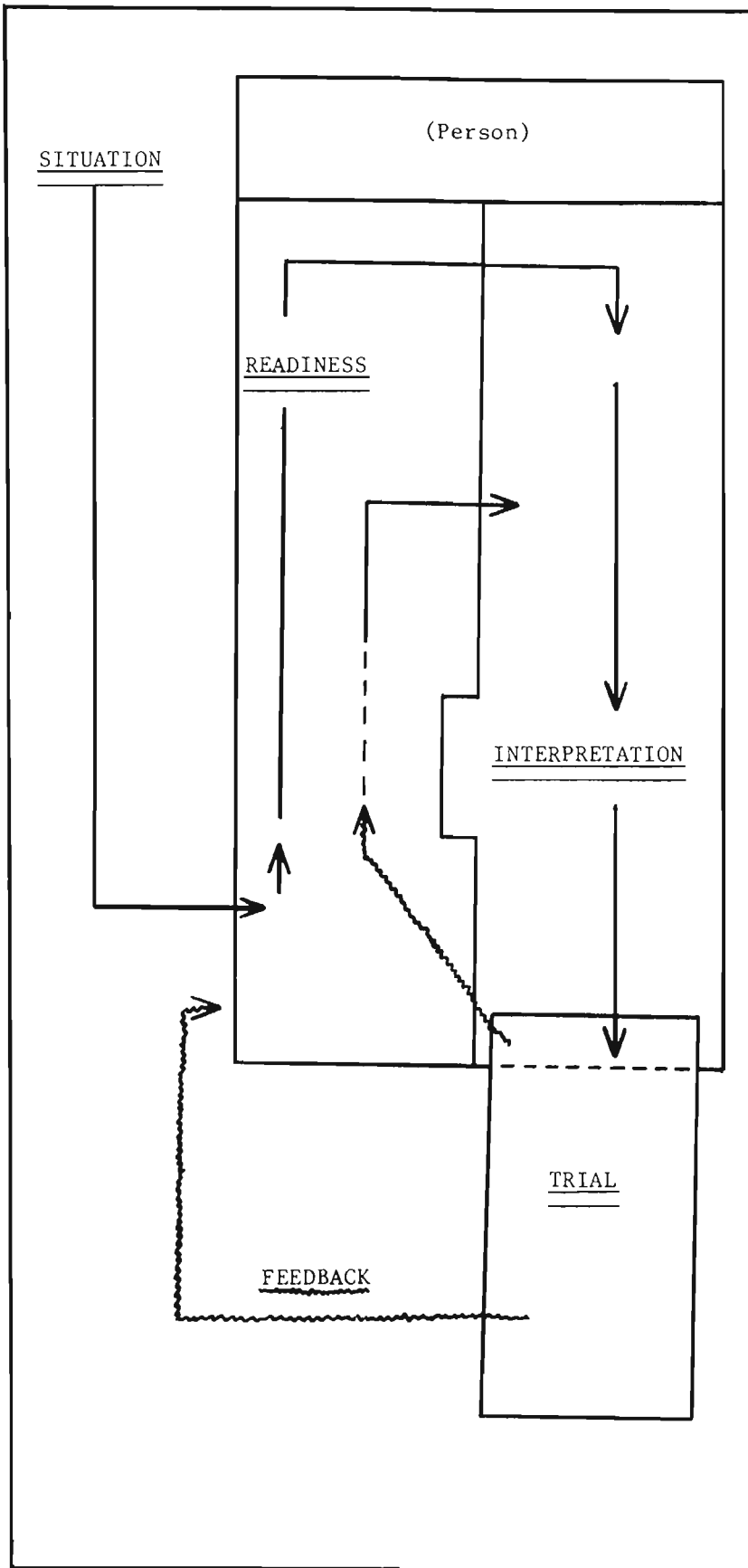
Figure S-1   The five clusters

taught to pick out the one which is different from oxxx. Then he is led gradually to dbbb, ppqp, etc.

Cognition is the next factor in the process of interpretive behavior. Cognition or thought has been the uniquely human factor in any value judgement of human potential. "Man is a reasoning animal;" "Cogito ergo sum;" (Descartes — "I think, therefore I am"), "With all thy getting, get understanding," "I see;" "Conceptualizing behavior;" are all phrases related to cognition.

Korzybski (1933) speaks of man's "time-binding capacity." We transform dynamic experience into static (internalized) representation. We develop a *sign* or *symbol* to represent a referent. Accompanying this tentative sign process (cognitive), is the concurrent feeling system of affect (connotative meaning).

In the field of learning some doors are being opened now on undiscovered territory of the universe in *inner space*. To discover a critical concept within self is more important to a given individual than the discovery of a new planet. It is now possible to take a college course in perception and another in cognition, for example.

When incoming data has been processed, the organism is ready to make a response. We refer to perception and cognition as implicit responses. When unqualified, however, the word "response" is taken to mean the observable behavior of a "trial."

Under the general title of *trial* are included two factors, mode of attack and reinforcement. The respondent can be persistent or flexible in his trying; i.e., his mode of attack may vary in style. The reward structure (now currently much discussed in psychology as behavioral management) is related, as Thorndike put it "satisfying or aversive effect."

Without "knowledge of results" little improvement, if any, develops from a trial. The *feedback* process is one of profiting from activity. The process can be hidden (covert) or observable (overt). When some kind of correction is possible by the

person or an outside agent in the form of a suggestion, or an evaluative comment, or an awareness of substantial structual relationships, feedback is possible. Testing life's consequences, understanding, and awareness of how a detail can support or qualify a principle are all part of the process. When feedback is confirmatory an assimilation or use of experience is verifying. When feedback requires an enlargement of the mental structure, Piaget (1952) speaks of cognitive growth or accommodation. Such are generated in the feedback process.

THE 14 FACTORS IN FIVE CLUSTERS

We have now looked at five clusters of learning factors. Now we want to look more particularly at the 14 factors which make up the clusters.

The 14 factors are:

Situational

    1. *Persons* influence the learning behavior of an individual.
    2. The *physical enviroment* influences the learning behavior of an individual.
    3. The *cultural environment* influences the learning behavior of an individual.
    4. The kind, extent, and level of *the stimulus* influence the learning behavior of an individual.

Readiness ,

    5. *Physiological processes* influence the learning behavior of an individual.
    6. *Aptitudes* influence the learning behavior of an individual.

Interpretation

    7. *Perception structure* influences the learning behavior of an individual.
    8. *Cognitive structure* influences the learning behavior of an individual.

SITUATION

(Person)

Persons
1

READINESS   INTERPRETATION

Aptitudes
6   Perception   7

Physical
2

Transfer
10

Cultural
3

Self   Cognition   8
9

Stimulus
4

Feedback II
14

Physiological
5   TRIAL

                              11 Mode of Attack

FEEDBACK   12 Reinforcement
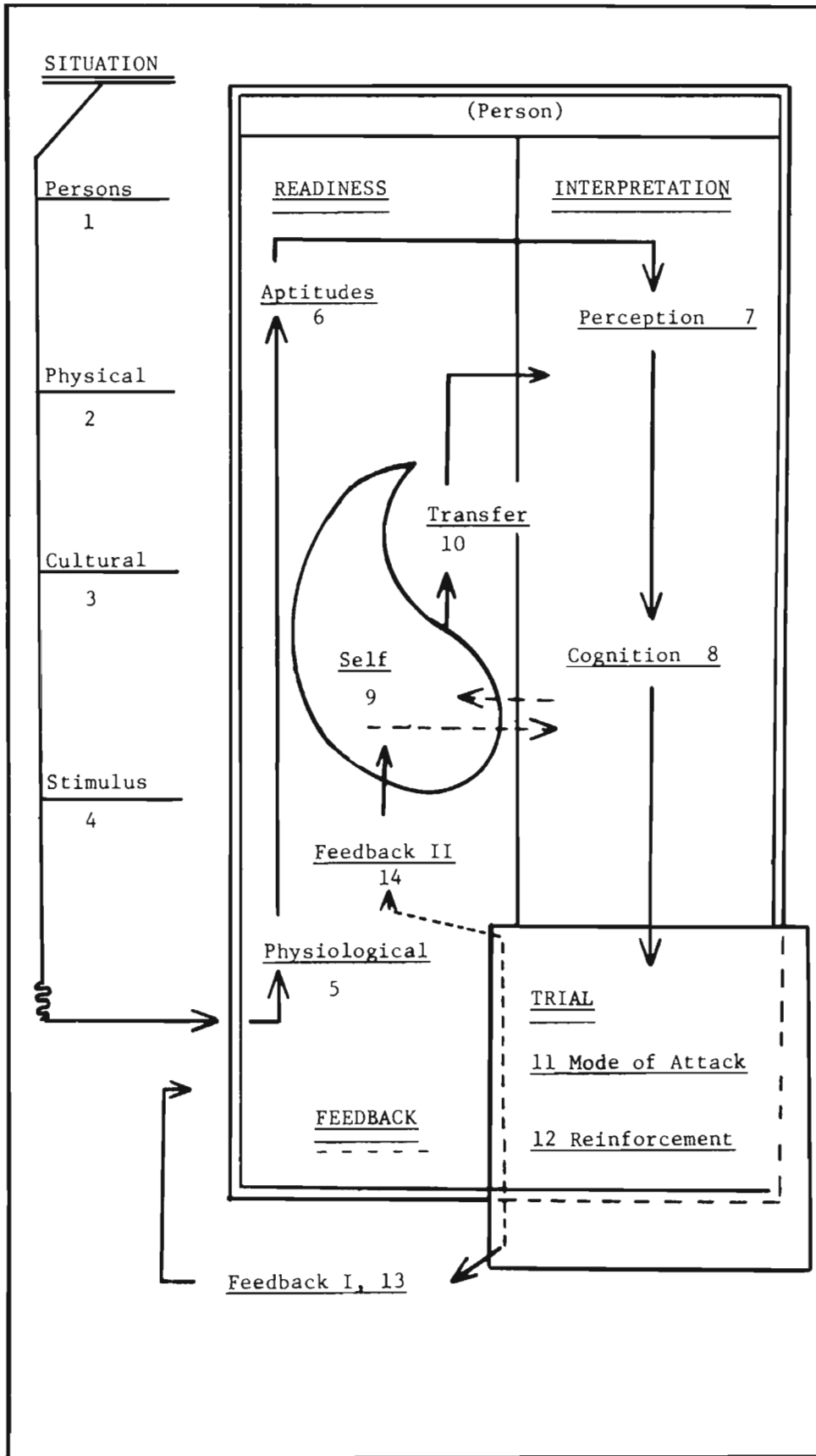
Feedback I, 13

Figure S-2   The 14   factors

Readiness $_2$

9. *Self structure* influences the learning behavior of an individual.
10. *Transfer structure* influences the learning behavior of an individual.

Trial

11. *Mode of attack structure* influences the learning behavior of an individual.
12. *Reinforcement structure* influences the learning behavior of an individual.

Feedback

13. *Overt feedback* influences the learning behavior of an individual.
14. *Implicit feedback utilization influences the learning behavior of an individual.*

Of course, study and research will allow the definition of a wide variety of principles related to the 14 factors listed. Such can only be hinted at because the subject of learning is so broad and extensive at this level of detail. For each factor, only a small sample of research or discussion can be given. Several topics will be suggested by reference to research titles which indicate current effort. The numerical order fits figure S2.

Topics and Examples and Research
Related to the 14 Factors

Factor 1. Persons

Early work on one aspect of this factor was done by Moreno (1934) under the title "Sociometry." One common device is to make a sociograph. In it, one may observe "stars," cliques, isolates, mutual admiration societies, and general social structure. The arrows show choices in response to the question: "What persons would you like to work with on a committee?" Elementary charts show a much greater fluctuation than

high school. Parents and teacher are well aware or the influence of friends on a child's behavior. But, what are the dimensions of such effect?

Some generalizations that come from experimental work in varied aspects of this complex area are:

      1.1   The social structure of the classroom may be quantified and graphed.

      1.2   The teacher's *expectations* will influence the students's learning behavior.
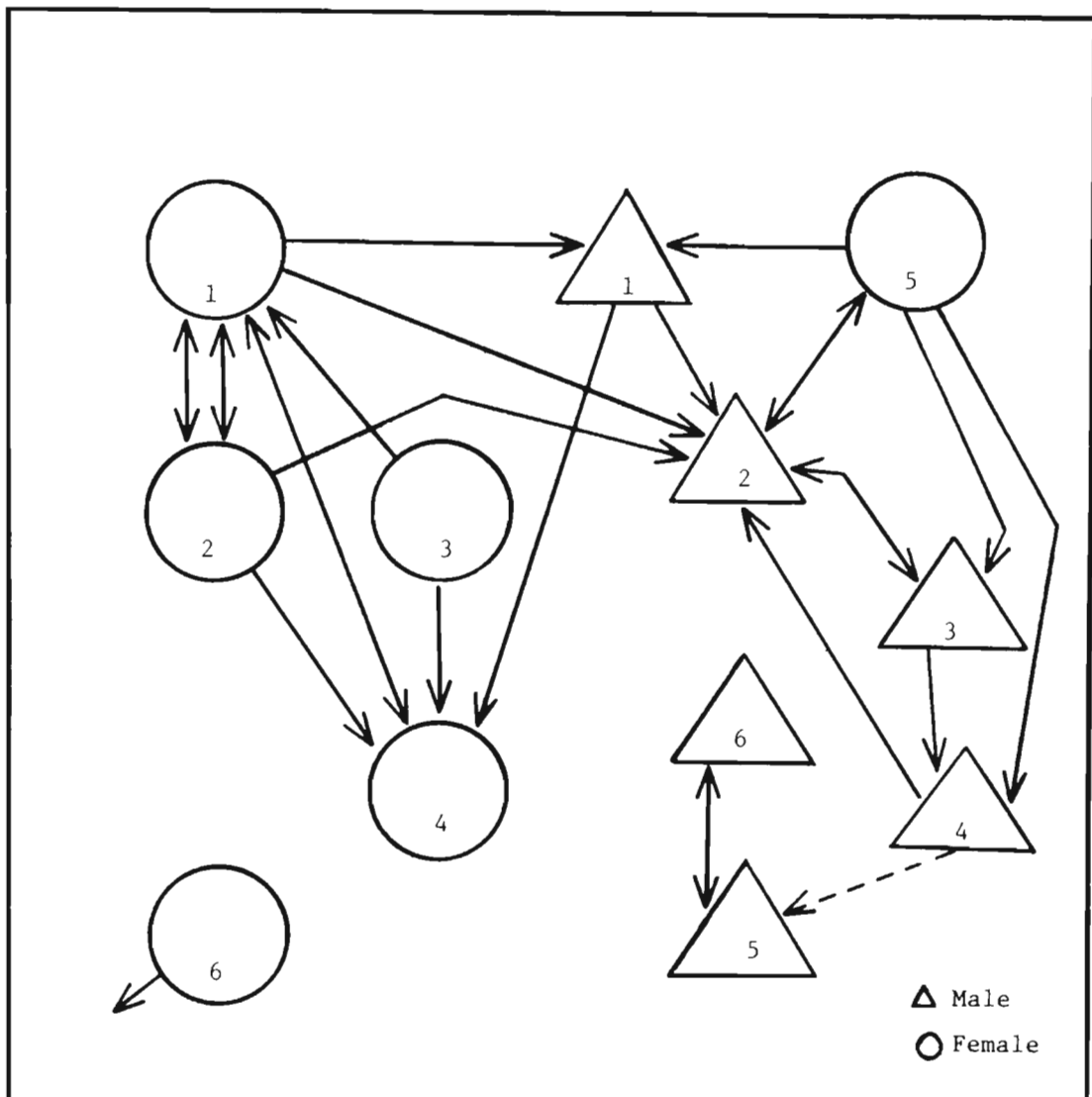
      1.3   Home atmosphere affects learning behavior.

Figure 1-I.   Factor 1 — sociogram

1.4   Flexible grouping, team teaching, and peer-to-peer teaching allow a variety of interpersonal arrangements.

1.5   Teacher leadership style can change the learning atmosphere.

1.6   Dimensions of classroom leadership can be measured.

Bartlett (1959), for example, isolated four dimensions:

(1) prestige, (2) contribution of ideas and information, (3) friendly atmosphere, and (4) policy and decisions.

1.7   Imitation can facilitate social learning.

1.8   Variations of group learning procedures produce

Figure 1-II.   Factor — peers

changes in immediate and long term performance.

Some representative research includes:

1.1 Bonney, M. E. "Sociometric Study of Agreement Between Teacher Judgments and Student Choices." *Sociometry*, 10: 133-146, 1947.

Moreno, J. L. *Who Shall Survive?* Washington, D. C.: Nervous and Mental Disease Publishing Co., 1934.

Morse, William C. and Wingo, G. Max, "Sociogram of First Choices." *Psychology and Teaching*, Chicago: Scott Foresman, p. 307, 1969.

1.2 Cunningham, R., et. al. *Understanding Group Behavior*, New York: Teachers College, Columbia Univ., 1951.

1.3 Caldwell, B. "The Effects of Infant Care." In *Review of Child Development Research*, Hoffman and Hoffman (eds.) New York: Russell Sage, 1964.

1.4 Thomas, R. Murray, and Thomas, Shirley M. *Individual Differences in the Classroom.* New York: David McKay, 1965.

1.5 Amidon, Edmund and Flanders, Ned. *The Role of the Teacher in the Classroom.* Minneapolis: Paul S. Amidon and Associates, Inc., 1963.

Bradford, L. P. and Lippitt, R. "Building a Democratic Work Group." *Personnel*, 22: 142-148, 1945.

Flanders, Ned A. *An Analysis and Projection of Research in Teacher Education.* Cooperative Research Project, No. F-015, U. S. Office of Education, "Interaction Models of Critical Teaching Behaviors," 1964.

Lippitt, R. and White, R. K. "An Experimental

Study of Leadership and Group Life." In *Readings in Social Psychology*, E. E. Maccoby, T. M. Newcomb, and E. E. Hartley (eds.), New York: Henery Holt, 1958.

1.6 Bandura, Albert, "Social Learning Through Imitation." *Nebraska Symposium on Motivation*, (Lincoln: University of Nebraska Press) 211-69, 1962.

Bartlett, Claude J. "Dimensions of Leadership Behavior in Classroom Discusion Groups." *Journal of Educational Psychology*, 50 (6) 1959.

1.7 Ash, Solomon E., "Imitation and Social Learning." *Scientific American*, 193 (5): 31-35, 1955.

Factor 2: The physical environment

The major areas of research here are: (1) The effect of material cultural deprivation; (2) ecological and geographical factors; (3) environmental control of classroom or work facilities; (4) optimum scheduling of resources; and (5) technological level.

Of the many hypotheses or principles which might be derived from the literature those selected here represent some of the more direct applications.

2.1 Animals raised in a restricted or aversive environment show a more limited behavioral repertoire than those in a normal or richer environment.

2.2 Cultural deprivation may affect IQ test scores and achievement.

2.3 Cultural deprivation may result in permanent aptitude damage.

2.4 Light and temperature can affect both feelings and output.

2.5 Noise levels affect classroom performance, but there are wide variations in adaptability to noise.

2.6 There are many ways to "enclose space" in addition to the traditional four walls.

2.7 Time may be controlled so that flexiblity and individualization are enhanced.

2.8 Technological aids need careful evaluation and adaptation to particular conditions.

2.9 Human factors can overrule physical conditions as related to output.

Supportive research includes:

2.1 Levine, Seymour, "Stimulation in Infancy." *Scientific American,* 202: 80-86, 1960.

2.2 Capobinaco, Ed. D. "A Pilot Project for Culturally Disadvantaged Preschool Children." *The Journal of Special Education,* 1 (2): 191-195, 1966.
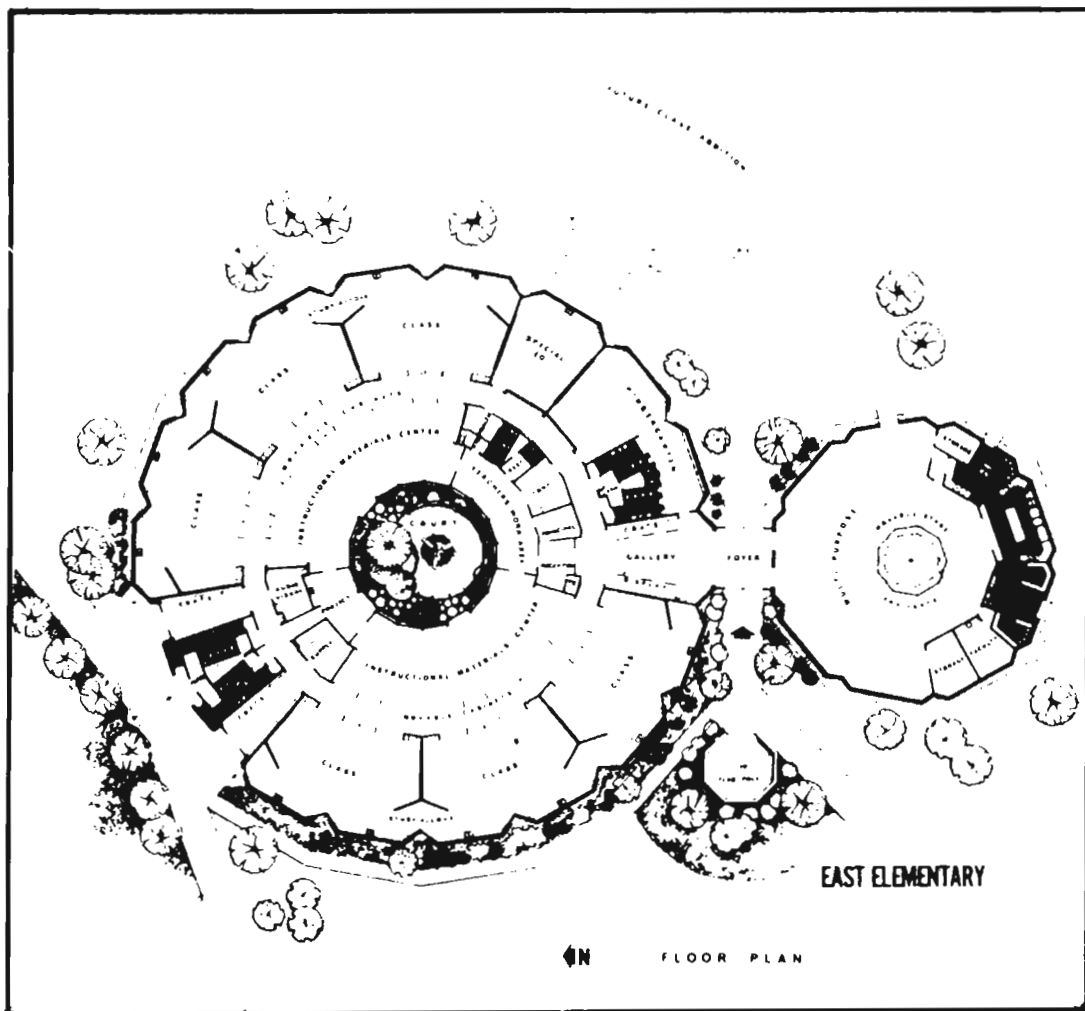

Figure 2. Factor 2 — a modern school

Domino, George. "Culture — Free Tests and the Academic Achievement of Foreign Students." *Journal of Consulting Clinical Psychology*, 32. (1): 102, 1968.

Gordon, Edmund W. "Characteristics of Socially Disadvantaged Children." *Review of Educational Research*, 35: 377-383, 1965.

Stone, David R. "Certain Verbal Factors in the Intelligence Test Performance of High and Low Social Status Groups." *unpublished dissertation*, University of Chicago, 1946.

2.3 Bruner, Jerome S. "Cognitive Consequences of Early Sensory Deprivation." *Psychosomatic Medicine*, 21: 89-95, 1959.

Hunt, J. McV. *Intelligence and Experience*. New York: Ronald Press, 1961.

2.4 Ford, Ronald. "Cool Class, No Sweat, For Teachers." *American School Board Journal*, pp. 48-49, 1966.

2.5 Sanders, Derek A. "Noise Conditions in Normal School Classrooms." *Journal of Exceptional Children*, pp. 344-353.

Schiller, Clarke E.; George J. Michel, and Donn L. Wadley, "Sound and Student Behavior." *Audiovisual Instruction*, 14 (3): 92, 1969.

2.6 *School Buildings in Utah*. Utah State Board of Education, Salt Lake City, Utah, 1969.

2.7 Dunsheath, Robert (Principal); Glines, Don (Asst. Principal). Canyon del Oro Jr.-Sr. High Amphitheater Public Schools, Tucson, Arizona. (Report in flexible scheduling).

Skidmore, Charles E. "Harritt School Attains Goal: Flexibility," *American School Board Journal*, pp. 10-11, April 1967.

2.8 Tinker, Miles A., "Devices to Improve Speed of Reading." *The Education Digest*, Sept. 1967.

2.9 Rothlisberg, F. J. and Dickson W. J. *Management and the Worker*, Cambridge: Harvard University Press, 1940.

Factor 3: The cultural environment

There are wide cultural variations in the definition and the attitude toward learning. The basic question is: "What does the culture want taught?" In this area should also be a consideration of how much national financial support is given to education. In this sense, factor 3 supports the level of physical environment sponsored in factor 2.

The focus of cultural impact of the school is reflected in statements of educational objectives. Such a focus clarifies exactly what is expected. Theoretically, it is based on a discussion between educators and the lay citizenry.

In this factor, the prime consideration is content. However, the sequence and difficulty of the content is most appropriately considered in factor 4 — the stimulus. Here, in factor 3, the broad, general objectives for education as in Kearney (1953) or French (1957) or Bloom (1956) must lead to the particulars of curriculation in a given major. What concepts and principles are to be selected for instruction? Grade placement is a later problem.

Here, a very real intersection takes place between the practical experience of the educator and the research interests of the psychologist (Blair 1948). Both content and behavior need to be related in curriculum development.

The major areas of research in this realm of cultural influences are: (1) Developmental tasks, (2) educational opportunities, (3) the "structure" of human knowledge, (4) the aims of a particular culture, as compared to others, (5) desired facts, attitudes, and skills, (6) the relation of readiness to desired behavior, (7) courses of study, units of instruction, and lessons, and (8) input from research to curriculum revision.

Some principles to be derived from research in the above areas include these:

3.1 To be effective, objectives should be stated in behavioral terms.

3.2 Vertical acceleration in a subject matter program seems to have no adverse effect on social adjustment, and does increase achievement.

3.3 A two dimensional chart is a standard basis for relating content to desired behavior.

3.4 Relating the variety of school subjects to a comprehensive theory of knowledge increases the share of integrative and meaningful learning.

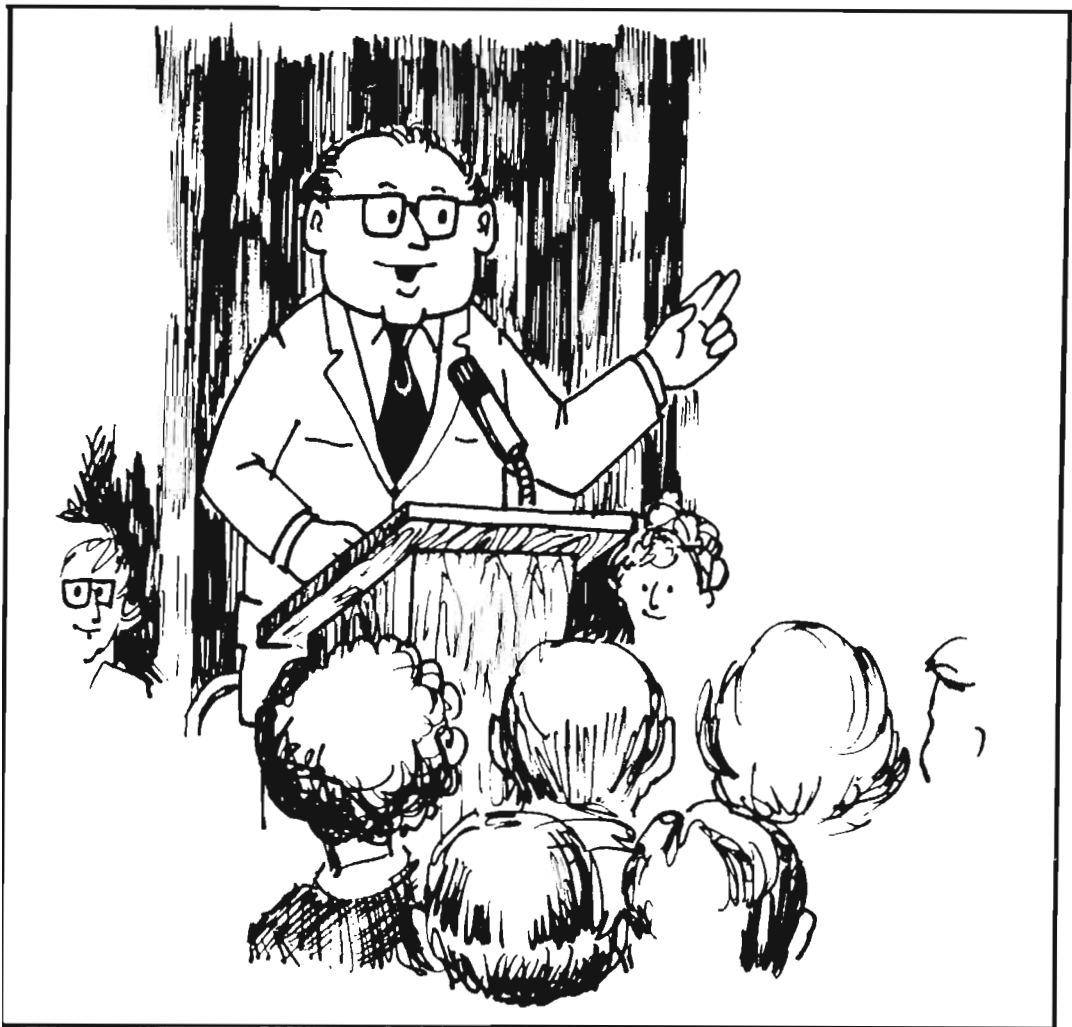3.5 Social forces seem to shape the curriculum more than organized curricular research.

Figure 3. Factor 3 — goal setting

3.6 Curricular objectives are now being stated with more precision and in behavior terms much more than 10 years ago.

3.7 Taxonomies of educational objectives have proven to be useful instruments in organizing curricular effort.

3.8 There is a need to relate research to practice.

3.9 A well organized unit or curriculum may be presented in *any* fashion. A well worked out content does *not* imply a mechanistic approach.

Some representative research includes:

3.1 Mager, R. F. *Preparing Objectives for Programmed Instruction.* San Francisco: Fearon, 1962.

3.2 Sears, Pauline S; Katz, Lilian; and Soderstrum, Lorraine. "Psychological Development of Children Participating In A Vertically Accelerated Mathematics Program." *Psychology in the Schools,* 3: 307-318, 1966.

3.3 Tyler, Ralph W. *Basic Principles of Curriculum and Instruction.* University of Chicago Press, 1957.

3.4 Elam, Stanley. *Analysis of the Structure of Knowledge.* Chicago: Rand McNally, 1964.

3.5 McNeil, John D. "Forces Influencing Curriculum." *Review of Educational Research,* 39 (3): June 1969.

3.6 Goodlad, John J. "Curriculum: State of the Field." *Review of Educational Research,* 39 (3).

3.7 Bloom, B. S; Englehart, M. D; Furst, E. J; Hill, W. H. and Krathwohl, D. R. *Taxonomy of Education Objectives — Handbook 1: Cognitive Domain.* New York: David McKay, 1956.

3.8 Clymer, Theodore. "Some Current Needs in Educational Research." *Phi Delta Kappan,* March, 1959.

3.9 Tyler, Ralph W., "A Tentative List of Common Elements for Social Studies." *Basic Principles of Curriculum and Instruction,* University of Chicago Press, p. 58, 1957.

Factor 4: The stimulus

The subject area of the "stimulus" is wide and deep. It does not refer merely to "what is stimulating." It refers to the process of being able to relate to or utilize an incoming message. The audio-visual communications area focuses here. Whatever makes a message more meaningful is to be defined and illustrated. The difficulty of the lesson, its sequence and the teaching strategy in its presentation are all part of this area of study. Using Lewin's notion of "psychological space," all stimulus whether environmental or personal can be considered "external" to the process.

There are two appropriate learning theories to consider here.

(1) *Contiguity theory.* This holds that one stimulus may be substituted for another by single association. It is called, also, classical conditioning. It involves stimulus substitution. In teaching the child to use the written symbols "dog," for example, you associate it with a real dog or a picture of a dog which serves as an adequate stimulus.

(2) *Cognitive theory.* This holds that if the lesson is structurally related to previously developed concepts, the student may assimilate or subsume the message directly.

Another theory, operant, figures prominently in the general area of *trial.* In all cases prior readiness is essential. The basic process is to relate a new, neutral stimulus to an older adequate or unconditioned stimulus. This association is a form of learning which results in a conditioned stimulus.

Major research topics are: (1) Kinds of stimulus tasks; (2) level of difficulty of concepts; (3) sequence of concepts; (4) teacher presentation strategy; (5) the use of programming for stimulus control; and (6) communication aids.

Some principles to be derived from research in these areas include these:

4.1 Task as a stimulus, as compared to verbal telling, requires more of learning by discovery.

4.2 Understanding the language process requires both conditioning theory and combinative mental structure theory.

4.3 Stimulus clarity aids concept learning.

4.4 Negative instances are valuable only in a restricted alternative problem.

4.5 Language has definable stimulus characteristics beyond mere sounds.

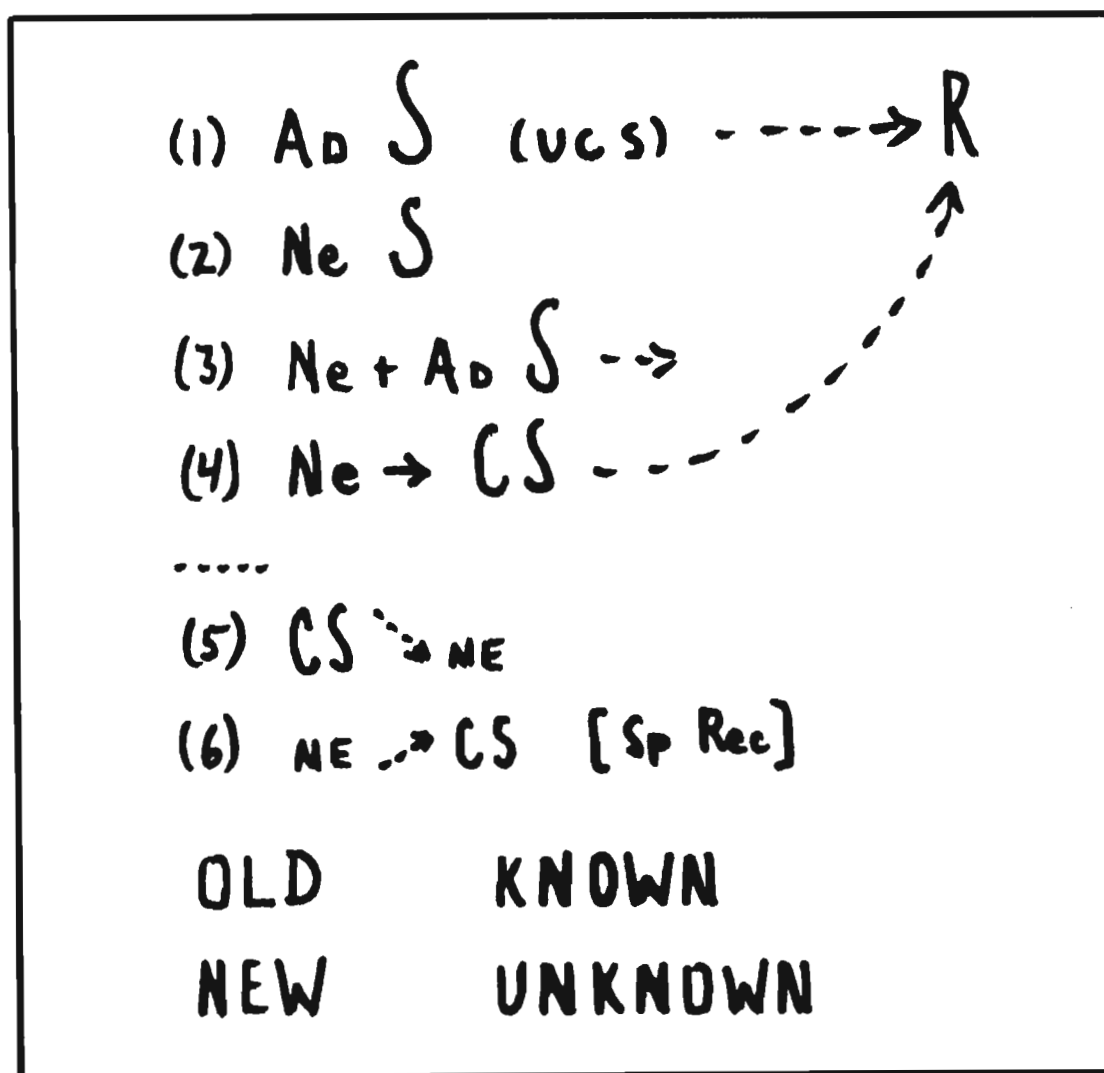4.6 Message intelligibility is affected by presentation rate.

Figure 4.   Factor 4 — the stimulus

4.7 Pictures are worth 999 words (some qualification noted).

4.8 A series of related experiences is necessary for the forming of single concepts.

4.9 Stimulus control may be achieved by the use of a teaching machine.

4.10 Stimulus intensity affects message decoding.

4.11 Thinking may be simulated and studied analyticaly by the programming of computers.

Related research includes these research reports:

4.1 Guthrie, John T. "Expository Instruction Versus a Discovery Method." *Journal of Educational Psychology*, 58: 45-49, 1967.

4.2 Miller, George A. "Some Psychological Studies of Grammar." Presidential address delivered before the Eastern Psychological Association at Atlantic City, New Jersey, April 27, 1962.

4.3 Kluppel, D. D. "Stimulus Labelability as a Factor in Concept Formation." *Psychological Reports*, 15: 918, 1964.

4.4 Huttenlocker, Janellen. "Some Effects of Negative Instances on the Formation of Simple Concepts." Psychological Reports, 11: 35-42, 1962.

4.5 Johnson, Paul E. "On the Communication of Concepts in Science." *Journal of Educational Psychology*, 60 (1): 32-40.

4.6 Foulke, Emerson. "Listening Comprehension as a Function of Word Rate." *The Journal of Communication*, 18: 3, 1968.

4.7 Deno, S. L. "Effects of Words and Pictures as Stimuli in Learning Language Equivalents." *Journal of Educational Psychology*, 59 (3): 202-206.

4.8 Carroll, John B. "Words, Meanings, and Concepts." *Harvard Educational Review*, 34: 178-202, 1964.

4.9 Greatsinger, Calvin. "An Experimental Study of Programmed Instruction In Division of Fractions." *AV Communication Review,* 16 (1): 87-90, 1968.

Moore, James C. "Manipulating the Effectiveness of a Self-Instructional Program." *Journal of Educational Psychology,* 59: 315-319, 1968.

Norberg, Robert B. "What Teaching Machines Can and Cannot Do," *Educational Digest* 27: 10-12, 1961.

Wohlwill, Joachim F. "The Teaching Machine: Psychology's New Hobbyhorse." *Teacher's College Record,* 64: 139-146, 1962.

4.10 Berlyne, D. E. "Stimulus Intensity and Attenion in Relation to Learning Theory." *Quarterly Journal of Experimental Psychology,* 2: 71-75 1950.

4.11 Hovland, Carl I. "Computer Simulation of Thinking." *American Psychologist,* 15: 687-93, 1960.

Factor 5: Physiological

The senses mediate between man and his world. The problems relating to the functions of the brain and nervous system have a long history. Leibnitz held that senses merely allowed the unfolding of previous (monodic) structure, while Locke insisted on a mental *tabula rasa* (blank state) which is changed only by direct experience. Early attempts to explain brain function in terms of "muscle" strength led to the errors of "formal discipline" and "faculty psychology" which overstressed the physiological effects of repetition. The work of brain physiologists such as that of Lashley (1929) and Penfield (1958), has led to a more precise knowledge of these functions. In addition, the study of j n d's (just noticeable differences) by Wundt and later psychologists led to a more precise definition of sensory mechanisms.

Topics of interest and application to daily living include:

(1) How we see, hear, touch, smell, and sense temperature; (2) how the central and peripheral nervous systems are related with implications for stress and consciousness; (3) potential and limitations of brain functions, including its major parts; (4) the effects of sensory deficiencies requiring remediation. (blindness, deafness, etc.); (5) implications of neural structure for learning memory, aroused and adaptation; and (6) gross physical growth and change patterns for boys and girls.

How strange it is that while most people can describe parts of a car, they cannot name the parts of the most fabulous machine of all — the brain! The braille in figure 5 gives another avenue to the brain when one's sight is blocked. It says "learning."

While a great deal of behavior can be explained by single conditioning, the "second signal system" (Pavlov) and the information processing done in higher brain centers is an exciting new frontier in human learning. For example, Travers (1967) points out the implication of Bindra's arousal theory for education and training.

From these topics, many principles may be derived. As a display of some of these we have:

5.1 Information that is transmitted from the senses to the higher centers undergoes compression during the process of transmission.

5.2 Adaption to one sensory condition makes one more sensitive to another.

5.3 There is a physiological difference between short-term and long-term memory.

5.4 Brain damage can affect abstraction capability.

5.5 Sensitivity to stimuli is related to the threshold level.

5.6 The congenitally deaf child will remain without speech until he is given special training.

5.7 RNA seems to be variable in fluency learning.

5.8 Sensory mechanisms are basic to learning.

Related representative research includes:

5.1 Travers, Robert M. W. *Essentials of Learning.* MacMillan: New York, Chapt. 7, 1967.

5.2 Helson, Harry. *Adaptation-Level Theory.* New York; Harper and Row, 1964.

5.3 Broadbent, D. E. "A Mechanical Model for Human Attention and Immediate Memory." *Psychology Review*, 64: 205-215, 1957.

Hebb, D. O. *The Organization of Behavior.* New York; Wiley and Sons, 1949.
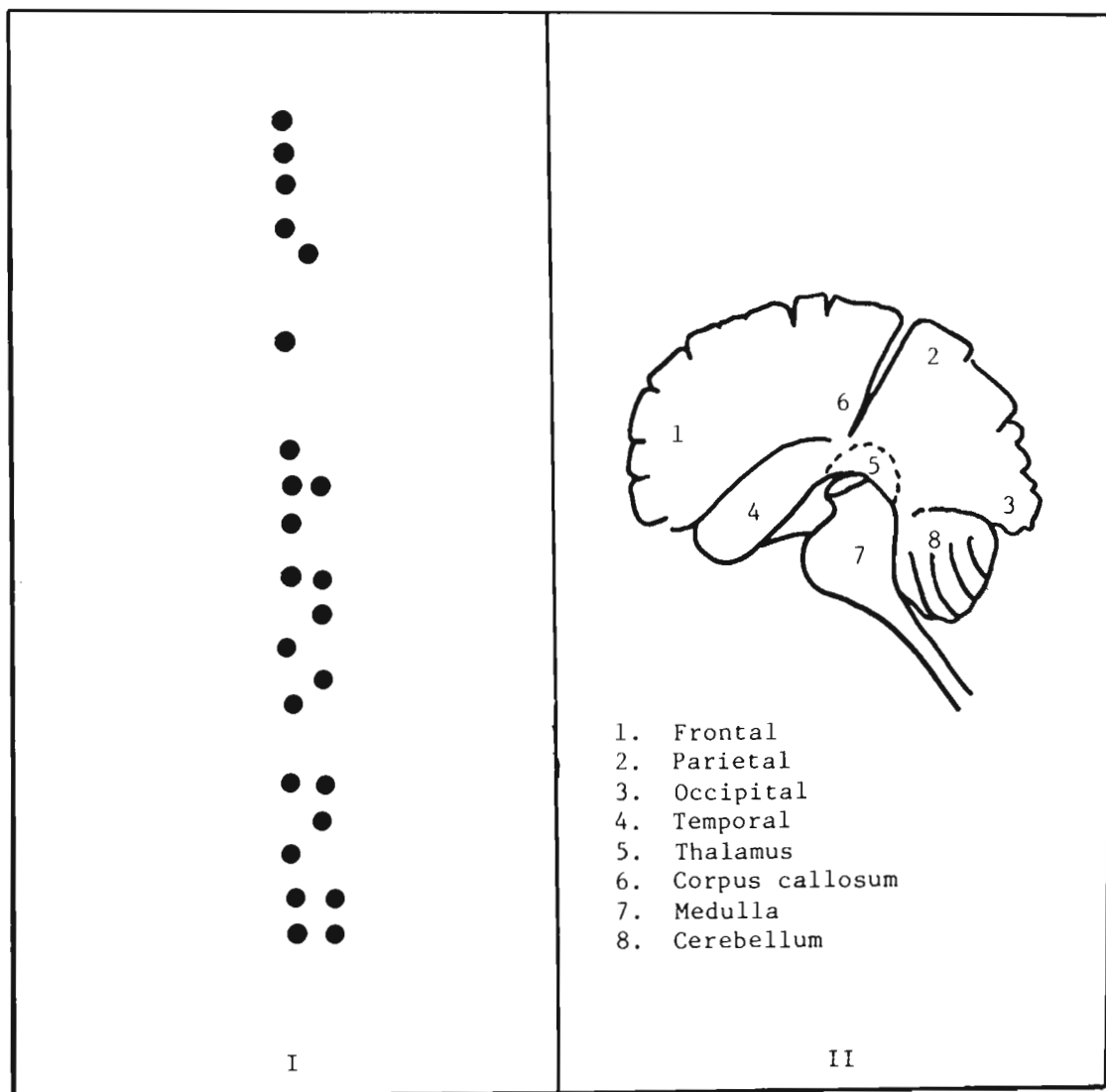
1. Frontal
2. Parietal
3. Occipital
4. Temporal
5. Thalamus
6. Corpus callosum
7. Medulla
8. Cerebellum

I   II

Figure 5-I, II.   Factor 5 — psysiological, braille, the brain

5.4 Darley, Frederick L.; Sherman, Dorothy; and Siegel, Gerad M. "Scaling Abstraction Level of Single Words." *Journal of Speech, Hearing Research.*, 2: 161-167, 1959.

5.5 Corso, John F. *Psychological Bulletin*, 60 (4): 356-369, Jul. 1963.

5.6 Lennenberg, E. H. "Language Disorders in Childhood." *Harvard Educational Review*, 34: 152-177, 1964.

5.7 Landauer, T. K. "Two Hypotheses Concerning the Biochemical Basis of Memory." *Psychological Review*, 71: 167-179, 1964.

5.8 Boring, Edwin G. A *History of Experimental Psychology*. New York: Appleton Century, 1950.

Factor 6: Aptitudes

Aptitude is a mediating process affecting behavior. Historically, aptitude was a single factor "g," with perhaps "s," (art) and "z" (music) as special aptitudes (Spearman).

Currently, three basic kinds of potential or apitudes are postulated: mental, emotional, and motor. These serve as the major topics for this area.

Mental. Following Spearman historically, Thurstone postulated seven primary mental abilities, and Guilford listed 120 (at least).

Motor. Fleishman (1956) and Guilford (1958) have both listed varieties of motor skills.

Emotional. Basic emotionality is not now measurable in the sense of measuring basal metabolism, for example, and must be inferred from studies of attitude and the self or personality. Schemes to categorize various personality factors are included here, while the particular profile of a given individual would be indicated in factor 9, self.

Aptitudes have been largely defined by the development of measuring devices. McCall's dictum that if something

exists, it can be measured, describes what has happened here. An extensive psychological testing movement now makes it possible to "measure" intelligence, attitudes, interests, motor ability, and personality.

Piaget and Inhelder (1958) have defined the growth of intelligence in a series of striking experiments. Children of lesser development see the bunched candy in figure 6-I as "more" and are unable to maintain equilibrium of mass in the pouring experiments seen in figure 6-II. They perceive the water in another shaped container as being "more" or "less" than the original, even when poured back and forth.
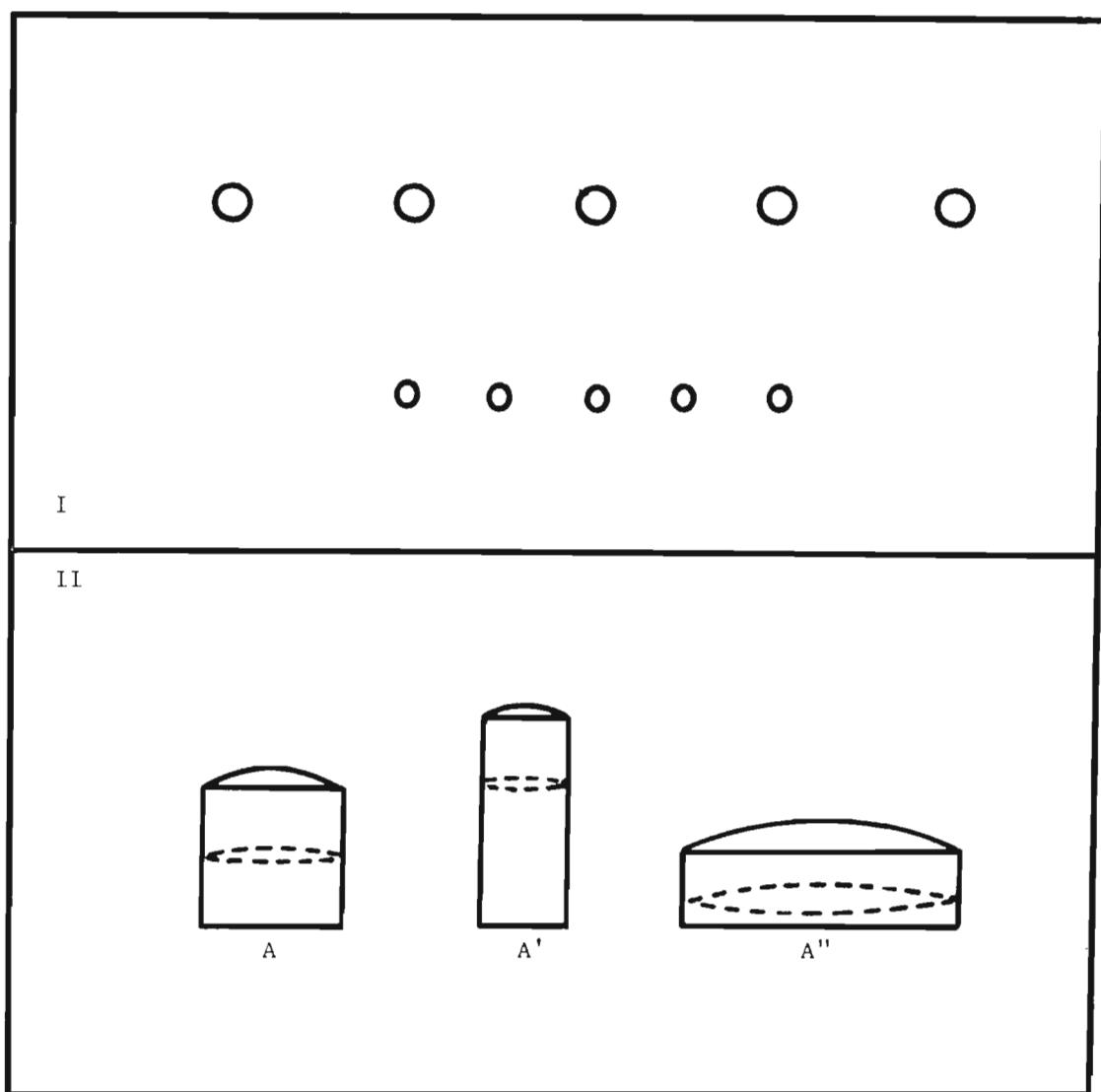

Figure 6-I, II. Factor 6 — aptitudes, maturity, and mental ability

Some representative principles derived from the literature on aptitude include these:

6.1 Tests of mental aptitude have a long history of practical use

6.2 Items in mental aptitude tests are selected to represent different ages, such as: "Three years—shows eyes, nose, mouth; names objects in a picture, repeats two figures, repeats six syllable sentences, gives last name."

6.3 Intelligence is multi-factored.

6.4 Motor abilities are multi-factored.

6.5 Emotions become more differentiated with age.

6.6 Mental ability accounts for around 35% of achievement.

6.7 Intellectual expression changes with age.

6.8 The type of test item, related to social opportunity, affects intelligence test performance.

6.9 Individual differences increase with age.

6.10 Personality is multi-factored.

Titles of articles relating to the principles above are listed here as a guide for beginning study and as a display of what research is providing.

6.1 Binet, Alfred and Simon, Theodore. "Upon the Necessity of Establishing a Scientific Diagnosis of Inferior States of Intelligence." In *The Development of Intelligence in Children*. Elizabeth S. Kite (translator) Williams and Wilkins Co., 1916.

6.2 Frandsen, A. N., and Grimes, J. W. " Age Discrimination in Intelligence Tests." *Journal of Educational Research*, 51: 229-233, 1957.
Frandsen, A. N., and Higginsan, J. B. "The Stanford-Binet and the Wechsler Intelligence Scale for Children." *Journal of Consultant Psychology*, 15: 236-238, 1951.

6.3 Guilford, J. P. "Intelligence: 1965 Model." *American Psychologist*, 21: 20-26, 1966.

Thurstone, T. G., "Primary Mental Abilities of Children," *Education and Psychological Measures,* 1: 105-116, 1941.

6.4 Fleishman, F. A., Hempel, W. "Factorial Analysis of Complex Psychomotor Performance and Related Skills." *Journal of Applied Psychology,* 40: 96-104, 1956.

Guilford, J. P., "System of Psychomator Abilities." *American Journal of Psychology,* 71:164-174, 1958.

6.5 Banhan, Katherine M. Bridges. "Emotional Development in Early Infancy." *Child Development,* III p. 324-341, Dec. 1932.

6.6 Bailey, Helen N. "A Study of the Correlations Between Group Mental Tests, Stanford-Binet, and Progressive Achievement Test Used in the Colorado Springs Elementary Schools." *Journal of Educational Research,* 43: 93-100, 1949-1950.

6.7 "Data on the growth of intelligence between 16 and 21 years as measured by the Wechsler-Bellevue Scale." *The Journal of Genetic Psychology,* 90: 3-15, 1957.

Inhelder, Barbel, "Criteria of the Stages of Mental Development." In J. M. Tanner, and B. Inhelder (eds.) *Discussions on Child Developments: a Consideration of the Biological, Psychological, and Cultural Approaches to the Understanding of Human Development and Behavior,* Vol. 1 of the Proceedings of the First Meeting of the World Health Organization Study Group on the Psychological Development of the Child, Geneva, 1953. New York: International University Press, pp. 75-96, 1953.

Siegal, I. E. "Development Trends in the Abstraction Ability of Children. " *Child Development,* 24: 131-144, 1953.

6.8 Eells, K; Davis, A; Havighurst, R. J; and Tyler,

R. W. *Intelligence and Cultural Differences.* University of Chicago Press, 1951.

6.9   Anastasi, Anne, *Differential Psychology*, New York: Macmillan, 1958.

6.10 Cattell, R. B. *Personality and Motivation Structure and Measurement*, New York: Harcourt and Bruce, 1957.

Factor 7: Perception

Perception is hard to define because the process of perception is essentially "wordless." It is silent "awareness." To be sure, however, past experience and language may influence how we perceive. In figure 7-I, for example, the individual who
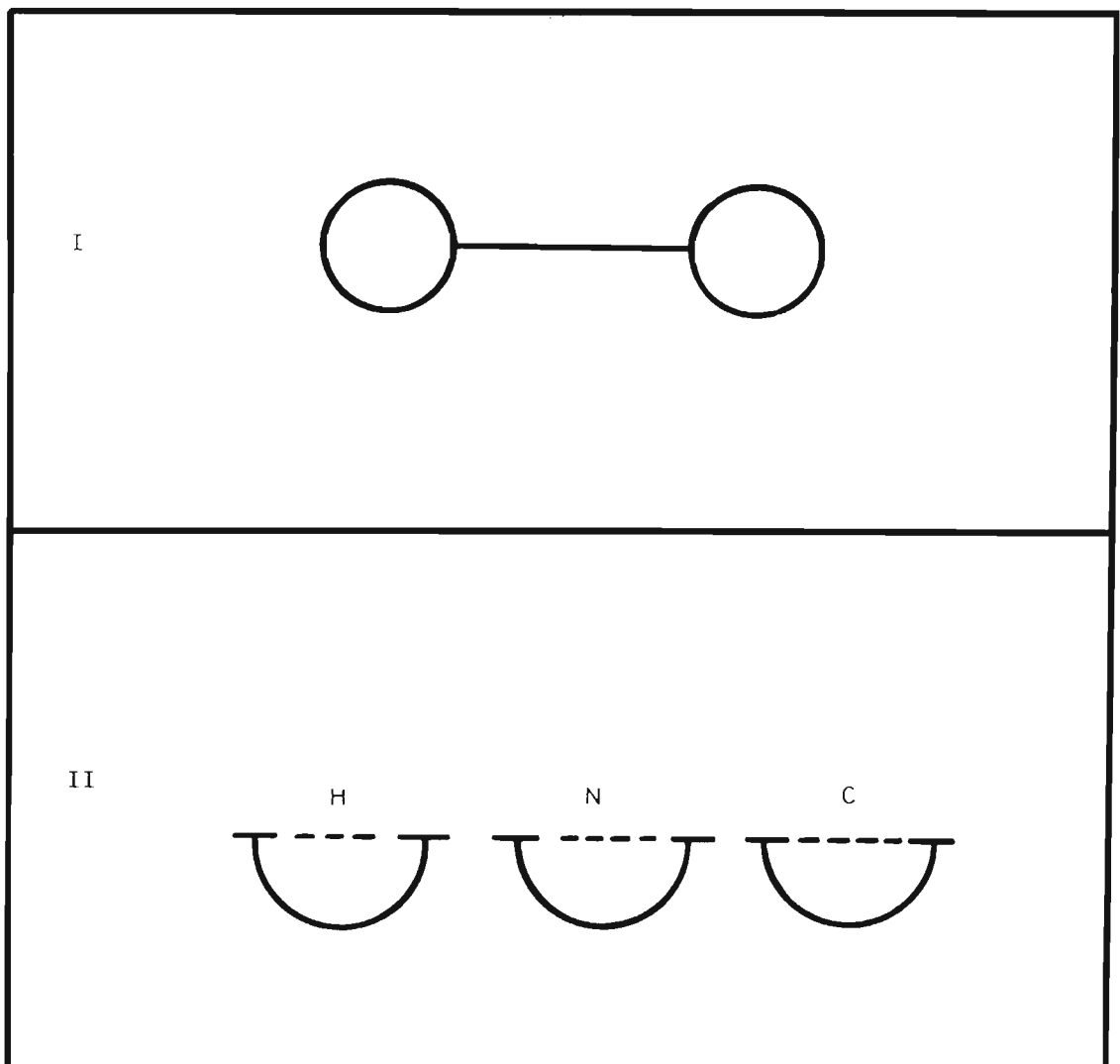

Figure 7-I, II. Factor 7 — perception and relativity of perception

has just had his eyes examined will label the figure differently than will one who has been in the gym lifting weights. In figure 7-II the classic analysis of Aristotle is set up. Person one puts his hand in bowl H containing hot water, and person two puts his hands in cold water of C. Then they both put these hands into N at room temperature. Now H perceives N as cool and C perceives N as warm. With the *same* experience they disagree. The same, of course, can be said of attitudes in politics with the radicals and the conservatives. The effect is to "expel the man in the middle position to the other side."

A convenient functional distinction can be made between perception and cognition in the process of "labeling." When we
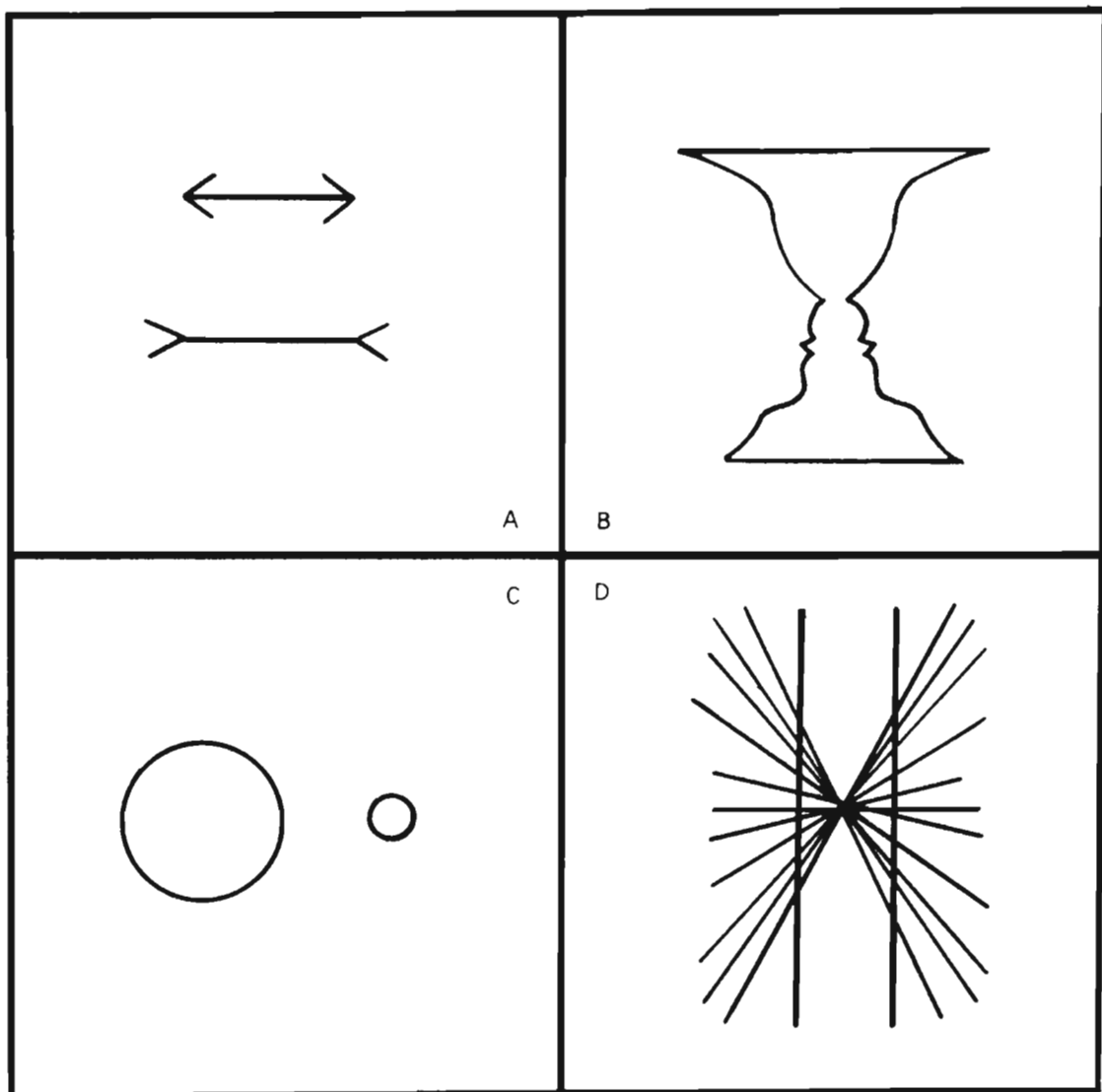

Figure 7-III. Factor 7 — perception of figure — ground and perspectives

silently appreciate beauty we are perceiving. When we try to define it we have moved to the next factor, cognition.

Allport's classic (1955) book on perception gives an excellent historical view of the major topics. The most penetrating recent analysis of the process of abstracting perceptual similarities to serve as data for thought is in Bruner (1963). In it he describes the percept as functionally related to the concept. Perception is a vital part of every action. It is generally very functional, but it also is easily distorted. The illusions and figure ground relations of form and distance are examples, as in figure 7-III. In A, the lines are equal; in B, you see a vase or faces; in C, if the ball is a golf ball, it is seen at a different
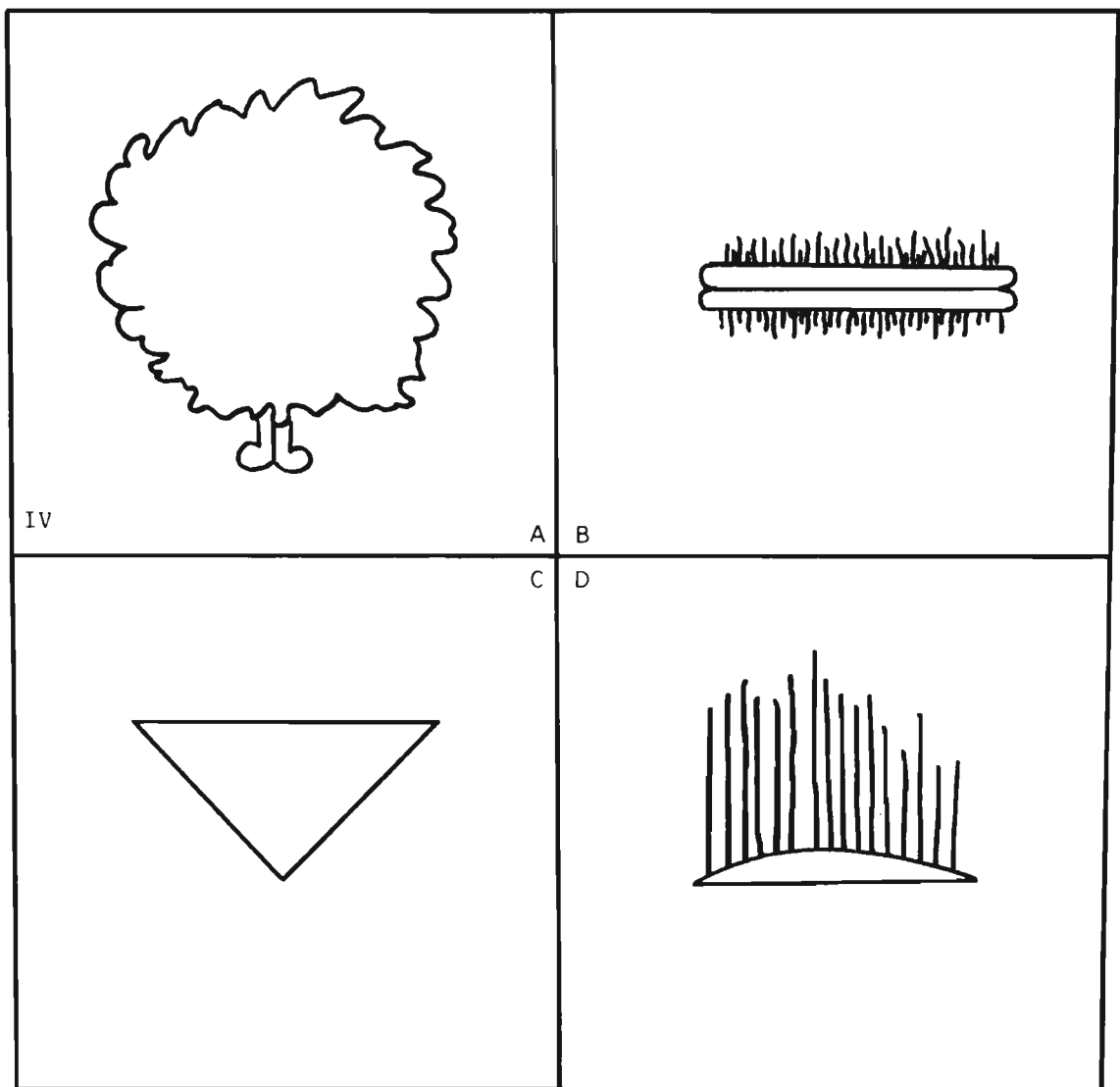

Figure 7-IV. Factor 7 — selective perception

distance; and D, the long lines are truly parallel, and not "bulged."

Context offers clues to perceptually brief data, as in figure 7-IV. In these, the person's background makes the titles meaningful.

The titles for the pictures are:

A — a small boy cleaning erasers.

B — a centipede carrying his bride over the threshold.

C — a basic seat cover.

D — the hairdo of a lady with her finger in a light socket.

Perhaps the most important applied element for school work is perceptual training for discrimination. The child is aided in reading by seeing *d* as different from *b*, and can be trained to do this quickly and easily in a program of reading readiness.

Essential topics for the understanding of perception include:

1. The relation of perception to sensory processes; 2. the relation or perception to cognition; 3. perceptual discrimination training; 4. perceptual processes, including constancies, orientation in space, illusion, thresholds, abstracting, movement and apparent movement, and adaptation; 5. perception of social situations; 6. past experience and perception; and 7. context and perception.

Some immediately useful principles of perception are these.

7.1 Perception begins as an implicit, internal S-R relationship which mediates between external S-R.

7.2 Events or objects which have been associated with reward tend to be perceived more readily.

7.3 Humans spend more time with novel than with familiar stimuli.

7.4 Structured data aid perception.

7.5 Perception may be improved by discrimination experience.

7.6 A "set" to search aids learning.

7.7 Language can aid perception.

7.8 The reward pattern influences perceptual learning.

7.9 Non-verbal communication is part of perception.

7.10 Some evidence exists that students can usefully perceive varied teacher-traits.

7.11 Value judgments can distort perception.

Illustrative references include the following:

7.1 Travers, Robert, M. W. *Essentials of Learning.* Macmillan: New York, Chapt. 14, 1967.

7.2 Rigby, M. K. and Rigby, W. K. "Perceptual Thresholds as a Future of Reinforcement and Frequency." *American Psychology.* 7: 321, 1952.

7.3 Berlyne, D. E. *Conflict, Arousal and Curiosity.* New York: McGraw-Hill, 1960.

7.4 Allport, Floyd H. *Theories of Perception and the Concept of Structure,* New York: Wiley, 1955.

Fellows, Brian J. *The Discrimination Process and Development.* New York: Pergamon Press, 1968.

7.5 Vetter, R. J. "Perception of Ambiguous Figure-Ground Patterns as a Function of Past Experience." *Perceptual and Motor Skills,* 20: 183-188, 1965.

7.6 Della-Piana, G. M. "Searching Orientation and Concept Learning." *Journal of Educational Psychology,* 48: 245- 253, 1957.

7.7 Dietze, Doris. "The Facilitating Effect of Words on Discrimination and Generalization. *Journal of Experimental Psychology,* 50 (4), 1955.

7.8 Cantor, Gordon N. and Spiker, Charles C. "Effects of Non-reinforced Trials on Discrimination Learning in Preschool Children." *Journal of Experimental Psychology.* 47: 239-256, 1954.

7.9 Meharabian, Albert. "Communication Without

Words." *Psychology Today*, p. 53, Sept. 1968.

7.10 Williams, Howard Yolen, Jr. "College Students' Perceptions of the Personal Traits and Instruction Procedures of Good and Poor Teachers." *Dissertations Abstracts*, 27 (11A): 3644, 1967.

7.11 Wilson, Paul R. "Perceptual Distortion of Height as a Function of Ascribed Academic Status." *The Journal of Social Psychology*, 74: 97-102, 1968.

Factor 8: Cognition

As a sub-system in a 14-factor system, cognition marks the distinctively human factor. The polemics on reason and thought testify to its importance, but as yet the total process is not defined. "Plans and structure" scientists avow that simple behaviorist concepts will not do justice to the complexity of cognitive behavior (Miller, Galanter, Pribram, 1960).

Three essentially cognitive activities that have been rather well defined and serve as major topics for this factor are: (1) concept learning, (2) abstracting, and (3) hypothesizing.

Despite the carefully refined description of the process of concept attainment now available, educators and lay persons use horse and buggy definitions that hardly do justice to the concept of the concept.

The achievement of the periodic table is a potent example of how discrimination, abstraction, and generalization are used to define the elements that are observable and also those that have been hidden, but are suggested by the theoretical concept structure. The work of Ramsay in discovering neon is a classic example.

A concept is a "set." It is usually represented by a label, such as *dog, animal,* or *honesty,* which represents objects or activities which have observable or definable common characteristics. A simple concept is the letter X in its own right, which is used to represent many other concepts also. Any letter or number is a concept by itself. Consider the concept of

"two," as in figure 8. The idea that "for every action there is an equal and opposite reaction" is a *complex* concept or set of concepts which is better referred to as a principle. For a delightful account of how language becomes a critical factor in learning, see Joseph Church, *Language and the Discovery of Reality* (Random House, 1961).

Of the many principles which could be drived from the literature on cognition and cognitive behavior, these are random examples, taken from the work of several generations of students in a class in educational psychology.

8.1   Concepts are based on percepts.
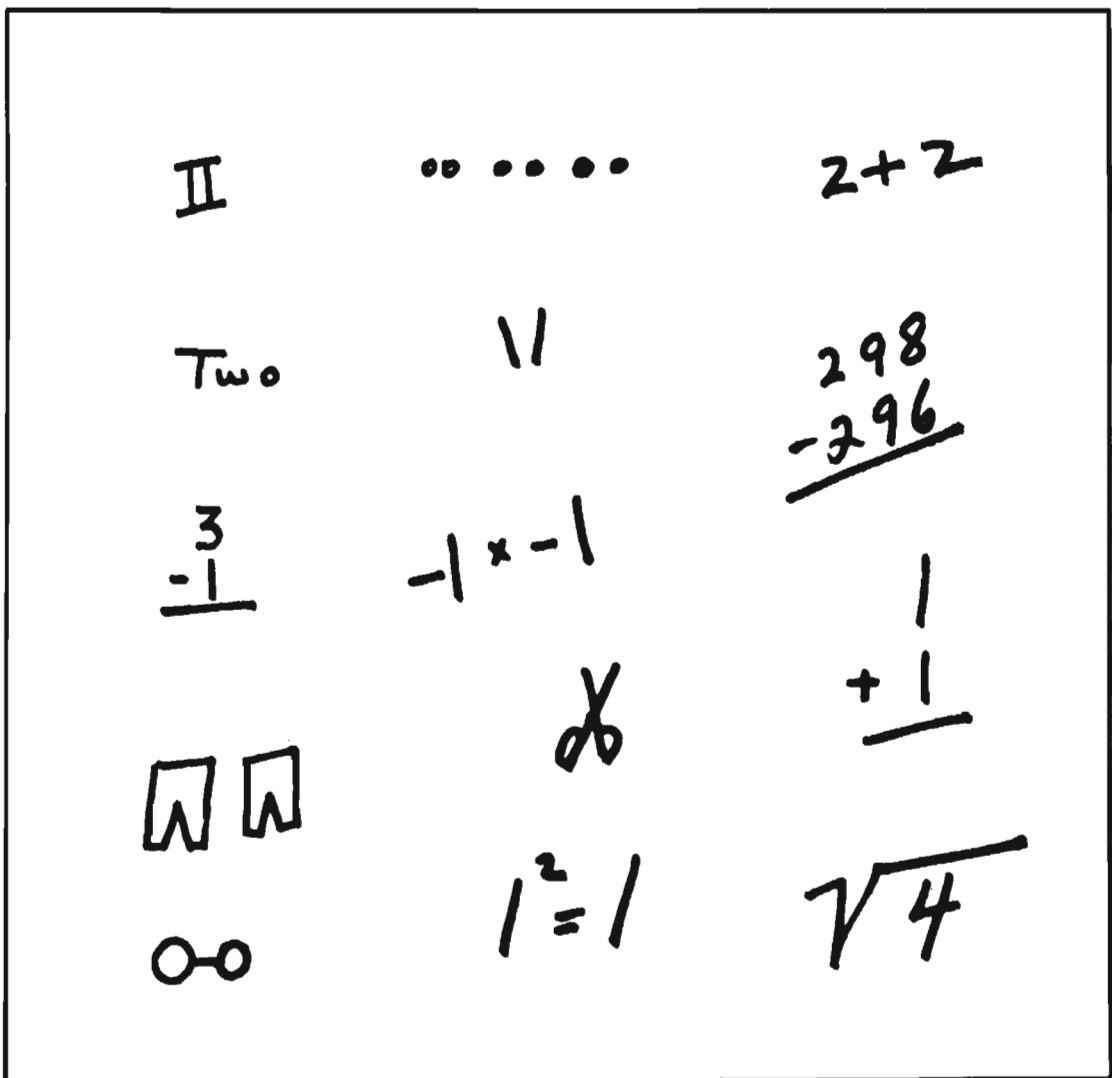8.2   The internal organization of knowledge is called a cognitive structure.

Figure 8.   Factor 8 — cognition of "twoness"

8.3 Learning a concept may be made easier by providing cues concerning the nature of the defining attributes.

8.4 For humans, words and concepts are inextricably bound.

8.5 Children make up "short cuts" in addition which may not be efficient unless guided.

8.6 Cognitive learning begins in infancy.

8.7 Problem solving involves a series of stages.

8.8 Three dimensional tasks require a high degree of maturity.

8.9 Thought is distinguished from sensation because it is a generalized reflection of reality.

8.10 Verbalization can aid problem solving.

8.11 Creativity can be improved by training.

8.12 Teaching strategy can be developed which increases the ability of students to think critically.

Supporting literature is found as follows:

8.1 Bruner, J. S. "Going Beyond the Information Given." in Bruner, J. S., et al, *Contemporary Approaches to Cognition*. Cambridge: Harvard University Press, pp. 41-69, 1957.
Bruner, J. S.; Wallach, M. A.; & Galanter, E. H. "The Identification of Recurrent Regularity." *American Journal of Psychology*, 72: 200-209, 1959.

8.2 Travers, Robert M. W. *Essentials of Learning: an Overview for Students of Education*. New York: Macmillan, p. 511, 1967.

8.3 Travers, Robert M. W. *Essentials of Learning: an Overview for Students of Education*. 2, New York: Macmillan p. 54, 1967.

8.4 Bourne, L. E., Jr. *Human Conceptual Behavior*. Boston: Allyn & Bacon, p. 21, 1966.

8.5 Flournoy, Francas. "Ways Children Think When Performing Higher Decade Addition." *Elementary School Journal*, pp. 204-208, 1957.

8.6 Fowler, W. "Cognitive Learning in Infancy and Early Childhood." *Psychological Bulletin,* 59: 116-152, 1962.

8.7 Cofer, C. N., "Reasoning As An Associative Process." *Journal of General Psychology,* 57: 55-68, 1957.

Dewey, J., *How We Think.* Boston: Heath, 1910.

8.8 Carey, Janice E. and Goss, Wilbert E. "The Role of Mediating Verbal Responses in the Conceptual Sorting Behavior of Children." *Journal of Genetic Psychology,* 90: 63-74, 1957.

Stone, David R. *"Developmental Aspects of Hierarchic Concept Attainment.* Summary of Final Report, U. S. Office of Education, Project No. S-061, Bureau No. 5-8162-2-12-1, Washington, D. C., Dec. 1965.

8.9 Vygotsy, L. S. "Language and Thought: The Problem and the Approach." In *Thought and Language,* translated by E. Hanfmann and G. Vakar. Cambridge: Institute of Technology Press (and jointly with Wiley & Sons), 1962.

8.10 Gagne, Robert M. and Smith, Ernest C., Jr. "A Study of the Effects of Verbalization on Problem Solving." *Journal of Experimental Psychology,* 63: 12-18, 1962.

8.11 Maltzman, I.; Simon, S.; Raskin, D.; and Licht, L. "Experimental Studies in the Training of Originality." Psychology Monograph., 74: 493, 1960.

8.12 Bruner, J. S.; Goodnow J. J.; and Austin, G. A. *A Study of Thinking.* New York: Wiley and Sons, 1956.

Taba, Hilda and Elzey, Freeman F. "Teaching Strategies and Thought Processes." *Teacher College Record,* 65: 524-534, 1964.

The most famous of *self* is Freud's analysis of *id, ego,* and *super-ego*. His analysis has re-appeared in the work of Horney and other neo-Freudians, and in popular accounts such as *Games People Play* (Berne, 1968). There are many other accounts of self as in work of Erickson, Maslow, and Rogers.

Self is what we *are*. Now. Self is what we have *become*, based on the interaction of potential and experience. It is maturation and learning. In factor 6, the idea of potential (intellectual, motor, and affective) was introduced. Here we look at these general constructs in terms of a particular individual or *self*.

Since self is what we *are*, we can conveniently class a self in terms of these general topics: (1) What he knows (transformed intellectual potential); (2) what he can do (transformed motor aptitute); and (3) his attitudes and interests (transformed affect or emotion).

On this basis, there are now available many useful achievement tests, skill tests, and attitude or personality tests. This is the logical place to refer to norms, standard scores, and percentiles, but time does not permit.

The achievement (knowledge) and skills segments of self are often neglected because of the high interest in personality testing, and the problems of adjustment which have to do with attitudes and values. We must always look at the *interaction of knowledge, attitudes,* and *skills,* however. A most vital interaction, for example, takes place in school learning in children who are not living up to their potential. These under-achievers often have low self esteem and a poorly worked out aspiration system.

Self is in the context of the extensive work done in human growth and development, child, and adolescent psychology.

Pascal put it this way:

What a chimera, then, is man! What a novelty, what a monster, what a chaos, what a contradiction, what a prodigy! Judge of all things, feeble worm of the earth, depository of truth, a sink of un-

certainty and error, the glory and the shame of the universe.

<p style="text-align:center">Pensees VIII</p>

Not all authorities define self as feeling or even primarily so. Idealism emphasizes values; realism emphasizes knowledge; and pragmatism accents doing (Wahlquist, 1943, in *The Philosophy of American Education*).

Following the three major topics defining self, we will give here the three major derived hypotheses.

1. The self is defined by the intra-personal subsystem of (1) knowledge, (2) attitudes, and (3) skills.

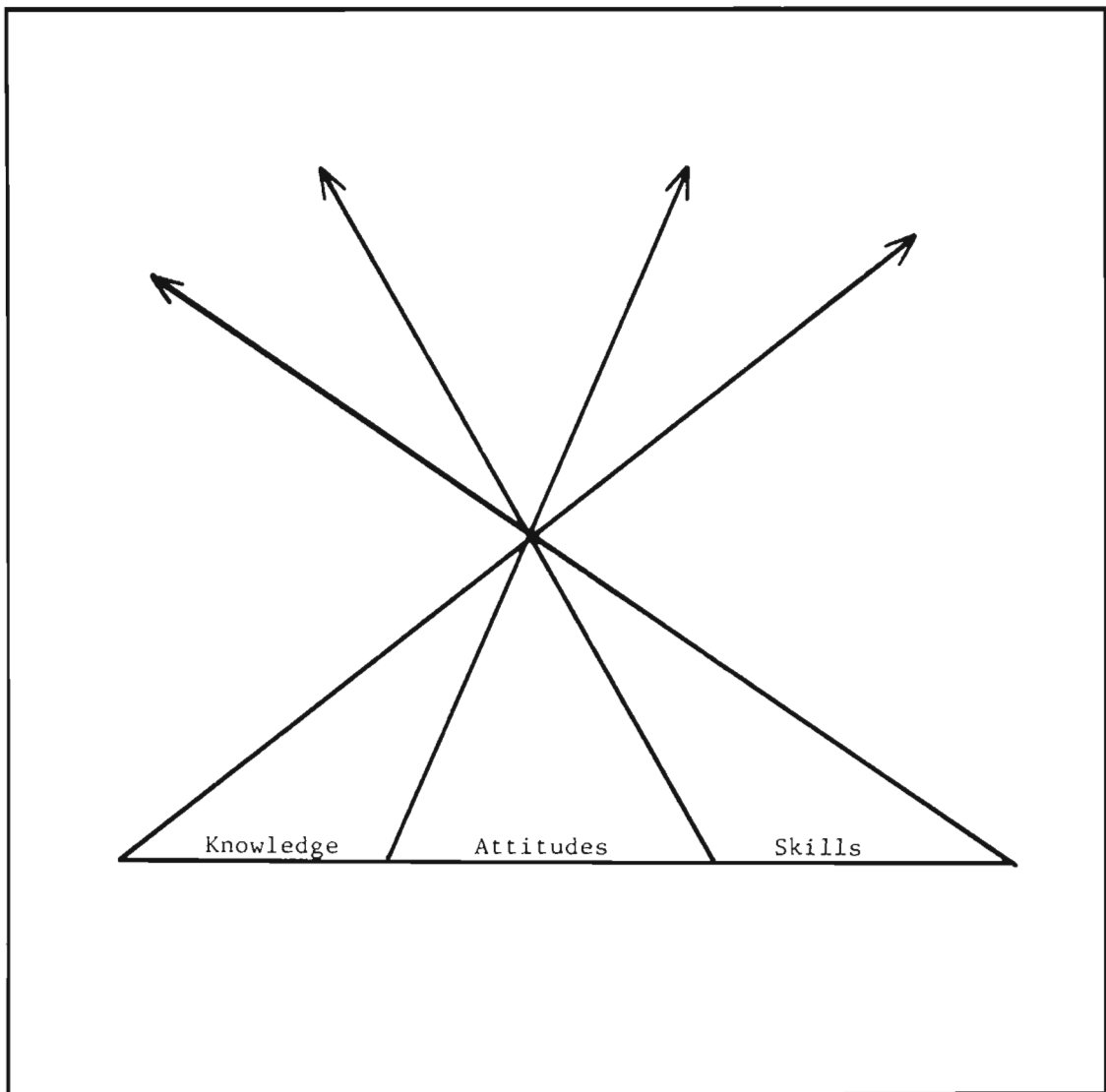2. These self-components are measurable to a useful degree.

Figure 9. Factor 9 — "self"

3. The regularities of self-components in interaction with environmental (situational) factors lead to varied levels of predictable behavior, but success is better with groups than with individuals, and there are wide individual differences.

The immense variety of research and development in the area of *self* is hinted at in these research generated findings:

9.1 Sense of humor is a complex of knowedge and attitudes.

9.2 Physical skill has different values in different cultures.

9.3 Different personal characteristics are valued at different ages and by different sexes.

9.4 Under-achievers have a different component system than do over-achievers.

9.5 Physical skill development has a wide variety of functional parts.

9.6 Interests serve as intra-personal motivators.

9.7 High need achievement as measured by the TAT is associated with gains in IQ scores.

9.8 The *successful* student will do better in either traditional or independent study.

9.9 The many complexities of self need to be put into a functionally whole system for study.

9.10 Ego development may be measured.

9.11 Level of aspriation affects decision-making.

9.12 "A good man" and "a good life" can now be defined.

9.13 Psychomotor skills can be measured.

9.14 The "self" is a poetic concept, not definable or useful in science (Skinner).

9.15 As the perception of self alters, behavior alters.

9.16 Changes in self concept are more difficult with increasing age.

9.17 A formula for behavior must be a function of (f) several things, including ability and learning (Kelly).

9.18 Elderly persons learn better with supportive rather than challenging instructions.

9.19 Teacher attitudes affect pupil achievement.

Supporting research titles are:

9.1 Stump, N. Franklin. "Sense of Humor and Its Relationship to Personality, Scholastic Aptitude, Emotional Maturity, Height, and Weight." *Journal of General Psychology*, 25: 20-21, 1939.

9.2 McCandles, B. R., and Ali, F. "Relations Among Physical Skills and Personal and Social Variations in Three Cultures of Adolescent Girls." *Journal of Educational Psycholgy.*, 57: 366-372, 1966.

9.3 Clark, Edward T. "Sex Differences in the Perception of Academic Achievement Among Elementary School Children." *The Journal of Psychology.* pp. 249-256, 1967.

   Kulhen, Raymond G. and Lee, Betrice J., "Personality Characteristics and Social Acceptability in Adolescence." *Journal of Education Psychology*, 34: 321-340.

9.4 Cowan, John Curtis. "Dynamics of the Underachievement of Gifted Students." *Exceptional Children.*, 24: 98-101, 122, 1957.

   Gawronski, Daniel A. and Mathis, Claude. "Difference Between Over-Achieving, Normal-Achieving, and Under-Achieving High School Students." *Psychology in the Schools*, 2 (2): 152-155, 1965.

9.5 Govatos, Louis A. "Motor Skill Learning." *Review of Educational Research*, 37: 592-594, 1967.

   Solkoff, Norman,; Tod, Gebson A.; Screven, Chandler G. "The Effect of Frustration on Perceptual-Motor Performance." *Child Development*, 35 (2): 569-575, 1964.

   Zeaman and Kaufman, "Individual Differences and Theory in a Motor Learning Task." Psychology Monographs, 69 (6): 1959.

9.6 Frandsen, Arden, and Sorenson, Maurice. "Interests as Motives in Academic Achievement." *Jour-*

nal of School Psychology, 7 (1): 52-56, 1968-69.

9.7 Kagan, Jerome,; Sontag, Lester W.; Baker, Charles T.; and Nelson, Virginia L. "Personality and IQ Change." *Journal of Abnormal and Social Psychology,* 56: 261-266, 1958.

9.8 Egbert, Robert L. "Personality Factors and Independent Study." *The Journal of Educational Research,* 62: 37-39, Sept. 1968.

9.9 Janis, Irving L.; Mahl, George F.; Kagan, Jerome; and Holt, Robert R. *Personality, Dynamics, Development, and Assessment.* New York: Harcourt Brace and World, 1969.

9.10 Loevinger, Jane. "The Meaning and Measurement of Ego Development." *American Psychologist,* 21 (3): 95-100, 1966.

9.11 Siegel, Sidney. "Level of Aspiration and Decision Making." *Psychological Review,* 64 (4): 253-262, 1957.

9.12 Maslow, Abraham H. "Psychological Data and Value Theory." In *New Knowledge in Human Values,* Maslow, (ed.), New York: Harper Bros., 1959.

9.13 Klausmeier, H. J. and Goodwin, Wm. "Learning and Human Abilities," *Educational Psychology.* Harper and Row, 1966, Chapt. 9, 1961.

9.14 Skinner, B. F. "The Science of Learning and the Art of Teaching," *Harvard Educational Review,* 54: 969-977, 1954.

9.15 Rogers, Carl R. "Some Observations on the Organization of Personality," *The American Psychologist,* 2: 359-368, 1947.

9.16 Hamachek, Donald E. "Dynamics of the Self: Implications for Teaching and Learning." *Utah Educational Review,* 62: 8, 9, 29-32, 1969.

9.17 Kelly, Frances J., and Cody, John J. *Educational Psychology, a Behavioral Approach.* Chas. E.

Merrill, 1969. The formula is $Ba = f$ (Pa, Eab, Rba, rs, . . . n), Sa, Cab, x. In it, Ba=behavior, Pa=relevant ability, rs == acquired response repertory, etc.

9.18 Ross, Edith. "Effects of Challenging and Supportive Instructions on Verbal Learning in Older Persons." *Journal of Educational Psychology,* 1968, 59 (4): 261-266, 1968.

9.19 Hoyt, Kenneth B. "A Study of the Effects of Teacher Knowledge of Pupil Characteristics on Pupil Achievement and Attitudes Towards Classwork." *Journal of Educational Psychology,* 46: 302-310, 1955.

Factor 10: Transfer

Modern theories of transfer come out of a long history of error which had to be overcome. It was assumed in the early 1800's that you could strengthen your mind with use as if it were a muscle. Phrenology, faculty psychology, and formal discipline were all part of the early, erroneous concept of how transfer works.

With the work of James and Thorndike, the modern theory of transfer, which includes identical elements and principles, began. The emphasis is not on methods of work, but on a "filled mind," with a structure of needed information. The "process x content" approach is similar to computer systems now in use.

The basic paradigm for the study of transfer is:

Experimental group	Learn A	Learn B
Control group	- - - -	Learn B

The question then is, did A help or hinder B? If it helped, you have transfer; if not, you have inhibition or negative transfer. More sophisticated designs are described in Ellis (*The Transfer of Learning*, Macmillan, 1965). If transfer does not occur and inhibition does, then the direction of inhibition may be studied.

In older persons, pro-active inhibition becomes more and

more a problem. Retroactive inhibition is greater if the matter is similar (as a list of numbers) but with different items (sets of numbers).

Memory and retrieval are basic to transfer. Transfer is not necessarily automatic, although in skilled action a minimum of the conscious use of cues is seen.

Care must be taken to distinguish between transfer as an implicit process feeding into perception and cognition, and the *effects* of transfer as seen in what the person does in trial.

Since a major aim of education is to *apply* what has been learned, transfer is of major concern in evaluating instructional outcomes.
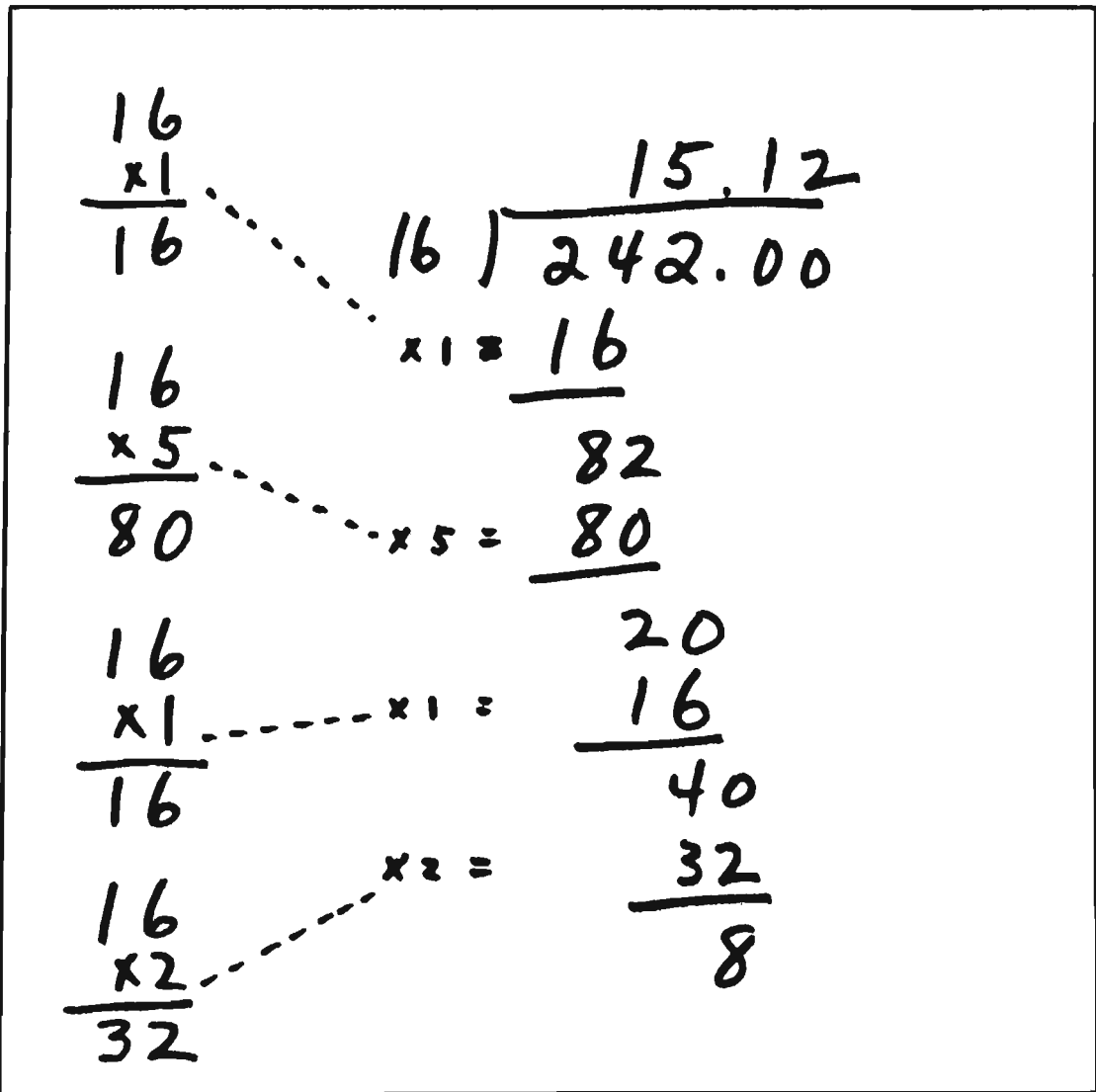

Figure 10. Factor 10 — transfer of x in ÷

Principles derived from the literature of transfer experiments include these:

10.1 Meaningful material which can be incorporated into cognitive structure is more easily transferred.

10.2 A high degree of original learning facilitates transfer.

10.3 Steps may be taken to combat retro- and pro-active inhibition.

10.4 Varied applications of a given principle aids transfer by avoiding "functional fixedness."

10.5 General principles last longer than specific details in transfer.

10.6 Intention to learn aids transfer.

Supportive research is seen in these examples:

10.1 Brownell, W. A., et al. "Meaningful Versus Mechanical Learning: A Study in Grade III Subtraction." *Duke University Studies Educ.*, No. 8, Durham, N. C.: Duke University Press, 1949.

10.2 Mandler, G. and Kuhlman, Clementina. "Proactive and Retroactive Effects of Overlearning." *Journal of Experimental Psychology*, 61: 76-81, 1961.

10.3 Atwater, S. K. "Proactive Inhibition and Associative Facilitation as Affected by Degree of Prior Learning." *Journal of Experimental Psychology*, 46: 400-405, 1953.

Ausubel, D. P.; Robbins, Lillian C.; and Blake, E., Jr. "Retroactive Inhibition and Facilitation in the Learning of School Materials. *Journal of Educational Psychology*, 48: 334-343, 1957.

Gilliland, A. R. "The Rate of Forgetting." *Journal of Educational Psychology*, 39: 19-26, 1948.

Miller, G. A.; Glanter, E.; and Pribram, K. H. *Plans and the Structure of Behavior.* New York: Holt, Rinehart, and Winston, 1960. Chapt. 10, pp. 125-138.

10.4 Duncan, C. P. "Transfer After Training With Single Versus Multiple Tasks." *Journal of Experimental Psychology*, 55: 63-72, 1958.

10.5 Hamilton, R. J. "Retroactive Facilitation as a Function of Degree of Generalization Between Tasks," *Journal of Experimental Psychology*, 32: 363-376, 1943.

Sterrett, M. D., and Davis, R. A. "The Permanence of School Learning: A Preview of Studies." Education Administration Supervisors, 40: 449-460, 1954.

Tiederman, H. R. "A Study of Retention in Classroom Learning." *Journal of Educational Research*, 42: 516-531, 1948.

10.6 Ausubel, D. P., Schpoont, S. H., and Cukier, Lillian. "The Influence of Intention on the Retention of School Materials." *Journal of Educational Psychology*, 48: 87-92, 1957.

Factor 11: Mode of attack

The set of 14 factors all reflect the study of learning from the viewpoint of the learner. We will dicuss the implications for teaching and instruction at the end of the section.

Mode of attack is a natural extension of the topic of transfer. Mode of attack is the active demonstration or product of the transfer process. In transfer the focus is on retrieval, memory, and inhibition. Of course the suggestions relative to improving transfer (by looking ahead to the mode of attack) are the same in many ways as for the action or trial when it occurs. However, the context is very different (that of transfer being implicit, mental activity), and the mode of attack for many behaviors is highly visible. This leads immediately to a powerful tool (well utilized by the Gilbreths' time and motion studies) which may be called *task analysis*. It is a vital part of what has been called *diagnostic* instruction. Also, the general course of improvement can be plotted.

Just exactly what did the person do right, and what did

he do wrong? Such error analysis paves the way for evaluation of process and focused feedback later. The learner's mode of attack reflects the task he has been given, and the quality of instruction he has had. As such, it becomes a very useful segment or the observation of learning behavior. It is somewhat difficult to focus on the learner's mode of attack, as such, since it is so easy to get sidetracked to the factors which are affecting the mode of attack itself.

The four major features of the mode of attack are:

(1) Flexibility in the use of alternatives; (2) the utilization of cues and context; (3) the distribution and quality of effort (practice); and (4) the content quality, i. e., appropriate use of needed facts, attitudes, and skills.
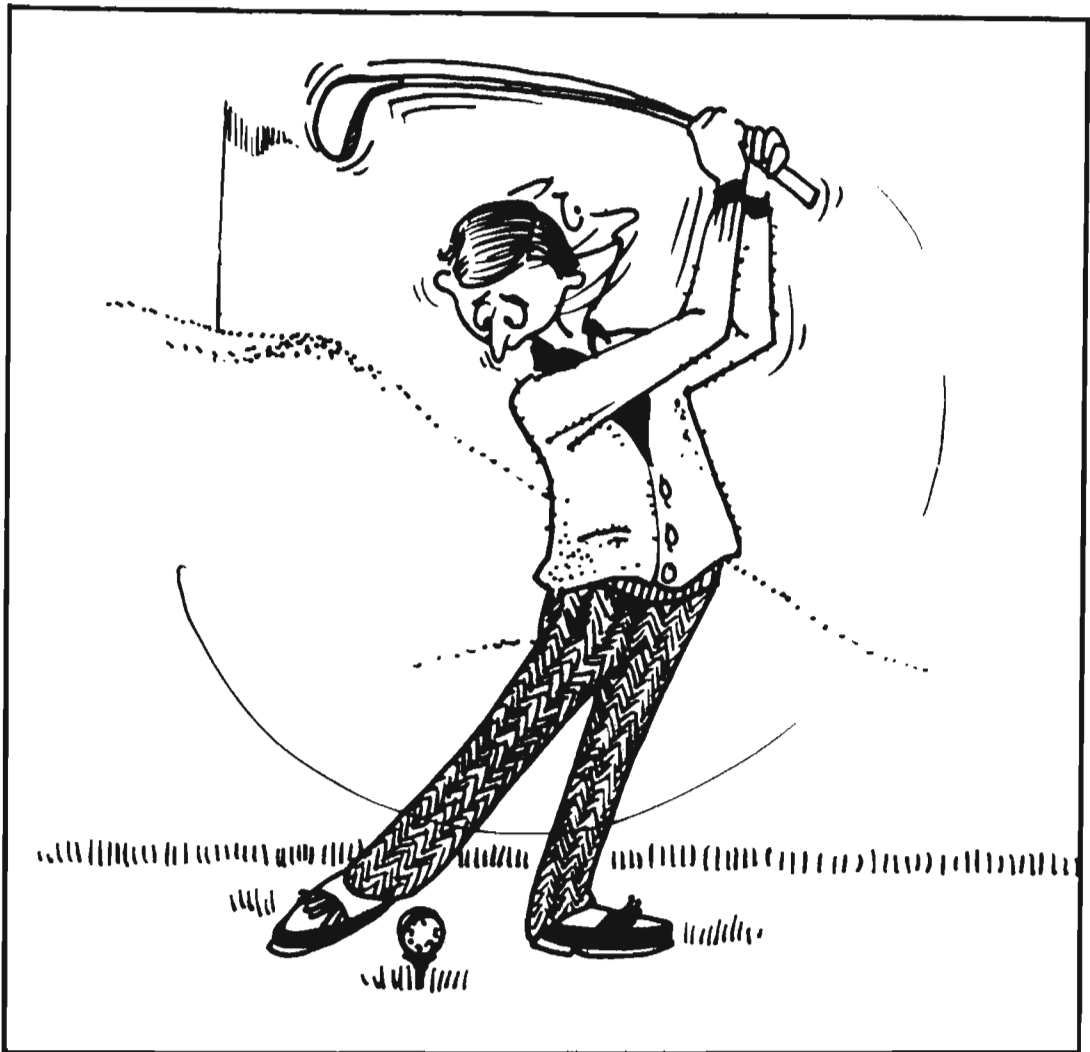

Figure 11.   Factor 11 — mode of attack

A series of principles derived from the literature on these topics includes these:

11.1 Alternate modes of attack can improve chances of success.

Stereotyped behavior and functional "fixedness" can be avoided by instruction in alternative behavior.

11.2 The skilled performer needs fewer cues to guide his performance.

In a highly skilled action, one portion serves as the cue for the next.

11.3 Distributed effort produces a more lasting effect than massed effort.

Overlearning gives positive results on learning permanence, particularly for rote material.

11.4 The trained person will make fewer errors than the untrained.

A knowledge background increases the chances of the correct application of needed facts, as in diagnosis.

Supporting research is found in the following:

11.1 Dietze, Doris. "The Facilitating Effect of Words on Discrimination and Generalization." *Journal of Experimental Psychology* 50: 255-260, 1955.

Epstein, W. "The Influence of Syntactical Structure on Learning." *American Journal of Psychology* 74: 80-85, 1961.

Frandsen, Arden. "Job Analysis of Learning Tasks." *Educational Psychology*, pp. 391-395, 1967.

Gunderson, Agnes G. "Thought-Patterns of Young Children in Learning Multiplication and Division." *Elementary School Journal*, 55: 453-461, 1955.

11.2 Bogoiavlenski, D. N. and Menchinskaia, N. A. "The Psychology of Learning 1900-1960." *Educational Psychology in USSR*, Simon, B. and Simon, Joan (eds.) Stanford Univ. Press, pp. 101-161, 1963.

Erickson, L. H. "Color as an Aid in Teaching Concepts." *Arithmetic Teacher*, 5: 10-14, 1958.

Priebe, R. E., and Burton, W. Y. "The Slow Motion Picture as a Coaching Device." *School Review*, 47: 192-198, 1939.

Stone, D. R. "Subsumptive Labeling as a Variable in Concept Organization." *Journal of Psychology*, 63: 135-141, 1966.

11.3 Brownell, W. A. "Meaning and Skill: Maintaining the Balance." *Arithmetic Teacher*, 3: 129-136, 1956.

Gates, A. I. "Recitation as a Factor in Memorizings." *Archives of Psychology*, 6(40): 1-104, 1917.

Jensen, B. T. "This Thing called 'Pratice'." *Peabody Journal of Education*, 33: 221-226, 1956.

Peterson, H. A. "Recitation or Recall as a Factor in Learning of Long Prose Selection." *Journal of Educational Psychology*, 35: 220-228, 1944.

Symonds, P. M. "What Education Has To Learn from Psychology: IV. Whole Versus Part Learning." *Teachers College Record*, 58:329-339, 1957.

11.4 Flournoy, Frances. "A Consideration of the Ways Children Think When Performing Higher-Decade Addition." *Elementary School Journal*, 57: 204-208, 1957.

Howell, W. J. "Work-Study Skills of Adolescents in Grades VII-XIV." *School Review*, 61: 227-282, 1953.

Leggitt, Dorothy. "Measuring Progress in Work-Skills in Ninth Grades Civics." *School Review*, 42: 676-687, 1934.

Lewis, E. R., and Lewis, Hilda P. "Analysis of Errors in the Formation of Manuscript Letters by First Grade Children." *American Educational Resources Journal*, 2: 25-35, 1965.

Factor 12: Operant conditioning

As pointed out in the factor 4 topic, "Stimulus," there are two theories which focus on the "entry" or stimulus phase of learning: classical conditioning and cognitive behavioral theory. Cognitive theory is also based on a further assumption of critical implicit activity involving self, perception, and cognition.

Operant conditioning quite differently focuses on the learner's *responses*. When the learner *emits* a series of responses

Figure 12.   Factor 12 — reinforcement

R1, R2, and R3, and when one is reinforced in subsequent activity, that Rx comes to have a higher probability of occurrence. Early versions by Thorndike referred to the "law of effect." The history of behavioral psychology goes back to "survival mechanisms" which are reinforced by the environment.

This powerful theory has a wide variety of uses, and is particularly helpful when the experimenter, leader, or teacher has full control of the situation and is willing to count specific instances of behavior as related to reinforcement pattern. In this way, a given stimulus is then said to "control" behavior. The cognitivists see the over-extension of this theory as at times encroaching on self-direction and self-control of behavior. The concept of reinforcement is in line with the "principle of natural selection" which held that a given physical feature did not "permit" a behavior, but that the feature was a consequence of previous behaviors (Honig, 1966). Thorndike followed this line with his "law of effect," and Skinner, in the same vein, concerned himself with the description of the ratios and intervals of the consequences and their effects on future behavioral probabilities (Skinner, 1966).

Hilgard and Bower (1966) suggested that the kind of explanation of learning may well depend on the complexity of the task hierarchy as defined in Gagne (1965). In such a case, one theory could apply to one level of learning and a second theory to another level.

Topics within this area are still in development, hence we will list only some major representative principles, as follows.

12.1   Human behavior is strengthened by certain kinds of reinforcing consequences.

An environment may be designed in which reinforcers which ordinarily generate unwanted behavior (overeating, agression) simply do not do so.

12.2   Reinforcement for an operant results not only in an increase of the frequency of the responses composing that operant but also in an increase in the frequency of similar responses.

12.3 For successful contingency management, never let R (competing response) occur in the presence of stimulus meant to control R.

12.4 Based on the proposition that "behavior is a function of stimulus events," at least 20 "laws" of operant behavior may be stated. An example: "If an operant no longer produces its customary reinforcers, it will eventually return to its operant level."

12-5 High probability responses can be used to reinforce those of lower probability.

12.6 Non-reinforcement produces behavior different from aversive reinforcement.

12.7 Reduction of anxiety may serve to powerfully reinforce behavior that brings a state of "relief" or "security."

12.8 Precision teaching (in which desired behaviors are defined and counted) allows for the careful analysis of classroom behaviors.

Related, supportive references are found in these sources:

12.1 Skinner, B. F. "Contingencies of Reinforcement in the Design of a Culture." *Behavioral Science*, 2 (3), May 1966.

12.2 Reynolds, G. S. *A Primer of Operant Conditioning*. Chicago: Scott, Foresman, and Co., 1968.

12.3 Home, Lloyd E. "Contiguity Theory and Contingency Management." *The Psychological Record*, 16: 233-241, 1966.

12.4 Burgess, Robert L. and Akers, Ronald L. "Are Operant Principles Tautological?" *The Psychological Record*, 16: 305-312, 1966.

12.5 Premack, David. "Reinforcement Theory," in *Nebraska Symposium on Motivation*, David Levine, (ed.), University of Nebraska Press, pp. 123-180, 1965.
Premack, D. "Toward Empirical Behavioral Laws: I. Positive Reinforcement." *Psychological Review*, 66: 219-233, 1959.

12.6 Smith, Wendell I. and Moore, J. William. *Conditioning and Instrumental Learning.* New York: McGraw-Hill, 1966.

12.7 Mowrer, O. H., "A Stimulus-Reponse Analysis of Anxiety and Its Role as a Reinforcing Agent." in *Foundations of Conditioning and Learning,* Kimble, Gregory A., (ed.), Appleton-Century-Crofts, 1967.

12.8 Lindsley, Ogden R., *Direct Measurement and Prosthesis of Retarded Behavior,* Northwest Regional Instructional Materials Center for Handicapped Children and Youth, Eugene, University of Oregon, 1969.

Factor 13: Overt feedback

After the trial, the learner is able to make use of what he did in order to plan needed corrections. This is feedback.

The literature is not clear on the terms reinforcement and feedback as they refer to specific behavior. They are often used interchangeably, a source of confusion.

The reinforcement-feedback processes cannot be separated in actuality since some degree of each enters into all behavior. But, the terms need specifying for study and analysis.

Reinforcement is primarily affect. (It could be called affective feedback, but this would result in the loss of the popular term, reinforcement.) Reinforcement refers to the timing, amount, and relative effectiveness of a motivator — a rewarder or punisher.

On the other hand, the unique quality of feedback is *informational.* To be sure, to find out your trial was *correct* is rewarding. At the same time, however, this conforming or disconforming of the trial has a needed informational component. Such feedback can verify an hypothesis, or partly so. Feedback gives information needed to make a plan for the next trial. Feedback gives data which can be checked and compared with criteron measures.

In this sense, the work of the parent or teacher in supply-

ing evaluative comment is very helpful. Some trials are self-evaluating, as in the case of a newly designed airplane. It will be quite apparent whether it flies or not. On the other hand, students and children often make trials without knowledge of results, and are handicapped by such a lack of information. In this section we are primarily interested in *defining* the process of overt feedback. In a later section, suggestions for motivating improvement will be considered. Further, factor 14 will take up *implicit feedback utilization.*

Major topics in this area are: (1) The need for the checking of trials; (2) ways and means of monitoring performance; (3) tutorial interaction; (4) using the results of diagnostic task analysis; and (5) modeling and imitation as a means of
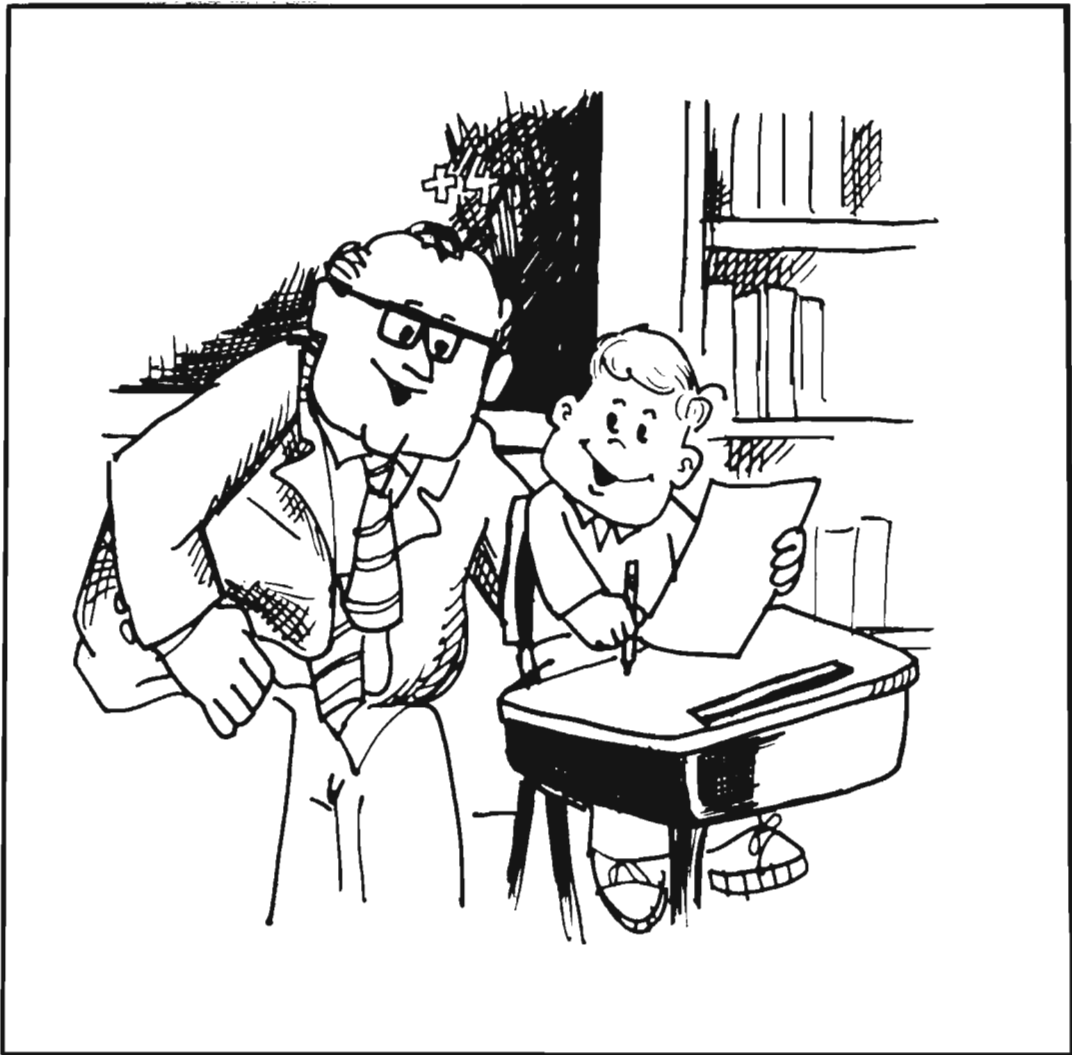

Figure 13. Factor 13 — diagnostic feedback

providing immediate feedback data (response generated cues).

Some of the principles which can be derived from the literature on the overt feedback process include:

13.1 Incomplete feedback information detracts from performance.
13.2 Immediate knowledge of results generally facilitates performance.
13.3 Analysis of errors can be useful in making revised presentation plans.
13.4 Overt responses have convert implication.
13.5 Human interaction information can be utilized in a feedback context.
13.6 Diagnostic achievement testing can show patterns and frequency of errors.
13.7 The teacher must take into account the cognitive and perceptual processes as well as the affective ones.

Some related references include these.

13.1 Abbey, D. S. and Cowan, P. A. "Incomplete Visual Feedback and Performance on the Toronto Complex Coordinator." *Perception of Motivational Skills,* 11: 43-45, 1960.

13.2 Angell, G. W. "Effect of Immediate Knowledge of Quiz Results on Final Examination Scores in Freshman Chemistry." *Journal of Educational Resources,* 42: 391-394, 1949.

Annett, J. "Learning a Pressure Under Conditions of Immediate and Delayed Knowledge of Results," *Journal of Experimental Psychology,* 11: 3-15, 1959.

Bilodeau, E. A.; Bilodeau, Ina M.; and Schumsky, D. A. "Some Effect of Introducing and Withdrawing Knowledge of Results Early and Late in Practice." *Journal of Experimental Psychology,* 58: 143-144, 1959.

Bourne, L. E., Jr. "Effects of Delay of Information Feedback and Task Complexity on Identifi-

cation of Concepts." *Journal of Experimental Psychology*, 54: 201-207, 1957.

Brackbill, Yvonne; Wagner, J. E.; and Wilson, Dorothy. "Feedback Delay and the Teaching Machine." *Psychology Scholar*, 1: 148-156, 1964.

Dusel, W. J. "Some Semantic Implications of Theme Correction," *English Journal*, 44: 390-397, 1955.

Greenspoon, J., and Foreman, Sally. "Effect of Delay of Knowledge of Results on Learning a Motor Task," *Journal of Experimental Psychology*, 51: 226-228, 1956.

Moore, J. W. and Smith W. I. "Knowledge of Results in Self-Teaching Spelling." *Psychology Reports*, 9: 717-726, 1961.

13.3 Lewis, E. R., and Lewis, Hilda P. "Analysis of Errors in the Formation of Manuscript Letters by First Grade Children." *American Educational Resources Journal*, 2: 25-35, 1965.

Shuman, R. B. "Theme Revision. Who Needs It?" *Peabody Journal of Education*, 40: 12-15, 1962-1963.

13.4 Stolurow, L. M. and Walker, C. C. "A Comparison of Overt and Covert Responses in Programmed Learning." *Journal of Educational Resources*, 55: 421-429, 1962.

13.5 Amidon, Edmund J. and Hough, John B., *Interaction Analysis Theory, Research, and Application.* Addison-Wesley Publishing Company, 1967.

13.6 Bloom, B. S. "Testing Cognitive Ability and Achievement." In N. L. Gage (ed.) *Handbook of Research on Teaching.* Chicago: Rand McNally, pp. 379-397, 1963.

Brim, O. G., Jr. "American Attitudes Toward Intelligence Tests. *American Psychologist*, 20: 125-130, 1965.

Hagen, Elizabeth. "Analyzing Test Results." *National Elementary Principal,* 41: 11-17, 1961.

13.7 Morse, William C., and Wingo, G. Max, *Psychology and Teaching,* Scott, Foresman, and Co., 1962, 1969.

Factor 14: Implicit feedback utilization

There are two levels of utilization, assimilative and accommodative. Implicit feedback utilization has both convergent and divergent aspects. It has both a confirmatory and an expansive function. All these paired terms refer to the twin processes of cognitive use and cognitive growth. If the task is known, feedback utilization is confirmatory or convergent in an assimilative sense, since the person is monitoring his own performance by matching his performance against a known internally existing (in self) criteria.

If the task is new, then feedback utilization refers to the development of what Piaget calls "structure" and "schemata." A classic example in history is the development of the *periodic table of elements.* In its development, its own structure and the laws governing known parts were creatively projected and extrapolated to hint at and guide new discovery. This is often spoken of as "having an idea."

In every case, the process results in a change in "self," and the result of every trial and check is a somewhat different self.

The process of perception and cognition, previously discussed as topics seven and eight, are the beginning of data utilization which comes to a full circle in the area of implicit feedback. The major intellectual function of perception and cognition is a "feed forward" process of either "gating" or "hypothesis" formation. Implicit feedback utilization is essentially an "hypothesis checking" process. The cognitive "hold" or don't hold" is then consummated by the cue-criteria checking available in implict feedback.

When a "new" problem is confronted, a process of creative divergence or a focusing convergence, or both is called for. Since concept learning is such an important element of cogni-

tion, it was emphasized in factor eight, and since criterial checking is so critical, it will be emphasized here as creative or productive thinking. But the distinction is arbitrary since all elements of learning are involved. The quantity of the hypothesis-making is a critical first step, but so is the checking and comparing process which is the essence of implicit feedback utilization in problem solving.

Since the two major topics of assimilative and accommodative use of feedback will serve as the major divisions of this area, we will now list some representative "principles" derived from the literature of feedback, both as a corrective guiding process, and as a problem solving process.

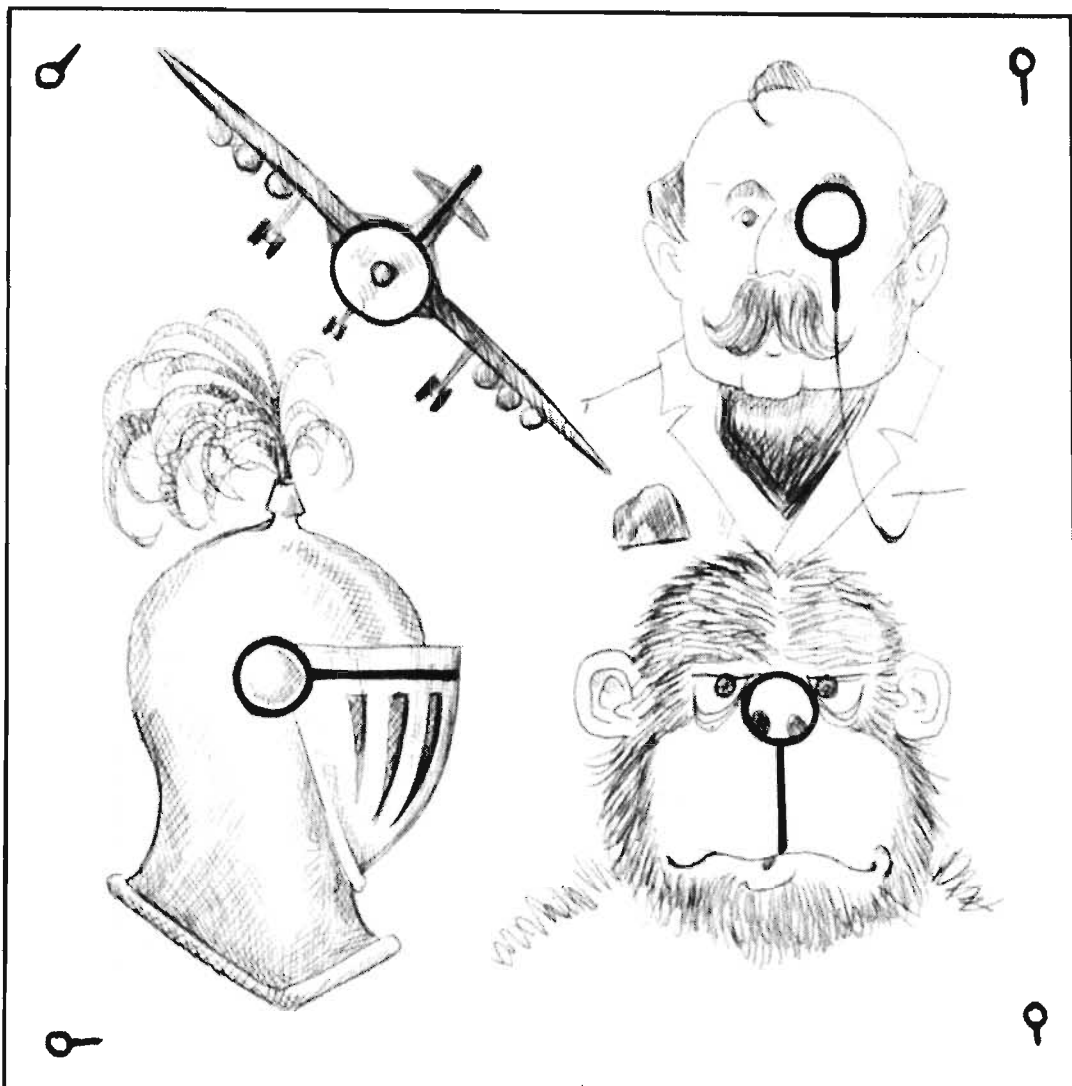### 14.1 There are at least 10 basic factors needed to pre-

Figure 14. Factor 14 — creative feedback

dict "talent" (utilization of experience) (Mc-Guire).

14.2 The three dimensions of creative behavior (productive divergence, content, teaching strategy) can be taught (Williams).

14.3 Creative behavior in children can be measured (Torrance).

14.4 Creative imagination can be cultivated.

14.5 Creativity may be differentiated from intelligence (Wallack and Kagan).

14.6 The deepest level of interaction with an educational computer is in the *dialogue systems* (Suppes).

14.7 Overt feedback process has an effect on covert feedback, an effect on covert feedback processes.

Representative related research includes these research titles:

14.1 McGuire, Carson. "A Comment on Personality Correlates of Creativity (McKensian)." In *Productive Thinking in Education*, Mary Jane Aschner and Charles E. Bish, (eds.). The National Educational Association and The Carnegie Corporation of New York, pp. 180-186, 1968.

14.2 Williams, Frank E. "Creativity — An Innovation in the Classroom." In *Productive Thinking in Education*. Chapt. 10, 1965, 1968.

14.3 Torrance, E. Paul. "The Measurement of Creative Behavior in Children." In *Productive Thinking in Education*, Mary Jane Aschner and Charles E. Bish (eds). The National Education Association and The Carnegie Corporation of New York, pp. 180-186, 1968.

14.4 Covington, Martin V., "Promoting Creative Thinking in the Classroom." In *Research and Development Toward the Improvement of Education*, Herbert J. Klausmeier and George T. O'Hearn (eds.), Dembar Education Research Services, Inc.

Gough, Harrison G. "Imagination — Undeveloped Resource." In *Proceedings of the First Conference on Research Development in Personnel Management*, University of California Institute of Industrial Relations, 1957.

Kogan, Zuce. "Methods of Futhering New Ideals." *Philosophy of Science*, 21 (2), April 1954.

Youtz, Richard P. "Psychological Foundations of Applied Imagination." In *A Source Book for Creative Thinking*, Sidney J. Parnes, and Harold F. Harding (eds.), New York: Charles Scribner's Sons, pp. 193-215, 1962.

14.5 Wallach, Michael A. and Kagan, Nathan. "A New Look at the Creativity-Intelligence Distinction." Reprinted from *Journal of Personality*, 33 (3), September, 1964.

14.6 Suppes, Patrick. "Computer Technology and the Future of Education." *Phi Delta Kappan*, April 1968.

14.7 Block, Henry and Ginsburg, Herbert. "The Psychology of Robots." *Psychology Today*, pp. 50-55, April 1968.

Halstead, Ward C. and Rucker, William B. "Memory: A Molecular Maze." *Psychology Today*, pp. 38-41, June 1968.

SUMMARY

Motivation in Learning

It is a common error to use the term "motivate" as a synonym for "stimulate," and then to reduce the motivational process to some kind of stimulus like a noise or sitting on a tack. Another too simple use of the concept of motivation is to regard it as pure reward process. such as giving food to a hungry person. Another oversimplified use of the term is to think

of it as representing only a drive process or an affect (feeling) process.

Since motivation involves such a variety of components, it can serve as a summary topic. The operational use of the term by a parent or teacher can be set up as a series of suggestions for improving learning. By motivating learning, we mean encouraging behavior which makes any of the 14 componets of learning more effective.

Strictly speaking, the translation of the principles of learning (defined by research and collected and organized by the educational psycholgist) is the professional responsibility of the educator. But experience shows that a great deal of co-operative communication needs to take place between the psychologist who is profound and the educator who is so practical! The same is true of any professional complex where growth is to take place. Petty squabbles over "jurisdiction" must be absorbed in compelling programs and planned discovery relationships.

Space allows only hints at possible points of improvement. The rest is left at this time to discovery on the part of the reader.

Factor 1: *Persons.* Locate isolates and plan with a popular student how to help the isolate become more a part of the community of the classroom.

Factor 2: *Physical Environment.* Carpet many classrooms as fast as possible (as part of innovative building plans).

Factor 3: *Cultural Aims.* Develop a vast public awareness of the annual amount of good learning that goes on in the schools of America every day. Try to extend it to all.

Factor 4: *Stimulus.* Experiment with varied sequences of concepts in developing principles.

Factor 5: *Physiological.* Support and expand visual and hearing screening programs.

Factor 6: *Aptitudes.* Understand and distinguish the various types of aptitude tests as compared to personality and achievement tests.

Factor 7: *Perception*. Cultivate the ability to observe hitherto unnoticed elements and designs.

Factor 8: *Cognition*. Vary the amount and kind of guidance in promoting concept learning as a discovery experience.

Factor 9: *Self*. Understand how knowledge, attitudes, and skills, are all basic sub-systems in a unique configuration for each self.

Factor 10: *Transfer*. Recognize that the amount and organization of a person's knowledge is the best guide in estimation of what he can do.

Factor 11: *Mode of Attack*. Provide a variety of tasks illustrating a principle in order to establish its generality.

Factor 12: *Reinforcement*. Set up a selective reinforcement schedule so that the desired behaviors receive consistent support.

Factor 13: *Overt Feedback*. Give guidance in judging the quality of a completed product.

Factor 14: *Implicit Feedback Utilization*. Develop internal criteria for recognizing that a given concept fits into a complex of related processes.

The Use of Theory

The prime use of theory is in the explanations of how science should be conducted.

We gain strength only by making use of the power of divergent views. To do this requires that we do not any longer try to answer the question: "Which theory is right?" We should rather ask: "Under what conditions does a given view make a contribution?" Sheer controversy does not add very much. As Jenkins (1968) put it:

In the 1930s and '40s, psychology was shaken with furious debates about what was and was not "scientific" in psychology. Advocates were outrageously prescriptive. It is easy to remember meetings at which distinguished psychologists, purple in the face, told other distingushed psychologists that what they were doing might be entertaining or clever but it was not and would

never be scientific psychology. At many schools graduate students were given the "correct" view and carefully innoculated with the proper philosophical serum against the "incorrect" views. One must seriously question whether the cause of science was advanced by these battles . . . One thing that psychologists also need to note is that the new viewpoint does not by any means "wipe out" or destroy the research that has been done.

Jenkins stresses the value of theory (an hypothesis) thus:

If one has some hypotheses, however, he can distinguish between relevant and accidental features of the monument with respect to that hypothesis (a problem) and perhaps seek confirmaton or disconfirmation of his notion by relating these features to other phenomena.

A current issue in psychology has to do with whether initiative for personal and social growth resides in the person or in the experimenter. The two views are summarized by Hitt (1969) as follows.

1. Man can be described meaningfully in terms of his behavior; or man can be described meaningfully in terms of his consciousness.
2. Man is predictable; or man is unpredictable.
3. Man is an information transmitter; or man is an information generator.
4. Man lives in an objective world; or man lives in a subjective world.
5. Man is a rational being; or man is an irrational being.
6. One man is like other men; or each man is unique.
7. Man can be described meaningfully in absolute terms; or man can be described meaningfully in relative terms.
8. Human characteristics can be investigated independently of one another; or man must be studied as a whole.
9. Man is a reality; or man is a potentiality.
10. Man is knowable in scientific terms; or man is more than we can ever know about him.

Hitt summarizes by saying that:

We must conclude that the behaviorist and the phenomenologist should listen to each other. Both, as scientists, should be

willing to listen to opposing points of view. Each should endeavor to understand what the other is trying to say. It would appear that a dialogue is in order.

We have now reviewed literature in the area of educational psychology as applied to learning. It is very clear that definable factors are available for futher use and study. The literature of research in learning makes it plain that measurable variables which affect the learner do exist. Further, a great deal of work has been done in describing how these factors work under varied conditions. They have been shown to represent an integrated system. It has been suggested also that varied theories are useful in explaining varied task variables, and that theories that may appear to be contradictory are not, since they describe varied learning situations.

We are, then, beyond the trial and error stage in making applications of what is known about learning. As Cronbach put it:

> To obtain new designs in education, it is not enough to proceed by trial and error. Trying one method after another and observing how much pupils learn under each method can lead in time to superior teaching procedures. Present education is, in a remote way, the result of trying out the successive inspirations of master teachers: Socrates, Comenius, Froebel, and others. But theory and principle hasten invention. Trial and error has less error in it when new proposals spring from understanding.

SUMMARY REFERENCES

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Hitt, William D. "Two Models of Man." *American Psychologist,* 24 (7): July 1969.

Jenkins James J., "The Challenge to Psychological Theorists." In *Verbal Behavior and General Behavior Theory,* T. R. Dixon and D. L. Horton, (eds.), Englewood Cliffs, N. J.: Prentice-Hall, pp. 538-549, 1968.

Appendix A

Name and Title of Theses and Dissertations
Directed by Dr. Stone

1950

West, Roy "Personality and Academic Success" M. S.

Dobson William, "College Freshman Responses to Testing During Test Week, and Later"

1951

Bateson, Russell "Occupational Information and Employment" M. S.

Overlade, Don C. "The Auditory Apperception Test (Stone) Compared with a Ten-Card Form of the TAT"

1953

Baer, Barbara Swenson "Interest Patterns for Four Occupations: Kuder Preference Record"

Ganung, George "A Study of Personality and Scholastic Achievement"

1954

Satoshi, Hibi " 'This' and 'That' as Verbal Expressions of Ego Involvement" M. S.

Thaddeus, N. Skolmoski "A Study of High School Students' Projective Response to Auditory Stimuli" M. S.

1956

Henderson, Erwin C. "The Kuder Preference Record-Vocational in Appraising the Apparent Suitability of Vocational Choices of High School Students" M. S.

1957

Cockrill, John Calvin "Descriptive Analysis of Teaching Social Attitudes at Intermountain School" M. S.

1958

Loosle, Douglas William "Curriculm Study" M. Ed.

Bagley, Clarence H. "A Study of Some of the Measured Variables Constituting the Reading Process at the College Level" M. S.

1959

Berghout, Leonard N. "A Study of Concepts for High School Geography" M. S.

Taylor Wheatley J. "An Historical Study of the Utah Elementary Principals' Association" M. S.

Thrasher, Marvin Edward "A Content and Sequence Analysis of Capitalization and Punctuation in the Language Arts Program"

Washburn, Dewain Calvin "A Study of the Problem of Coordinating the Completion of Driver Education Training with Legal Driving Age"

Hill, Carl David "Music Education" M. Ed.

Steed, Lynn "Curriculum Study" M. Ed.

1960

Leavitt, Merettie "An Evaluation of an Attempt at Homogenous Grouping in the Afton Elementary School" M. S.

1961

Bartschi, Vilda Young "A Basic Graded Word List in the Primary Grades and for Remedial Reading" M. S.

Groutage, Lorenzo "Sequence and Emphasis of Arithmetical Concepts as Presented in Six Texbooks, and an Analysis of Student Error in Fifth Grade Arithmetic" M. S.

Stock, Janet Clark "Responses of Normal Subjects to the Halstead-Wepman Aphasia Screening Test" M. S.

1962

John, Ronald "The Effectiveness of the Teaching Machine for Spelling Instruction at the College Levels" M. S.

Rosine, Hanna "Remedial Instruction" M. Ed.

Wallis, Reva Knowles "Remedial Reading" M. Ed.

1963

Rhees, Jay Herbert "An Evaluation of Mechanical Usage Errors in English Made by Eight Grade Pupils in the Weber County School District" M. S.

Christiansen, Shanon Leon M. Ed.

1964

Richman, Jay T. "A Comparison of Phonetic Structures of A Basal List and the DAT Spelling"

1965

Carson, Gary Lane "Cognitive Equivalence Transformation in Concept Formation" E. D.

Nicholls, Gordon H. "The Programmed Text as an Aid to Teaching Spelling in Junior High School" M. S.

Richman, Jay T. "A Comparison of the Phonetic Structure of a Basal Vocabulary List and the Spelling Section of the Differential Aptitude Test"

Thorderson, Parley E. "An Item Analysis of Language Responses" M. S.

Warnke, John Henry, Jr. "Science Education" M. Ed.

1966

Christiansen, Ted L. "A Study of the Function of Visual Imagery, Type of Mediator, and Associative Frequency in Induced Mediation Paradigms" Ph.D.

Beutler, Larry Edward "A Comparative Study of Motor Memory in Deaf and Hearing Children by the Use of High-Relief Finger Mazes and MFD Task," M.S.

Ellis, Philip Emery "A Comparison of Teacher Texbook Method and Programmed Method of Algebra in Relation to the Retention and Understanding of Algebraic Principles" M.S.

1967

Carlson, Lester Alvin "The Relationship of Delinquent Types in an Industrial School Setting to Personality-Movitation Profiles" Ed.D.

Faas, Larry Andrew "The Effect of Preferred and Disliked Color upon the Pattern of Form and Size Choice among Indian Students" Ed.D.

Jensen, Lewis Carl "Occurrence of Unifying Principles of Science and Concepts of Physics in Elementary School Science Textbooks" M.S.

Kamprud, James C. "Normal and Retardate Performance on a Three Dimensional (Stone) Task"

Marsden, Ralph Davenport "Topological Representation and Vector Analysis of Interest Patterns" Ed.D.

Wilson, John Willard, Jr. "The Relationship Between Perceptual Discrimination and Reading Ability of High School Students" M.S.

1968

Derbyshire Maurice A. "The Effect of Two Documentary Films Upon Parents' Attitudes Toward the Value of Phonics in Teaching Reading" Ed.D.

Gill, Noel "Comparison of Instructional Methods for Teaching Basic Statistics Course Involving Interpretation of Research Literature and Additional Problems" M.S.

Harris, Richard Carl, Jr. "Differential Hawthorne Effects by Cueing Sex, and Relevance" M. S.

Noel, Frank G. "A Developmental Study of Concept Learning in Selected Public School Students" M. S.

Powell, Antoine T. "Remedial Reading: Evaluation of a Reading-and-Study Course with Implications for a College Reading Center" M.S.

Richards, Hyrum Edwards "Variations on Piaget's Pre-number Development Test Used as Learning Experiences" Ph.D.

1969

Butorac. Marlene A. "Literal and Inferential Concept Responses of Male and Female Six-Year-Old Subjects" Ed.D.

Hunter, Leon William "Counseling Responses" M.Ed.

Larsen, Melvin Howard "Counseling and Learning" M.Ed.

Pearson, Winifred Smith "A Comparative Analysis of Phoneme Identification as it Relates to Phonics Procedures Utilized Through Primary Grades in Five Basal Series" M.S.

Smith, Leland James "Vector Studies of Occupational Choice" M.D.

Vajanasoontorn, Chalermwong "Superordinate Words and Subordinate Words in Mediate Association" Ph.D.

OTHER LECTURES IN THE SERIES

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by Willard Gardner

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by Eldon J. Gardner

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SOCIAL ORDER
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